University of Reading
Department of Economics

The impact of regulatory reforms on cost efficiency, ownership and competition in the Turkish commercial banking sector

BY

NURI ALTINTAS

SUPERVISED BY

DR. ALESSANDRA FERRARI

DR. SIMON BURKE

A THESIS SUBMITTED TO THE UNIVERSITY OF READING IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (PHD) IN ECONOMICS

June 2020

Declaration

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

Name: Nuri Altintas
Date: June 2020

Department of Economics
University of Reading

Acknowledgements

First and foremost, I offer my sincerest gratitude to my first supervisor, Dr. Alessandra Ferrari who has given continuous encouragement and guidance throughout my years of study with her experience, detailed and constructive comments, and patience. I would like to say thank you to my second supervisor, Dr. Simon Burke, for his motivation and support, and for his contribution in the final stage of this thesis. Without their guidance and assistance, this thesis would not have been possible to complete.

I must express my special gratitude to my wife, Eun Kyung Joo, for her love, kindness and support, also to my family and to my friends for giving me with continuous support throughout the process of researching and writing this thesis. This accomplishment would have not been possible without them. In addition, many thanks go to Prof. Claudia Girardone (University of Essex) for her comments and advices for my thesis.

Abstract

The Turkish government commenced banking deregulation reforms with the objective of fostering competition in the early 1980s. Yet several financial crises emerged in the aftermath of the reforms, indicating structural weaknesses. The financial crisis in 2001 has been a cornerstone of the regulatory framework, changing the policy focus from deregulation to stability. This study aims to investigate the evolution of the regulatory reforms on cost structure characteristics and on ownership. It also evaluates the impact of reforms on the dynamic of competition in the loan market. Changes in accounting rules and introduction of re-regulation policies took place as of 2002, resulting in previous literature focus on either side of the change. This thesis builds a homogenous data set to allow for accounting changes and to look at the whole reform process, enabling it to draw more robust comparisons and policy implications. It accordingly uses a comprehensive and unique panel dataset of 51 banks for the period 1988-2016, capturing the pre- and post-reform periods.

To examine the impact of reforms on cost efficiency and ownership, a stochastic cost frontier with inefficiency determinants is estimated. The results suggest that pure cost technology trend worsens over time, confirming that banks have yet to adjust to the new regulatory environment. The trend in cost efficiency shows a non-monotonic pattern over time, implying that efficiency gains have been unsustainable. The results also suggest that reforms influence the ownership-cost efficiency relationship. Specifically, domestic private and foreign banks appear to benefit from an environment with operational freedom and functional autonomy during the pre-reform period. The implementation of tighter prudential norms in the aftermath of the 2001 crisis seems to have had adverse impacts for all ownerships at the early stages. Yet state banks and domestic private banks in particular are initially better equipped to adapt to the new regulatory environment compared to foreign banks. The results of the persistence of profits (POP) model indicate that the reforms had no discernible effect on the competitive conditions of the lending market. Furthermore, the foreign bank entry also did not improve competition. The complementary analysis undertaken using the Boone indicator (BI) suggests that competitive conditions are stronger in the early stages of prudential reforms yet it significantly worsens after 2008, implying that once again the reform package does not seem to have had the desired competition-inducing effects.

Table of Contents

List of tables

List of figures

List of abbreviations

BAT	Banks Association of Turkey
BC95	Battese and Coelli (1995) model
BI	Boone Indicator
BRSA	Banking Regulation and Supervision Agency
CAR	Capital Adequacy Ratio
CPI	Consumer Price Index
CBT	Central Bank of Turkey
CR5	Five-firm Concentration Ratio
CV	Conjectural Variations
DEA	Data Envelopment Analysis
GLS	Generalised Least Squares
GDP	Gross Domestic Product
GMM	Generalised Method of Momentum
HHI	Herfindahl-Hirschman Index
IMF	International Monetary Fund
IV	Instrumental Variables
IO	Industrial Organisation
LR	Likelihood Ratio
LM	Lagrange Multiplier
LSDV	Least Squares Dummy Variable
NEIO	New Empirical Industrial Organisation
NIM	Net Interest Margin
ML	Maximum Likelihood
NPLs	Non-performing Loans
OBS	Off-balance Sheet Items
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
POP	Persistence of Profits
PR	Panzar-Rosse
RMP	Relative Market Power
SCP	Structure-Conduct-Performance

SFA	Stochastic Frontier Analysis
SDIF	Savings and Deposits Insurance Fund
SMEs	Small and Medium-size Enterprises
TRY	Turkish Lira
M&As	Mergers and Acquisitions

Chapter 1
Introduction

1.1 Background of the study

Several emerging market economies have carried out financial reforms over the past half century. The main objective of these reforms was to end repressive financial policies by deregulating [1] their banking sectors. The deregulation reforms included easing or eliminating bank interest rate ceilings, lifting entry barriers, and reducing government intervention into credit allocation decisions. These countries have also opened their banking sectors to foreign financial intermediaries and allowed domestic banks to be foreign-owned. These reforms were, *ceteris paribus*, in turn expected to foster competition in the local banking markets and hence increase efficiency and result in a better allocation of capital.

This positive view of the banking deregulation, nevertheless, is somewhat clouded by the remarkable increase in subsequent financial fragilities. It is argued that these reforms were undertaken without establishing a sound regulatory framework and supervisory institutions. This in turn induced banks to take on excessive risks,[2] which later contributed heavily to the fragilities (Demirguc-Kunt and Detragiache, 1998; Hellmann et al., 2000; Noy, 2004; Rossi, 1999). As a result, many emerging market economies having weak regulatory and supervisory structures, such as Thailand, Indonesia, and the Republic of Korea in Asia, Mexico, Brazil, and Argentina in Latin America, and Turkey in the periphery of Europe, were all hit by severe financial crises after deregulating their banking systems, highlighting the dangers of pell-mell deregulation of banks.

---

[1] Deregulation in banking refers to the reforms undertaken by governments to remove, diminish, or simplify restrictions on banks with the intent of promoting their efficient operation. The rationale behind this, arguably, is that fewer and simpler regulations foster competition, thereby leading to higher productivity, higher efficiency, and lower prices. Deregulation and liberalisation are often used interchangeably to indicate the reduction in government regulations and restrictions to the financial sectors in exchange for a greater participation of private players. In addition, with respect to developing economies, liberalisation also stands for opening up their economies to foreign capital and investments, arguably to remain competitive in attracting and sustaining both their domestic and foreign investments. Therefore, although deregulation is different from liberalisation because a liberal economy can have regulations to increase efficiency and protect consumer rights, these terms are often used interchangeably within deregulated/liberalised economies.

[2] Hellmann et al. (2000) argue that banking deregulation raises competition, which then erodes profits. Lower profits indicate lower franchise value, namely the capitalised value of expected future profits. Lower franchise value in turn reduces incentives for high quality loans, increasing the moral hazard issue.

These crises in turn rendered re-examination of the risk assessment practice of banks and the regulatory and supervisory structure. The regulatory authorities have taken active steps to improve prudential regulation of banks by introducing tighter prudential norms on capital requirements, by strengthening official supervision and by enhancing market discipline. These were expected to result in sound and resilient banking systems. As such, instead of focusing solely deregulation of banking sector to promote competition, the policy makers have started to also focus on strengthening financial stability, which in turn has generated an environment characterised by a coexistence of bank deregulation and prudential re-regulation.

The changing regulatory environment was therefore expected to have profound effects on the operations, competition, efficiency, and profitability of banks (Goddard et al., 2011; Maudos and Fernandez de Guevara, 2007, 2004). Research on the impact of these reforms on bank performance and competitive conduct has very crucial policy implications. Establishing empirical evidence would enable regulators to test the effectiveness of reforms and a treatment plan can be tailored to improve efficiency and stability of the banking sectors accordingly. Moreover, although interrupted by the recent global financial crisis, the past few decades have seen a dramatic increase in cross-border banks flows encouraged by the reforms (Claessens and Van Horen, 2014). Therefore, there is a necessity for empirical evidence investigating the influence of foreign banks on domestic banking industries. It is against this background that this thesis is undertaken within the context of the Turkish banking sector, as will be discussed in the next section.

1.2 Aims of the study

There is a large body of empirical literature focusing on the association between financial reforms and the performance and competition of banks. The evidence derived from the literature nevertheless seems to be inconclusive on whether financial reforms improve competition and efficiency of banks. Moreover, most of these studies do not take into account the fact that regulatory reforms are often a mixed process of deregulation and prudential re-regulation. However, deregulation and prudential re-regulation might exert opposite impacts on the efficiency and competition of banks. Therefore, an investigation of the effects of the parallel use of prudential re-regulation along with deregulation processes

on the banking industry would enhance the capacity to design better bank regulation and supervision. In addition, the regulatory reforms[3] aimed to generate a level playing field among different ownerships by applying regulatory policies uniformly across banking groups. Yet it appears from the literature that different degrees of pressure were received by different ownerships, calling for more empirical evidence. Furthermore, the increasing globalisation of financial systems has resulted in a drastic increase in foreign bank entry, yet the number of empirical studies explicitly taking into account the effect of foreign bank entry on the competition and efficiency of hosting countries' banking sectors are still inconclusive, particularly in emerging and developing countries. Thus, this research aims to contribute to the literature on these issues.

More specifically, this thesis aims to answer the following three main research questions: 1) What is the impact of a deregulation and prudential re-regulation policy framework on Turkish banks' cost efficiency and on the relation between cost efficiency and ownership? 2) What are the effects on the dynamics of competition in the loan market? 3) Has the recent wave of foreign bank penetration improved the competition and efficiency of the Turkish banking sector?

To answer these research questions, we carry out our empirical studies on the Turkish commercial banking sector. The Turkish banking sector has experienced a similar reform process observed in many emerging market economies' banking sectors. Initially Turkish banking sector authorities started to introduce banking deregulation policies in the early 1980s with the objective of lowering regulatory costs and stimulating competition in the banking sector. Accordingly, they lifted bank interest rate ceilings, lowered compulsory reserve requirements and entry barriers, and encouraged penetration of foreign financial intermediaries. The introduction of these policies was expected to improve the performance of banks, since deregulation-induced competitive pressures were going to eliminate monopoly rents enjoyed in the form of inefficiency or slack. Yet these expectations were not fully realised because the frequency of systemic banking problems, due partly to excessive risk taking, increased markedly soon after the implementation of deregulation policies.

[3] Regulatory reform is a mixed process of deregulation and prudential re-regulation (Kay et al., 1988)

Although many other factors contributed to these fragilities, it is widely accepted that the weak institutional environment, the politicisation of banking affairs, and macroeconomic instability were the main factors, and they contributed to home-grown financial crises in 1994, 2000 and 2001 (see, Alper and Öniş, 2004, 2003; Bakır and Öniş, 2010). The twin crises of 2000-2001 opened a window of opportunity, facilitating the successful implementation of major regulatory reforms. In the aftermath of the twin crises, the Turkish banking authorities implemented banking restructuring programmes to resolve the bad debts of problematic banks and introduced prudential norms to foster stability and minimise excessive risk taking. More specifically, they introduced regulation practices such as capital regulations accounting for market risk, external governance, official supervision, and private sector monitoring, all of which have been uniformly applied among different bank ownerships.

1.3 Research methodology

Turkey's reform process can be divided into two periods. In the first period, spanning from 1988 to 2001, banking deregulation was at the core of the reform process and it aimed at stimulating competition. In the second period, from 2002 to 2016, prudential re-regulations have been at the centre of the reform process with the objective of fostering stability in the banking sector (Bakır and Öniş, 2010). In addition, the regulatory reforms aimed at creating a level playing field among different ownerships operating in the Turkish banking sector. More specifically, regulatory policies associated with deregulation and prudential re-regulation have been applied uniformly across banking groups. Although these tools have been expected to stimulate stability, they may impose higher cost and impact on the competition and performance of banks. Therefore, this offers us an excellent laboratory to investigate the impacts of deregulation and the concomitant prudential re-regulation framework implemented by the Turkish banking authorities on cost structure, ownership, and competition in the commercial banking industry. Moreover, despite some early foreign banks' entry in the aftermath of deregulation, they only controlled a minimal 3% of the total banking sector assets throughout the 1990s and early 2000s (Altunbaş et al., 2009). This trend significantly changed as of 2005. New foreign banks, mainly via the acquisition of mid-sized domestic private banks, started to enter the Turkish banking market after this year. As of today, almost one third of total banking sector assets are controlled by these

new banks. This process therefore allows us to explore the effects of foreign bank penetration on competition and efficiency of domestic banking sector.

To address the first and third research questions, we employ a stochastic cost frontier analysis approach by following Battese and Coelli (1995). This allows us to estimate the efficient cost structure and the determinants of cost inefficiency through a one-step Maximum Likelihood (ML) method. Using the cost inefficiency model, we determine the effect of the change of regulatory framework on cost structure and also the cost efficiency-ownership relationship. In addition, we will explicitly account for the recent wave of foreign penetration in the stochastic cost frontier analysis to examine whether their entry has exerted any influence on the cost efficiency of Turkey's banking sector.

This study investigates the overall influence of regulatory reforms on the competition of the credit market by using two complementary approaches. First, we estimate the persistence of profits (POP) model. We use the marginal cost of loans derived from the stochastic cost frontier to obtain the overcharge on loans (calculated as implicit loan price to marginal cost ratio). Then, we estimate the persistence of loan overcharge by employing a partial adjustment model which is in line with the POP literature's idea following Zhao et al. (2010). An increased persistence in the loan overcharge would imply that competition in the lending market did not reduce over the sample period and vice versa. In addition to this analysis, we also employ a relatively new competition measurement approach, the Boone indicator (BI). This approach not only enables us to examine the evolution of competition over time to infer the effects of regulatory reforms, but also crosscheck the results derived from the POP model.

1.4 Contributions to the literature

This study contributes in several respects to the literature, in particular on Turkish banking. It furthers the understanding of the effect of regulatory reforms on bank conduct, efficiency, and ownership in general. In addition, the impact of foreign penetration on the efficiency and competition of the banking sector is also investigated to contribute to the literature. More specifically:

- Financial reforms are often a mixed process of deregulation and prudential re-regulation and therefore this process may have opposite impacts on efficiency, ownership, and competition. Previous studies on the effect of regulatory reforms on Turkish banking sector efficiency and competition overlooked this issue. Moreover, they either used pre-reform data or focused on a short time period immediately following the post-reform period. Our unique dataset[4] spanning from 1988 to 2016 covers both the first stage (1988-2001) and the second stage (2002-2016) of reforms. This therefore allows us not only to explore the overall effect of regulatory reforms in general, but also the shift in policy focus (post-2001) characterised by the tightening of prudential re-regulations in particular. To our knowledge, only one empirical study[5] merges these two periods (1990-2007), yet it adopts a non-parametric approach to measure performance. Given Turkish banks suffered from financial crises and were exposed to regulatory changes during this period, using a non-parametric approach might lead to biased estimations. This is because this method assumes away statistical noise in data and fails to successfully account for environmental impacts on estimated inefficiency (Liu and Tone, 2008). This study attempts to handle this issue by employing a parametric approach. Moreover, their sample dataset includes only the banks that consistently operated during their sample period. This in turn is likely to cover only best-performing banks, concealing the true nature of the banking sector, and is likely to suffer from survivorship bias (Carhart et al., 2002). Instead, this study not only includes survivor banks but also the failed ones. Furthermore, hardly any study investigates to what extent the changes in regulatory environment affect the performance of various ownerships differently.

- Previous literature on the competitiveness of Turkey's banking sector largely used static approaches. Considering that competition is a continuous selection and discovery process, this might lead to inconsistent results. Therefore, this study relies on two alternative competition measurement approaches, the POP model and the relatively new BI model, and enable us to capture the competitive dynamics in

[4] A great deal of care had to be taken as the same headings had often a different meaning before and after the change in accounting rules as of 2002, along with the re-regulation process. The challenges we faced in the construction of our database are presented in Section 5.3.1.
[5] Fukuyama and Matousek (2011).

the lending market. Moreover, this study is the first attempt in the Turkish banking literature that explicitly investigates the effects of deregulation-prudential reregulation framework on competition. Furthermore, no other study used the POP model to investigate the intensity of competition in the lending market.

- The heavy foreign bank penetration, largely realised in the form of the acquisition of domestic private banks, allows us to explore the effects of this penetration on efficiency and competition. This study is one of the first attempts to explicitly account for this penetration in both efficiency and competition models to explore the possible influence generated by the entry of these banks.

1.5 Structure of the thesis

Besides this general introduction, this thesis is organised into seven chapters. Chapter 2 provides a historical overview of the Turkish banking sector with particular reference to the regulatory reforms. It details politico-economic developments that have shaped financial sector reforms and the evolution of the banking sector reforms since 1960s. It then elaborates on the structural changes of the banking sector due to the changing regulatory framework. Chapter 3 provides a literature review on the impact of bank deregulation on bank efficiency, the impact of prudential re-regulation on bank performance, and the ownership and bank performance relationship. It also reviews the existing literature on the relationship between regulatory reforms, ownership, and bank competition. In particular, each sub-section discusses the major drawbacks in the existing literature, which serve to establish motivation for our empirical study. Chapter 4 presents theoretical concepts of frontier efficiency, and largely elaborates on the parametric and non-parametric approaches used to measure frontier efficiency. It discusses the pros and cons of both approaches and hence explains the underlying factors, leading us to choose our preferred methodology for our empirical analysis. Chapter 5 presents the results of the empirical analysis investigating the impact of banking reforms on cost efficiency and ownership using the stochastic cost frontier approach. Chapter 6 presents the approaches used to measure competition. It then discusses why this study adopts two complementary approaches, the POP and the BI, to measure the competition dynamic. Chapter 7 presents the empirical analysis of the impact of regulatory reforms on competition in the lending market using the aforementioned competition measuring approaches. It also investigates if

the recent wave of foreign bank entry improved the competitive dynamics in the lending market. Chapter 8 summarizes the major findings of the thesis and draws some general conclusions and policy implications. It also highlights limitations of the study and offers suggestions for future research.

Chapter 2
The Evolution of Regulatory Reforms and Recent Developments in Turkish Commercial Banking

2.1 Introduction

This chapter aims to discuss the evolution of regulatory reforms undertaken by Turkish banking authorities since the early 1960s. It details the underlying factors leading to the introduction of the reforms and sheds lights on their effects on the structure and behaviour of banks. Particular attention will be paid on the politicisation of reforms and the government's intervention into credit allocation, and their ramifications for the effective implementation and structure of the banking sector during the 1980s and 1990s. This chapter will therefore facilitate the interpretation of the empirical analysis carried out in this thesis.

The rest of the chapter is organised as follows: Section 2.2 examines the gradual evolution of the regulatory framework from financial repression towards financial deregulation between 1960-1988, with particular attention devoted to the initial phase of the banking deregulation implemented in 1980. Section 2.3 and Section 2.4 review the legislation introduced in the post-deregulation period and discuss why these regulations could not prevent the financial and banking crises from breaking out in 1994 and 2000/2001. Section 2.5 examines the reforms, including the restructuring programme and the concomitant prudential regulation and supervision activities, undertaken in the aftermath of the twin crises experienced in 2000 and 2001. Section 2.6 presents some descriptive statistics of the banking sector from 1988 to 2016, with particular interest devoted to the effects of the regulatory reforms and Section 2.7 concludes.

2.2 The transition from financial repression to deregulation

Turkey adopted a state-led economic development strategy by following import substitution policies in the period between 1960 and 1980. During this protectionist period, the alternative financing sources such as money and capital markets were underdeveloped and the country was facing a lack of real resources (Yeldan, 1997). The Turkish banking

sector therefore essentially served as the agent of successive governments and the success of the economic development strategy largely relied on banking funds.

Parallel to this strategy, Turkish banking authorities adopted repressive financial regulations. Although these regulations were primarily used as a means to facilitate the channelling of financial funds into investments undertaken in line with state-led industrialisation policy, they also had ramifications on the structure of the banking industry (Isik and Hassan, 2003a). More specifically, the primary financial repression regulations implemented in the banking industry were the controls over entry-exit into the sector and the barriers on loan and deposit interest rates. On the one hand, the strict controls imposed on entry and exit were designed to protect incumbent banks from competitive pressures. The regulators arguably sought to increase the profitability of banks by imposing barriers to bank entry to ensure their safety and soundness (Isik and Hassan, 2003a). As a result, these regulations eventually led to the entry of only two new banks into the sector, while twenty banks exited through either liquidation or mergers within these two decades. On the other hand, the interest rate ceiling on loans provided cheaper funds for investment undertaken through the state-led development strategy. Yet it kept the nominal deposit rates below their market rates, resulting in negative real interest rates for deposits due to inflationary monetary policy. This phenomenon provided rents to the banks, but it reduced the amount of funds held in saving accounts, adversely affecting the accumulation of real resources in economy adversely.

In addition, in an environment where there were no price competition and interest rate risks, many banks expanded their branch network to collect more deposits on negative real interest rates. Thus, the number of branches increased almost threefold from 1963 to 1980, despite the significant reduction in the number of banks, which in turn arguably gave rise to over-branching and over-staffing (Altunbaş et al., 2009; Zaim, 1995). Furthermore, this uncompetitive environment, coupled with excessive government involvement, arguably led to the erosion of effective credit evaluation and risk management policies (Denizer, 1997). Overall, the financial repression policies arguably generated a banking system that was highly concentrated, over-branched, inefficient, and protected from competitive pressures, raising concerns over these repressive policies.

In January 1980, a package of economic stability measures known as the 'January 24 Decisions' were introduced to resolve the problems that emerged in the late-1970s stemmed from the aforementioned repressive policies. Therefore, the beginning of the 1980s was a period of liberalisation transforming the Turkish economic structure from a state-led economy into a market-based economy where the banking reforms were at the centre of this process. The banking authorities accordingly initiated a deregulation process under the guidance of the International Monetary Fund (IMF) and the World Bank. They introduced strong legal, structural, and institutional changes to reform the repressive regulations imposed on the banking sector before the 1980s.

A series of deregulation reforms targeting the banking sector were introduced in 1980. Some of these reforms (i) removed the interest ceilings from deposits and loans, (ii) eliminated barriers to bank entry, (iii) permitted the establishment of new financial institutions, and (iv) allowed the introduction of new financial instruments by banks. In addition, Turkish banks were encouraged to operate in international markets and joint ventures and partnerships between domestic and foreign banks were also welcomed (Isik and Hassan, 2002a). This new regulatory framework sought to increase the efficiency and productivity of banks by reducing the intervention of the state and subsequently enhancing competition and the role of market forces (Isik and Hassan, 2003a; Zaim, 1995). In addition, it also aimed to facilitate the integration of the domestic banking sector into the rest of the world and provide a more competitive and dynamic business environment for Turkish commercial banks (Ertugrul and Selcuk, 2001).

Other complementary financial liberalisation reforms expected to contribute to the development of the financial and banking sectors were also introduced in the 1980s. For instance, in the early 1980s, capital account controls were partially removed and a flexible exchange rate policy was adopted, enabling banks to carry out foreign exchange transactions and offer new related services. The Istanbul Stock Exchange and Interbank Money Market were founded in 1986 to provide extra liquidity and promote the development of the financial system. In addition, new institutional and legal arrangements were introduced to stimulate the development of capital markets. Government securities started to be auctioned in 1985 and quickly accounted for a sizeable portion of the stock of the financial assets of banks (Denizer et al., 2000). Therefore, it can be inferred that many

of the restrictions imposed on the financial and banking sector were eliminated, or at least minimised by the end of the 1980s.

This reform process inevitably led to significant changes in the structure and conduct of the Turkish banking sector. It is argued that Turkish banks initially responded to deregulation and financial liberalisation by growing and improving their technological and human capital to improve their competitiveness (Yildirim, 2015). Increased competitive pressures and operational freedom forced banks to enrich their service portfolios and increase the range of their banking activities (Fukuyama and Matousek, 2011). As a result, they offered new financial products and services such as interest and currency rate forwards, options, asset-backed securities, credit cards, foreign exchange deposits accounts, leasing, factoring, underwriting, fund management, and ATMs. Moreover, besides diversifying their services, they also invested heavily in computer systems to improve their technological infrastructure as well as beginning to employ higher quality human resources (Ozkan-Gunay and Tektas, 2006). These changes were expected to improve speed, quality, and efficiency in the provision of services (Altunbaş et al., 2009). The removal of bank entry barriers also led to a rapid increase in the number of banks, branches, and employees, indicating a rapid structural change of the banking sector in the 1980s. The total number of banks increased from 43 in 1980 to 66 in 1990, while the number of foreign banks[6] rose from 4 to 19 during the same period.

Yet this reform process has also attracted widespread criticism in the banking literature. This is arguably because the regulatory authorities implemented the liberalisation reforms without establishing strong regulatory institutions and a sound legal framework (Ganioglu, 2008; Yildirim, 2015). That is, the liberalisation of interest rates and the reduction of government intervention into the Turkish banking sector, coupled with inadequate prudential regulation and supervision framework, led to increased risk taking by banks and brokers. Financial institutions started offering high interest rates for deposits that they

[6] Many of these new foreign banks only established branches in the three largest cities in Turkey and opted not to engage in retail banking. Instead, they tended to focus on trade financing and wholesale corporate banking although there were no restrictions on the scope of their operations (Denizer, 1997). In addition, although the number of foreign banks increased significantly, they only controlled 3-4% of total banking sector assets until the early 2000s (Altunbaş et al., 2009; Yildirim, 2015). The possible reasons for this low participation of foreign banks will be discussed in the next section.

could not afford (Odekon, 2002). All these contributed to the outbreak of a small crisis in the financial sector in 1982, resulting in the collapse of six banks between 1983 and 1984. The banking authorities were obliged to suspend the deregulation of deposit and lending rates due to the crisis and this re-regulation of the interest rates carried on until 1988.[7] The crisis of 1982 revealed that without having a proper regulatory and supervisory legal and institutional framework, liberal reforms could lead to problems in the financial and banking sector (Boratav and Yeldan, 2006).

The banking authorities sought to fill this legislative gap by establishing the Savings Deposit Insurance Fund of Turkey (SDIF)[8] in 1983 to insure the saving of deposits and by introducing a new banking law[9] in 1985, which were the first substantial attempts to re-regulate the Turkish banking sector. The Banks Act of 1985, the first comprehensive regulation of the Turkish banking sector, aimed at dealing with structural problems of the banking sector by providing a stronger legal basis for the regulation and supervision of banks. The Treasury was assigned as the primary regulatory and supervisory board, which undertook both on-site and off-site regulation of banks. Moreover, a division at the Central Bank of Turkey (CBT) was established to support the Treasury in the regulation process. Banks were required to disclose information about their balance sheets to the CBT on a regular basis. The authorities had the right to change the management of troubled banks. In addition, new attempts to update the Bank Acts in line with international best practices were also introduced. Accordingly, banks were compelled to report their non-performing loans (NPLs) separately and to allocate provisions to cover defaulted loans. External auditing became mandatory for banks, with a view to increase market discipline as of 1987. In 1989, in line with the Bank for International Settlements guidelines, a new capital

[7] In the late-1988, deposit rates were freed again and this policy has been sustained since. Due to this fact, in our empirical analysis we focus on the post-1988 period when interest rates have been determined in the financial market.

[8] This regulatory institution aimed to ensure the saving of deposits were established under the administration and representation of the Central Bank of Turkey. Following the 1994 crisis, this institution was also assigned other responsibilities apart from the administration of the deposit insurance scheme. It performed activities for the resolution of the four bankrupt banks that were transferred to the SDIF in the aftermath of the crisis and the banks with a revoked operating license. It also played a crucial role in the domestic twin crises of 2000 and 2001, given the fact that the number of bankrupt banks was 25 in the aftermath of the domestic twin crises. Although the administration and representation of it was given to the BRSA in 1999, it has gained an autonomous status as of 2003 and has obtained the authority to make regulations as of 2005.

[9] Banks Act No: 3182.

adequacy ratio (CAR) was introduced to ensure that banks had enough capital for their risky assets.

In conclusion, it can be argued that the Turkish banking sector quickly responded to financial liberalisation and deregulation reforms. New banks entered the sector following these reforms, although most of the foreign banks entered into the sector were in the form of branches. Incumbent banks sought to adjust to the liberalised and more competitive business environment by introducing new financial instruments and by adopting state-of-the-art technologies. Yet the crisis in 1982 revealed the deficiencies of the regulatory institutions and the legal framework, for the first time highlighting their relevance. Therefore, the banking regulatory authorities attempted to introduce and implement prudential regulations with the introduction of the Banks Act in 1985 along with the adoption of further liberal policies. In the following section, we will investigate the repercussions of financial liberalisation as well as the politicisation of the regulation and supervision of banks.

2.3 The post-deregulation period

Following the completion of the banking sector deregulation in the late-1980s, the regulatory authorities adopted further financial liberalisation policies to become a truly "open economy". Capital accounts, which were partially deregulated in the early 1980s, were fully liberalised in 1989[10] and the full convertibility of the Turkish Lira was recognized in 1989,[11] which in turn fully exposed Turkish banks to the forces of financial globalisation. Successive governments used the capital account liberalisation as a

[10] Neoclassical economic theory posits that easing restrictions would lead capital to flow from the capital-rich developed countries, where return for the capital is low, to the capital-scarce developing countries where return to the capital is high (Henry, 2007). This flow in turn would reduce the cost of capital in developing countries and thereby foster temporary increases in investments (Fischer, 1998).

[11] This decision indicated that the Turkish Lira exchange rate was left to market factors without any regulatory intervention and allowed local currency to be exchanged for foreign currency without any restriction on the amount. Yet it is argued that the opening of the capital account in Turkey was premature, since the Turkish financial market was not sound and deep enough to insulate itself from shocks from international capital flows. Instead, political authorities politicised the legislation process to capitalise on short-term gains based on short-term capital inflows without paying adequate attention to the disastrous medium- and long-term consequences. Therefore, this decision was one of the primary factors contributed to the financial crises in 1994, and 2000-2001 in Turkey (Onis and Bakır, 2007).

fundamental policy initiative to sustain and finance the fiscal deficits[12] of the 1990s (Balkan and Yeldan, 1998; Demir, 2004). During this period, a "hot money" policy of high real interest rates for government securities was implemented, along with domestic currency appreciation. This is because after the removal of interest ceilings as of 1988, real interest rates rose to unprecedented levels. This policy in turn attracted a significant amount of short-term foreign capital[13] (Biçer & Yeldan 2003). While borrowers had difficulties to adapt to excessive real rates on loans, banks adapted swiftly to the new conditions by investing into government securities instead of extending loans to the private sector. Successive governments therefore found it easier to finance its borrowing requirements from domestic banks by means of government securities. As a result, the high real interest rates, coupled with financial arbitrage opportunities, prompted banks to focus on government deficit funding as the annual real interest rates for the government securities averaged 32% in the 1990s (Bakır and Öniş, 2010). These securities were also granted tax exemptions and could be used as collateral to attract banks. Furthermore, macroeconomic instability experienced in the Turkish economy in the 1990s[14] induced banks to adopt a more risk-averse approach with their lending decisions, preferring to undertake a limited maturity transformation by investing in government securities. This business practice under macroeconomic instability enabled banks to avoid the potential NPLs that would have resulted from extending loans to the private sector (Atiyas and Ersel, 1994; Yildirim, 2002). These factors caused both state and private banks in particular to invest most of their funds, obtained through short-term foreign capital inflows, in government securities[15] rather than channelling them to private and corporate lending.

The Treasury and the CBT were the sole authorities of banking regulation and supervision, yet it arguably contributed to the politicisation of regulatory and supervisory institutions. It

[12] A comprehensive deterioration of fiscal balances occurred in the post-1988 era in Turkey. While the public sector borrowing requirement as a ratio of GDP averaged 4.5% during 1981-1988, it increased to 8.6% for the 1989-1997 period.

[13] Turkey failed to attract substantial long-term foreign direct investment until the early 2000s, partly due to the unstable macroeconomic environment and lack of strong regulatory infrastructure for the financial sector (Alper and Öniş, 2003).

[14] Between 1990 and 2000 GDP ranged from -5.5% to 9.3% with an average of 4.7%. Inflation rates had lain in the range of 65–90% throughout the 1990s.

[15] The proportion of government securities in total assets soared from 10% to 23% from 1990 to 1999 (Bakır and Öniş, 2010).

is posited that the primary focus of the Treasury was to finance the budget deficit instead of ensuring the prudent behaviour of banks and politicians were therefore able to manipulate the decisions of the leading officials of the CBT (Alper and Öniş, 2002; Ganioglu, 2008). For example, Turkish banks had large open foreign exchange positions[16] in the first half the 1990s since they were borrowing foreign currency at very high interest rates to benefit from the opportunities provided by holding domestic currency denominated government securities (Alper and Öniş, 2002). This exposed them to significant foreign exchange risk since they were vulnerable to sudden changes in foreign exchange rates and speculative attacks. However, the Treasury and the CBT completely overlooked the problem, laying the ground for future issues in the banking sector. Altınkemer (2005) argues that the government postponed the necessary fiscal adjustments by preventing the CBT and the Treasury from taking necessary measures since it was able to finance the deficit via domestic borrowing from banks. This in turn increased both the budget deficit and domestic external debt stock,[17] raising doubts on the sustainability of the budget and external deficits.

The concerns in the banking sector due to increasing foreign exchange risk, coupled with unsustainably high real interest rates on government securities, triggered a foreign exchange crisis in 1994 (Yildirim, 2015). The crisis had serious repercussions on both the economy and the banking sector. The Turkish Lira depreciated in real terms by a staggering 24% while inflation and interest rates soared to 132% (Altınkemer, 2005). Three banks were closed down and the total assets of the banking sector reduced by 28%. Significant bank runs compelled the government to introduce deposit insurance to all savings deposits to restore confidence in the banking sector.[18] Moreover, the authorities did not close down some insolvent banks to prevent the financial sector from losing its reputation and confidence.

---

[16] The total open foreign currency positions of the banking sector increased to USD 5 billion in 1993 from USD 1.8 billion in 1991 (Altunbaş et al., 2009). Specifically, the majority of the open positions were given by private banks that were investing heavily in the government securities financed by the short-term foreign capital inflows.

[17] The stock of domestic debt was only about 6% of GNP in 1989, just when the liberalisation of the capital account was completed, yet it skyrocketed to 20% by 1997.

[18] This has led to a moral hazard problem since some of the banks predicted correctly that the government would not allow banks to fail, thereby they reported asset deterioration to be able to get capital injections and be bailed out by the government (Fukuyama and Matousek, 2011).

Nevertheless, the crisis was short-lived and the Turkish economy experienced a rapid recovery between 1995 and 1998. Yet this fast recovery raised many questions. Specifically, it is argued whether this expeditious recovery was achieved in exchange for further politicisation of the regulatory framework and supervisory institutions (Öniş and Bakır, 2007). For example, the Treasury and CBT introduced a new ratio (the 'Foreign Exchange Net Position/Capital Base') to control foreign exchange assets and liabilities consistent with the capital base to monitor and control the foreign exchange risk of banks.[19] However, although this ratio showed that many Turkish banks needed to close down their foreign exchange open positions in the aftermath of the 1994 crisis, this action did not stop excessive foreign exchange exposure of banks, indicating that they were not properly regulated and supervised (Ganioglu, 2008). Moreover, these banks reopened their foreign exchange positions in spite of the high cost of funding (Altunbaş et al., 2009). As a result, they resumed borrowing from abroad and foreign currency deposit demand was kept high in the aftermath of the 1994 crisis.

In addition to the foreign exchange risk, Turkish banks had other fragilities due to the weak regulation and supervision. For example, due to high interest rates and inflation, investors turned towards very short-term financial instruments such as repurchase agreements. They directed their funds into the overnight repo market with the return of high interest rates. Turkish banks funded their security portfolios using mostly funds from the repo market, leading them to give open positions on contingencies and commitments (Altunbaş et al., 2009). They also exploited new financial instruments to hide their foreign exchange positions. Consequently, Turkish banks were exposed to a large maturity mismatch between their assets and liabilities along with foreign exchange risks since they were funding longer-term loans and government debt.

State banks in particular began to bring serious distortions to the financial system after the crisis. It is posited that they were heavily used as an apparatus for rent distribution by political authorities (Alper & Onis 2002; Bakır & Öniş 2010). They extended loans at subsidised rates (below market interest) to the government and favoured sectors, which in

[19] The rule imposed that the net foreign exchange position (domestic currency equivalent of foreign exchange assets and liabilities) to capital base could not exceed 50%, which by 1999 was reduced to 20%.

turn undermined their capitalisation, liquidity, and profitability (Altunbaş et al., 2009). The losses that occurred due to the exploitation of the state banks were called "duty losses" and they reached significant levels after 1994.[20] The IMF put pressure on the government to halt the rent distribution, to keep fiscal expenditure under control, and implement tighter regulations. Yet it is argued that political concerns dominated and hampered external actors' pressure (Alper and Öniş, 2004; Ganioglu, 2008). For example, the establishment of an independent regulatory and supervisory agency was inhibited since the political authorities were able to control and affect the decisions of the leading officials of the Treasury and the CBT, which enabled the politicians to control banks and thereby resource allocation. Therefore, the rent distribution through the state banks mechanism was actively used[21] till the end of 1990s (Altunbaş et al., 2009).

The entry of new banks was arguably based mainly on political criteria due to politicisation of the regulatory institutions (Alper and Öniş, 2002). For example, the number of banks increased from 66 in 1990 to 81 in 1999, most of which were domestic private banks. Although these new entries would not be expected to create negative outcomes, lax regulations, together with political interventions, not only allowed easy entry but also made the subsequent monitoring difficult (Yildirim, 2015). Therefore, six private banks which were granted licences following the 1991 elections failed within a decade of their inception, giving more support to the argument that entry by new banks was determined primarily by political criteria.

Finally, an important point to note is that the participation of foreign banks into the Turkish banking sector was minuscule and rent-oriented throughout the 1990s and early 2000s (Altunbas et al., 2009). Yet the country embarked on a deregulation and liberalisation

[20] The duty losses of the largest two state banks soared from 3% of Gross National Product (GNP) in 1993 to 12% of GNP in 2000, while the NPLs ratio reached about 37% of their total loans as of 2001 (Bakır and Öniş, 2010). These losses reached almost 50% of their balance sheets at the end of 2000 (BRSA, 2009).

[21] There were potential reasons explaining the government's exploitation of the state banks' resources to reinforce the domestic economy in the second half of the 1990s. They were arguably: (i) the economic downturns and financial crises which occurred in emerging markets (Brazil, South East Asia, Russia) in the late 90s; and (ii) conflicts such as the Russian economic crisis, which lead to exports from Turkey to Russia to dropping by 35%, and Gulf War, which had serious negative impacts on the domestic economy, led to sharp capital outflows and a slowdown in international trade. In addition, domestic political instability, terrorism, and the Marmara earthquakes of 1999 afflicted densely populated, industrialised regions all contributed to the economic slowdown in the second half of the 1990s (Altunbaş et al., 2009).

process as of 1980 with the aim of attracting foreign investment. In addition, foreign banks have shifted their strategy from pursuing internationally active corporate clients towards the exploration of business opportunities in emerging and developing economies (Moreno and Villar, 2005). Despite these favourable developments, foreign-owned banks accounted for only 3-4% of total banking assets until 2002 (Altunbas et al., 2009). Moreover, the foreign banks entered into the Turkish banking sector focused mainly on corporate finance, where one representative office or single branch basis would be all that was required to manage their business. It is argued that the persistent macroeconomic imbalances, the shortcomings, and implementation problems of banking regulation and supervision, and the lack of internationally accepted banking principles, contributed to the failure of attracting foreign investment and the mode of entry of foreign banks (Alper and Onis, 2002).

One standard proxy of foreign bank presence is the share of total assets of foreign owned banks in a banking industry. As discussed above, foreign banks have started to penetrate into developing and emerging market economies to seize business opportunities, leading to radical increases in their shares of total assets in these economies. Moreno and Villar (2005) provides descriptive data regarding the degree of foreign ownership of banks across countries including Turkey. This allows us to compare the foreign bank presence in Turkish banking sector with other emerging and developing countries with liberalised banking systems. Table 2.1 shows that foreign bank penetration has differed significantly across countries. Turkish banking sector appears to have the lowest foreign bank ownership of banks as of 2002. This might lend support to the discussions above that Turkish banking sector failed to attract foreign investment. Specifically, there has been a significant transformation in Latin America and Eastern European[22] countries having the highest foreign ownership ratios.

[22] The comparison with these countries is to be made with caution though, since transition economies had no history of commercial banking and therefore faced quite specific problems and needs compared to the long-established players of the Turkish sector (Steinherr et al 2004).

Table 2.1 Percentage of foreign ownership of banks across countries

		1990	2000	2002
	Turkey	**2.9**	**3.6**	**3.3**
Asia	Hong Kong SAR	45.7	87.2	88.6
	India	21.0	42.0	40.0
	Malaysia	22.3	24.9	25.2
	Singapore	89.4	75.7	76.0
Latin America	Argentina	17.0	48.1	41.6
	Brazil	-	25.2	21.5
	Chile	18.6	33.1	44.8
	Colombia	3.7	18.0	16.4
	Mexico	0.3	54.6	81.9
	Peru	0.0	32.6	30.4
Eastern Europe	Czech Republic	26.4	65.4	85.8
	Hungry	11.4	69.9	90.4
	Poland	0.02	69.5	67.4

Source: Adapted from Moreno & Villar (2005). Assets owned by banks with 50% or more foreign ownership.

In conclusion, despite completing the bank deregulation process and undertaking further financial liberalisation policies to become a truly "open economy" as of 1988, the politicisation of banking regulation and supervision led to excessive risk taking that distorted the financial market. External bodies such as the IMF and the WB played important roles in the introduction of regulations, yet their pressure to get these implemented was not enough due to the involvement of the political authority into the regulatory and supervisory institutions. Moreover, the negligible presence of foreign banks and the politicisation of bank entry and bank lending decisions distorted competition and the stability of the banking sector. All these incidents in the banking sector, coupled with persistent macroeconomic imbalances, chronic fiscal deficits and high rates of inflation,

contributed to the outbreak of the deep economic recession towards the end of 1990s. The government again cooperated with the IMF and introduced a new economic stabilisation programme, including a new banking act, which was introduced in 1999 to reinforce the economy and to revamp the inefficient regulatory and supervisory structure.

2.4 The outbreak of the twin crises in 2000-2001

Prior to the outbreak of the 2000-2001 twin crises, the IMF-supported exchange-rate-based stabilisation programme[23] introduced in December 1999 brought tight monetary control, a wide ranging fiscal adjustment to eliminate inflationary pressures, and a series of structural precautions designed to liberalise the economy further. In addition to this stabilisation programme, the IMF-sponsored Banks Act (No. 4389) was passed in June 1999. This act involved a combination of measures to ensure financial stability, improve the functioning of the Turkish banking sector and align Turkish banking regulations with European Union (EU) directives.[24] At the centre of these measures was the establishment of a new independent Banking Regulation and Supervision Agency (BRSA) in conjunction with the Banking Act. The supervision duties that had been shared between the Treasury and the CBT until this point were accordingly transferred to the BRSA. As a result, this institution became the sole authority responsible for regulating, supervising, and auditing Turkish banks.[25] Moreover, a new central banking law giving a legal independence to the CBT from the government was being drafted. These efforts were arguably an attempt at the de-politicisation of bank lending and the rise of the regulatory state in monetary and financial governance (Bakır and Öniş, 2010). In addition, other primary measures, including tighter risk control and management procedures, external auditing of banks, as well as new principles used to calculate the minimum capital requirement and foreign exchange exposure were introduced. In other words, with the introduction of this new Banking Act, the authorities aimed to strengthen regulatory and supervisory institutions and ensure that

[23] Turkish authorities had had 16 stand-by agreements with the IMF before this stabilisation programme, all but two of which were abandoned.

[24] Turkey was granted a formal candidate status in the EU's Helsinki Summit in 1999. This arguably gave the key political and economic actors incentives for change and the implementation of deep-seated institutional reforms (Öniş and Bakır, 2007).

[25] According to Barth et al. (2013), the Turkish policy makers have empowered the supervisory agency by providing more explicit power to the supervisors.

the prudential regulatory and supervisory framework was compatible with internationally accepted banking principles.

However, the implementation of this act was discontinuous and it did not have the expected favourable influence on the banking sector's stability and performance. For example, it is contended that there was no natural constituency pressuring for the establishment of an regulatory and supervisory agency like the BRSA and there was also a lack of political and bureaucratic will as well as strong resistance from powerful banking lobbies before the twin crises experienced in 2000 and 2001 (Öniş and Bakır, 2007). As a result, the operation of the BRSA was delayed until mid-2000 due to the late appointment of the members of the administration board. This phenomenon accordingly contributed to the aggravation of the asset quality of banks in the early 2000s (BRSA, 2001). Moreover, it is posited that the design of the stabilisation programme put more emphasis on correcting the fiscal disequilibrium, namely that it did not put necessary emphasis on the restructuring and regulation of banking sector (Alper and Öniş, 2002). In addition, both duty losses and open positions were well above the regulatory limits, with the full knowledge of the Treasury and the Central Bank. Besides to the caveats in the banking sector, endemic problems of the Turkish economy such as high and volatile inflation, high fiscal deficits and soaring concerns about the financing problems of the current account deficit, contributed to loss of confidence of foreign investors. All these economic and banking sector related incidents inevitably induced a huge capital outflow and due to the lower liquidity levels in financial market, this volatility induced interest rates to soar up to 100%.

In retrospect, these developments arguably triggered the first liquidity crisis occurred in November 2000. As a result, five banks and two investment banks went bankrupt. Twenty banks were transferred to the Savings Deposits Insurance Fund (SDIF), which proves the severity of the crisis. Following this crisis, although the authorities endeavoured to strengthen policies and regulations introduced by the stabilisation programme of 1999, fragilities in the banking sector aggravated. First, banks heavily suffered from bad loans due to the sharp contraction in the economy. Second, the duty losses of state banks soared due to the need to finance large budget deficits, which is arguably one of the most crucial point contributed to the subsequent liquidity crisis of February 2001. Since the Treasury was not willing to finance the duty losses, this role was filled with the state banks which had to borrow heavily from the inter-bank market to finance their day-to-day liquidity

needs. This inevitably led to artificially high interest rates on deposits and interbank borrowing, and subjected the financial system extremely vulnerable to an exogenously generated shock (Altunbas et al., 2009). Third, the IMF insisted on the controlled exchange rate policy under this unstable macroeconomic situation, thus contributing to a full-scale capital outflow at the outset of 2001, which effectively put an end to the stabilisation programme of 2000 (Alper and Öniş, 2002).

All these factors led the Turkish currency depreciated by about 130%, triggering one of the country's most severe domestic financial crises in February 2001. The gross domestic product (GDP) contracted by almost 6% and inflation rates rose to about 70%. In addition, while the budget balance to the GDP ratio reached almost 12%, the ratio of public debt to GDP was almost 80%. The number of banks taken over by the SDIF reached 22. Thus, this crisis proved that there was a need for more precautions in the Turkish banking sector despite the endeavours of regulatory authorities.

2.5 Regulatory reforms in the post-crisis period

The previous sections have pointed out that the regulatory reforms undertaken in the post-crisis era were incomplete and discontinuous.[26] This discontinuity have been explained by the fact that: (i) the regulatory reform process was heavily politicised,; (ii) the Treasury, the principal institution responsible for bank supervision and regulation, was far from effective in terms of accomplishing a proper regulatory role due to the conflict objectives that characterised its operation; (iii) these reforms were largely driven by external actors and manifested itself as a discontinuous process; [27] (iv) the participation of foreign banks into the Turkish banking sector was peripheral and rent oriented.

However, in the aftermath of the destructive twin crises experienced in November 2000 and February 2001, the BRSA introduced the "Banking Sector Restructuring Programme"

[26] Due to the discontinuity in the regulatory reform processes of 1980s and 1990s, we accept the regulatory reforms introduced in the aftermath of the November 2001 crisis, which have been implemented effectively and have manifested continuity in their implementations, as a corner stone in the regulatory process of the Turkish banking. Not sure why but this will not move into footnotes on previous page!

[27] This is arguably because only when the domestic economy experiences crises, the power of external actors rises while the power of domestic actors such as politicians and banking lobbies shrinks.

in cooperation with the IMF in May 2001. This programme initially focused on restructuring problematic banks and then introduced many new prudential regulation and supervision norms in 2002. It aimed to restore the fragilities in the banking sector and improve the regulation and supervision structure, which in turn can promote efficiency, competition, and stability of the banking sector (Pazarbasioglu, 2005). Compared to the regulatory reforms of the 1980s and 1990s it is fair to argue that the implementation of the programme has been more effective despite the authorities implementing the reforms without adopting a consultative or gradual approach. This is arguably due to the fact that these crises provided a window of opportunity for banking sector restructuring via various channels (Alper and Öniş, 2004; Öniş and Bakır, 2007). First, it created public support for the reform process that broke down the resistance of bank lobbies and politicians. Second, it strengthened the role of key external organisations such as the IMF and the EU,[28] enabling them to push in the direction of reform. Third, it exposed the structural weakness and the fragility of the sector since some banks experienced erosion of their capital base and deterioration of their asset quality. Fourth, the independent regulatory and supervisory agency, the BRSA that started to function properly as of 2000, contributed to the establishment and implementation of an effective prudential regulation and supervision. Lastly, the ongoing EU membership negotiations and a favourable global environment in the first half of the 2000s, leading to strong capital inflows, facilitating the ease of implementation of the reforms since 2002 (Altunbas et al., 2009). As a result, the independent regulatory institutions have been able to reform the banking regulatory and supervisory framework with the support of domestic and international organisations.

The fundamental pillars of the programme are: (i) the restructuring of state-owned banks in both a financial and operational manner; (ii) the resolution of the banks that were taken over by the SDIF;[29] (iii) the resolution of the private banks adversely affected by the crises; and (iv) the strengthening of the regulatory and supervisory frameworks. We will now elaborate on these pillars. The first pillar of the banking restructuring process was to seek

[28] These external anchors can support governments to overcome the resistance of domestic interest groups and can create greater commitments on the part of key economic and political agents. They can also make the reforms more credible by imposing conditional agreements on governments, compelling them to implement reforms (Öniş and Bakır, 2007).

[29] The resolution of these banks involved acquisitions by either domestic or foreign banks, consolidations into a single bank, or liquidations.

solutions for state banks facing financial and operational problems with the ultimate aim of privatising these banks. Their balance sheets were significantly deteriorated due to the delays in the repayment of loans used by the Treasury for budget financing, the duty losses that reached almost 50% of the balance sheet as of the end of 2001 and the shortcomings in management (BRSA, 2002). Therefore, public resources were transferred to the state banks to liquidate their duty losses which amounted to a total of USD 21.9 billion at the end of 2001 and the regulations leading to duty losses were abolished. Their capital base was strengthened through capital support. Efforts were also accelerated towards their operational restructuring, which was strengthened through mergers between the state banks and by significantly reducing branches and employees by 33% and 50% respectively by the end of 2003 (BRSA, 2009). In addition, their technological infrastructure, financial control and risk management were restructured, enabling them to operate more in line with the requirements of modern banking and international competition.

The second pillar of the restructuring process was the resolution of the banks taken over by the SDIF since their financial structure weakened and they faced problems to meet their liabilities. Twenty banks were transferred to the SDIF in 1996-2003. The funds used in this process were borrowed by the SDIF from the Treasury, reaching USD 28.2 billion at the end of 2003. The resolution process of these banks was carried out rapidly to avoid greater losses and ensure stability in the sector (Pazarbasioglu, 2005). The SDIF either sold them to foreign and domestic investors or encouraged mergers with other domestic banks. Only two banks were still under its management in 2003 and only one as of today.

The third pillar was the establishment of a sound private banking sector. The financial structure and profitability of the banks deteriorated sharply with the twin crises. Therefore, the authorities aimed to reinforce the equity capital of private banks, limit foreign currency open positions, resolve the NPLs, and promote mergers and acquisitions (M&As) to ensure soundness and sustainability of private banking. In line with the scope of the programme, considerable steps were taken towards strengthening the capital base of private banks, which had eroded during the crises. While one bank was transferred to the SDIF due to shortage of capital, solvent banks that did not satisfy minimum capital requirements were recapitalised through capital injections by the SDIF or forced to merge with other banks. The NPLs problem of banks, which had considerably increased by 2001, was sought to be resolved through debt restructuring programmes. A multiphase auditing process was

undertaken in 2001 to enhance transparency and credibility. Banks were required to improve their accountability and transparency to shareholders. Tax advantages were given to banks by the law of 2001 to encourage M&As with the hope that this consolidation process would eliminate weaker banks and increase activity and competition in the sector.

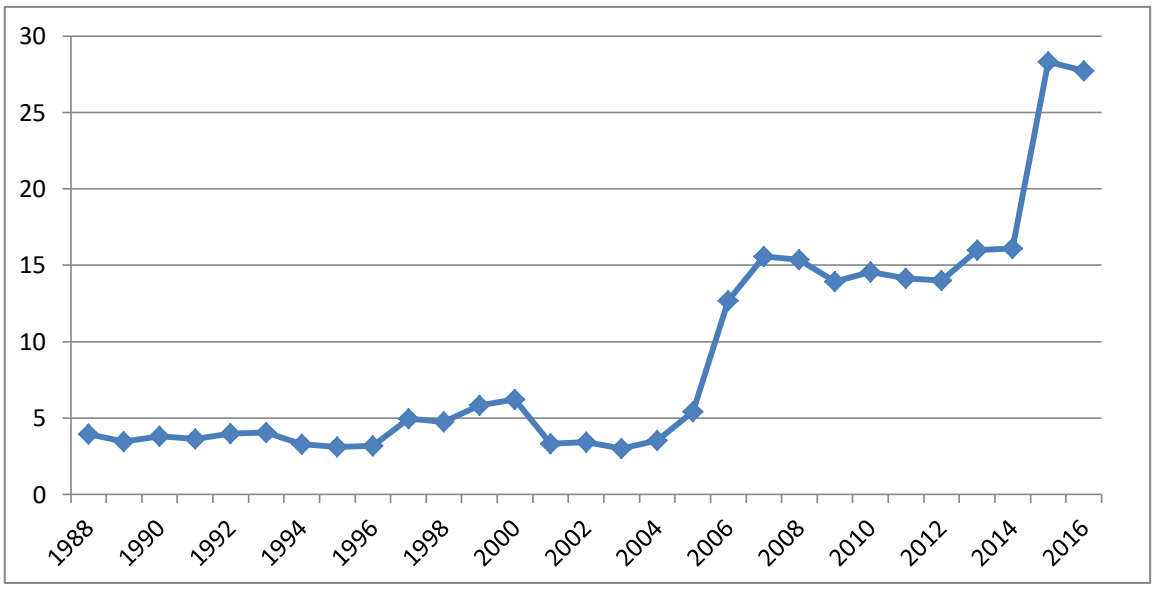
The aim of the fourth pillar was to reinforce the regulatory and supervisory framework, ensure efficiency and competitiveness, and facilitate sound banking practices to establish confidence in the banking sector (BRSA, 2002). Therefore, prudential regulations were concentrated on the following areas: capital adequacy, internal audit and risk management, loan exposures, loan loss provisioning, accounting standards, independent audit, and M&As, all of which were made compliant with international regulatory standards. For example, the "Regulation on Measurement and Assessment of Bank Capital Adequacy" that defines principles and procedures for the calculation of the CAR of banks by taking into account market risks (namely interest rate, exchange rate, and equity risks) was published in January 2002 (BRSA, 2002). The "Regulation on Banks' Internal Audit and Risk Management System" that sets out principles and procedures to establish an effective internal auditing system and an effective risk management system was put into force in January 2002. This in turn aims to ensure risk-focused supervision of banks on an activity basis (BRSA, 2002). The "Regulation on External Audit Principles" was put into force in 2002 to determine the procedures and principles for auditing the conformity of accounts and records of banks (BRSA, 2002). In addition, some other reforms were introduced to improve the regulatory structure and prudential re-regulation/supervision (see Appendix 2.1). Finally, reforms concerning market infrastructure, such as the formation of the Competition Authority and the Capital Market Board, were also introduced to enhance competition and efficiency in the financial and banking sectors.

The developments in regulatory standards after 2001 have probably affected the presence of foreign banks in the Turkish banking sector. As discussed in Section 2.4, despite the relatively early adoption of liberal policies, the market share of foreign banks had been negligible until the early 2000s. Yet this trend showed a drastic change following the implementation of the regulatory reforms in the post-crisis era. The potential factors explaining this phenomenon are that the regulatory reforms led to a banking sector characterised by strongly recapitalised banks having higher capital ratios, a tightly

regulated banking sector, and the banking regulations that have been aligned with internationally accepted norms (Aysan and Ceyhan, 2006). Moreover, the ongoing membership negotiations with the European Parliament, the growth potential of the Turkish banking sector, the growing consumer credit and mortgage markets, along with notable untapped banking potential, arguably also raised the interest of foreign banks to the Turkish banking sector (Altunbaş et al., 2009). As a result, foreign investors' interest started to increase after the twin crises, engendering a considerable number of foreign banks penetrated into the Turkish banking sector during 2005 and 2006 (see Appendix 2.2). Specifically, foreign investors such as Citigroup, UniCredito, BNP Paribas, and Fortis, whose headquarters are located in EU countries, invested around USD 14 billion between 2005 and 2006. Figure 2.1 shows the participation trend of foreign banks into the Turkish banking sector over time. It denotes that until 2005, the market share of foreign banks was miniscule. Yet this trend reversed as of 2005. That is, the total assets of foreign banks started to increase comprehensively after 2005 when the heavy penetration of foreign banks was realised. It should be also noted that the entry of new foreign banks into the Turkish banking sector were realised either through acquisition of the shares of locally established medium-sized domestic private banks or opening of a branch. In other words, instead of starting a *de novo* bank or greenfield investment, they entered into the Turkish banking sector through acquisition. This in turn has affected not only the efficiency of the domestic banking sector, but also the degree of competition (Clarke et al., 2003).[30]

[30] We will elaborate on the impact of the mode of foreign bank entry in Section 3.3.

Figure 2.1 Ratio of total assets of foreign banks to total industry assets



Note: Figure is based on the scheduled commercial banks (excluding local banks, banks under the SDIF, development and investment banks)
Source: The Banks Association of Turkey (BAT), author's calculation

In conclusion, the lack of internationally accepted banking principles and the pervasive failure to provide proper prudential regulation and supervision of the banking sector due to the political intervention into the regulatory process and the lack of a sound regulatory framework and institutions, led banks to take excessive risks, increasing fragilities in the sector in the 1980s and 1990s. The fragile banking sector coupled with macroeconomic instabilities and large fiscal deficits arguably laid the basis for the financial crises in 1994, 2000, and 2001. Yet the radical changes undertaken in the legislative and institutional framework following the twin crises have contributed to the improvements in the prudential regulation and supervision of Turkish banks, which in turn have had repercussions on the market structure, performance and soundness, which will be analysed in the following section.

2.6 A brief analysis of contemporary Turkish banking

The changes in the regulatory environment since 1980s have not only rendered alterations in the market structure of the Turkish banking sector but also have changed the business strategy of banks. Therefore, to shed light on the transformation of the sector in response to the changes in the regulatory environment, this section investigates selected primary banking sector metrics for the period 1988-2016. These metrics are not necessarily

measures of competition or efficiency, yet they give preliminary evidence as to how the Turkish banking sector has reacted to the legislations introduced by the banking authorities over time, with particular interest devoted to repercussions of the regulatory reforms implemented in the aftermath of the twin crises. The metrics that will be investigated below are related with market structure, cost structure, competition, income structure, and quality of assets.

First, we start by investigating the impacts of alterations in the regulatory framework on the market structure of the Turkish banks. The changes in market structure are manifested in the increasingly diversified ownership and reduction of the number of banks. As seen in Table 2.2, summarising the changes in the number and market share of three ownerships, the number of public banks dropped until 2001 and remained stable thereafter. It is noteworthy that these banks have witnessed an almost consistent decline in market share during the entire period. Thus, it can be inferred that the efficiency-driven ownership reforms and concomitant privatisation policy implemented after 2001 reduced the state ownership of banks. At the end of 2016, the three public banks accounted for 33.5% of market share in terms of total assets, a decline of 21.2% compared to 1988. The loan market share of public sector banks also plummeted from 54.7% in 1988 to 33.5% in 2016. The changes in the number and share of public banks arguably stemmed from the introduction of the deregulation policies aiming to increase the role of private banks and the concomitant regulatory reforms of consolidated or privatised state-owned banks. On the other hand, the number of domestic private banks was inconsistent until 2001 and their numbers have consistently dropped thereafter. This trend is largely attributable to the restructuring programme, introduced in the aftermath of the twin crises, inducing the private banks that were taken over by the SDIF to be closed or consolidated. In other words, the restructuring programmes (in the form of compulsory M&As) worked as an exit strategy for weak commercial banks. Specifically, new foreign banks have penetrated into the Turkish banking sector by acquiring domestic private banks since 2005, which explains some of the drops in the number of private domestic banks. The market share of domestic private banks in terms of total assets has showed inconsistency during the entire period, though the market share of these banks in terms of loans showed a steady increase from 1988 to 2005 and then started to reduce thereafter, possibly due to the global financial crisis. However, it is interesting to note that these banks extended the largest amount of loans compared to other ownerships as of 2016, indicating their importance in the loan

market. Foreign banks used to have a miniscule share in the sector until 2005, yet their number and specifically the shares in the sector in terms of assets and loans have almost quadrupled after 2005 due to their heavy penetration into the Turkish banking market at this time. In other words, although their market shares in terms of assets and loans are still low compared to their domestic counterparts, it can be concluded that these banks are not anymore marginal players in the Turkish market.

Table 2.2 Summary of the number and market share of three ownerships (1988-2016)

	Public banks			Domestic private banks			Foreign banks		
Year	Number of banks	Share in sector (assets)	Share in sector (loans)	Number of banks	Share in sector (assets)	Share in sector (loans)	Number of banks	Share in sector (assets)	Share in sector (loans)
1988	8	47.6	54.7	25	48.4	41.9	19	4.0	3.4
1992	6	46.4	47.6	31	49.6	49.0	20	3.9	3.4
1996	5	40.7	38.9	33	56.1	59.1	18	3.2	2.0
1999	4	38.9	32.7	31	55.2	63.9	19	5.8	3.4
2001	3	35.3	25.1	22	61.4	71.1	15	3.3	3.9
2005	3	32.6	21.7	17	62.0	71.1	13	5.4	7.1
2009	3	32.4	28.4	11	53.6	53.9	17	14.0	17.6
2013	3	30.9	29.3	11	53.1	54.6	17	16.0	16.0
2016	3	32.7	33.5	9	39.5	39.4	21	27.7	26.8

Note: Figures are based on the scheduled commercial banks (excluding local banks, banks under the SDIF, development and investment banks)
Source: The BAT, author's calculation

Table 2.3 presents two measures of the changing level of concentration of the banking sector, the Five-firm Concentration Ratio (CR_5) and the Herfindahl-Hirschman Index (HHI). The CR_5, which measures the market share of the five largest banks in every given year, is generally used to reflect the extent of market control of the largest firms, but it does

not provide much detail on the competitiveness of the sector.[31] The HHI, on the other hand, is calculated as the sum of the squares of the market shares of all the banks within the industry. The higher level of index indicates that the higher level of concentration in the industry, namely the index, is inversely proportional to the level of competitiveness.

Table 2.3 Summary of selected market structure indicators (1988-2016)

Year	Number of banks	Defined by total assets		Defined by gross loans	
		HHI	CR_5	HHI	CR_5
1988	52	1.024	0.624	1.324	0.676
1992	57	0.860	0.542	1.151	0.611
1996	56	0.779	0.504	0.891	0.526
1999	54	0.822	0.530	0.788	0.530
2001	40	1.013	0.619	1.001	0.644
2005	33	1.069	0.658	0.906	0.587
2009	31	1.071	0.657	0.934	0.586
2013	31	0.966	0.609	0.944	0.595
2016	33	0.976	0.608	0.976	0.602

Note: Figures are based on the scheduled commercial banks (excluding local banks, banks under the SDIF, development and investment banks); Herfindahl-Hirschman Index (HHI) and Five-firm Concentration Ratio (CR5) are calculated relative to total assets and total loans respectively.
Source: The BAT, author's calculation

Looking at concentration ratios (see Table 2.3), both the CR_5 and the HHI exhibit similar trends over time. Specifically, both indexes are defined by total assets and total loans and showed a decreasing trend between 1988 and 1999, due possibly to the introduction of deregulation policy, increasing the number of banks in the industry. This trend was reversed in 2001 as the indexes increased in the aftermath of the twin crises. This is largely because banks having weak financial structures were either closed or merged into stronger

[31] Bikker & Haaf (2002) provided a detailed discussion on why this ratio does not provide information on the competition level of a banking sector.

banks, hence a significant drop in the number of banks was experienced. What is noteworthy is that while the concentration levels defined by the total assets tended to decline after 2005, the levels defined by total loans tended to increase after 2005. To put it differently, the concentration levels in terms of total assets was higher than the concentration levels in terms of loans between 2001 and 2013. This may indicate that competition in the loan market was higher than the total assets after 2005. This can be explained by the fact that fiscal discipline comprehensively reduced the public sector borrowing requirement and decreased interest margins, which in turn rendered Turkish banks to focus on the lending market instead of keeping most of their assets in the form of government securities. However, the concentration levels measured by using HHI or CR_5 need to be treated with caution, since these concentration measures have been found to be poor proxies for competition in banking (Claessens and Laeven, 2004; Delis, 2012). Therefore, we now report more specific information concerning with the competitiveness of the banking sector.

Second, we now turn our attention to the impact of changes in the regulatory framework on the cost structure of the Turkish banks. As illustrated in Table 2.4 presenting the ratio of non-interest expenses over total earning assets shows an inconsistent trend between 1988 and 1999, yet it skyrockets in 2001 and it shows a persistent decline thereafter. As discussed by (Elliehausen, 1998), the incremental compliance cost incurred by the revision of regulation is primarily manifested in the increase of non-interest expenses. Therefore, the extraordinary increase of non-interest expenses corresponding with per unit earning assets observed from 1999 to 2001 seems to relate with banks' effort of implementation of adaptation to the change in the prudential regulations introduced in the aftermath of the twin crises. Table 2.4 also shows that the changes in the ratio of personnel expenses over total earning assets closely mirror the change of the ratio of non-interest expenses over total earning assets. This point also restates Elliehausen (1998), who argues that labour costs are the main component of the compliance cost. Therefore, it is possible to expect Turkish banks to intensify their labour intensive collection efforts with the introduction of the regulatory reforms in the aftermath of the twin crises. This is because these reforms have dictated to the banks to close their open positions and resolve the NPLs that skyrocketed after the twin crises of 2000-2001, possibly resulting in one-shot large increase in personnel expenses and non-interest expenses.

Table 2.4 Non-interest expenses as a percentage of total earning assets

Year	Non-interest expenses		Total earning assets	Ratios	
	Personnel expenses	Physical capital expenses		The ratio of non-interest expenses over total earning assets	The ratio of non-interest expenses over personnel expenses
1988	382.83	677.31	9,187.88	11.4	4.1
1992	621.79	697.52	10,721.83	12.3	5.8
1996	561.05	1,041.85	16,593.51	9.7	3.4
1999	745.02	1,145.71	18,578.01	10.2	4.0
2001	703.01	2,144.67	13,383.05	21.3	5.3
2005	583.34	1,635.63	32,802.06	6.8	1.8
2009	774.53	1,913.50	52,830.43	5.1	1.5
2013	930.11	2,150.06	77,034.36	4.0	1.2
2016	1,008.31	2,586.77	96,046.24	3.7	1.0

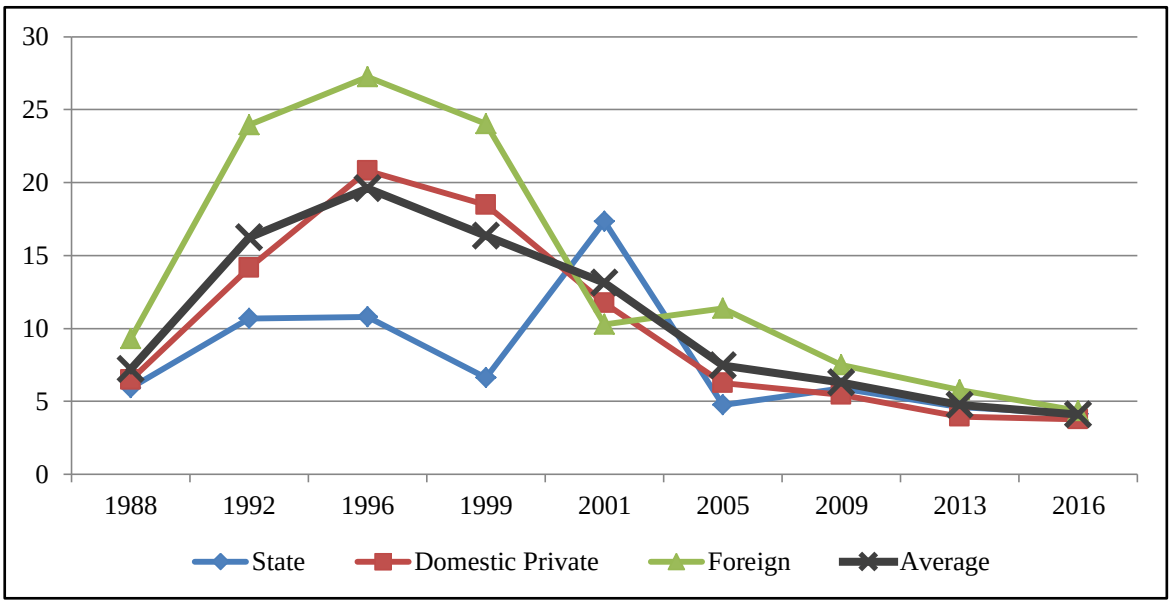
Note: Figures are based on the scheduled commercial banks (excluding local banks, banks under the SDIF, development and investment banks). Monetary values are adjusted for inflation (millions TRY).
Non-interest expenses=personnel expenses + physical capital expenses;
Total earning assets=total loans +other earning assets.
Source: The BAT, author's calculation

Third, the impact of changes in the regulatory framework on the competition of the Turkish banks can be examined by looking into the net interest margins (NIM). Turkish banking deregulation that began in the early 1980s has allowed the Turkish banks to become bigger by achieving economies of scale and scope. Yet, this has arguably contributed to the fact that the realised outcome of high levels of concentration and the formation of conglomerates may have negative effects on competition if banks collude over setting interest rates. The evolution of the NIM can reflect the competitive climate facing Turkish commercial banks. Figure 2.2 presents the evolution of the NIM by ownership and average of the NIM of these ownerships. To begin with, average of the NIM values of three ownerships indicates that these banks experienced a strong growth in the NIM from 1988 to 1996. In other words, despite the banking deregulation programme initiated in the early 1980s and accompanying reductions in concentration levels (see Table 2.3), the Turkish

banking sector had a non-competitive banking structure. Yet the increasing trend in the NIM has been reversed as of 1996 and Turkish banks arguably have faced fiercer competitive pressure since that time. Once we investigate this graph by ownership, different stories emerge. For example, all ownerships manifested an increasing trend in their NIM between 1988 and 1999. Yet state banks experienced a sharp increase from 1999 to 2001 while the opposite trend is observed in other ownerships' margins. This might be due partly to the fact that duty losses accumulated due to the extension of loans at subsidised rates (below market interest) to the government and favoured sectors were eliminated with the introduction of regulatory reforms as of 2001. Another interesting point in the figure is that foreign banks had higher margins compared to domestic counterparts during 1988-2001, which is compatible with the findings of Demirguc-Kunt and Huizinga, (1999). The authors argue that foreign banks have higher margins and profits compared to domestic banks in developing countries, since they are less subjected to credit allocation rules, have better production technologies, and have relatively low loan loss provisions because they do not generally engage in retail banking. Similarly, Turkish state banks had the lowest margins in the same period, arguably because of the fact that the rent distribution through the state banks mechanism was actively used until the end of 1990s (see Section 2.3). In the same vein, Altunbaş et al. (2009) suggest that the primary objective of these banks was performing specific missions that they undertook rather than profit maximisation. Yet it is noteworthy that the differences in the margins of different ownerships observed prior to 2001 have almost vanished since 2005. Moreover, there has been significant drops in the NIM of all ownerships, which in turn might indicate that recent regulatory reforms have to some extent managed to generate a more level playing field for Turkish banks, leading to greater competition in the Turkish banking sector. Conversely, some studies argue that shifting from deregulation to re-regulation and making domestic legislation more compatible with international standards can reduce competition in a banking sector (Casu et al., 2017). Therefore, it is possible to infer that the evolution of NIM may not necessarily reflect the changes in competitive condition in a banking market. Furthermore, there is also no consensus in the literature whether a high or low interest margin manifest is better for a more efficient banking system. Some argue that high NIM is unfavourable since it induces a disintermediation (Brock and Rojas Suarez, 2000; Demirguc-Kunt and Huizinga, 1999). Moreover, high NIM might stem from low deposit rates and indicates the unattractiveness of maintaining deposit accounts, which in turn discourages savings. Furthermore, high lending rates associated with high NIM in turn

prohibit potential borrowers and hence restrain investment. On the other hand, low NIM may not necessarily be a good thing, in particular in liberalised systems that have weak management and legal systems, since some weak banks may adopt a strategy of offering lower lending rates to acquire additional market shares. Moreover, low NIM might damage the stability of the overall banking system, because in this case banks are not able earn enough profit which could be channelled to their capital bases (Claessens et al., 2001).

Figure 2.2 Evolution of net interest margin (1988-2016)



Note: Figures are based on the scheduled commercial banks (excluding local banks, banks under the SDIF, development and investment banks); NIM values defined as the net interest income divided by total assets following Naceur and Goaied, (2008).
Source: The BAT, author's calculation

Fourth, Table 2.5 illustrates some selected banking indicators to further investigate the effects of the undertaken legislations and reforms on the income structure of Turkish banks. To start with, Spread I and Spread II, measured as the difference between the implicit loan rate and implicit deposit rate, and as the difference between the implicit loan rate and loanable fund price respectively, tend to show a declining trend over time. These trends may indicate the fact that the spreads have been narrowed for the Turkish banks, which in turn may indicate that Turkish banks have obtained less profit from traditional banking activities. Yet it is not straightforward to suggest reasons behind the declining trends of the spreads, since both the implicit loan rate and the deposit/loanable fund rates have showed similar declining trends over time. Likewise, the average of the pre-tax profit ratios in the pre-2001 period is larger than average based on the post-2001 period,

indicating that a decline in the profits derived from the traditional banking activities. Furthermore, the fee-based income ratio manifesting a progressive increasing trend over time signals a change of business focus from on-balance-sheet to off-balance-sheet activities. This trend may indicate Turkish banks' efforts to catch new development opportunities, generated by financial innovation and deregulation as of the 1990s, allowing banks to generate new forms of intermediation and other fee-based activities. This could also be rooted in the fact that Turkish banks have sought to neutralise the negative impacts of the fall in the spread of traditional banking activities on their profits.

The table also shows that the total loans ratio had an increasing trend from 1988-1996; yet the economic turmoil of the 1990s, coupled with the financial crises of 2000 and 2001, reversed this situation. This ratio dropped almost 10% after 1996 and it bottomed as of 2001. In the post-crisis period, this ratio presented a slow growth until 2005, yet the loan market has experienced a noticeable growth following the global financial crisis in particular and it has peaked as of 2016. The evolution of this ratio could be, among other things, explained by the change in banks' risk taking considerations. That is, Turkish banks inherited high NPLs from the pre-reform period and the post-2001 reforms compatible with the international standards have brought about a risk-based capital regulatory regime. Therefore, these factors induced banks to shift from loans to safer, more liquid earning assets, in particular government securities in the post-2001 period. Since the upward revised risk-based capital requirement made lending more expensive, banks changed their product mix in favour of assets having lower risk weight. As a result, the securities, the composition of risk-free assets to total earning assets ratio skyrocketed in the aftermath of the financial crises of 2000 and 2001. However, the shares of securities have dropped considerably after 2009 specifically, coinciding with the drastic increase in the shares of loans.

Table 2.5 Descriptive statistics of chosen banking indicators (1988-2016)

	1988	1992	1996	1999	2001	2005	2009	2013	2016
a) Implicit deposit rate (1)	19.0	21.6	22.3	30.7	22.3	8.0	6.7	4.1	5.0
b) Implicit loan rate (2)	33.7	36.0	35.7	35.8	31.7	13.9	14.0	8.4	9.5
c) Loanable funds price (3)	19.5	20.7	20.1	27.0	20.3	7.5	6.5	3.9	4.8
Spread I = (b) – (a)	14.7	14.4	13.4	5.1	9.4	5.8	7.3	4.2	4.5
Spread II = (b) – (c)	14.2	15.3	15.6	8.8	11.4	6.3	7.5	4.5	4.6
d) Pre-tax profit/total earning assets (4)	3.5	3.3	4.4	7.4	-2.6	2.3	3.1	1.8	1.8
e) Fee-based income/total income (5)	9.4	4.4	3.8	3.7	6.4	13.1	11.9	14.7	12.4
f) Total loans/ total earning assets	47.1	50.1	52.2	43.9	41.5	41.9	49.4	63.9	68.5
g) Securities (6)/ total earning assets	13.9	14.6	20.1	26.7	16.0	40.4	37.5	20.1	16.4

Note: Figures are based on the scheduled commercial banks (excluding local banks, banks under the SDIF, development and investment banks).
(1) implicit deposit rate = interest paid on deposits/ total deposits,
(2) implicit credit rate = interest income received on loans/total loans,
(3) loanable funds price = total interest payment/total deposits + total money market borrowings,
(4) total earning assets = total loans + (cash + due from banks + central bank + other financial institutions + interbank funds sold + securities + legal reserves + financial assets),
(5) total income = fee-based income + total interest income.
(6) securities = treasury bills + government bonds + other securities,
Source: The BAT

Finally, turning to the effect of reforms on the quality of assets (see Table 2.6), both gross NPLs and net NPLs ratios consistently reduced between 1988 and 1996, indicating an amelioration in the quality of loan portfolios in relative terms. This might be due to, among other things, the fact that after the 1994 crisis, the SDIF sought to strengthen and restructure poorly performing banks. Yet this declining trend observed in the NPLs was reversed after 1996, due probably to the ongoing chronic problems in economy and banking regulation (see Section 2.3). The biggest jump in the NPLs ratios came in 2001 and stemmed largely from the sharp contraction in the economy and the financial crises. Turkish banks nevertheless recovered quickly after the financial crises and the NPLs ratios dropped to their pre-crises levels. The amelioration of the NPLs was arguably driven by vigorous economic activity and coupled with decreasing inflation and real interest rates and an increase in the provisions maintained by the banking sector for non-performing

receivables (Altunbaş et al., 2009). Moreover, the debt-restructuring programme adopted in the aftermath of the crisis in 2001 has also relieved the pressure on the absolute amount of NPLs. Yet one should investigate further whether banks manage to reduce the NPLs ratios either through the recovering NPLs or through inflating their loan portfolios. This is because the empirical findings show that the NPLs burden is accumulated while the NPLs ratio reduces, shedding light on the propensity of banks engaging in "upward window dressing" adjustments at the quarter-end reporting dates, which enables banks to build up a large loan balance (Allen and Saunders, 1992).

Table 2.6 Profile of the NPLs in Turkish banking (1988-2016)

Year	Gross loans	Gross NPLs	Net loans	Gross NPLs ratio	Loan loss provisions	Net NPLs	Net NPLs ratio
1988	6,812.85	440.32	6,372.53	6.46	320.84	119.48	1.87
1992	8,230.01	260.86	7,969.15	3.17	173.33	87.53	1.10
1996	11,926.16	249.77	11,676.39	2.09	173.96	75.81	0.65
1999	11,347.11	644.11	10,703.01	5.68	300.09	344.02	3.21
2001	7,936.32	3,174.36	4,761.97	40.00	1349.34	1,825.02	38.32
2005	16,658.53	830.36	15,828.17	4.98	745.31	85.05	0.54
2009	29,873.99	1,662.06	28,211.93	5.56	1406.84	255.22	0.90
2013	58,349.21	1,944.13	56,405.08	3.33	1577.9	366.23	0.65
2016	77,015.24	2,601.09	74,414.15	3.38	2042.54	558.55	0.75

Note: Figures are based on the scheduled commercial banks (excluding local banks, banks under the SDIF, development and investment banks); Monetary values are adjusted for inflation (millions TRY). Net NPLs refer to loan loss provisions adjusted gross NPLs, is measured by the difference between gross NPLs and loan loss provisions; Gross NPLs ratio=gross NPLs/gross loans; Net NPLs ratio=net NPLs/net loans
Source: The BAT, author's calculation

To examine this issue further, Table 2.7 tabulates the correlation matrix among the variables. It is observed that the correlation coefficient of the net and gross NPLs ratios have the most positive, significant (except with the gross NPLs) and strongest correlation between the absolute amount of NPLs. This in turn might depict that Turkish banks did not engage in "upward window dressing" as the ratios were likely to be reduced by the

improvement in the NPLs and not by inflating the loans. This result might also signal that the restructuring programme and concomitant regulatory reforms have induced banks to adopt a comprehensive risk management framework, resulting in the improvement in credit quality since 2002. Furthermore, the loan loss provisions, reflecting credit quality of banks over time and the overall attitude of the banking system to control risks, have significantly increased after 2002 when the reforms initiated. This increase therefore is likely to lend support to the conclusion drawn regarding the improvement in the NPLs in the post-reform period.

Table 2.7 Univariate matrix, net/gross loans, net/gross NPLs, net/gross NPLs ratio

	Net loans	**Net NPLs**	**Net NPLs ratio**
Net loans	1		
Net NPLs	-0.035	1	
Net NPLs ratio	-0.3165	0.9551*	1

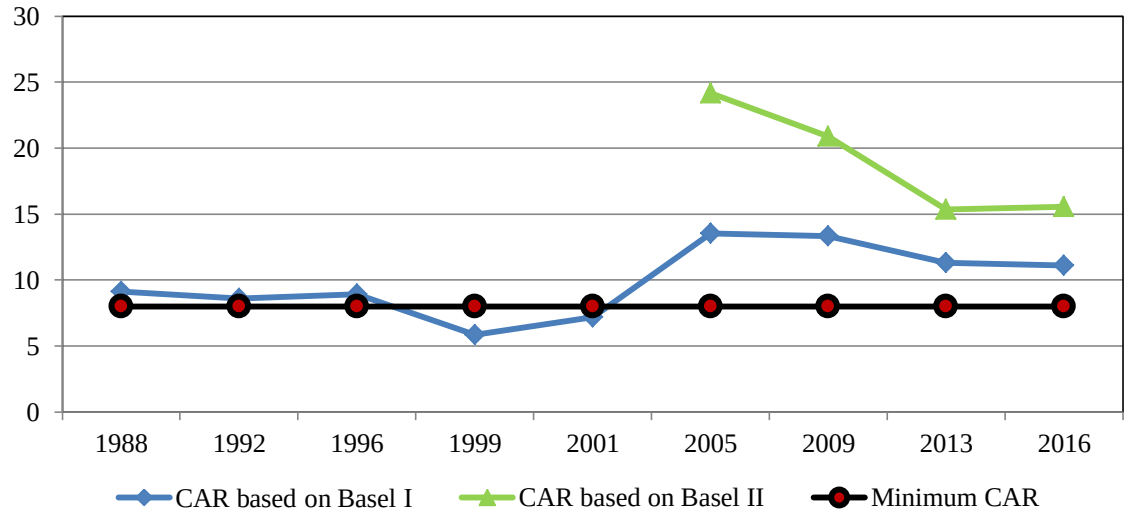
	Gross loans	**Gross NPLs**	**Gross NPLs ratio**
Gross loans	1		
Gross NPLs	0.54	1	
Gross NPLs ratio	-0.293	0.6331	1

Note: * shows significant at 5% level

Capital adequacy ratio (CAR) is a proxy measured by dividing a bank's amount of capital by its assets weighted by risk. This ratio is used by banking authorities to ensure that a bank has enough cushions to absorb a reasonable amount of losses before it becomes insolvent. Therefore, higher CAR ratios lower the risk of becoming insolvent, i.e. if a bank has a higher CAR ratio, it will be more likely for it to meet its financial obligations during a winding-up and so provides a higher degree of protection to its depositors. A bank's total capital is composed of Tier 1 and Tier 2 capitals. Tier 1 capital, composed of a bank's disclosed reserves such as shareholders equity and retained earnings, is capable of absorbing shocks without causing any drastic impact on its business operations. Tier 2

capital, consisting of a bank's undisclosed reserves such as revaluation reserves, hybrid capital instruments and subordinated term debt, general loan-loss reserves, and undisclosed reserves, is used as supplementary capital. A bank's risk-weighted assets are obtained by undertaking a risk assessment of each type of bank asset. That is, an asset backed by little or no collateral induces a bank to a higher propensity of credit exposure. According to the Basel III rules, the CAR of a bank should be a minimum of 8%, yet Tier 1 capital should be at least 6% of the CAR of the bank. Figure 2.3 shows the CAR of Turkish banking during the period between 1988 and 2016. The figure denotes that Turkish banks largely managed to meet the minimum CAR set by the banking authorities, except for 1999 and 2001, which largely stemmed from the economic turmoil and the financial crises. Yet this ratio improved immediately after the crises due largely to the restructuring programme and the regulatory reforms and stayed above the minimum requirements thereafter. The banking authorities of Turkey introduced legislation on the Measurement and Evaluation of Banks Capital Adequacy (2006) and this is compliant with the Basel-II Provisions related to market risk. Therefore, the figure also shows the risk-adjusted capital ratios as of 2006. This ratio appears to be higher than the CAR based on Basel I. This can be partly attributed to the large government debt portfolios of Turkish banks, which are accepted as risk-free assets.

Figure 2.3 Capital adequacy ratios, 1988-2016



Note: Figures reflect the entire Turkish banking sector; CAR based on Basel I is measured by shareholders' equity/total assets; whilst CAR based on Basel II is measured by shareholders' equity / ((capital to be employed to credit + market + operational risk)*12.5)*100
Source: The BAT.

2.7 Conclusion

This chapter has reviewed the development of the Turkish banking sector with respect to the changes in the regulatory environment. During the pre-deregulation period, the role of the Turkish banking sector was to meet the needs of the state-led economic development programme. Economic turmoil and an inefficient banking sector contributed to the change in policy focus from 1980. This year has been a cornerstone in the regulatory framework of the Turkish banking sector, as the banking authorities started to adopt banking deregulation policies to enhance competition and hence improve efficiency and productivity. Yet the implementation of deregulatory reforms without establishing a proper regulation of the banking system contributed to the domestic financial crises of the early 1980s and hence forced the authorities to start a process of prudential re-regulation as of 2001. The new policy focus aimed at strengthening the foundations of the banking system to ensure the smooth functioning of the Turkish banks in the long run. In short, it is therefore possible to divide the whole reform process into two stages: the first stage relates to structural deregulation targeted at enhancing competition and efficiency; the second stage targeted strengthening financial stability. After reviewing the evolution of the regulatory reforms, we provided descriptive statistics to shed some light on the changes in market structure and behavioural responses of banks during the reform period. However, one cannot achieve a clear understanding of whether the regulatory reforms have had the intended positive effects on banking competition and efficiency by only looking into the metrics, thus this study will use an empirical approach to further investigate the impact of financial reforms on Turkish banks' efficiency and competition.

Appendix 2.1 Turkey legislation for regulatory reforms

Important acts and principles	Date
Act on Restructuring of Debts to the Financial Sector and Making Amendments to Some Acts (4743)	January, 2002
Regulation on Measurement and Evaluation of Capital Adequacy of Banks	January, 2002
Pursuant to the Regulation on the Calculation and Implementation of Foreign Currency Net General Position/Equity Standard Ratio by Banks on Consolidated and Non-Consolidated Basis	January, 2002
Regulation on External Audit Principles	January, 2002
Regulation on External Audit Principles and Regulation on Authorisation of Institutions to Perform External Audit and Termination of Authorities Temporarily or Permanently Thereof	January, 2002
Regulation on General Conditions Concerning Approval, Recognition and Implementation of Financial Restructuring Framework Agreements	April, 2002
Accounting Practice Regulation and related Communiqués	
Communiqué on Uniform Accounting Plan and Prospects	June, 2002
Communiqué on Accounting Standard of Financial Instruments	June, 2002
Communiqué on Accounting Standard of Provisions, Contingent Liabilities and Assets	June, 2002
Communiqué on Accounting Standard of Effects of Changes in Foreign Exchange Rates	June, 2002
Communiqué on Accounting Standard of Net Profit/Loss of the Period, Fundamental Errors and Changes made in Accounting Policies	June, 2002
Communiqué on Uniform Accounting Plan and Prospects	June, 2002

Source: BRSA (2009)

Appendix 2.2 Entry of foreign banks to the Turkish banking sector 2001-2015

Year	Target domestic bank	Foreign bank	Country of origin of foreign bank	Stake bought (%)
2001	Demirbank	HSBC	UK	100
2002	Kocbank	UniCredito	Italy	50
2005	Yapi ve Kredi	UniCredito/ Kocbank	Italy/Turkey	57
2005	TEB	BNP Paribas	France	50
2005	Disbank	Fortis	Belgium	89
2005	Garanti Bank	GE Capital	USA	26
2005	C bank	Bank Hapoalim	Israel	58
2005	Finansbank	Naional Bank of Greece	Greece	46
2006	Tekfenbank	EFG Eurobank*	Greece	70
2006	Denizbank	Dexia Bank*	Belgium	75
2006	Sekerbank	BTA	Kazakhstan	34
2006	MNG Bank	Arab Bank/ Bank Med	Lebanon	91
2006	Akbank	Citigroup	USA	20
2007	Oyak Bank	ING Bank	Netherland	100
2013	Alternatifbank	Commercial Bank of Qatar	Qatar	100
2013	EFG Eurobank*	Burgan Bank	Kuwait	99.3
2013	Dexia Bank*	Sberbank Rossii	Russia	99.9
2015	Tekstil Bank	Industrial and Commercial Bank of China	China	75.5

Note: Adapted from Altunbas et al. (2009) and from annual reports published by the BAT.
*These banks, whose parent banks are located in EU, sold their investments to other foreign investors.

Chapter 3
Literature Review

3.1 Introduction

The core activity of a bank is to collect deposits from savers and extend loans to borrowers.[32] Phrased differently, it acts as an intermediary between savers and borrowers since it collects funds from surplus units and channels these funds to those with a deficit of funds. This intermediary role of enabling surplus funds to be transferred and allocated to their most productive opportunities in turn results in a better allocation of financial resources and thereby increases economic efficiency (Hermes and Lensink, 1996; Casu et al., 2015). To investigate how a bank improves the allocation of financial resources in an economy, one needs to focus on the functions of a bank. In theory, these functions are classified into four main categories: A bank (i) offers liquidity and payment services, (ii) transforms assets, (iii) manages risks, and (iv) processes information and screens borrowers, which will be briefly examined below (Freixas and Rochet, 2008).

First, surplus units prefer holding assets that are more easily converted into cash due to their lack of knowledge of future events. Therefore, once they deposit their cash into a bank, this bank offers financial or secondary claims that are easily convertible into cash without loss of capital value. A bank facilitates the transfer of funds between the bank accounts of economic agents by settling the debt of the payer to the payee through a transfer of money. Second, a bank provides the missing link between savers and borrowers by performing size, maturity, and risk transformations. A bank has access to a larger number of depositors than any other individual borrower does, it thus performs a size transformation by collecting funds from savers in the form of small size deposits and then invests these into larger-sized loans. A bank's liabilities (i.e. the deposits collected from savers) are generally repayable on demand or at relatively short notice, while a bank's assets (loans extended to borrowers) are normally repayable in the medium- or long-term. It hence undertakes a maturity transformation by transforming funds lent for a short period

[32] Although the core activity of a bank is to be a financial intermediary between savers and borrowers, it can also offer payment services as well as a wide range of additional services such as securitisation, brokerage, etc. Yet its former function constitutes its distinguishing feature compared to other financial intermediaries.

of time into medium- and long-term loans. Individual borrowers have a risk of default, namely not being able to repay their loans. A bank therefore performs a risk transformation by diversifying its loan portfolio, pooling risks, monitoring and screening individual borrowers and holding capital which can be used in case of turmoil. Third, another important function of a bank is to manage risks such as credit, interest rate, and liquidity risks. The task of monitoring and screening credit risk is costly for an individual saver. Yet this depositor can delegate the task of monitoring to the bank that has expertise and economies of scale in processing information on the risks of borrowers. A bank also takes risks when transforming maturities and when issuing liquid deposits guaranteed by illiquid loans. The cost of deposits depending on short-term interest rates may rise above the interest income received from loans granted by the bank. Moreover, even a bank pays no interest on deposits, it may be forced to seek more expensive sources of funds in the case of unexpected cash withdrawals of depositors. That is, it needs to manage the interest rate risk stemming from differences in maturity and liquidity risk driven by the nature of deposits and loans. Finally, a bank has a particular part to play in managing some of the issues arising from imperfect information on borrowers. For a bank, moral hazard occurs after a loan has been extended, because the borrower may engage in activities that are undesirable for the bank since these activities make it less likely that the loan will be repaid. Thus, a bank regularly monitors the project and the performance of the borrower by acquiring a series of financial information. In addition, adverse selection may result for a lender to attract the wrong type of clients, which in turn increase loan rates or insurance premiums to the levels that are to the detriment of lower-risk borrowers. A bank therefore invests in technologies allowing them screen out excessively high-risk lenders by investigating their risk profile and adjusting loan rates to manifest the risks of borrower.

Aside from potential increases in the savings rate, a well-functioning banking sector renders improved financial products and services, risk-taking capabilities, and intermediates greater amounts of funds by offering better prices and service quality for customers (Berger and Humphrey, 1997; Molyneux et al., 1996a). Moreover, both the theoretical and empirical literature posit that a well-functioning banking system is likely to result in a much better allocation of capital and thereby increase economic growth (Beck and Levine, 2004; King and Levine, 1993a). Nevertheless, banks are fragile, and the banking sector is exposed to instability owing to unique characteristics of this business such as risk-shift incentives, moral hazard, and financial contagion (Allen & Gale 2004).

Their fragilities, which would trigger banking sector-induced systemic crises, will of course disrupt the flow of credit from savers to consumers and investors, resulting in a reduction in investment and consumption. Therefore, to obtain an efficient yet sound banking sector, policy makers have implemented financial deregulation and concomitant regulatory reforms consisting of prudential re-regulations and restructuring programmes. We thereby investigate the theoretical arguments and empirical evidence concerning the effects of financial reforms on bank performance. This is of interest since if efficiency is increased, the improvement in allocation of capital benefits society and may result in price reductions and/or service expansion for consumers, if competition warrants (Berger and Humphrey, 1997). The rest of the chapter will thereby review the theoretical arguments and empirical evidence on the four interrelated aspects associated with the impacts of financial reforms on bank efficiency and competition. Therefore, Section 3.2 examines the impacts of financial deregulation on bank efficiency. Section 3.3 assesses the impacts of regulatory reforms on bank performance, Section 3.4 looks into the relationship between bank ownership and efficiency, and finally, Section 3.5 reviews the association between regulatory reforms and ownership, and bank competition.

3.2 Banking deregulation and bank efficiency

The discussion on financial liberalisation more or less starts with the seminal publications of McKinnon (1973) and Shaw (1973). These authors coincidentally developed a theoretical model concerned with the growth-inducing effects of financial liberalisation in contrast to financial repression. They posit that financial repression policies - forcing financial institutions to pay low and often negative real interest rates - reduces the volume of funds available for investment and hence engendered low growth rates in many developing countries during the 1950s and 1960s. They instead advocate financial liberalisation policies that abolish institutional constraints on nominal interest rates and eliminate the obstacles on competition among financial institutions. This is because financial liberalisation would increase the volume of savings as well as the quantity and quality of investments, which in turn would lead to higher economic growth rates.

In the late-1970s, many emerging market countries experienced deteriorating economic and financial conditions. They therefore undertook economic reforms to generate a sustainable investment environment and develop an economic system that relied on the

market mechanism. Financial liberalisation was the primary component of these economic reforms. Beginning with financial liberalisation, from the 1980s banking authorities embarked on a process of deregulatory reforms, including elimination of the control on interest rates and credit allocation, privatisation of public banks, and liberalisation of capital flows. These deregulatory policies are in turn expected to promote competition and thereby improve both static and dynamic efficiency (Stefano and Nicoletti, 2003). Static gains occur due to the elimination of x-inefficiencies, since deregulation-driven competition is likely to hinder the monopolists' "quiet life" habits. Dynamic gains, on the other hand, are also likely as banks' managers continue to enhance their productivity under more competitive pressure, since they need to do so to stay in business or to maximise their own wealth (Evanoff and Israilevich, 1991). Accordingly, the first sub-section investigates theoretical arguments concerning the impacts of bank deregulation on both static and dynamic efficiency. The second sub-section reviews empirical literature focusing on this relationship and in particular elaborates on the studies testing this relationship for the Turkish banking sector.

3.2.1 Theoretical arguments

The anticipated positive impacts of deregulation-driven competition on static efficiency stems from the fact that it should sharpen incentives for managers to avoid sloth and slack (X-inefficiency) (Vickers, 1995; Schmidt, 1997).[33] The theoretical arguments investigating the effects of competition on static efficiency can be summarised in the following five channels. First, x-inefficiency, i.e. managerial slacks, can only persist in the presence of supernormal profits, since owners who lack of information on costs due to imperfectly competitive situations assume that the poor performance of the bank emanates from higher cost not from managerial slacks. Yet increased competition is likely to reveal more information about prices and costs in the banking industry and is also likely to disclose information concerning managerial effort by increasing the sensitivity of profits to costs,

[33] X-efficiency reflects the ability of management to control costs and employ resources to produce outputs. In other words, this measure reflects to what extent a bank is operating with an efficient mix of inputs. This proxy consists of technical and allocative efficiency. Technical efficiency for a given bank can be calculated as the ratio of the input usage of a fully efficient bank producing the same output vector to the input usage of the bank under given consideration, whilst allocative efficiency can be defined as the success of a bank in choosing the cost minimising combination of inputs.

which in turn induce owners to design better incentive systems and to monitor managers, in turn reducing managerial inefficiency (Hart, 1983). Second, deregulation-induced competition puts pressure on the monopoly rents enjoyed by banks. This in turn mitigates the potential for bank managers to seize these rents in the form of slack or lack of effort (Molyneux et al., 1996a; Nickell, 1996). Third, increased competition in product markets threatens bank managers' of inefficient banks since these banks may lose their market share under more competitive conditions (Machlup, 1967). Furthermore, potential entrants into the sector can also pose a threat to inefficient banks (Aghion and Howitt, 2012). These in turn provide substantial incentives for inefficient banks' managers to improve their efficiency to protect their market share. Finally, banking deregulation open the domestic banking sector to new entrants having better superior management skills and expertise. This in turn is expected to develop indigenous technological infrastructure and management practices of incumbents via technology transfer and skill diffusion, resulting in improvements in the efficiency of domestic banking sector (Glass and Saggi, 1998).

Banking deregulation arguably leads to favourable impacts on the dynamic efficiency of banks via four different channels. Firstly, it relaxes regulatory restrictions and reserve requirements, which in turn result in a decrease in the regulatory costs of production. Therefore, the cost of producing a given level of output plummets and the cost-output relation level increases (Kumbhakar and Lozano-Vivas, 2005a). Secondly, it reduces restrictions on activities, hence providing incentives for banks to exploit cost-saving opportunities from broad financial services provisions; that is, it enables them to take advantage of economies of scale and scope (Evanoff and Fortier, 1988). Thirdly, it creates new development opportunities and forces bank managers to speed up the adoption of new technologies to avoid loss of control rights due to bankruptcy. These motives in turn induce banks to be proactive in research and development activities as well as in the adaptation of technological innovation (Berger and Mester, 2003). Lastly, it is suggested that cost-reducing improvements in productivity can result in higher revenue and profit in a more competitive operational environment where the price elasticity of demand is likely to be higher (Stefano and Nicoletti, 2003). Therefore, since banking deregulation speeds up the reallocation of resources from inefficient banks to efficient banks, this in turn provides more incentives for the efficient ones to invest in technological development enabling them to reduce the cost of production further.

At the other end of the spectrum, the relationship between competition and bank efficiency is more complex and the theoretical considerations suggesting that competition is unambiguously beneficial to static and dynamic efficiency is more naïve in banking than in other markets (Claessens and Laeven, 2004). From a static efficiency point of view, the adverse impact of deregulation on banking efficiency posits that deregulation of deposit interest rates coupled with the increased competition from non-bank financial intermediaries may raise funding costs and lower profits for banks. Although banks seek to compensate these losses driven by deregulation by reducing operating costs, they also embark on concentrating on a more risky set of borrowers in search for higher revenue which is likely to result in loan losses and adversely affect profit efficiency (Humphrey and Pulley, 1997). Deregulation bringing freedom to banks to engage into non-traditional activities may also reduce bank efficiency due to diseconomies of scope in the joint production of traditional and non-traditional banking activities (Mester, 1992). It is argued that the negative impact might be due to the inexperience of managers in dealing with deregulation-induced non-traditional activities and/or the rise in agency costs, provided that the joint production requires another layer of management. The adverse effect of deregulation on dynamic efficiency might be related to the basic Schumpeterian model positing that incentives for innovation and R&D may plummet in accordance with the increase in competition since the monopoly rents derived from these activities tend to disappear more quickly when there is fiercer competition (Stefano and Nicoletti, 2003). Moreover, deregulation-induced competition may push banks to invest in new financial technologies and new services and improve the quality of some of the services in operation. These additional services or higher service quality in turn could increase costs, resulting in reductions in cost productivity (Berger and Mester, 2003).

3.2.2 Empirical evidence on deregulation and bank efficiency relationship

Empirical studies investigating the relationship between banking deregulation and banking efficiency within and across countries have so far given rather mixed results. For example, evidence from the US banking industry indicates that banking cost efficiency and productivity remained relatively unchanged or showed little improvement in the aftermath of deregulation reforms (Bauer et al., 1993; Elyasiani and Mehdian, 1995; Grabowski et al., 1994). The researchers attribute the poor trends in the performance of US banks to the increased cost of funds brought about by the liberalisation of deposit rates and by the

increase in non-bank competition that forced banks to lower the interests charged on loans. Others however suggest that reforms encouraged banks to innovate and to offer a wider variety of financial services and products to customers. So although the measured cost efficiency of banks decreased, the unmeasured quality of outputs might have increased (Bauer et al., 1993).

Rather mixed results are also found by studies investigating the impact of deregulation on the performance of banking sectors in Asia. Evidence from South Korea (Gilbert and Wilson, 1998), Thailand (Leightner and Lovell, 1998), China (Chen et al., 2005), and India (Zhao et al. 2010; Casu et al 2013) finds that deregulation led to improvements in efficiency and productivity. Opposite findings for India are, however, reported by Kumbhakar & Sarkar (2003) and Das and Ghosh, (2006). The latter attribute this result to the unique characteristics of the Indian banking sector which is dominated by state-owned banks that arguably did not respond well to the introduction of deregulatory reforms due to their different business strategy and customer orientation compared to their private counterparts.

Evidence for European banking sectors generally supports the hypothesis that deregulation leads to improvements in efficiency and productivity. Improvements in efficiency are reported for Spain (Kumbhakar and Lozano-Vivas, 2005), Norway (Berg et al., 1992), Portugal (Canhoto and Dermine, 2003), Hungary (Hasan and Marton, 2003), and the Czech Republic (Matoušek and Taci, 2004). Contrary to the above findings, however, Lozano-Vivas (1998), analysing the Spanish banking sector, finds that deregulation is associated with a decline in the relative cost efficiency of commercial banks which is attributed to the under-utilisation of resources and over-branching. A similar finding is also reported by Havrylchyk (2006) who could not find improvements in efficiency in the Polish banking sector following the implementation of deregulatory reforms, attributed in part to the increasing costs of funding for banks.

Focusing on the Turkish banking sector, the studies investigating the impact of financial deregulation on Turkish banks' efficiency also show mixed results. While some papers find that financial deregulation-induced Turkish banks to improve their efficiency (Ertugrul and Zaim, 1999; Isik and Hassan, 2003a; Zaim, 1995); others find that the banking sector's overall trend in efficiency was negative or that banks could not gain sustainable efficiency

improvements (Denizer et al., 2007; Isik and Hassan, 2002b; Yildirim, 2002). These papers offer some country-specific explanations. The former group of studies finding favourable impacts of deregulation on bank efficiency attributes their findings to the notion that deregulation-induced competition stimulated banks to use their resources more efficiently. Consequently, inefficient banks managed to catch-up with the best-practice banks and hence overall efficiency in the sector increased.[34] Moreover, deregulation allowed banks to offer and benefit from new financial products and services, further enabling them to improve their technical and allocative efficiency. The latter group of studies finding adverse or no impact of deregulation on bank efficiency suggests a rather different interpretation of events. In their view, financial repression policies led to over-branching and over-staffing problems in the pre-1980s period, and the deregulatory policies of the early 1980s were expected to help these very large banks to optimise their scale economies via an increase in competition, forcing them to reduce their costs. However, capital account liberalisation along with rather uncontrolled bank deregulation enabled banks to borrow from abroad and induced them to increase their risks. The excess demand for banking services stemming from the large funding needs of the public sector, coupled with an under-developed financial system that made banks the main source of funds, exacerbated the scale inefficiency problems of Turkish banks, undermining the benefits of bank deregulation and liberalisation.

In conclusion, the inconsistency observed in theoretical arguments has been reflected in empirical evidence investigating the impact of deregulation policies on bank efficiency. The reviewed literature indicates that this discrepancy might be due to the fact that empirical studies employ different methods, or measure variables using different approaches, or focus on different periods, or investigate different countries, all of which might arguably explain the contradictory findings. Some countries have also implemented prudential regulations along with deregulation policies, complicating the isolation of impacts of the deregulation policies. Moreover, it is argued in the literature that the effects of bank deregulation may rely on industry conditions prior to the deregulation process (Berger and Humphrey, 1997). In addition, deregulation policies are multi-faceted; namely

[34] It is argued that Turkish banks did not have sustainable technological progress in the 1990s (Isik and Hassan, 2003a; Kasman, 2002). This in turn might have made it easier for the banks entered into the sector following the liberalisation policies in 1980s to catch-up with the best-practice ones given the technological regress.

they comprise of many different policy tools that can affect the performance of banks in different ways. Finally, yet importantly, deregulation is a continuous process with possibly lagged effects. The short time periods analysed by many empirical studies obviously limit the inference that can be taken and this study aims to circumvent this issue in our study by taking a very long time span in our empirical analysis.

3.3 Prudential re-regulations and bank efficiency

Deregulation reforms implemented in many countries since the 1980s were followed by financial crises in developing countries during the 1990s in particular. This in turn lends support on the hypothesis that deregulation triggerred fragilites in financial sectors - in particular in banking sectors - because the deregulation-induced competition undermined banks prudent behaviour and these reforms were implemented without establishing sound and independent regulatory and supervisory institutions (Andersen and Tarp, 2003; Demirguc-Kunt and Detragiache, 2000; Demirgüç-Kunt and Detragiache, 1998; Hellmann et al., 2000; Mishkin, 1999). This explains why from the late-1990s the emphasis of reforms shifted from deregulation to the stability of banking sectors through the implementation of regulatory reforms, including prudential re-regulations and restructuring programmes. The first sub-section investigates theoretical arguments concerned with prudential re-regulation and bank performance. The second sub-section reviews empirical literature focusing on this relationship.

3.3.1 Theoretical arguments

The prudential re-regulations which are essential pillars of regulatory reforms consist of four basic instruments: (i) mixture of regulations such as tighter capital requirements, (ii) activity and entry restrictions, (iii) powerful and independent official supervision, and (iv) private monitoring policies (Barth et al., 2006, 2013). However, the impact of these instruments on banks' performance is not clear from a theoretical perspective as each instrument can produce opposite effects on the efficiency of banks. First, there are different views on the influence of capital requirement on bank performance. Tighter capital requirements can diminish banks' perceived risk, which in turn reduces their borrowing costs and improves their cost effectiveness. However, they may also impose unnecessary costs on banks if they are compelled to raise equity capital at a price higher than the

interest rate on deposits (Barth et al., 2013). Moreover, Hellmann, Murdock and Stiglitz (2000) who developed a theoretical dynamic model on the impacts of capital requirement of bank performance, posit that capital requirements render banks to invest in prudent assets rather than gambling since they put their own capital at risk, which in turn forces them to internalise the efficiency of gambling. On the other hand, they argue that while this policy makes it possible to combat moral hazard, it is found that only adopting this policy to ensure the prudent behaviour of banks forces them to hold an inefficiently high amount of capital. This is because deregulation policies led deposit rates to be determined in free markets; thus, under this condition banks tend to offer inefficiently high deposit rates with the objective of stealing share from their rivals. In other words, freely determined deposit rates are inconsistent with Pareto efficiency, which in turn reduces the cost efficiency of banks.

Second, there is a discrepancy on the impact of activity restrictions and bank performance. On the one hand, the activity restrictions can prevent banks from exploiting economies of scale and scope in collecting and processing information concerned with borrowers, building reputational capital and providing various services to customers (Laeven and Levine, 2007). They can also reduce banks' ability to diversify their income streams. This decreases their franchise value, potentially encouraging banks to take more risks which increases instability in the sector (Barth et al., 2013). On the other hand, unrestricted activities could intensify moral hazard issues which too can make banks more likely to take more risks, bringing about a reverse impact on banking sector performance (Boyd et al., 1998). The improved official supervision could reduce market failure and weaken corruption in bank lending by monitoring and screening banks, thereby improving their effective functioning. Nevertheless, strengthening the power of official supervisors may lead them to extract private or political benefits (Barth et al., 2004). Independence of supervisors also affects the performance of banks in different ways. This is because independent supervisors are free from political pressure and are likely to monitor the financial health of banks in a strictly professional and consistent manner and give banks constructive criticisms and guidance (Barth et al., 2013), and vice versa.

Third, the official supervisor power and its independence arguably affects bank performance in different ways. On the one hand, the public interest hypothesis suggests that banks' supervisors having necessary incentives and expertise are likely to tackle

market failures arising from imperfect information (Barth et al., 2006). Therefore, powerful supervisors who can directly monitor and discipline banks would increase the ownership of banks and enhance bank efficiency (Barth et al., 2013). This in turn indicates that the power of supervisors positively affects bank efficiency. On other hand, the private interest hypothesis suggests that powerful supervisors are likely to not focus on circumventing market failures; they instead would focus on promoting their private interest or extract bribes (Djankov et al., 2002). It is argued that if they have power to discipline non-compliant banks, they might exploit their powers to induce or compel banks to allocate credit to create private or political benefits (Barth et al., 2006). This in turn indicates that the power of supervisors may negatively affect bank efficiency.

Finally, private monitoring would be a useful complement to the official supervision, yet the success of private monitoring depends to a great extent on the ability of private investors to overcome informational barriers (Beck et al., 2006; Bliss and Flannery, 2002). This is because if private investors have accurate information on the financial conditions of banks, they could exert effective screening and governance, which in turn improves the effectiveness of the banking sector. Moreover, official supervision does not have an ownership stake in banks, in turn inducing different incentives than private monitoring when it comes to monitoring and disciplining banks. Furthermore, banks are more likely to ask politicians to pressure official supervisors to take actions that mainly serve the special interests of banks (Barth et al., 2013). However, the implementation of private monitoring is challenging due to the complexity of financial markets.

3.3.2 Empirical evidence on re-regulations and bank efficiency relationship

Earlier studies investigating the impacts of prudential re-regulations on bank performance tend to use accounting ratios to investigate their effects on the efficiency and productivity of banks. One of these studies examines the effect of re-regulations, market structure, and national institutions on the cost of financial intermediation measured by accounting ratios (Demirgüç-Kunt et al., 2004). They find that regulatory restrictions tightening bank entry and limiting banks from engaging in non-traditional activities tend to increase the cost of financial intermediation. Another similar yet more comprehensive study by Barth et al. (2004) investigates the relationship between specific regulatory and supervisory practices and bank development, performance and instability using a survey dataset covering 107

countries. They find that stringent capital regulation and official supervisory indicators do not have a statistically significant relationship with bank performance and stability. On the other hand, they find that restricting banking activities has a negative impact on bank performance and stability, highlighting the importance of allowing banks to diversify their income sources. In addition, they suggest that regulations encouraging and facilitating the private monitoring and accurate information disclosure of banks improve their performance.

Another well-developed strand of the literature criticises the above studies since they rely on accounting ratios to measure the performance of banks. Recent empirical studies instead rely on either parametric or non-parametric methods to obtain efficiency and productivity measures, arguably providing sounder information on the performance of banks. After obtaining these measures, the instruments of prudential regulations are regressed on these measures. Two recent pieces of international empirical evidence provided by Barth et al. (2013) and Pasiouras et al. (2009) suggest that stricter capital requirements and greater market discipline are more likely to have favourable effects on banks' performance. Yet they find that restrictions imposed on bank activities are more likely to have an adverse impact on bank efficiency. The former study finds that there is no significant relation between the strengthening of official supervisory power and bank efficiency, yet the independence of supervisory authorities tends to exert a significant and positive impact on banks' performance. The latter study finds that empowered supervisory authorities improve bank efficiency, since they compel banks to release accurate and timely information facilitating proper monitoring by private agents, therefore improving market discipline, which in turn induce banks to increase their efficiency. Another cross-country study by Chortareas et al. (2012) provides evidence from 22 EU countries between 2000-2008. They also find some results are consistent with previous studies. That is, they contend that capital requirements and official supervisory power improve the efficiency of banks, since these may diminish agency problems, market power, and the likelihood of financial distress. In addition, they similarly suggest that activity restrictions exert negative impacts on bank efficiency. Finally, one recent cross-country study by Delis et al. (2011) also provides evidence about the impact of prudential re-regulations on the productivity of banks operating in 22 transitional countries over the period 1999-2009. Contrary to the above studies, they find that capital requirements and official supervisory power do not have a statistically significant impact on bank productivity, which are attributed to specific

characteristics of the transition countries, such as overcapitalisation and the difficulties in enforcing regulatory rules. However, they also suggest that these re-regulations have started to exert a positive impact in the aftermath of the global financial crisis.

As mentioned above, the emphasis of the reform process switched from deregulation, aimed at fostering competition, towards strengthening the stability of the banking system through prudential re-regulations and banking restructuring in the aftermath of the financial crises in Asia, Latin America, and some European countries. There are some empirical studies evaluating the overall impact of such regulatory reform processes on the performance of banks instead of focusing on the impact of individual instruments of regulatory reforms. One of these studies is based on banks in eight Asian countries in the period 2001-2010 and finds that financial liberalisation policies exerted a positive impact on bank efficiency and cost technology (Casu et al. 2016). However, prudential re-regulation and supervision policies adversely affected the efficiency of banks but not cost technology. Therefore, they argue that the coexistence of deregulation and prudential regulation - that is, regulatory reforms - has been beneficial for the cost performance of Asian banks. Although recent tighter prudential regulations have slowed down efficiency, they did not aggravate cost technology improvements. This highlights the importance of combining policies that enhance financial stability with policies that foster financial intermediation. In another cross country study, Hermes & Meesters (2015) examine the impact of financial liberalisation and the quality of bank regulation and supervision on bank efficiency using data covering 61 countries during 1996-2005. Similar to their previous study, they also find that that financial liberalisation has exerted a positive impact on bank efficiency, although this is conditional on the quality of regulation and supervision; that is, liberalising financial markets without setting a sound and strong regulatory and supervisory framework may reduce the efficiency of banks. Accordingly, it can be inferred from these studies that financial liberalisation policies should be implemented along with a proper and sound prudential regulation and supervision.

Another recent strand of literature pays more attention to the impact of regulatory reforms on the ownership-performance relationship. On the one hand, regulatory changes aim at creating a level playing field for all banks and this in turn may lead to inter-ownership convergence in efficiency levels. For example, deregulation-induced competition should discipline managers and induce them to enhance the efficiency of banks regardless of the

type of ownership (Zhao et al., 2010). On the other hand, the differences in operational structure and customer base may lead banks to be affected differently by changes in their operational environment. Similarly, once banks start operating in a deregulated framework, the changes in policy towards prudential regulations may affect them differently. For example, a prudential regulatory framework requires better risk management tools for which foreign banks might have a relative superiority due to better risk management strategies, experienced managers and staff, resulting in a relative advantage, but they may need more time to adjust to the domestic regulatory framework, resulting in disadvantages. Empirical evidence from India by Zhao et al. (2010) shows that at the initial stages of deregulation, foreign banks are more efficient due to their relatively stronger operating background, but they lose their advantage compared to state banks once tighter prudential regulations are implemented. They ascribe this finding to the fact that the majority of public banks' customers are state-owned, credit-worthy firms. Moreover, domestic private banks have been more greatly affected under tighter regulations since they are more likely to provide financial services to the small and medium-sized enterprises (SMEs) customers that are informationally opaque small firms. In a complementary study, Casu et al. (2013) investigate the impact of financial regulations on productivity of Indian banks. They find that different ownerships react differently to the changes in regulatory policies and operating environment. In particular, foreign banks have benefited more from regulatory changes compared to state banks, thanks to their superior ability at engaging in cost technology innovation. They suggest that the removal of restrictions has allowed foreign banks to familiarise themselves with the local loan market and they have reached an optimal scale of production of performing loans. However, they conclude that the technology gap between foreign banks and state banks has increased, suggesting the lack of prominent technological spill-overs among different types of banks.

Focusing on the empirical evidence on the Turkish banking sector, many studies find an improvement in the performance of banks in the post-2001 period when effective and tighter prudential regulation and supervision were implemented along with liberal policies. Assaf et al. (2013) and Fukuyama and Matousek (2011) find an improvement in the productivity of Turkish banks and attribute this to new modern risk management techniques and internal control systems adopted by banks following the implementation of prudential regulations, which required them to adopt better risk management technologies. Another study investigates the profit efficiency of Turkish banks in the same period and

concludes that regulatory changes initially led to a decline in profit efficiency (Davutyan & Yildirim, 2015). Yet Turkish banks on average improved their efficiency once they implemented the necessary regulatory changes and adjusted to the new market environment, indicating that it takes time for banks to adjust themselves to the changes in the regulatory environment. However, it should be noted that these studies investigated the bank efficiency relationship after or during the prudential re-regulation period without covering the period before re-regulations; that is, they do not cover whole regulatory reform process. This might have changed the real effect of such programmes. Moreover, their model specification does not include a proxy variable capturing the effect of regulatory reforms. Instead, they interpret the general trend in efficiency and attribute the changes over time to the regulatory reforms. Therefore, extending the examination to before and after re-regulation as well as incorporating a proxy capturing the effects of reforms are more likely to disclose the real effects of re-regulation on bank performance.

In conclusion, the literature investigating the performance change of banks following the implementation of regulatory reform policies has inconclusive findings. This result may relate to the fact that banking prudential regulation and supervision reforms are multi-faceted; that is, some instruments of the reforms may lead to favourable outcomes, while others may adversely affect performance. Financial fragilities driven by the adoption of liberal financial reform have led authorities to implement prudential regulations to eliminate risks linked to reforms that are more liberal. Although regulatory reforms have widely been implemented by policy makers, only a limited number of empirical studies have investigated the joint impact of these reforms. In particular, none of the Turkish banking efficiency studies have investigated their joint, overall influence on the banking sector and on bank ownership. This study intends to fill this gap.

3.4 Bank ownership and performance

The previous section briefly mentioned that banking deregulation might have different impacts on different bank ownerships, namely resulting in efficiency differences among different ownerships.[35] Therefore, this section aims to shed light on the impact of

[35] Three ownership structures have usually dominated the majority of the commercial banking sectors around the world: state banks, domestic private banks, and foreign banks. In literature, state-owned banks - namely

ownership and bank performance. It begins with comparing state ownership versus private ownership of banks, and then reviews the theoretical arguments focusing on the differences in efficiency between foreign banks and domestic banks. It also reviews the theories arguing the pros and cons of foreign bank penetration. Moreover, evidence investigating how different ownerships react to the changes in the regulatory environment is also presented. Finally, we summarise the empirical evidence investigating how different ownerships have manifested different performance in the Turkish banking sector.

3.4.1 Theoretical arguments

i. State vs private ownership

State-owned banks were the major player in the banking sector of many developing countries during the pre-deregulation period. Although this domination has started to reduce with the implementation of banking deregulation and privatisation policies, these banks still remain a significant player of the banking sector of developing countries. The well-established banking efficiency literature suggests that although state-owned and privately-owned banks operate in the same competitive markets, state-owned banks tend to be less efficient compared to their private counterparts. This discrepancy in performance is generally explained by three main reasons: political intervention, ownership issues, and problems concerning competition (Shirley et al., 2001). First, state-owned banks are more prone to political intervention aiming to use these institutions to achieve their political and personal goals, in turn resulting in the inferior performance of the state banks (Clarke et al., 2005). It is argued that private banks might also be exposed to interventions by politicians, but compared to state banks run by public managers these banks are more likely to oppose such interventions so as to protect the bank's prudential lending or cost minimisation policies (Shleifer and Vishny, 1994). Second, the principal-agent theory[36] suggests that private ownership can result in better performance because managers are prone to incentives and are being observed closely by the capital market, which has been

public banks - are defined as the banks where the government or a government agency holds more than 50% of voting rights. Private domestic and foreign banks are also defined in a similar way. This study thereby classifies ownership by relying on this approach.

[36] The principal stands for the shareholders of a bank while agent represents the managers of a bank, indicating that there is a separation between ownership and management.

the fundamental underlying factor leading to the privatisation of publicly owned banks (Fama, 1980; Jensen and Meckling, 1976; Levy, 1987). State banks' ownership on the other hand have many objectives and principles that have no clear responsibility for screening and monitoring, while private banks have clearly defined incentives and objectives (Alchian, 1965). Moreover, state banks' managers have less motivation compared to private banks' managers, since they are less likely to be fired for non-performance and less likely to receive performance-related bonuses, which in turn engenders poor performance (Clarke et al., 2005). Finally, state-owned banks may face less competition compared to their private peers. This is because these banks may have more branches, higher deposit interest rates and lower lending rates then its private counterparts since they can compensate these losses through government subsidies. In other words, they can undermine competition by undercutting private rivals that need to be profitable to survive (Sappington and Sidak, 2003).

Although these three reasons discussed above are in favour of the privatisation of state banks, there is no guarantee that a privatised bank will perform better than it would under state ownership. One explanation states that privatised banks do not usually mimic private banks perfectly (Kay and Thompson, 1986). Moreover, underdeveloped capital markets, coupled with inadequate procedure for takeover, may prevent privatised banks from performing efficiently (Caves, 1990). Furthermore, the same government officials contributing to the poor performance of state-owned banks are responsible for designing and executing privatisation programmes, which might also lead to the poorer performance of the privatised banks (Clarke et al., 2005).

An alternative theoretical argument contends that the degree of competition might have a more substantial effect than the ownership structure and internal governance mechanisms on disciplining agents. In other words, competition and ownership can be substitutes in the sense that the higher the competitive pressures, the lower the relative significance of management and vice versa (Berglöf and Roland, 1997). Therefore, this theoretical argument posits that if deregulation-induced competition is sufficient to equalise the performance of public and private banks, then there is little or no need to deem the nature of ownership (Shirley et al., 2001).

ii. Domestic banks vs foreign banks

The literature investigating the performance of foreign banks in host countries has gained further importance following the growing trend of the internationalisation of banking sectors spurred by financial liberalisation/deregulation as well as increased international trade flows and foreign direct investment (Lensink et al., 2008). As a consequence of these developments, since the 1980s foreign banks have increasingly been allowed to operate not only in developed countries but also in many developing countries. Therefore, it is crucial for policy makers and researchers to examine the performance of foreign banks and their impact on the banking sectors of host countries.

We will first briefly review the theoretical arguments investigating the potential impacts of foreign penetration on the banking sector of host countries. Levine (1996) argues that foreign banks would lead to improvements in financial services in host countries by bringing high-quality financial services and products as well as modern banking management skills and state-of-the-art technologies. They may also facilitate accessing international financial markets, which in turn facilitate the raising of capital to meet financing needs. In addition to these direct benefits, the entry of foreign banks is expected to exert competitive pressure on domestic banks (Levine 1996; Claessens et al. 2001; Claessens & Laeven 2004). This in turn would force domestic banks to improve the quality of their products and services, reduce their costs, and start operating more efficiently in order to retain their market shares. Moreover, foreign bank entry would put pressure on governments to improve and harmonize the legal, regulatory, and supervisory systems with internationally accepted standards.

On the other hand, Stiglitz et al. (1993) postulate that the penetration of foreign banks would have adverse impacts on the host country's banking sector, local entrepreneurs and regulatory structure. First, domestic banks have to compete with foreign banks that are larger and have a better reputation, which may impose extra costs on the domestic banks. Second, these foreign banks tend to extend less loans to SMEs or local entrepreneurs because these banks may focus on multinational firms, namely they may cherry-pick high quality (low default risk) borrowers, which in turn might weaken domestic banks'

profitability.[37] Third, governments and local regulatory and supervisory institutions may find it more difficult to control these banks since they are more likely to be less sensitive to their wishes. Another point argues that if foreign bank entry increases competition, this in turn would reduce the franchise value of domestic banks and they would be forced to take more risks, thereby making the domestic banking sector more vulnerable (Claessens et al., 2001).

Recent literature also elaborates on the implications of the modes of entry of foreign banks on bank performance. Foreign banks enter into a host country in different forms. First, they can open a branch or a subsidiary, second they set up a new (de novo or greenfield) operation, and finally they acquire a domestic bank (takeover) (Clarke et al., 2003). Greenfield or de novo entrance implies the establishment of a foreign bank from scratch, while a merger or acquisition involves the purchase of a domestic bank's shares or other form of capital.[38] It is argued that entering through a greenfield investment enables entering a foreign bank to benefit from its international reputation, specifically in less developed or less stable economies where depositors might prefer their savings in this well-known bank (Thi and Vencappa, 2008). In addition, greenfield entry mode can allow entering a foreign bank to choose their targeted market segments, which would not be possible in the case of the acquisition of a domestic bank. This is arguably because the acquisition of a local bank would in turn leave the acquiring foreign bank with the customer profile of the old domestic banks. This might be inconsistent with the overall market positioning of the parent bank of the acquiring foreign bank which might need to undertake costly adjustments (Thi and Vencappa, 2008). Whilst, greenfield banks often penetrate into new markets following their clients or large multinational corporates, this in turn enables them to have higher efficiency (Havrylchyk, 2006). Moreover, greenfield banks are more likely to benefit from better risk management technologies and rely on modern information technologies than acquisition banks (Havrylchyk, 2006). However, it is also posited that once business strategy requires a comprehensive retail network, acquisition might be a more advantageous mode of entry, since the acquirer bank which inherits the customer

[37] See Clarke et al. (2003) for a comprehensive review on foreign bank entry

[38] In this paper, we suggest that if a foreign banks' acquirers are equal to or more than 50% of a domestic bank's capital, the ownership changes from a domestic to a foreign bank. Moreover, since we do not include foreign banks in the form of branch or subsidiary in our empirical analysis, we do not review literature concerning these forms of entry.

base of the acquired local bank are likely to access to local knowledge (Thi and Vencappa, 2008).

Following these arguments discussing the performance impact of foreign banks penetration, we now elaborate on why foreign and domestic banks might have different efficiency levels. Two alternative hypotheses can explain the discrepancy in performance between foreign and domestic banks: the home-field advantage and the global advantage. The former posits that domestic banks are more efficient than foreign banks. This could be due to operational diseconomies as foreign banks are operated and monitored from a distance. The disadvantages of foreign banks could also be due to barriers other than distance such as language, culture, regulatory and supervisory structure, legal environment, and potential bias against foreign banks. Finally, information asymmetries would make it difficult to establish and maintain local retail banking relationships, for example with SMEs and households, since such accounts require local information and a local focus. All these disadvantages may impose extra costs on foreign banks or lead to lower revenues, and thus to lower efficiency compared to domestic banks.

On the other hand, the global advantage hypothesis suggests that some efficiently managed foreign banks can overcome the above disadvantages and operate more efficiently than domestic banks. It is argued that their superior management skills and advanced technologies may enable foreign banks to enjoy and maintain lower costs. Their superior risk management and investments skills not only enable them to offer higher quality and variety of services to customers but also allow them to undertake investments with higher risks and higher expected returns, which in turn may increase their revenues. It is also noteworthy that the authors Berger et al. (2000) consider two forms of the global advantage theory: the general and limited form.[39] Under the general form, efficiently managed foreign banks are more efficient than domestic banks irrespective of their country of origin, since they are able to overcome the disadvantages. Under the limited form of the hypothesis, foreign banks from one or a limited number of nations are more efficient than domestic banks. This is because these successful foreign banks have headquarters in

[39] This is because some studies find that on average foreign banks are less efficient than domestic banks, but these results do not indicate that all foreign banks in those markets are showing poor performance. To unlock the mystery, they propose two forms of the global advantage hypothesis.

specific countries where favourable markets as well as regulatory and supervisory conditions provide a proving ground for efficient organisations. The favourable conditions in the home country may include having access to an educated labour force that has the ability to develop and adopt state-of-the-art technologies and risk-management strategies; tough product market competition forcing banks to be efficient and to employ superior management skills to survive; and having access to well-developed security markets enabling banks to exploit economies of scope. Therefore, banks coming from countries with competitive markets and sound regulatory and supervisory structures are able to overcome the disadvantages related to distance.

3.4.2 Empirical evidence on the relationship between ownership and bank efficiency

Studies investigating this association between ownership and bank efficiency are likely to rely on cross-country analysis since this may help to draw general conclusions on the association. For example, evidence drawn from two comprehensive review papers (Berger, 2007; Clarke et al., 2003) and one cross-country empirical study (Claessens et al., 2001) suggest that foreign banks operating in developing countries are more likely to be more efficient than domestic banks, while the opposite is the case for developed countries. That is, the general conclusion would be that while the global advantage hypothesis is more likely to hold for developing countries, the home-field advantage hypothesis is realised in developed countries. Evidence on the efficiency of transition banks also suggests that the performance of these banks with foreign ownership are likely to be better than that of their domestic counterparts (Kenjegalieva et al., 2009). There are, however, notable exceptions to these findings. For example, although Berger et al. (2000) similarly find that domestic banks are more efficient than foreign banks in developed countries, this finding does not hold all the time. They argue that some foreign banks from specific countries, e.g. the United States, could outperform their domestic peers even in developed countries, lending some support on the limited global advantage hypothesis. Contrary to the general conclusion, a cross-country study by Lensink et al. (2008) investigating 105 countries for the years 1998-2003 also finds that on average foreign banks are less efficient than domestic banks. However, they suggest that good governance as well as the sound regulatory and supervisory structure in the home and host country boosts the efficiency of foreign banks. In addition, the higher quality of institutions in the home country and similarities in the governance and institutional quality between home and host countries

improve foreign banks' efficiency. Another contradictory finding comes from Micco et al. (2007) who look at banks from 179 countries for the period 1995-2002. They suggest that there is no correlation between ownership and efficiency in developed countries, though they find that state banks in developing countries are more likely to be less efficient compared to their private peers and foreign banks are more profitable, lending some support to the general conclusion. They also highlight that state banks in developing countries are subject to political influence while this is not true for developed countries. This may explain the underperformance of state banks in developing countries while justifying their findings for developed country case. Bonin et al. (2005) look at 11 Eastern European transition countries and find that state banks are as efficient as their private counterparts, thus concluding that privatisation is not in itself sufficient to boost efficiency. Finally, there are also single country studies finding evidence in favour of the inferior operating performance of foreign banks compared to their domestic counterparts in Hungry (Hasan and Marton, 2003) and Indonesia (Hadad et al., 2011). Considering all accounts, it seems that it is difficult to reach a clear conclusion related with the ownership and efficiency association.

Another recent strand of literature pays more attention to whether the entry strategy - namely entry mode - of foreign banks influences the efficiency of bank performance differently. The empirical studies suggest that a different entry mode is likely to affect the performance of banks differently. For example, it is found that greenfield banks employ better risk management techniques and rely on more modern information technology compared to acquisition banks, therefore resulting in superior performance (Havrylchyk, 2006). Another study finds that greenfield banks are more efficient than domestic banks while this is not the case of acquisition banks (Havrylchyk and Jurzyk, 2011). In an another attempt to compare the performance of foreign banks entered through two modes of entry, Thi and Vencappa (2008) conclude that greenfield banks are more cost efficient than acquisition banks. These empirical studies therefore suggest that the mode of entry should also be accounted for when the association between ownership and efficiency is analysed.

Focusing on the Turkish banking sector, studies also reveal contradictory results. Some studies find that state banks are more efficient than private banks, both domestic and foreign (see Zaim, 1995 and Yildirim, 2002), while others find the opposite result (Demir

et al., 2005; Isik and Hassan, 2002a; 2003b). The former studies suggest that, until 2001 the government was interfering too heavily with public banks' lending decisions in order to extract political benefits. These banks accessed the cheaper funds provided by state institutions but were then forced to extend credit to specific sectors, even in unstable economic conditions. The positive result on efficiency of these studies might depend heavily on the fact that all of them considered total loans as an output and ignored the existence of NPLs. This would possibly mask the inefficient lending practices of public banks which would report higher than real loan portfolios, resulting in higher efficiency scores.[40] The studies finding in favour of private banks' superior efficiency generally ascribe their results to the relatively smaller size of domestic and foreign private banks, which they say might have been optimal, especially at times of macroeconomic and financial instability, along with the higher interest rates that were effective in the 1990s. Foreign banks, albeit smaller in size, may have managed to attract both sound foreign and domestic customers due to their modern techniques, business practices and better management skills, which in turn lead to better loan performance when NPLs were high in the 1990s. Moreover, inclusion of off-balance sheet (OBS) items by some studies may also be one of the underlying reasons leading to discrepancies in the empirical findings, as private banks have a higher proportion of these assets compared to state banks, resulting in higher output to input ratios. However, most of these studies use a two-step procedure to investigate the ownership and efficiency relation and this might produce misleading results. It is argued that if environmental variables (ownership in this case) are not incorporated in the first stage, this practice results in biased estimators of the parameters of the deterministic part of frontier, thereby one obtains biased estimators of efficiency as well (Coelli et al., 2005; Simar and Wilson, 2007). It is for this reason that in our study we will account for both NPLs and the OBS items and will employ a one-step procedure to address the potential drawbacks of the two-step procedure detailed above.

Recent studies have also investigated the association between ownership and efficiency, yet they also produce different results. Most of the studies find that foreign banks outperform their domestic counterparts (Akın et al., 2013; Assaf et al., 2013; Davutyan and

[40] It is expected that this practice is highly likely to exacerbate the quality of loan portfolios due to higher the NPLs. Thus, these studies, by not taking into account the NPLs, would over-estimate the public banks' performance.

Yildirim, 2015), with the exceptions of Fukuyama & Matousek (2011), who do not find any difference, and Aysan et al. (2011), who find that state banks are more efficient. The studies confirm the hypothesis and also suggest that most foreign banks in Turkey targeted the acquirement of the best performing local banks, with lower NPLs, better practices and technologies. This would explain why they outperformed their domestic counterparts. Fethi et al. (2012) also suggest that the heavy penetration of foreign banks after 2005 has contributed to technological improvements since they are expected to bring new practices and state-of-the-art technologies and escalate competitive pressure, resulting in performance improvements. The studies not confirming the hypothesis argue instead that foreign banks did not engage in retail banking and lending to SMEs businesses until 2001, thus they could not improve the managerial skills and infrastructure necessary for these businesses. They started to engage in retail banking and other services with a wide branch network and employment following the effective implementation of restructuring and prudential re-regulation policies in 2002. This put them at a disadvantage compared to domestic banks that had already developed the necessary management and technological infrastructure and were therefore able to perform better.

To sum up, foreign banks tend to operate more efficiently than domestic banks in developing countries, though there are some notable exceptions. Moreover, changes in the operational environment tend to affect the performance of different ownerships differently due possibly to the differences in operational structure, customer base, and management strategies. The empirical evidence concerning the Turkish banking sector is mixed, making it difficult to draw some clear general conclusions. In particular, there is a lack of empirical evidence investigating the impact of different reforms such as deregulation, prudential re-regulation and banking restructuring on different ownerships. Therefore, this study undertakes a long-term analysis to investigate how the deregulation and coexistence of deregulation along with effective prudential regulation and supervision have affected the performance of different ownerships.

3.5 Regulatory reforms, ownership and bank competition

The efficient functioning of the banking sector is important for a better economic performance of a country. This is arguably because banking sector funds in developing countries in particular are still the main source of funds for customers and SMEs for their

financial services and external finance. Therefore, the factors affecting the efficient functioning of the banking sector have caught attention of policy makers and researchers. Competition is argued to be one of these factors that can improve the efficient functioning of the banking sector, since it has direct impacts on the conditions for access to finance, such as lower interest rates for loans, and on financial innovation (OECD, 2009). In the following sub-sections, we will investigate two phenomena that impact banking competition. Accordingly, we initially review theoretical arguments on the association between competition and regulatory reforms, and between competition and ownership, then provide relevant empirical evidence on these arguments.

3.5.1 Theoretical arguments

Regulatory reforms affecting the competitive structure of a banking sector can be classified into two strands. First strand of regulatory reforms promotes deregulation of the banking sectors to stimulate competition among banks, while the second strand of reforms impose regulations on the banking sector to ensure the coexistence of competition and stability. The proponents of the banking deregulation argue that regulations limit competition and this lack of competitive pressure leads to the accumulation of substantial managerial slack or inefficiency; that is, firms do not minimise the cost of producing a given level of output (Winston, 1998). Instead, they suggest that authorities should liberalise the banking sector, which in turn would stimulate competition among banks and consequently lead to a more efficient production and marketing practices. That is, in theory it is expected that removal of restrictions on entry and on private ownership, lifting controls imposed on interest rates, and increasing the range of permissible activities both lead to an increase in competition among incumbents and allow new entrants into the sector stimulating competition further. For example, the removal of entry restrictions allows new banks to enter into the sector and this in turn would foster competitive behaviour as incumbents' market power reduces (Pasadilla and Milo, 2005). Moreover, foreign banks, which are likely to have superior technology and risk management skills, can penetrate into the domestic banking sector, creating a more competitive environment (Claessens et al., 2001). In addition, allowing banks to engage in a wide range of activities as well as deregulation of branching restrictions increase competition in the banking sector (Claessens and Klingebiel, 2001; Rice and Strahan, 2010). Furthermore, banking deregulation is likely to have positive implications for advances in information technology, in the processing of transactions

(automatic tellers, e-banking), in computational capacity, in management technique and risk coverage, and consequently generates a more competitive environment (Vives, 2001). Finally, deregulation forces inefficient banks to either enhance their performance to be able to survive or exit the banking industry through merger and outright failure (Winston, 1998). However, banking deregulation tends to induce consolidation in the banking sectors, since it exposes incumbents to more intense competition through new entry and lowers bank spreads by removing interest rate ceilings (Berger et al., 1999). These in turn foster mergers and acquisitions between banks to offset the impact of declining bank spread by exploiting scale and scope economies. As suggested by the structure-conduct-performance hypothesis, a rise in concentration due to increase in consolidation is regarded as increasing collusive opportunities among banks and therefore would lead to higher prices and hence lower competition in the market. In addition, the contestable market theory suggests that competitiveness of the banking sector does not merely depend on market structure indicators like concentration or number of incumbent banks. A concentrated banking sector can behave competitively even if the barriers to new entry are low. This because this theory posits that incumbent banks are always susceptible to hit-and-run entry when they seek to exploit their potential market power, therefore the threat of potential entry pushes these banks to price their products competitively under certain conditions. That is, it can be argued that market structure may not be a significant determinant of competitive structure; instead, market contestability rather than the structure might be more important for competitive behaviour (Casu and Girardone, 2006; Claessens and Laeven, 2004). Therefore, there is no academic consensus on whether banking deregulation leads to more or less competition in the banking system.

The second strand of reforms suggests imposing prudential regulations on banks to increase the solvency of the banking sector (Schargrodsky and Sturzenegger, 2000). This view, based on the "competition-fragility" hypothesis, argues that deregulation-induced competition among banks can lead to more financial fragility; as more competition erodes market power, reduces profit margins, and consequently results in reduced franchise value. This in turn induces banks to take on more risk to increase returns, resulting in higher fragility (Keeley, 1990). Similarly, it is argued that elimination of interest rate barriers on deposit rates erodes franchise value and hence leads to moral hazard behaviour by banks (Hellmann et al., 2000). Furthermore, banks gain lower informational rents from their relationship with borrowers due to increased competition, this in turn reduces their

incentives to properly screen borrowers, again rising the risk of fragility (Allen and Gale, 2004). Therefore, this view proposes that increased competition due to banking deregulation may lead to instability in the banking sector, calling for increased prudential regulation to control banks' risk taking incentives. However, the "competition-stability" view argues that an increase in competition can result in more, rather than less, stability in the banking sector. It is argued that deregulation of loan interest rates increases competition in this market and hence lower the lending rates. This reduction in the cost of borrowing for the entrepreneurs increases the success rate of investments, and consequently banks face lower credit risk on their loan portfolio in more competitive markets, resulting in increased banking sector stability (Boyd and De Nicolo, 2005). Yet the issue of regulation and its impact on competition and stability is suggested to be considerably more complex and multi-faced, as the theoretical analyses based on different models provide different answers (Allen and Gale, 2004).[41] Although these arguments have led to an extensive body of work focusing on the impact of regulations on competition and stability, we will specifically review the theoretical arguments focusing on the impacts of prudential regulations on competitive conducts in the banking sector.

In general, stricter prudential regulations impose higher costs and hence increase the costs of operating in the industry (Freixas and Rochet, 2008). This may in turn reduce the number of firms and hence with fewer banks, the market becomes less competitive. On the other hand, it is argued that stringent prudential regulations do not necessarily imply lower competition (Schargrodsky and Sturzenegger, 2000). This is because higher costs imposed by regulations may induce exit from the industry, yet the stricter regulatory environment may motive banks to choose a lower degree of product differentiation, forcing banks to compete more aggressively in prices. Further investigation of the individual prudential regulations also gives controversial arguments regarding their impacts on competition. That is, some of the banking regulations target limiting permissible banking activities in space and scope; they impose restrictions on the banks' potential to diversify and utilise scale and scope economies (OECD, 2006). On the one hand, these restrictions may prevent banks engaging in securitisation and insurance activities, which in turn lower competition

[41] There is also empirical evidence showing that different environmental factors (market, regulatory and other institutional factors) in which banks operate is critical in assessing the impact of competition on stability (Beck et al., 2013).

in the banking sector. Yet, these restrictions would lead to greater competition in banking since without these restrictions banks are likely to have market and political power, which in turn could impede competition (Barth et al., 2004). Some other regulations impose restrictions on asset holdings and activities, tighter capital requirements, separate banking and other financial service industries, and require official supervision and private monitoring (OECD, 2009). As before, these policies may weaken competition, but also may result in higher competition. For instance, greater supervision, depending on the incentives facing bank supervisors and the ability of taxpayers to screen this supervision might hinder bank operations and hence competitive structure of the banking sector (Barth et al., 2004). On the other hand, stringent capital requirements render banks to choose a lower level of product differentiation, allowing for more competition and lower spreads (Schargrodsky and Sturzenegger, 2000). However, imposing minimum capital requirements on banks might lower competition; since the owners of banks are forced to put up considerable amounts of capital, they in turn would be less eager to take risks as they can lose large amount of funds (Allen and Gale, 2004). Therefore, from theoretical arguments point of view, the issue of prudential regulations and their impact on competition is inconclusive.

We now investigate the theoretical arguments on the relationship between ownership structure and its effect on competition in the banking sector. In theory, foreign banks can stimulate competition of a host country's banking sector via higher efficiency and improved quality of service delivery. Moreover, their penetration can also contribute to the deployment of modern banking technologies, superior management, better risk analysing skills, high product quality, human resource development, and can also improve the regulatory framework and legal structure of the host country (Hawkins and Mihaljek, 2001). Their entrance exerts competitive pressure on domestic banks by forcing them to lower their costs (Clarke et al., 2003). It can be inferred from these arguments that foreign banks may spur domestic competition and their existence may therefore compel domestic banks to adopt strategies that would improve their competitiveness. In addition, Claeys and Hainz (2007) suggest that the mode of entry of foreign banks would have a different impact when they compete with domestic banks. That is, foreign banks can either penetrate a host country's banking sector by acquiring a domestic bank (takeover) or establishing a foreign greenfield bank. While both these entry modes would have superior screening technology compared to domestic banks, the takeover banks would also enjoy access to

soft information obtained from the acquisition of an existing domestic bank. Therefore, this indicates that domestic banks have to charge lower loan rates when competing with takeover banks than with greenfield banks when soft information is important (i.e., opaque borrower). However, when hard information matters (i.e., transparent borrower), greenfield banks are likely to behave more competitively and charge lower lending rates as their screening advantage compensates its disadvantage of having no information on incumbent firms (Claeys and Hainz, 2007). State ownership of banks can also influence the competitive dynamics of a banking sector due partly to their strategies or their roles. It is suggested that these banks may compete differently than privately-owned banks, since they tend to finance politically attractive projects, not economically efficient ones (Shleifer, 1998). Moreover, their existence might impede private-sector corporate control of banks, since banking authorities might be more willing to deny entry applications to protect these banks, which in turn reduces bank competition (Barth et al., 2004).

3.5.2 Empirical evidence

We first review the empirical evidence concerning the impact of deregulation on the competitive structure of the banking sector. Although majority of the literature tends to treat the increase in competition as an automatic outcome of banking deregulation, this literature provides conflicting results. For example, a positive link between bank deregulation and competition is documented by Shaffer (1993) for the Canadian banking sector, Angelini and Cetorelli (2003) for the Italian banking sector, Zhao et al. (2010) for the Indian banking sector, Mwega (2011) for the Kenyan banking sector, Claessens and Laeven (2004) based on 50 countries' banking sectors. On the other hand, there are studies finding a certain level of decline in competition following the deregulation (Maudos and Solís, 2011; Yildirim and Mohanty, 2010; Zardkoohi and Fraser, 1998). Therefore, the empirical literature suggests that banking deregulation may not necessarily lead to the increase of competition in the banking sector. Among others, this unexpected adverse impact in given literature arguably might arise from the oligopolistic nature of the banking sector, coupled with the freedom granted by deregulation over both interest rates and credit allocation, enabling banks to engage in collusive behaviour to gain monopoly rents (Demetriades and Luintel, 1996). In addition, various studies tend to use different approaches to measure the evolution of competition during the deregulation process; this in turn might lead to the contradictory results. Finally, regulatory reforms are often a mixed

process combining banking deregulation and re-regulation policies. That is, as it will documented below, greater prudential control might imply a cost in terms of competition (Schargrodsky and Sturzenegger, 2000), thus the parallel use of different policies makes it difficult to assess the net impact of financial reforms on competition.

The evidence from studies investigating the impact of prudential regulations on bank competition also gives controversial results. An empirical study relying on three different waves of the World Bank survey spanning between 1998 and 2006 finds that, in general, stringent prudential regulations do not have an adverse effect on the intensity of competition (Ahrend et al., 2009). However, the same study indicates that some of the regulations have different impacts on competition. For example, while the strength of official supervision improves competition since it generates a level playing field among banks in a market; tighter regulations with respect to entry rules and ownership structure reduce bank competition, implying that not having contestable market conditions adversely affects competitiveness. Another empirical study examining this relation based on a sample of developed and emerging market economies finds that an increase in capital requirements lower the bank spread for emerging economies while it has no influence for developed countries (Schargrodsky and Federico, 1998). From a different perspective, There are also single country studies investigating this relation. For example, a study using a dummy variable to capture the impact of prudential regulations on competition in the Indian banking sector concludes that prudential regulations might not necessarily come at the expense of competition, because despite the implementation of tighter prudential norms, competition in the lending market increases (Zhao et al., 2010). Another single-country empirical study investigating prudential regulation and competition in the case of the Argentine banking industry finds that the effects of capital requirement on profitability are not clear (Burdisso and D'Amato, 1999). It can be inferred from the review of these empirical studies that each prudential norm may lead to different effects on competition, thus making it difficult to conclude that prudential regulations benefit competition in general.

The association between ownership and competition is also not clear-cut. In a cross-country study, Claessens and Laeven (2004) find that greater foreign presence is more likely to result in more competitive banking sectors. Another cross-country study obtains similar findings, suggesting that increased foreign bank presence is correlated with a

reduction in profitability and margins for domestic banks (Claessens et al., 2001). There are also evidence in favour of the positive effect of foreign participation in a single-country case (see, Unite and Sullivan, 2003; Simpasa, 2013). However, a cross-country study focusing on the African banking sector finds that there is an inverted U-shaped association between foreign bank entry and competition, indicating that when the share of the foreign bank is less than or equal to the value of the turning point, foreign bank entry increases the competitive environment in banking (Boubacar, 2016). In addition, Yildirim (2014) finds that, despite foreign participation, the level of competition in the Turkish banking sector did not increase. Furthermore, Barajas, Steiner and Salazar (2000) find that foreign entry gives rise to a deterioration in the quality of domestic banks' loan portfolio, which is attributed to the hypothesis that greater competition increases risk by inducing a loss of bank franchises' value.

The empirical studies indicate that the mode of entry of a foreign bank generates a differential competition effect. For example, Claeys and Hainz (2007), investigating this hypothesis for ten Eastern European countries, find that on average foreign bank entry results in reductions in interest rates due to their screening technology and that increased competition has a stronger effect on domestic banks if the mode of entry is greenfield. Similar findings support this evidence when new foreign banks are likely to charge lower interest rates relative to domestic banks, and this is more so for greenfield bank than takeover banks (Dell'Ariccia and Marquez, 2004). However, another study suggests that greenfield banks charge lower interest rates, not solely due to their superior performance or screening technology, but because they have a higher share of the most transparent borrower in their portfolio whose cost of credit is lower than opaque borrowers (Degryse et al., 2012). Moreover, another study also suggests that if foreign banks are unable to distinguish between good and bad borrowers, the mode of entry comes to a standstill. This is because foreign banks are more likely to concentrate on the sector least subject to information asymmetries (Dell'Ariccia et al., 1999).

3.6 Discussion and conclusion

This chapter has reviewed the effects of financial deregulation, prudential re-regulations, and ownership on bank efficiency and competition from both theoretical and empirical perspectives. It is possible to infer from this review that inconsistencies observed in

theoretical arguments are reflected in empirical evidence investigating the impact of banking reforms and ownership on bank efficiency and competition. In other words, despite a growing number of studies, these literatures are still rather limited and inconclusive on many aspects. One of the most important points not fully recognised is that banking deregulation is a continuous process with possibly lagged effects. Therefore, the short time periods analysed by many empirical studies obviously limit the inference that can be driven. Another point is that financial fragilities stemming from the implementation of deregulatory policies without setting out a sound regulatory framework have led authorities to implement concomitant prudential re-regulations to eliminate risks linked to reforms that are more liberal. Although regulatory reforms have widely been implemented by policy makers, the number of empirical studies investigating the joint impact of these reforms is rather limited. The Turkish banking sector in particular does not have any study investigating the joint impact of these reforms. Moreover, changes in the operational environment tend to affect the performance of different ownerships differently due possibly to the differences in operational structure, customer base, and management strategies. However, the literature sheds light on the reactions of different ownership and the different mode of entry of foreign banks to the changing regulatory environment is lacking. Furthermore, the existing empirical studies tend to focus on the existence of a relationship between competition and bank efficiency without digging into the means by which this association takes place. That is, the literature lacks a measure of the evolution of competition during the banking reform process and to what extent this reform process affects competition.

Chapter 4
Measuring Frontier Efficiency

4.1 Introduction

Banking sector funds form surplus units to deficit units, thus increasing economic efficiency by improving a better allocation of economic resources (Casu et al., 2015). This important financial intermediary role played by banks make competition and efficiency among banks pivotal and timely policy issues. Therefore, a crucial question to be answered is: what is an effective way to measure the degree of efficiency and competition? This chapter will focus on the approaches used to measure efficiency, while Chapter 6 will elaborate methodologies used to measure the degree of competition.

This chapter is organised as follows. Section 4.2 starts by introducing approaches, parametric and non-parametric, used to measure the efficiency of a decision-making unit. Section 4.5 describes the non-parametric method and pays more attention to the Data Envelopment Analysis. Sections 4.3 and 4.4 focus on parametric methods with particular attention paid onto the Stochastic Frontier Analysis and its extensions. Section 4.5 compares these two different approaches and Section 4.7 concludes.

4.2 Frontier efficiency

The two most widely used concepts to assess a firm's production performance are productivity and efficiency. Although these two concepts are sometimes used interchangeably, they are not identical (Coelli et al., 2005). That is, whilst productivity is a descriptive measure of the ratio of outputs to inputs for a particular firm, efficiency is a normative measure of the observed ratio of outputs to inputs for a particular firm against an optimal one that is generally accepted as the "frontier."

The notion of "frontier efficiency" is based on the recognition that some firms in an industry are more successful than their counterparts in meeting their objectives and hence it is usual to observe different efficiency levels among them. The available techniques that enable identifying the efficiency of competitors can be grouped into two major streams: parametric and non-parametric approaches. Although both approaches measure efficiency

as a radial distance from an efficient frontier consisting of best-practice firms, one of the fundamental differences between these methods lies in how the efficient frontier is constructed. That is, given that the efficiency in production among firms is investigated, the parametric approaches require imposing a specific functional form characterising the production process. The non-parametric methods instead construct a piece-wise linear convex frontier from the linear combination of the best observed practices on the sample.

4.3 Parametric frontier efficiency approaches

Early parametric frontier approaches used to estimate firm-level efficiency levels did not allow for the presence of statistical noise. Aigner and Chu (1965), Afriat (1972) and Richmond (1974) considered a Cobb-Douglas production frontier of the form:

$$\ln q_i = f(x_i; \beta) - u_i \tag{4.1}$$

where q_i is the output vector for firm i, $f(.)$ is the production function, x_i is the input vector for firm i, β is a vector of unknown parameters to be estimated, and u_i is a non-negative random variable. Therefore, this model indicates that all deviations from the efficient frontier are assumed to be the result of technical inefficiency. The model (4.1) does not take measurement errors and other sources of statistical noise into account. The inefficiency component, u_i, possibly captures all these effects, resulting in inconsistent measurements of inefficiency. An obvious solution to this issue is to incorporate another random variable representing statistical noise into the model. The resulting frontier is known as a stochastic frontier approach.

4.4 Stochastic parametric frontier approaches

Stochastic parametric frontier approaches include methods such as the stochastic frontier analysis (SFA), the thick frontier analysis (TFA), the distribution free approach (DFA) and the recursive thick frontier analysis (RTFA). Since the SFA is the most widely employed method among the stochastic parametric frontier approaches and it will be used in Chapter 5 to measure cost efficiency levels of Turkish banks, we elaborate on this method as a representative stochastic parametric frontier approach.

4.4.1 The stochastic frontier analysis

Similar to the early parametric frontier approaches, the SFA also makes assumptions on the functional form of the production process and includes a non-negative random variable capturing inefficiency, but it differently adds a symmetric random error to account for statistical noise. That is, the stochastic parametric frontier approaches depart from the early literature by including a random error to capture the effects arising from the unintentional omission of relevant variables, from measurement errors as well as from approximation errors related with the choice of functional form. This approach accordingly requires an explicit functional form for the frontier as well as distributional assumptions on random error and inefficiency. Therefore, this model attributes the radial distance between the observed performance of a firm and the efficient frontier to both random noise and inefficiency.

Aigner et al. (1977) and Meeusen & van Den Broeck (1977) independently proposed the stochastic frontier production function model which is specified as follows:

$$\ln q_i = f(x_i;\beta) + \varepsilon_i \tag{4.2}$$

$$\varepsilon_i = v_i - u_i \tag{4.3}$$

where q_i is the output vector for firm i, $f(.)$ is the production function, x_i is the input vector for firm i, β is a vector of unknown parameters to be estimated. ε_i is the composite error terms that can be directly observed in the estimation and it consists of u_i, one-sided inefficiency term, and of v_i, two-sided random error. The random error, which can be positive or negative, captures measurement error and other random factors affecting the production process that go beyond the control of the firm, while the non-negative inefficiency term (as this can only reduce output) accounts for technical inefficiency, namely each firm's shortfall in output relative to the frontier. In addition, v_i and u_i are assumed to be independently distributed from each other. The model (4.2) therefore is called a stochastic frontier production function, since the output values are bounded from above by the random variable $exp(x_i'\beta + v_i)$. In other words, since the symmetric random error v_i can be negative or positive, the stochastic frontier outputs vary about the deterministic component of the model.

These features of the stochastic frontier model can be illustrated graphically. To ease the illustration, two firms, A and B, producing output q_i using only one input, x_i are taken into consideration. In this case, a Cobb-Douglas stochastic frontier model can be shown below:

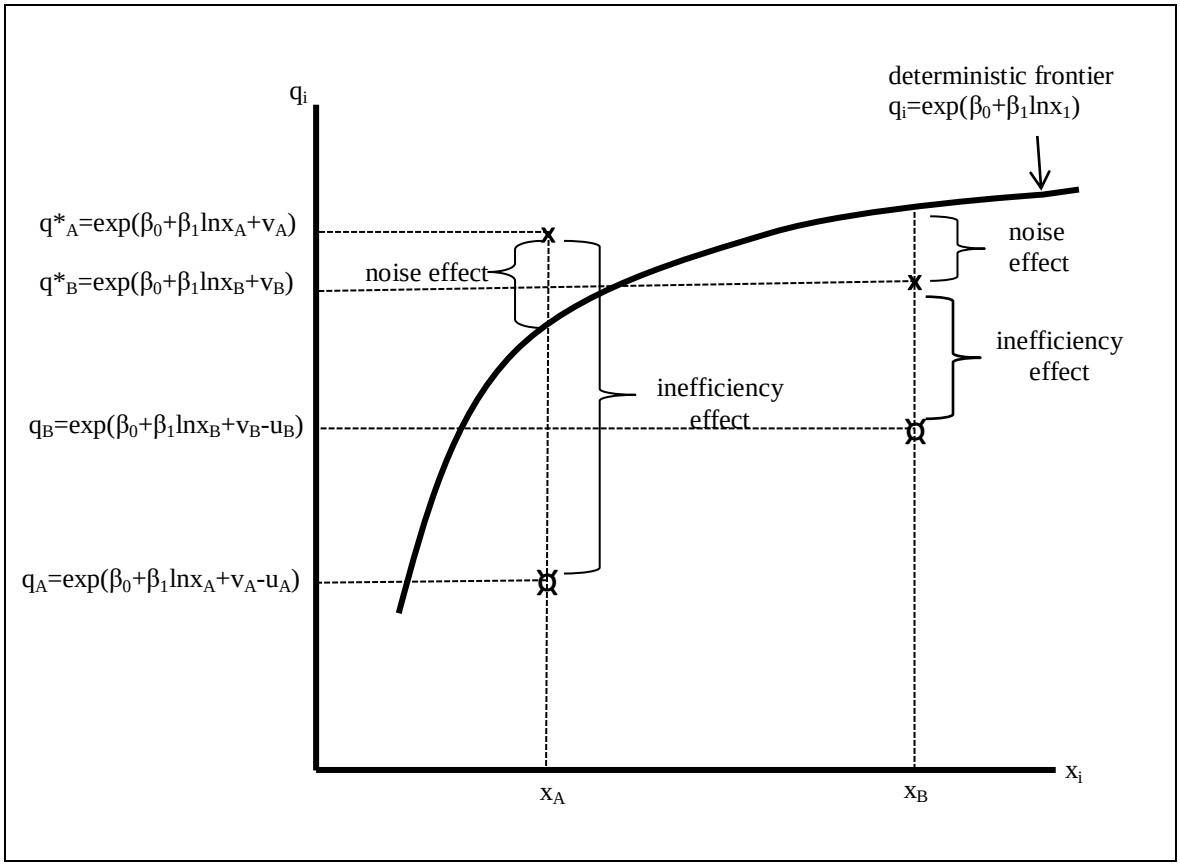
$$\ln q_i = \beta_0 + \beta_1 lnx_i + v_i - u_i \tag{4.4}$$

or

$$q_i = \underbrace{e^{(\beta_0+\beta_1 lnx_i)}}_{\text{deterministic component}} \times \underbrace{e^{(v_i)}}_{\text{noise}} \times \underbrace{e^{(-u_i)}}_{\text{inefficiency}} \tag{4.5}$$

Figure 4.1 depicts the inputs and outputs of two firms, A and B, and the deterministic frontier model reflects the existence of diminishing returns to scale. Output values are shown on the vertical axis, while input values on the horizontal axis. Firm A employs input x_A to produce output q_A, while Firm B employs input x_B to produce output q_B (these observed values are illustrated by the points marked with ¤, while the unobserved frontier values are shown by the points marked with ×).

Figure 4.1 Stochastic production frontier



Source: (Coelli et al., 2005)

Figure 4.1 shows the deterministic frontier, $q_i = \exp(\beta_0 + \beta_1 lnx_i)$, which reflects the efficient (or best practice) maximum output level attainable by using a given quantity of input, and it is estimated based on the observed outputs and inputs of all firms in the industry. The key points in the figure are that the frontier output of Firm A [$q_A^* = \exp(\beta_0 + \beta_1 lnx_A + v_A)$] lies above the deterministic part of the production frontier only because the impact of noise is positive (i.e., $v_A > 0$), while the frontier output of Firm B [$q_B^* = \exp(\beta_0 + \beta_1 lnx_B + v_B)$] lies below the deterministic part of the production frontier only because the impact of noise is negative (i.e., $v_B < 0$). Since v_j is assumed to be a two-sided random error term, noise can be positive and negative reflecting this assumption. Moreover, stochastic frontier outputs tend to be evenly distributed above and below the deterministic part of the frontier. The observed output of Firm A [$q_A = \exp(\beta_0 + \beta_1 lnx_A +$

$v_A - u_A)]$ lies below[42] the deterministic part of the frontier as the sum of the noise and inefficiency effects is negative (i.e., $v_A - u_A < 0$). The same applies to the case of Firm B. The primary aim of the stochastic frontier analysis is to predict inefficiency effects. Therefore, the most common output-oriented measure of technical efficiency is the ratio of observed output to the corresponding stochastic frontier output, namely:

$$TE_i = \frac{q_i}{\exp(x_i'\beta + v_i)} = \frac{\exp(x_i'\beta + v_i - u_i)}{\exp(x_i'\beta + v_i)} = \exp(-u_i) \tag{4.6}$$

The predicted technical inefficiency effects take a value between 0 and 1 and they measure the output of the *i-th* firm relative to the output that could be produced by a fully efficient firm employing the same input vector. Since predicting inefficiency effects is the most important objective of stochastic frontier analysis, the estimation of parameters of the model is understated in the literature. Yet the estimation process is quite complicated given the fact that the model itself has two random errors, a symmetric error, v_i, and a one-sided random variable, u_i, requiring assumptions with regards to these two random variables.

4.4.2 Estimating parameters and predicting efficiency

i. Choosing a functional form

Estimation of the parameters of the stochastic production frontier model starts with choosing a functional form for the production process. Among the possible models discussed by the literature are the Cobb-Douglas, the normalised quadratic, the transcendental logarithmic (translog), the generalised Leontief and the constant elasticity of substitution. In detail, the translog offers a flexible functional form and makes fewer assumptions than alternative forms on the structure of the production process, specifically on production and substitution elasticities. It is also argued that more flexible functional forms such as the alternative Fourier flexible leads to a further loss of degrees of freedom (Filippini et al., 2008), yet it produces similar average levels of inefficiency (as found by Berger & Humphrey (1997)). Non-flexible alternative functional forms like Cobb-Douglass

[42] Observed outputs tend to lie below the deterministic part of the frontier, yet they can (though rarely) lie above the deterministic frontier if $v_A - u_A > 0$ (Coelli et al. 2005).

and Leontief, on the other hand, are too restrictive compared to the translog functional forms as they place a priori restrictions on the substitution possibilities among the factors of production. Yet the increased flexibility leads to loss in econometric efficiency and other econometric challenges due to possible multicollinearity and loss of degrees of freedom. Therefore, this study will use the translog form in the one of the empirical analyses of this thesis.

The choice between these different forms can also be made based on four principles which are discussed by Coelli et al. (2005). First, if a functional form has sufficient parameters to yield a first-order differential approximation to an arbitrary function at a single point, this function is called *first-order flexible*, while if it has sufficient parameters to yield a second-order approximation it cis called *second-order flexible.* The Cobb-Douglas form is a first-order flexible, whilst other functional forms are second-order flexible. The literature suggests one to use a second-order flexible functional form since this provides greater information reflecting the input-output relations more clearly. Second, the functional forms should be linear in parameters to be able to estimate them by applying linear regression techniques. Third, the functional forms need to satisfy the economic regularity features, which are non-negativity, non-decreasing in input prices, non-decreasing in quantity, homogeneity and concave in input prices. Lastly, the principle of parsimony contends that simplest functional form that is adequate for the estimation should be preferred. Therefore, while it is suggested to examine the adequacy of a functional form before estimation, this practice is not straightforward, leading practitioners to determine adequacy by conducting post-estimation tests such as a residual analysis, hypothesis testing, calculating measures of goodness-of-fit, and examination predictive superiority (Griffin et al., 1987).

ii. Estimating parameters via the maximum likelihood method

As noted, the model (4.2) has two random errors, a symmetric error, v_i, and a one-sided random variable, u_i, making it more complicated to estimate. Therefore, it is common in the literature to assume that each v_i is distributed independently of each u_i and that both errors are uncorrelated with the independent variables in x_i. Also,

$$E(v_i) = 0, \tag{4.7}$$

$$E(v_i^2) = \sigma_v^2, \tag{4.8}$$

$$E(v_i v_j) = 0 \; for \; all \; j \neq i, \tag{4.9}$$

$$E(u_j^2) = constant, \tag{4.10}$$

$$E(u_i u_j) = 0 \; for \; all \; j \neq i. \tag{4.11}$$

Therefore, it is possible to assume that the statistical noise component, v_i, has similar properties to the noise component in the classical linear regression model. That is, the errors are independently and identically distributed normal random variables with zero means and variances $\sigma^2, \left(v_i \sim iidN(0, \sigma_V^2)\right)$. Although the inefficiency component has similar properties with the statistical noise, it has a non-zero mean since inefficiencies can only have negative impacts on production process.

Given these assumptions, one can obtain consistent estimators of the slope parameters employing ordinary least square (OLS). Yet this estimation method arguably results in a downward bias in the intercept term, indicating that the OLS estimates cannot be used to compute measures of technical inefficiency. Therefore, it is suggested in the literature that the maximum likelihood (ML) method enabling one to make distributional assumptions for the two error terms as well as having many desirable large sample features offers better solution (Coelli et al., 2005).

The ML method has been widely used by many empirical studies. The estimation of stochastic frontier models via this method requires distributional assumptions on the inefficiency component entering the composite error, in addition to the customary ones made for the stochastic error. The symmetric random error, v_i, is commonly assumed to be identically and independently distributed with zero mean and constant variance, while the stochastic frontier literature offers various specifications for the distribution of the second non-negative random error term ($u_i \geq 0$) associated with inefficiency. That is, overall one needs to estimate all parameters under the assumptions and then the separate effects of inefficiency and statistical noise from the estimated composite error term.

iii. The Half-Normal Model

Aigner et al. (1977) assumes $iidN(0,\sigma_V^2)$ for v_i, yet assumes $iidN^+(0,\sigma_u^2)$ for u_i, indicating that a half-normal distribution with zero mean and constant variance. Aigner et al. (1977) parameterised the log-likelihood function for the half-normal model in terms of $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\lambda^2 = \sigma_u^2/\sigma_v^2 \geq 0$. This suggests that if λ=0 technical inefficiency effects do not exist, which in turn indicate that all the deviations from the efficient frontier stems from statistical noise. On the other hand, Battese & Corra (1977) parameterised the log-likelihood in terms of $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2/\sigma^2$. This suggests that γ parameter ranges between 0 and 1, and if γ =0 then all deviations from the efficient frontier driven by statistical noise, while γ =1 indicates that all deviations are thanks to technical inefficiency. The latter parametrisation is arguably a more convenient way for iterative optimisation and will hence be elaborated below.

Under the Battese & Corra (1977) method, the log-likelihood function is parametrised as follows:

$$lnL(q|\beta,\sigma,\gamma) = -\frac{1}{2}\ln\left(\frac{\pi\sigma^2}{2}\right) + \sum_{i=1}^{J} ln\Phi\left(-\frac{\varepsilon_j\sqrt{\left(\frac{\gamma}{1-\gamma}\right)}}{\sigma}\right) - \frac{1}{2(\sigma_v^2+\sigma_u^2)}\sum_{i=1}^{M}\varepsilon_i^2 \quad (4.12)$$

In the equation (4.12), q is a vector of outputs; $\varepsilon_i = v_i - u_i = lnq_i - \boldsymbol{x}_i'\beta$ is the *i-th* composite error term; $\Phi(x)$ is the cumulative distribution function of the standard normal random variable evaluated at *x.* The maximisation of the log-likelihood function in equation (4.12) with respect to the unknown parameters (β,σ,γ) results in the ML estimates of these parameters.

Once we have the estimates of the technology parameters, β, and the two distributional parameters, σ and γ, the next step is to derive estimates of firm specific efficiency scores. As noted in the equation (4.12), the estimated residual of the model is $\varepsilon_i = v_i - u_i$. Although this obviously contains information on u_i, it is not straightforward to extract information from ε_i about u_i. A solution offered by Jondrow, Lovell, Materov, and Schmidt (1982) (JLMS) is to use the conditional distribution of u_i given ε_i. Namely, if $u_i \sim N^+(0,\sigma_U^2)$, then the conditional distribution of *u* given *ε* is as follows:

$$f(u|\varepsilon) = \frac{f(u,\varepsilon)}{f(\varepsilon)} = \frac{1}{\sqrt{(2\pi\sigma_*)}} \times \exp\left[-\frac{(u-\delta_*)^2}{2\sigma_*^2}\right] / \left[1 - \Phi\left(-\frac{\delta_*}{\sigma_*}\right)\right] \quad (4.13)$$

where $\delta_* = -\varepsilon\sigma_u^2/\sigma^2$ and $\sigma_*^2 = \sigma_u^2\sigma_v^2/\sigma^2$.

Moreover, because $f(u|\varepsilon)$ is distributed as $N^+(\delta_*, \sigma_*^2)$, either the mean or the mode of this distribution can serve as point estimator of u_i (Kumbhakar and Lovell, 2000). They are given as follows:

$$E(u_i|\varepsilon_i) = \delta_{*i} + \sigma_* \left[\frac{\theta\left(-\frac{\delta_{*i}}{\sigma_*}\right)}{1 - \Phi\left(-\frac{\delta_{*i}}{\sigma_*}\right)}\right] = \sigma_* \left[\frac{\theta\left(\frac{\varepsilon_i\lambda}{\sigma}\right)}{1 - \Phi\left(\frac{\varepsilon_i\lambda}{\sigma}\right)} - \left(\frac{\varepsilon_i\lambda}{\sigma}\right)\right] \quad (4.14)$$

Finally, when point estimates of u_i are acquired, estimates of firm-specific technical efficiency can be derived from $TE_i = exp(-\hat{u}_i)$.

Alternatively, the point estimator of firm-specific technical efficiency can be obtained from the conditional expectation given the observed composite error term following Battese & Coelli (1988) as follows:

$$TE_i = E[\exp(-u_i|\varepsilon_i] = \left[1 - \frac{\Phi\left(\sigma_* - \frac{u_i^*}{\sigma_*}\right)}{1 - \Phi\left(-\frac{u_i^*}{\sigma_*}\right)}\right] exp\left\{\frac{\sigma_*^2}{2} - u_i^*\right\} \quad (4.15)$$

where $u_i^* = -\varepsilon_i, \gamma = -(lnq_i - x_i\beta)\sigma_U^2/\sigma^2$ and $\sigma_*^2 = \sigma_u^2\sigma_v^2/\sigma^2$.

iv. Other models

As noted, the models assuming a half-normal distribution for the inefficiency component is a single-parameter distribution, which in turn arguably restricts the distributional shapes of inefficiency. This led researchers to develop more flexible two-parameter distributions for the inefficiency term: Stevenson (1980) offered a truncated-normal distribution model generalisation of a half-normal distribution, and Greene (1990) proposed a gamma

distribution model generalisation of an exponential distribution. The former assumes the inefficiency term, u_i, is assumed to be distributed as a truncated normal with mean μ:

$$u_i \sim iidN^{+}[\mu, \sigma_u^2]. \tag{4.16}$$

The gamma distribution assumes that inefficiency term is assumed to be distributed as:

$$u_i \sim iidG(\lambda, 0) \quad (exponential\ with\ mean\ \lambda) \tag{4.17}$$

It is argued in the literature that the half-normal distribution which has a zero mode is somewhat restrictive, since most of the observations are clustered near full efficiency. For example, operational units in the state sector or firms in a recently privatised industry are likely to suffer from inefficiency (Kumbhakar et al., 2015). That is, the appropriate distribution of inefficiency should have a non-zero mode. The truncated and the gamma densities having a mean and mode different from zero[43] do not impose any a priori restrictions on the efficiency. Since the half-normal is a special case of truncated normal, it is suggested that one should estimate the model with the truncated normal assumption and test the hypothesis that the mean is zero (Kumbhakar et al., 2015).

However, the flexibility of these distributional assumptions comes at the cost of substantial numerical complexity, as there are more parameters to be estimated. There are also studies controlling the effect of possible misspecification in the density assumption imposed on inefficiency. For example, Greene (1990), investigating to what extent the average inefficiency scores are sensitive to choice of distributional assumption (half-normal, truncated normal, exponential and gamma) imposed on inefficiency, found that mean inefficiency levels across these distributional specification for inefficiency are quite similar. Ruggiero (1999) assumed two distributional assumptions (half-normal and exponential) for inefficiency and found that the rankings of firms on the basis of predicted efficiency levels were quite robust to the distributional specification. Although one should

[43] If μ=0, the truncated normal density collapses to the half-normal density.

take into consideration the specific conditions observed in the market and their repercussions on the firms before imposing a distributional assumptions, the principle of parsimony favours the simpler single-parameter distributions of half-normal models (Coelli et al., 2005).

v. Hypothesis testing

Practitioners are usually interested in testing the significance of the inefficiency effects. In the half-normal model, this can be undertaken by testing the null hypothesis of $H_0 = \sigma_u^2 = 0$, against $H_1 = \sigma_u^2 > 0$. In addition, a practitioner can also use estimates from the truncated-normal model to test to what extent the simpler half-normal model is sufficient. Moreover, it is also suggested to undertake a test of model adequacy, for example, to test to what extent a restricted Cobb-Douglass functional form is sufficient against a more flexible translog functional form. This test can be conducted by proposing a Wald, Likelihood Ratio (LR) or Lagrange Multiplier (LM) tests. The Wald, LR and LM tests are all only asymptotically valid. The same applies to the t-test and F-test since the stochastic frontier model which has a composite error term is no longer normally distributed. That is, the distribution of composite error is either negatively or positively skewed depending on whether it is measuring cost or production efficiency.

4.4.3 Accounting for exogenous environmental factors

The analysis of productive efficiency arguably has two objectives. The first one is the prediction of a stochastic frontier serving as a benchmark against which to estimate efficiency of firms, which has been reviewed in the above sections. The second aim, although much less frequently explored, is to the incorporation of exogenous environmental factors with neither inputs nor outputs to the production process, yet it exerts an impact on firms' performance (Kumbhakar and Lovell, 2000). That is, the ability of firms to transform inputs into output is often affected by some exogenous factors characterising the production environment. Examples of such factors are regulatory changes, the degree of competitive pressure, input and output quality proxies, ownership structure, network characteristics, and various managerial features. For instance, Coelli et al. (1999), measuring the efficiency of international airlines in their study, account for environmental factors like network conditions and geographical factors.

In the SFA literature, two alternative methods have been used to take into account environmental factors. First, since they might affect the structure of the production technology by which conventional inputs are converted into output(s), leading practitioners to incorporate these observed factors into the deterministic part of the stochastic frontier model. Second, since they may influence the efficiency with which inputs are converted into output(s), led practitioners to include these factors as covariates in the inefficiency term of the stochastic frontier model.

i. Early approaches handling exogenous environmental factors

The first approach handles the exogenous environmental variables by incorporated them directly into the structure of production process, giving the form of:

$$lnq_i = \ln(x_i\beta) + z_i\delta + v_i - u_i \tag{4.18}$$

where z_i is a vector of environmental factors and δ their corresponding vector of unknown parameters to be estimated. The equation (4.18) has the same structure as a conventional stochastic production frontier model discussed in Section 4.4 and this expanded model can also be estimated using similar estimation techniques. If one uses the ML approach for the estimation, it is inherently assumed that the environmental factors as well as the input variables are not correlated with each disturbance component v_i and u_i. This indicates that the environmental factors affect the production performance by influencing the structure of the production frontier by influencing efficiency with which it is assumed to be uncorrelated. Therefore, although these factors are assumed to affect efficiency, the variations in efficiency are left unexplained by this model.

Some researchers take into account the environmental variables in a two-step approach (eg., Pitt & Lee 1981). The first-step involves estimating the stochastic frontier model without incorporating the environmental variables, thus firm-specific efficiency scores are obtained without controlling for environmental factors. The second-step involves regressing these predicted firm-specific efficiency scores on the environmental variables

with the expectation that variations in efficiency are explained. This approach arguably produces biased and inefficient estimators for the following reasons. The environmental variables, z_j, must be assumed to be uncorrelated with the elements of x_j. If they are correlated, the first step estimation undertaken by omitting the environmental variables from the frontier in turn give biased ML estimates of $\beta, \sigma_u^2, \sigma_v^2$. Therefore, the predicted inefficiencies being accounted for in the second-stage regression are biased predictions of the true inefficiencies, since they have been predicted relative to a biased representation of the production frontier. A second and less widely recognised problem is that in the first stage it is assumed that inefficiency, u_i, is assumed to be identically distributed. Yet this assumption is contradicted in the second stage regression, as the inefficiencies predicted in the first step are now assumed to have a functional relationship with the environmental variables, z_j. Due to these caveats, concerning the validity of the results of the two-step approach, recent empirical studies have preferred using different ways of handling the environmental factors.

ii. Incorporating exogenous environmental factors as covariates

The one-step approach handles the environmental variables by allowing them to directly affect the stochastic component of the frontier model; namely, the environmental variables are included as covariates in the inefficiency term of the stochastic frontier model. Kumbhakar et al. (1991) formulated this model as:

$$lnq_i = \ln(x_i\beta) + v_i - u_i \tag{4.19}$$

$$u_i = \delta' z_i + \omega_i \tag{4.20}$$

so that single-step production frontier model is:

$$lnq_i = \ln(x_i\beta) + v_i - (\delta' z_i + \omega_i) \tag{4.21}$$

where one-sided error term, u_j, in the equation (4.19) has a truncated normal structure with the mean relying on the vector of environmental variables, z_i, shown as $u_i \sim N^+(z_i'\delta, \sigma_u^2)$. This approach involves simultaneous estimation of the stochastic frontier model and the

inefficiency component expressed as a function of the environmental variables. It offers a solution to the endogeneity issues presented in the two-step approach and hence has been widely used in the empirical literature.

In the literature, similar models have been proposed following Kumbhakar et al. (1991). Huang & Liu (1994) proposed a model imposing a different specification for inefficiency, which is:

$$u_i = \mathrm{g}(h_i; \delta) + \omega_i \tag{4.22}$$

so the one-step production frontier is written as:

$$lnq_i = \ln(x_i\beta) + v_i - [\mathrm{g}(h_i; \delta) + \omega_i]. \tag{4.23}$$

The novelty of this model is that the function $\mathrm{g}(h_i; \delta)$ allows for incorporating interactions between exogenous environmental variables (h_i) and explanatory variables (x_i) into the deterministic frontier and the environmental variables can exert non-neutral impacts on inefficiency.

Lastly, other approaches handling with the environmental variables do not clearly target the deterministic or stochastic components of the frontier. For instance, the study carried out by Reifschneider & Stevenson (1991) takes into account the conventional frontier model shown in the equation (4.19) and assumes that:

$$u_j = g(z_i) + \omega_i \tag{4.24}$$

where $g(.)$ is a non-negative function and $\varepsilon_i \sim N^+(0, \sigma_\varepsilon^2)$. On the one hand, this model seems to correlate the environmental variables with the inefficiency effects, yet substituting the equation (4.24) into the equation (4.19) results in a model of the form:

$$q_i = x_i\beta - g(z_i) + v_i - \omega_i \tag{4.25}$$

which apparently has the identical error structure as a basic half-normal stochastic frontier. Therefore, it is possible to view the model proposed by Reifschneider & Stevenson (1991) as the one assuming that the environmental factors affecting the shape of the production technology (or deterministic component of the frontier), though with a slightly different variance to the model (4.18). This indicates that this approach of tackling environmental variables raises an identification problem; namely, it is not straightforward to distinguish whether the environmental variables affect the inefficiency effects or the production technology itself (Coelli et al., 2005).

4.4.4 Predicting cost efficiency

When input price data are available and cost minimisation is a reasonable assumption to make for firms, one can estimate the economic characteristics of the production technology using a cost frontier from which cost efficiency measures can be derived. In the case where we have cross-sectional data, the Cobb-Douglas cost frontier model can be written as:

$$lnc_i = \beta_0 + \sum_{m=1}^{M} \beta_m lnw_{mi} + \sum_{n=1}^{N} \beta_n lny_{ni} + \varepsilon_i \tag{4.26}$$

$$\varepsilon_i = v_i + u_i \tag{4.27}$$

In the equation 4.5, c_i represents the observed cost of the *i*-th firm; w_{mi} is the *m*-th input price of the *i-th* firm; y_{ni} is the *n*-th output of the *i*-th firm; ε_i is composite error term, consisting of a two-sided random variable, v_i, accounting for statistical noise and a non-negative random variable, u_i, representing cost inefficiency, which may increase costs above the best-practice level. The cost function is non-decreasing in input prices and outputs, linearly homogenous and concave in inputs prices, so that the following restrictions must be true:β_m >0 and $\sum_{m=1}^{M} \beta_m = 1$. Linear homogeneity is customarily imposed prior to estimation leading to the following specification:

$$ln(c_j/w_{Mi}) = \beta_0 + \sum_{m=1}^{M-1} \beta_m ln(w_{mi}/w_{Mi}) + \sum_{n=1}^{N} \beta_n ln y_{ni} + v_i + u_i \quad (4.28)$$

Expressing the equation (4.28) in a compact form as:

$$ln(c_i/w_{Mi}) = r_i'\beta + v_i + u_i \quad (4.29)$$

The measure of cost efficiency for the *i-th* firm is the ratio of minimum cost, adjusted for the random error, to observed cost:

$$CE_i = \frac{\exp(r_i'\beta + v_i)}{\exp(r_i'\beta + v_i + u_i)} = \exp(-u_i) \quad (4.30)$$

Similar to technical efficiency scores, predicted cost efficiency scores range over (0,1). This indicates that a firm is assumed to be fully cost efficient (with an efficiency score equal to 1) if it lies on the efficient cost frontier, while it is classified as inefficient (with an efficiency score between 0 and 1) if its outputs could be produced at lower cost under the same conditions. The cost frontier function in the equation (4.28) is structurally similar to the production frontier function specified in the equation (4.2). This indicates that from a statistical viewpoint the analysis tools used for the stochastic production frontier model can be utilised to analyse the stochastic cost frontier model.

The empirical estimation of a cost function for a banking sector entails a set of requirements. It involves the specification of an appropriate functional form of the cost function, the input-output composition of the cost function, the measurement of quantities and prices of such inputs and outputs, the specification of other cost drivers, and post-estimation tests associated with the nature of the frontier model and regularity conditions to ensure the consistency of the cost function with its theoretical properties.

4.4.5 Stochastic frontier panel data models

The stochastic frontier models discussed up to this point are generally for the analysis of cross-sectional data. This section now extends the discussion to cases where the stochastic frontier models are based on panel data. Panel data, which consists of observations for each firm over more than one period of time, inherently contains more observations than a cross-sectional data set and hence, for this reason alone, it is expected to obtain more efficient estimators of the unknown parameters as well as more consistent predictors of inefficiency. Another advantage of panel data models is that they allow for examining the evolution of efficiency and production technology over time. In addition, it also enables one to relax some strong distribution assumptions imposed on error components due to the nature of cross-sectional data. Yet, the panel data models also require making some other assumptions that will be outlined below.

The fundamental stochastic frontier model of Aigner et al. (1977) of the equation (4.2) is based on cross-sectional data. A panel data version of this model can be written in the general form

$$q_{it} = f(x_{it}; \beta) + v_{it} - u_{it} \tag{4.31}$$

where the only difference stems from the additional subscript *"t"*, representing time. Arguably, if one assumes that the statistical noise (v_{it}) and inefficiency component (u_{it}) are independently distributed, then this model can be estimated using methods applied in the cross-sectional cases (see Section 4.4.2). Although it is appropriate to use these methods for estimation purposes, the assumption that the inefficiencies are independently distributed is likely to be incorrect. This is because it is expected that an efficient firm is more likely to stay efficient over time, while an inefficient one is likely to improve its efficiency levels over time as it will learn from its counterparts and mistakes. For these reasons, one needs to impose some structure on the inefficiency effects in equation (4.31).

i. Time-invariant inefficiency models

This case imposes the simplest structures on inefficiency. This model is related to whether inefficient firms enhance their inefficiency over time. If inefficiency is assumed to be fixed over time, this phenomenon can be modelled as:

$$q_{it} = f(x_{it}; \beta) + \varepsilon_{it} \tag{4.32}$$

where $u_{it} = u_i$ and $\varepsilon_{it} = v_{it} - u_i$.

As previously noted, the subscript *"t"* is dropped from u_i to reflect fact that the inefficiency of firm *i* is not changing over time. The model in equation in (4.32) can be estimated by assuming u_i as a fixed or as a random parameter. The former can be estimated by employing the fixed effects model in the OLS regression framework using dummy variables (known as LSDV), while the latter can be estimated by employing the random effects model using either generalised least squares (GLS) or the ML method. While the LSDV approach does not impose any distributional assumptions for the $u_i s$, the GLS and ML require imposing an arbitrary structure for the distribution of $u_i s$. One study finds that efficiency estimates obtained using the LSDV are very similar to the GLS and ML estimators (Gong and Sickles, 1992). On the one hand, this finding favours the LSDV method. This is arguably because, first, it does not require to impose any arbitrary structure for the distribution of inefficiency to separate statistical noise and inefficiency, and second, one does not need to assume that input levels and inefficiency are uncorrelated. On the other hand, the LSDV method does not allow including any other time-invariant repressor, while the GLS and the ML make it possible to include other time-invariant variables into the vector of explanatory variables without leading to the perfect collinearity issue.

The time-invariance assumed by these methods arguably may not be realistic for many industries, as it is expected that firms learn over time or competitive forces induce them to enhance their efficiency. This assumption becomes untenable for firms operating in an environment constantly changing due to globalisation, technological advancements and shifts in regulatory framework. Therefore, researchers have developed time-varying models to overcome the restrictiveness of the time-invariant models.

ii. Time-varying inefficiency models

The time-invariant inefficiency models discussed in the previous section are somewhat restrictive, as it is expected that managers would learn from experience and hence the efficiency levels change systematically over time. Moreover, the levels of production efficiency are likely to change due to, among other things, the adoption of technologies. The assumption that inefficiency levels do not change over time therefore would be misleading when the time period of panel data gets longer. Due to these caveats, various models allowing inefficiency to change over time have been proposed and time-variant inefficiency models are expected to accommodate the productivity and efficiency improvements as well as accounting for market competition.

Two stochastic frontier models allowing for time-varying inefficiency take the form:

$$u_{it} = f(t)\, u_i \tag{4.33}$$

where $f(.)$ is a function determining how inefficiency varies over time:

Kumbhakar (1990) $f(t)=[1+\exp(\varphi_1 t+\varphi_2 t^2)]^{-1}$

Battese and Coelli (1992) $f(t)=exp[\eta(t-T)]$

where φ_1, φ_2, and η are unknown parameters to be estimated. On the one hand, Kumbhakar's (1990) $R(t)$ function ranges [0,1], thus it might be non-increasing, non–decreasing, concave or convex based on the results of the estimated parameters of φ_1 and φ_2. On the other hand, Battese and Coelli's (1992) $R(t)$ function has features $R(t) \geq 0$ and $R(T) = 1$, and the function can be non-increasing or non-decreasing based on the sign of η, yet it is convex for all values of η. The former model has two parameters and hence the temporal pattern is more flexible compared to the Battese & Coelli (1992) model. Both of the models can be estimated by using the fixed effects method, yet neither Kumbhakar (1990) nor Battese & Coelli (1992) proposed estimating the models in a random effects framework employing the ML method. Therefore, they needed to assume the independence of inefficiency and impose distributional assumptions on the composite error which is defined as $v_{it} - R(t)u_i$. These assumptions are $v_{it} \sim N(0, \sigma_v^2)$ and $u_i \sim N^+(\mu, \sigma_u^2)$ where u_i

has a truncated normal distribution. If these assumptions are correct, it would be possible to disentangle inefficiency from technical change, which was a shortcoming in other time-varying models.

One of the limitations of the Kumbhakar (1990) and Battese & Coelli (1992) time-varying models is that they assume inefficiency is driven by time in the same manner for all firms, and that the efficiency ranking of firms within the sample is therefore the same over time. Another limitation might arise from the fact that there might be non-stochastic exogenous factors which are observable during production process are likely to exert influence on efficiency of firms. Therefore, the model allowing both environmental variables and time effects to interact with the inefficiency component might increase the efficiency of estimators. We now investigate the model, proposed by Battese & Coelli (1995), accommodating these cases.

iii. The Battese and Coelli (1995) model

The models proposed by Kumbhakar et al. (1991) and Huang & Liu (1994) in Section 4.4.3 allow non-stochastic environmental variables to directly affect the inefficiency component of the stochastic frontier. These models were originally developed in the context of cross-sectional data. Then they were extended to panel data by the Battese & Coelli (1995) model (hereafter BC95) which allows not only non-stochastic environmental variables, but also time effects to affect the inefficiency component.

The BC95 model of the stochastic frontier production function for panel data is specified as:

$$lnq_{it} = \ln(x_{it}\beta) + v_{it} - u_{it} \tag{4.34}$$

$$u_{it} = z_{it}\theta + w_{it}$$

where z_{it} is a vector of non-stochastic environmental variables with an intercept and θ is a vector of unknown parameters to estimate. The $u_{it}s$ is assumed to be independently but not identically distributed, such that u_{jt} is obtained by truncation at 0 of the normal distribution as $u_{it} \sim N^{+}(z_{it}\theta, \sigma_u^2)$. The statistical noise is assumed to be normally distributed with 0 mean and constant variance $v_{it} \sim N(0, \sigma_v^2)$. The random error variable,

w_{it}, is defined by the truncation of the normal distribution with 0 mean and variance $w_{it} \sim N(0, \sigma_w^2)$, such that the truncation point is at $-z_{it}\theta$, so that $w_{it} \geq -z_{it}\theta$, which in turn guarantees $u_{it} \geq 0$.

The log likelihood function of the BC95 model is a generalisation of Stevenson's (1980) truncated-normal distribution model where the constant mean μ is exchanged with the variable mean $z_{it}\theta$. The unknown parameters of the BC95 model (β, θ, σ_u^2, σ_v^2) can be estimated using the ML method. Then the estimated parameters can be used to predict firm-specific technical efficiency, which is shown as:

$$TE_{it} = e^{(-u_{jt})} = e^{(-z_{it}\theta - w_{it})}. \tag{4.35}$$

The conditional expectation of technical efficiency, $e^{(-u_{it})}$, is specified by Battese & Coelli (1993) as:

$$TE_{it} = E(e^{-u_{it}}) = \frac{\Phi\left(\frac{\mu_*}{\sigma_*} - \sigma_*\right) e^{-\mu_* + \frac{1}{2}\sigma_*^2}}{\Phi\left(\frac{\mu_*}{\sigma_*}\right)}. \tag{4.36}$$

where $\Phi(.)$ stands for the cumulative distribution function of the standard normal distribution, $\hat{\sigma}_v^2$ is the estimated variance of the statistical noise v_{it}; $\hat{\sigma}_u^2$ is the estimated variance of the inefficiency component u_{it}; $\mu_* = (1 - \hat{\gamma})\hat{\mu} + \hat{\gamma}\varepsilon$; $\sigma_* = \left(\hat{\gamma}(1 - \hat{\gamma})\hat{\sigma}^2\right)^{\frac{1}{2}}$; $\hat{\sigma}^2 = \hat{\sigma}_u^2 + \hat{\sigma}_v^2$; $\hat{\gamma} = \frac{\hat{\sigma}_u^2}{\hat{\sigma}^2}$; $\mu = z_{it}\theta$ is the expected value of the inefficiency component derived from the estimators of the θ-vector in equation (4.34). After obtaining the technical inefficiency, the partial effect of each non-stochastic environment variable on technical inefficiency can be investigated by employing the formula proposed by Battese & Coelli (1993).

The advantages of the BC95 model compared to the Kumbhakar et al. (1991) and Huang & Liu (1994) models are that it accounts for both environmental and time effects on inefficiency and the specification of the model allows the estimation of change in

production technology and efficiency of firms. The BC95 model can be estimated simultaneously in a single-step using ML; this allows one to estimate the parameters of the cost function, the inefficiency estimates, and the potential correlates of bank inefficiency while avoiding the bias and inefficiency problems of two-step methods (Wang & Schmidt, 2002; Coelli et al., 2005; Simar & Wilson, 2007). ML estimation seeks to maximise the log-likelihood function to derive the parameter estimations. Due to these novelties, this thesis will apply the BC95 model to investigate how the shifts in the regulatory environment influences the cost efficiency of Turkish banks.

4.5 Non-parametric frontier efficiency approaches

Non-parametric methods rely on mathematical linear programming tools to construct the efficiency frontier and then measure efficiency of a firm as a radial distance from this frontier. In other words, unlike many parametric methods involving specification of a functional form for the frontier and distributional assumptions about statistical noise and inefficiency, these approaches neither impose a functional form for the production process nor distributional assumptions on inefficiency. Moreover, widely used deterministic non-parametric methods such as Data Envelopment Analysis (DEA) and the Free Disposal Hull (FDH) methods do not account for statistical noise and hence attribute deviations from the constructed efficiency frontier as inefficiencies. Since the DEA has been extensively employed in the frontier efficiency literature, this approach will be briefly discussed below.

The DEA uses linear programming techniques to construct the efficient frontier and does not require a choice of functional form for the frontier or any distributional assumptions on inefficiency. Inefficiency scores are measured as deviations from the frontier, with no allowance made for statistical noise. The method was first introduced by Charnes et al., (1981; 1978) who contended that an input oriented model with constant returns to scale and the technical inefficiency for the *i*-th firm can be derived by solving the linear programming (LP) problem:

$$min_{\vartheta,\mu}\vartheta \tag{4.37}$$

$$\text{st} \qquad -q_i + Q\mu \geq 0,$$

$$\vartheta x_i - X\mu \geq 0,$$

$$\mu \geq 0,$$

where q_i is a (K×1) vector of outputs for the *i*-th firm (*i=1,2,….,I*), x_i is a (L×1) vector of inputs for the *i*-th firm, Q is a (K×1) matrix of outputs for *I*, and *X* is a (L×1) matrix of inputs for *I*, . μ is a (1×1) vector of constants and ϑ is a scalar that will be estimated. The LP problem above should be solved for *I* times to acquire estimates of each firm in the sample. Each LP generates estimates for ϑ and μ. On the one hand, the ϑ stands for the estimation of technical efficiency for the *i*-th firm and these estimates range between 0 and 1 where 1 indicates the firm is technically efficient. On the other hand, the vector μ defines the projected point ($Q\mu, X\mu$) against which efficiency measures of the *i*-th firm is obtained. This projected point represents the linear combination of all the observed data points in the sample. In other words, this projected point is an efficient frontier set by firms exhibiting best practices and the efficiency levels of other firms that are not on this frontier are then assigned according to their distances to this efficient frontier.

4.6 Comparison of parametric and non-parametric approaches

There are several advantages leading many practitioners to adopt the DEA approach in their analyses. First, this approach is a computationally easy method and less data demanding. Moreover, it can be undertaken without knowing the deterministic connections between outputs and inputs. In other words, it does not require any assumptions concerning the functional form of the production process or with the distribution of component errors. Therefore, it can be concluded that this method enables one to avoid the issues associated with model sensitivity and functional instability. Yet this method is not without caveats. The primary disadvantage is its deterministic nature; that is, this method cannot account for the statistical noise stemming from luck, data issues, and other measurement issues. This translates into the fact that this method is sensitive to outliers and treats any deviations from the estimated efficient frontier as inefficiency. The deterministic nature also prevents one to undertake statistical tests on estimation results.

4.7 Conclusion

This chapter has examined the concept of efficiency and frontier efficiency before reviewing non-parametric and parametric approaches used to measure it. A brief revision

has been made on the most widely used non-parametric method, DEA. In particular, this chapter has elaborated on the SFA method and a number of its extensions, based on the considerations of our research focus. It has also compared the relative merits of the DEA and the SFA. Overall, it can be inferred from this review that the SFA model is more flexible and arguably takes a better account of exogenous environmental factors. Yet there is no theoretical foundation for suggesting one method over another, indicating that the decision of the method and/or model should be given on a case-to-case basis.

Chapter 5
The Impact of Regulatory Reforms on the Cost Efficiency of Turkish Banks

5.1 Introduction

This chapter empirically investigates the impact of a deregulation-prudential re-regulation framework on the characteristics of cost structure and on the ownership-cost efficiency relationship. Moreover, this study also explicitly accounts for the recent heavy penetration of foreign banks on the cost efficiency of Turkish banks. Let us summarise at this stage what we believe are the main contributions of our work to the existing literature in more detail.

First, we start by investigating the impact of the regulatory reforms on banking cost characteristics related to the cost efficiency and production technology enabling a bank to reduce cost of production. As expounded in Chapter 2, the regulatory reform process in Turkish banking comprised of two stages: the first stage[44] consisted of the deregulation of the sector aimed at increasing its competitiveness (1988-2001);[45] the second stage (post-2001) [46] shifted the emphasis onto the stability of the banking system by introducing restructuring programmes as well as prudential re-regulation and supervision policies. Despite its relevance and complexity and the potentially important lessons for countries in similar positions, very little work has been carried out on Turkey. Specifically, the empirical studies investigating the regulatory reforms and performance of Turkish banks have provided rather mixed results (for a review of literature, see the Sections 3.2.2 and

[44] The main policy focus of the regulatory authorities in the period before 2001 was the deregulation of Turkish banking market; therefore, the authorities overlooked the prudential regulation and supervision of the banking sector (see Section 2.3)

[45] As we mentioned earlier, although the financial deregulation policy was initiated in 1980, the liberalisation of interest rates on deposits and loans was short-lived due to the banking sector induced crisis in 1982, resulting in re-regulation of interest rates by the CBT until 1988. Since the liberalisation of interest rates is one of the fundamental components of the deregulation policy, we start our empirical analysis in 1988 since then interest rates have been determined under free market conditions.

[46] After 2001, the regulatory authorities implemented the restructuring programme along with a prudential regulation and supervision programme that is compatible with international standards, these policy implementations has indicated that ensuring stability has been the focus of the policies undertaken in this period.

3.3.2 of Chapter 3). Moreover, the established literature examining this relationship tends to focus either on the pre-2001 period when the policy focus was deregulating banking sector or the post-2001 period when stability-oriented prudential re-regulations was at the centre of policy reforms. That is, despite the fact that the banking authorities have adopted a deregulation and concomitant prudential re-regulation framework, there is need for more study to shed light on the effects of the deregulation-prudential re-regulation framework on cost characteristics. To the author's knowledge only one empirical study[47] merges these two periods (1990-2007), yet it adopts a non-parametric approach to measure performance and does not explicitly account for changes in regulatory reforms. Given Turkish banks suffered from financial crises and were exposed to regulatory changes during this period, using a non-parametric approach might lead to biased estimations. This is because this method assumes away statistical noise in data and fails to successfully account for environmental impacts on estimated inefficiency (Liu and Tone, 2008). This study attempts to handle this issue by employing a parametric approach. Moreover, their sample dataset includes only the banks that consistently operated during their sample period. This in turn is likely to cover only the best-performing banks, concealing the true nature of the banking sector and is therefore likely to suffer from survivorship bias (Carhart et al., 2002). This study instead includes both surviving and failing banks. Unlike any of the existing literature, we undertook a rigorous process of data adjustments to homogenise the dataset before and after the accounting reporting changes were introduced. Our very long dataset spanning from 1988 to 2016 puts us in an ideal position to isolate and investigate the impact of the shift in regulatory reforms on cost characteristics and to evaluate to what extent financial deregulation is conditional on a quality and proper implementation of prudential re-regulation and supervision of the banking system. This improves the quality of the resulting policy recommendations and deals with the limitations of former research based on insufficient data. This study also explicitly takes into account risk, loan quality and the off-balance sheet (OBS) items when we estimate stochastic cost frontier, which have been overlooked by the existing empirical literature on Turkish banking as discussed in Chapter 3.

[47] Fukuyama and Matousek (2011).

Second, this study expands the current literature by scrutinising the ownership-cost efficiency relationship in the context of these reforms to find out the potentially different reactions of different ownership structures to the changes in the regulatory reforms. Hardly any study investigates to what extent the changes in the regulatory environment affect the performance of various ownerships differently. However, it is argued that different ownerships tend to react with different speeds to the change of regulatory environment (Zhao et al., 2010). Therefore, the other aim of this chapter is to contribute to the literature by empirically examining the impact of the regulatory reforms on the cost efficiency-ownership relation. Third, the effect of the recent wave of foreign bank penetration on the performance of Turkish banks has not been widely explored. To the author's knowledge, no other study has yet to account for the impact of this penetration on the cost efficiency of Turkish banks.

In summary, this chapter attempts to address the following research questions:

1) *What is the pattern in the production technology in a changing regulatory environment?*
2) *What is the cost efficiency trend for Turkish banks in a changing regulatory environment?*
3) *Do various ownership structures react with different speed and direction to the shift in policy focus?*
4) *Does the recent wave of foreign bank entry exert an influence on cost efficiency?*

Our results indicate that the banking industry experienced technological regress during the whole period, yet this is part of a general convex pattern indicating that technological regress is slowing down, namely because there are some improvements in production technology over time. This may also mirror that overall the average banks may find it easier to operate efficiently. The characteristics of cost efficiency are overall significant and show a general non-monotonic trend over time. More specifically, the cost efficiency gains realised during the 1988-1993 and 1995-1997 periods in the pre-2001 era. This goes hand-in-hand with deregulatory reforms and also with the worsening of the frontier as explained before. In the post-2001 period, cost efficiency gains were realised during 2002 and 2007, which can be partly explained by the change in policy focus. The increase in efficiency slows down after 2007, indicating that the banks have yet to adjust to the new regulatory environment and to benefit from efficient production technologies. Our results also show the existence of an ownership impact on the level and trend of cost efficiency.

That is, domestic private and foreign banks outperformed state banks in the pre-2001 period when the policy focus was on deregulation. In the post-2001 period, when the policy focus moves to stability, domestic private banks are still the best performers, indicating that they are better equipped to cope with prudential re-regulation. Surprisingly, foreign banks start to lose their initial efficiency advantage in a more regulated environment. The heavy penetration of foreign banks since 2005 appears to have no significant impact on the cost efficiency of the banking sector.

The rest of the chapter is organised as follows. Section 5.2 discusses the applied methodology and data issues, including the specification of empirical cost frontier model and inefficiency model. Section 5.5 presents the empirical estimation of the stochastic cost frontier model, hypothesis tests and discussion of the results. Section 5.6 concludes the chapter.

5.2 Methodology

To answer the research questions pointed out above, a stochastic cost frontier following Battese and Coelli (1995) (BC95) is modelled and estimated simultaneously with the determinants of cost inefficiency by employing a one-step Maximum Likelihood (ML) estimation. This not only allows us to examine the evolution of cost efficiency but also helps us to shed light on the association between ownership and inefficiency. The technical details of the SFA approach and BC95 model have been expounded in Chapter 4.

The first step of estimating a stochastic cost frontier is to specify a functional form. This study opts for the translog functional form, since this functional form can accommodate multiple output cases without necessarily violating the curvature conditions, which is an advantage for this study defining three output variables (Kumbhakar and Lovell, 2003). In addition, as discussed in Section 4.5.1 the translog functional form offers advantages such as being flexible without leading to a further loss of degrees of freedom and making fewer assumptions than alternative forms.

5.3 Identifying input and output variables

Following the specification of the cost frontier based on the translog cost function, one needs to identify the input prices and output variables. The identification of the variables is made based on the intermediation approach (Sealey and Lindley, 1977).[48] The underlying theoretical assumption of this approach is that banks are accepted as intermediators of financial services; accordingly, they collect deposits, employing labour and capital, then transform these deposits into loans and other earning assets. We employ a three-output and two-input specification, briefly shown in Table 5.1.

Table 5.1 Definition/computation of input and output variables

Variable	Notation	Definition/Computation of Variable
Total Cost	TC	Interest expenses + non-interest operating expenses
Outputs		
Net loans (LOANS)	Y_1	Gross loans - NPLs
Other earning assets (OEA)	Y_2	Total of securities and other liquid assets
Fees and commissions received (FEES)	Y_3	Proxy for off-balance sheet activities
Inputs		
Price of loanable funds (P_{FUND})	W_1	Interest expenses / (Deposits + other borrowed funds)
Price of non-interest operating expenses (P_{OPEX})	W_2	Non-interest operating expenses / total assets

The first output is the book value of performing loans (LOANS), obtained by subtracting NPLs from total loans. We do this to avoid overestimating the volume and quality of loans provided by Turkish banks (Girardone et al., 2004; Zhao et al., 2010). This is especially crucial for the Turkish banking case, as the banks suffered from high levels of NPLs in particular during the domestic twin crises, as discussed in Section 2.4. It should be noted that the empirical studies investigating the efficiency of Turkish banks have rarely accounted for the NPLs. To our knowledge, only two studies (Akın et al., 2013; Fethi et al.,

[48] Kenjegalieva et al. (2009) find that although the efficiency levels differ across the intermediation, production and profit approaches, change in positions of the banks relative to the mean is miniscule across the three approaches.

2012) used net loans as one of the outputs. This is a serious limitation of the existing literature since Turkish banks - in particular state banks - carried large NPLs and not accounting for these losses will overestimate banks' efficiency (Denizer et al., 2000; Özkan-Günay et al., 2013). The second output is other earning assets (OEA), which aggregates public sector debt securities, securities representing a share in capital, other marketable securities (i.e. total financial assets (securities)), and other liquid assets including due from banks and other financial institutions.[49] The third output is received fees and commissions[50] (FEES) that is included as a proxy for the non-traditional OBS. This is a crucial inclusion since Turkish banks' business focus has significantly shifted from traditional on-balance sheet activities to non-traditional OBS, especially after 2001 (see Section 2.6) and this has been overlooked in the Turkish banking efficiency literature. This variable reflects the scale of this shift and its exclusion would lead to biased cost efficiency estimates (Clark & Siems 2002; Isik & Hassan 2003b; Lozano-Vivas & Pasiouras 2010).[51]

Our two inputs are chosen to match the characteristics of the outputs selected. The first input is non-interest operating expenses, which aggregates the costs associated with labour,

[49] Interbank money market replacement accounts could not be included due to the many missing values, as well as measurement and reporting errors. Given its miniscule scale, we trust the omission to be insignificant.

[50] Including non-interest income (as a proxy for the OBS) as one of the outputs is crucial from an empirical point of view to avoid biased cost efficiency estimates, given the increasing volume of it. Non-interest income is defined as the sum of net fees and commission income/expenses, dividend income, net trading profit/loss, and other operating income reported in the income statements of Turkish banks. However, since many banks suffered from huge trading losses before 2001 in particular, this definition of non-interest income leads to negative total values, preventing us from undertaking logarithmic transformations. In addition, due to changing accounting principles after 2002, the trading profit/loss account reports net values rather than showing profit and loss separately, with the exception of fees and commissions which are still reported as having been received and paid separately. As a consequence of this we cannot include trading income in our non-interest income measure and we only take fees and commissions received as a proxy for non-interest income and fees and commissions paid as other operating expenses. This practice is adopted because some banks' net fees and commissions are negative during the twin crises; therefore, we could not take into account net fees and commissions without separating them into received and paid fees and commissions. A similar practice is adopted by Yildirim (2002). Lastly, the fees and commissions account is the biggest in scale among the non-interest income variables, which makes it reasonable to use as a proxy for a non-interest income account.

[51] Although it is not possible to categorise the fees and commission income variable with respect to its source, it is normal practice to expect this income to be generated by off-balance sheet activities alone (Clark and Siems, 2002). This prevents us from suffering from a potential double counting issue that would arise if part of it came from balance sheet items already captured by other output variables. Our approach of using both fees and commission income and other earning assets is also followed by, for example, Lozano-Vivas and Pasiouras (2010), Lieu et al.(2005) and Zhao et al.(2010), Casu et al. (2013).

physical capital and other operating expenses; its relative price (P_{OPEX}) is calculated as the ratio of total operating expenses associated with these inputs to total assets.[52] Total loanable funds is the second input and it aggregates deposits and funds borrowed; its relative price (P_{FUNDS}) is given by the ratio of total interest expenditure on loanable funds to the total loanable funds.[53] Finally, the dependent variable total cost (TC) is given by the sum of interest and non-interest operating expenses.

5.3.1 Dataset

The data used in this study is obtained from the Banks Association of Turkey's data base named "Data Query System" and from the annual periodicals (so called "Banks in Turkey") issued by the same institution. This database has a more exhaustive sample and spans a longer period compared to commercially available databases such as BankScope/Orbis. The unconsolidated balance sheets are used to lessen the probability of aggregation bias of accounts (Manlagñit, 2011). We focus on commercial deposit banks and exclude four banking groups since their structures and objectives are expected to be different. These are Islamic banks, development and investment banks,[54] foreign banks operating as a single branch[55] and banks under the deposit insurance fund.[56]

---

[52] Bank efficiency studies tend to separate the price of labour (the ratio of personnel expenses to number of employees) and the price of other operating expenses. We could not adopt this practice because changes in the accounting practice (the reporting of personnel expenses and the content of other operating expenses were changed) made the distinction impossible. We followed instead the suggestions of the BAT and adopted a unified accounting system that aggregates non-interest operating expenses, including costs associated with labour, physical capital and other operations. The aggregate measure was subject to negligible changes, allowing us to use this variable as a total.

[53] (a) Deposits, (b) funds borrowed from banks and other financial institutions, (c) interbank funds, (d) securities issued have been reported as loanable funds in the balance sheet of Turkish banks. However, (c) the interbank funds and (d) the securities issued have many observations recorded as zero as well as having many missing values in the sample period. To ensure consistency of the dataset over time and to avoid measurement issues we do not include these to the loanable funds account. Moreover, on average 90-95% of the reported loanable funds account are composed of the (a) deposits and (b) funds borrowed from banks and other financial institutions, indicating that these two accounts can be used as a proxy for the loanable funds account.

[54] Development banks obtain funds mostly from either governments or international organisations such as the IMF and the World Bank in order to extend loans for medium- or long-run investments.

[55] Foreign banks operating on a single branch basis are excluded since their structures and customer portfolios are different and they generally face very low initial start-up costs and asymmetric information.

[56] Banks under the SDIF are excluded as they are being restructured and therefore do not work on a conventional banking basis.

One of the novelties of this dataset is that, unlike any other studies investigating the efficiency of Turkish banks, the period of analysis runs from 1988 to 2016, allowing us to investigate the long-term impacts of structural changes and policy shifts on the cost characteristics and ownership-efficiency relation in Turkish banking sector. Yet such a long time span of course presented us with some serious challenges in the construction of our dataset. First, as we specified in footnotes in 44-54, changes in accounting reporting led us to make necessary adjustments to obtain an homogenised dataset. Secondly, banks adopted inflation accounting[57] in 2003 and 2004 due to the hyperinflation of the period and this might create distortions (Fukuyama and Matousek, 2011). However, there is not a clear way mentioned in the literature of showing how one can avoid the possible distortion driven by inflation accounting[58] and neither does the Bank Association of Turkey disclosed pre- and post- adjustment dataset. Therefore, we refer to the Turkish banking efficiency papers[59] of 2003 and 2004 when the financial data was adjusted for hyperinflation with other years. This indicates that a dataset including these years have been used for estimation, implying that it is an accepted practice in the Turkish banking efficiency literature. Moreover, we undertake a comparison estimation to find out whether our empirical analysis might have suffered from the inflation accounting practice. That is, we estimate the same model with the same data for the period 1988-2002 and then for 1988-2004, resulting in two estimations for two different periods. A significant difference in the estimated parameters of the two models would in turn signal that the inflation accounting practice distorted the consistency of the series, stopping us generating a dataset starting from 1988 to 2016, covering the years 2003 and 2004 (see Appendix 5.2). The third challenge that came with the dataset is that the number of banks significantly changed during the estimation period. This is because some of them were acquired by domestic or

[57] Inflation accounting involves recalculating the financial amounts of the non-monetary assets by multiplying them with the calculated adjustment rate to show their real values at the time when the financial statements are presented (Arsoy and Gucenme, 2009). Inflation adjustment was firstly applied at the end of 2003 and was ended after 2004 due to favourable economic environment and decreasing inflation rate, authorities decided that inflation accounting method would not be implemented in 2005. The financial statements of the companies began to give correct, reliable and comparable information (Arsoy and Gucenme, 2009).

[58] It is argued that the denomination of variables in US dollars would eliminate the adverse effect of inflation on real magnitudes and this would mean direct adjustment of variables for inflation (Isik and Hassan, 2002a). Turkish economy suffered from hyper-inflation between 2002-2004, led firms including banks to adopt inflation accounting that could cause difficulties to provide an unbiased comparison of the results. Yet we find that the denomination of variables in US dollar or in real Turkish Lira does not change the estimation results (see Appendix 5.3).

[59] see Fukuyama and Matousek (2011); Assaf, Matousek and Tsionas (2013); Özkan-Günay, Günay and Günay (2013); Yildirim (2014).

foreign banks, some of were forced to merge with other banks or were taken over by the SDIF since these banks failed and their operating permission were revoked. This study treats the merger and acquisitions in a way that banks' pre-merger or pre-acquisition financial data was treated separately, with the combined post-merger or post-acquisition financial data for the merged or acquirer bank. Concerning the banks taken over by the SDIF, it includes these banks' data until the year when the transfer to the SDIF was realised. This is because while those banks were commercial banks with the aims of cost minimising and profit maximising, once they were undertaken by the SDIF whose aim is to restructure the banks that were in deficiency, or to facilitate their sales in full or in part, or to liquidate them, instead of operating them as normal commercial banks. Therefore, the dataset is an unbalanced panel of 51 banks between 1988 and 2016, totalling 860 observations.[60] They were either in operation in each year during the sample period or operated for at least four consecutive years within this period in the Turkish banking sector. All the bank-level data are in millions Turkish Lira and they are adjusted to real values using the consumer price index (CPI) with 1998 as the base year.

We now provide descriptive statistics of inputs and outputs. Firstly, Table 5.2 shows the total cost (TC), input prices (P_{FUNDS} and P_{OPEX}), and ratios showing the composition of the total costs. The table shows that TC slightly increased from 1988 to 1996, but it showed a sharp rise from 1996 to 2001. This increase was partly due to the significant increase in the price of deposits due to the removal of controls over deposit interest rates and adverse repercussions of economic instabilities in the late-1990s. It can be seen from the table that P_{FUNDS} doubled from 1996 to 2001, while the P_{OPEX} presented a slight increase during the same period. The trend was reversed in total cost and prices of inputs after 2001, since they presented a steep decrease from 2001 to 2005, which can be seen as a positive sign of reduction of expenses. Yet this reduction trend did not last long for the TC after 2005, although the P_{FUNDS} and the P_{OPEX} tended to persist their declining trends after 2001. This controversy might be partly caused by the shift in the policy focus from deregulation to prudential re-regulation in the aftermath of the twin crises. That is, as discussed in Section 2.6, Turkish banks have faced with stricter prudential re-regulations after 2001 and have been subjected to an increase in compliance costs due to the efforts to adapt to the new regulatory environment. Therefore, post-2001, non-interest expenses have started to

[60] All yearly observations refer to the end of December of each year, which is the financial reporting date.

comprise almost half of the total costs, changing the composition of total cost and thus is likely to contribute to the increase in total cost despite a drop in the prices of inputs.

Table 5.2 Average values of total costs, input prices and ratios of cost components

				Ratios		
	TC	**P_{OPEX}**	**P_{FUNDS}**	**OPEX/ TC**	**Interest paid on deposits/ TC**	**Interest paid on other funds/ TC**
1988	97.68	0.06	0.17	0.34	0.55	0.10
1992	115.20	0.06	0.17	0.37	0.45	0.18
1996	156.55	0.05	0.16	0.32	0.61	0.07
1999	351.85	0.05	0.20	0.29	0.56	0.14
2001	465.41	0.08	0.32	0.27	0.62	0.11
2005	171.26	0.05	0.07	0.46	0.47	0.07
2009	207.07	0.04	0.06	0.44	0.49	0.08
2013	206.12	0.03	0.04	0.49	0.45	0.06
2016	268.80	0.02	0.05	0.41	0.53	0.06

Note: Monetary values are adjusted to real values using the CPI index with 1998 as the base year (millions, TRY).

Secondly, Table 5.3 presents the mean values of outputs, net loans (LOANS), other earning assets (OEA), and fees and commissions received (FEES), respectively. With regards to the mean values of outputs, the average net loans (LOANS) were relatively stable between 1988 and 2001. The mean performing loans presented an increasing trend in the post-2001 period, stemming partly from recovery in the economy[61] and concomitant increase in demand for corporate and consumer loans. Interestingly, the average OEA did not show a constant trend like other outputs and instead fluctuated significantly over time. As

[61] The Turkish economy showed a fast recovery in the aftermath of the twin crises by growing almost 7% on average between 2002 and 2007 and around 5% on average between 2002 and 2016.

discussed in Section 2.6, Turkish banks have preferred to invest more in these assets, which are relatively more liquid and less risky than loans. More specifically, they increased their investments in these assets when the economy was instable during 1996-2001 and when prudential re-regulations imposed stricter rules and upward risk-based capital requirements in the post-2001 period. Nonetheless, Turkish banks have started to reduce their investment in these assets after the global financial crisis. The mean value of fees and commissions income (FEES) constantly increased after 1992, mirroring the growing tendency of Turkish banks to engage in OBS activities.

Table 5.3 Average of values of outputs

	LOANS	OEA	FEES
1988	187.29	143.91	10.27
1992	204.07	146.77	5.60
1996	287.71	205.04	6.75
1999	321.57	708.87	12.00
2001	208.15	282.00	23.28
2005	658.20	465.44	29.46
2009	1,213.25	656.75	38.64
2013	2,446.43	595.24	47.21
2016	3,185.95	595.32	53.89

Note: Monetary values are adjusted to real values using the CPI index with 1998 as the base year (millions, TRY).

Table 5.4 shows the descriptive statistics of the TC, input prices, and output variables at the industry level and per ownership category to be able to compare the scales of various ownerships within the industry. As it can be seen in the table, the state banks always account for the maximum values at industry level, whilst the shares of the foreign banks have the lowest values at industry level. The values of the domestic private banks tend to be close to the industry average, except their FEES value that is above the industry average, which in turn indicates that OBS activities are an important business activity for

domestic private banks. With regards to input prices, foreign banks have the highest mean price of non-interest operating expenses. This is an expected result, as argued in the literature, as these banks seek to attract skilled employees by offering them higher salaries and rely heavily on state-of-art technology and automation of banking services compared to their domestic counterparts, which in turn subject them to higher price of capital (Havrylchyk, 2006). However, they have the lowest P_{FUNDS} in the industry, which could be due to their diversified funding bases, including access to liquidity from their parent banks as well as from the international interbank market (Claessens and Van Horen, 2014). This is in fact a crucial advantage for them, as one of the main challenges Turkish banks face is the high cost of domestic deposit funding. According to the IMF report (2016), the Turkish household saving rate is not only significantly below the average of upper middle-income countries, but considerably below the worldwide average. Therefore, banks have to pay up to attract more deposits. In addition, households tend to invest in short-term bank deposits, which in turn lead banks to offer even higher interest rates to attract and retain more household savings.

Table 5.4 Data descriptive statistics by ownership

Variable	Statistics	Mean	Stdev	Min	Max
TC	Industry mean	19,329.64	36,083.24	2.71	516,309.50
	State banks	55,849.06	54,627.22	306.72	288,862.70
	Domestic private	14,217.08	18,621.56	85.73	82,383.79
	Foreign banks	10,177.26	41,973.91	2.71	516,309.50
LOANS	Industry mean	76,318.16	154,494.50	27.54	1,094,112.00
	State banks	161,933.60	210,757.10	30.43	1,094,112.00
	Domestic private	70,197.96	156,877.50	82.19	950,377.80
	Foreign banks	39,799.08	62,919.15	27.54	280,253.10
OEA	Industry mean	35,952.30	83,797.38	34.70	1,530,049.00
	State banks	72,046.00	79,536.30	1,024.76	335,394.80
	Domestic private	31,599.76	60,225.79	98.35	339,640.80
	Foreign banks	25,007.89	122,738.20	34.70	1,530,049.00
FEES	Industry mean	2,074.93	3,584.33	0.02	20,744.75
	State banks	2,968.89	2,473.25	6.86	9,699.69
	Domestic private	2,255.56	4,188.17	0.02	20,744.75
	Foreign banks	1,067.10	1,861.85	0.20	8,660.72
P_{OPEX}	Industry mean	0.050	0.036	0.001	0.512
	State banks	0.046	0.038	0.012	0.238
	Domestic private	0.051	0.030	0.015	0.295
	Foreign banks	0.051	0.046	0.001	0.512
P_{FUNDS}	Industry mean	0.140	0.131	0.001	1.957
	State banks	0.217	0.149	0.036	0.815
	Domestic private	0.140	0.110	0.020	1.691
	Foreign banks	0.096	0.146	0.001	1.957

Note: Monetary values are adjusted to real values using the CPI index with 1998 as the base year (millions, TRY).

5.4 Model specification

The estimable stochastic cost frontier is written in Eq. (5.1). TC is total cost, Y_j are the three outputs and W_m are the two input prices, which we discussed in the previous section. We use Y_1, Y_2, Y_3 to represent LOANS, OEA, and FEES respectively; while W_1 and W_2 represent P_{OPEX} and P_{FUNDS}. Additional control variables are also incorporated in the deterministic part of the cost frontier. Various studies suggest including risk factors, since the strategic decisions of banks concerning asset quality and capital composition influence the risk premium of their output and input prices (Berger and Mester, 1997; Brissimis et al., 2010; Casu et al., 2017; Glass et al., 2014; Hughes and Mester, 2013; Mester, 1996). This study incorporates two risk factors in our model: the equity capital to assets ratio (EAR) and loan loss provisions (LLP) to account for latent heterogeneity of banks. The EAR, which is measured as the ratio of shareholder's equity (capital) to total assets,[62] accounts for the different risk preferences of banks. This might be an important practice for our case, since as discussed in Section 2.6, Turkish banks have largely managed to meet the minimum capital adequacy ratio (CAR) requirements compliant with Basel-I and Basel-II provisions, indicating that banking authorities have always paid great attention on this issue and one should thus account for the cost related repercussions. We do not have a priori expectations on the EAR variable sign. On the one hand, a higher capital ratio and lower leverage can signal a bank as a less risky institution, which could diminish its costs of borrowing on the international interbank market. On the other hand, a risk-averse bank may hold capital that is well above the minimum regulatory requirements, which translates into extra costs because capital is more likely to be more expensive than deposits. The LLP, measured as the ratio of loan loss provisions to gross loans, reflect a bank's credit risk. Again, we do not have any a priori expectations. A higher LLP indicates higher risk of loan default, and thereby lower loan quality. This should increase the borrowing costs of a bank but could also translate into short-run cost savings for a bank, presumably driven by lower *ex ante* resources invested in screening and monitoring activities. That is, as suggested in the literature, this study both takes NPLs (loan quality) and LLP into consideration, thus allowing us to penalise the bad bank management of problem loans and

[62] The risk adjusted capital ratio is obtained by dividing a bank's shareholder equity (capital) to its assets weighted by risk. Since this ratio started to be released from 2005 in the Turkish banking sector, we have had to divide a bank's equity capital to its total assets, compliant with Basel-I standards, to reflect the risk preferences of banks.

reward prudential perception in terms of loss provision set aside by banks (see Asmild and Zhu, 2016). We also include time trends (linear and quadratic) to allow for a non-monotonic pattern of the changes in production technology; that is, this modelling allows the technological change effect to increase or decrease with time (depending on whether the quadratic term is positive or negative) (Coelli et al., 2005). In addition, the time trend also interacts with the input price and output variables to evaluate non-neutral and scale augmenting technological change, since technological biases may occur in the multiple-input and multiple-output production cases (Altunbaş et al., 1999; Casu et al., 2013; Zhao et al., 2010). This can also lead to notable consequences in the context of a changing regulatory framework for banks (Asaftei, 2008).

$$
\begin{aligned}
lnTC_{it} = {} & \alpha_0 + \sum_{j=1}^{3} \beta_j \, lnY_{jit} + \sum_{m=1}^{2} \delta_m \, lnW_{mit} + \sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} \, lnY_{jit} \times lnY_{kit} \\
& + \sum_{m=1}^{2}\sum_{n=1}^{2} \delta_{mk} \, lnW_{mit} \times lnW_{nit} + \sum_{m=1}^{2}\sum_{j=1}^{3} \varphi_{mj} \, lnW_{mit} \times lnY_{jit} \\
& + \theta_1 T + \theta_{11} T^2 + \sum_{j=1}^{3} \chi_j \, lnY_{jit} T + \sum_{m=1}^{2} \acute{\eta}_m \, lnW_{mit} T \\
& + \sum_{j=1}^{3} \rho_j \, lnY_{jit} PD + \sum_{m=1}^{2} \vartheta_m \, lnW_{mit} PD + \upsilon PD + \tau_1 EAR + \tau_2 LLP \\
& + v_{it}
\end{aligned}
\tag{5.1}
$$

As discussed earlier, the whole regulatory reform process in Turkish banking can be divided into two stages: in the first stage policies focused on deregulation aimed at increasing competition (1988-2001) and in the second stage (post-2002) policies focused on strengthening the stability of banks via implementing prudential re-regulations (Bakır and Öniş, 2010). Therefore, to isolate and assess the impact of regulatory change on cost technology, this study introduces a bilateral policy shift dummy (PD). This dummy is set equal to 1 for the period 2002-2016, while it takes a value of 0 for 1988-2001. The dummy

is created to compare the periods before and after 2001, when the main regulatory changes took place. It should be noted that we could only capture the impacts of deregulatory policies and prudential re-regulations by modelling them as aggregate variables bundling all different individual deregulation and prudential re-regulation associated policies. In other words, we are not able to investigate the individual effects of specific deregulatory policies, which could lead to different and even conflicting results. Therefore, disclosing the effects of individual policies would in turn guide the banking authorities to adopt more tailor-made policies. Yet this has not been possible for our case because neither the Association of Turkish Banks nor the recognised literature building worldwide surveys on bank regulations (e.g. Abiad et al., 2010; Barth et al., 2013) have released data enable us to disentangle deregulatory or prudential re-regulations into their components. Thus, we stick with the aggregation method adopted in the literature (e.g. Zhao et al., 2010). Furthermore, following Gollop and Roberts (1983) and Zhao et al. (2010) this study also allows the policy-shift dummy variable to interact with the input price and output variables. This practice enables us to evaluate the response of the best practices associated with the input mix and output composition stemming from the changes in policy focus rather than with the simple passing of time.

Coming to the cost inefficiency model of Eq. 5.6, this is specified as:

$$\begin{aligned} u_{it} = {} & \phi_0 + \phi_1 DB + \phi_2 FB + \phi_3 T + \phi_4 (T * DB) + \phi_5 (T * FB) + \phi_6 PD \\ & + \phi_7 (PD * DB) + \phi_8 (PD * FB) + \phi_9 (PD * T) \\ & + \phi_{10} (PD * T * DB) + \phi_{11} (PD * T * FB) + \phi_{12} T^2 + \phi_{13} CRS_{94} \\ & + \phi_{14} CRS_{TWIN} + \phi_{15} CRS_{GLOBAL} + \phi_{16} FB_{ENTRY} + \varepsilon_{it} \end{aligned} \tag{5.2}$$

Eq. (5.2) includes 16 explanatory variables to reflect the impact of time, regulatory policy, ownership and their interaction on the cost efficiency of Turkish banks. The inclusion of the interactive terms eases the investigation of the inter-ownership cost efficiency differences and their change over the sample period. The crises dummies (CRS_94, CRS_ TWIN, CRS_GLOBAL) are defined as before. Since the Turkish banking sector has witnessed a dramatic increase in foreign bank entry since 2005, it in turn provides a unique laboratory for analysing the impact of the mode of foreign bank entry on bank efficiency.

Therefore, in order to capture the possible cost efficiency impact of the heavy penetration of foreign banks, we introduce a bilateral dummy (FB_ENTRY). This dummy is set equal to 1 for the period 2005-2016, while it takes value of 0 for 1988-2004. We do not have any a priori sign expectation. This is because, as expounded in Section 3.4, the entry of foreign banks can exert competitive pressure on domestic banks, which in turn is expected to increase the efficiency of domestic banks as they need to operate more cost efficiently to retain their market shares. In addition, foreign banks are expected to introduce new technologies and superior management skills and products which are likely to result in performance increases. On the other hand, the penetration of these banks may impose extra costs on domestic banks, since foreign banks cherry-pick high quality (low default risk) borrowers, thus rendering domestic banks to extend loans to more risky customers, increasing their risk and management costs. In addition, domestic banks have to compete with reputable banks, which in turn impose extra costs. Furthermore, the entry mode of foreign banks also affects their performance. Therefore, since the entry mode of foreign banks into the Turkish market has been in the form of acquisition of domestic private banks rather than greenfield or de novo entrance, this might in turn influence the efficiency differently (Havrylchyk, 2006).

Economic theory requires that the cost function should be homogenous of degree one in input prices. This is customarily imposed prior to estimation via the following additional parameter restrictions:

$$\sum_{m}^{2} \delta_m = 1, \quad \sum_{m}^{2} \delta_{mk} = 0 \; \forall \; k, \quad \sum_{m}^{2} \varphi_{mj} = 0 \tag{5.3}$$

We implement (5.3) by using the price of funds W_2 to normalise total cost (TC_{it}) and the price of capital (W_1). Symmetry restrictions are also imposed such that $\delta_{mk} = \delta_{km}$ and $\beta_{jk} = \beta_{kj}$.

5.5 Empirical results

The estimation of equations (5.1)-(5.2) is simultaneously performed via a one-step ML method[63] using the software LIMDEP 10 and the results are presented in Table 5.5 below.

Table 5.5 Maximum likelihood estimates of the stochastic cost frontier and inefficiency model

$Ln(TC/P_{FUNDS})$	LnTC	Parameter	Coeff.	Std. errors	z-Stat.
Intercept	constant	α_0	1.174***	0.25	4.62
$Ln(P_{OPEX}/P_{FUNDS})$	lnw1	δ_1	0.781***	0.07	12.01
Ln(LOANS)	lny1	β_1	0.695***	0.06	12.23
Ln(OEA)	lny2	β_2	0.299***	0.04	6.94
Ln(FEES)	lny3	β_3	0.060	0.05	1.15
$Ln(LOANS)^2$	$(lny1)^2$	β_{11}	0.034***	0.00	21.24
$Ln(OEA)^2$	$(lny2)^2$	β_{22}	0.080***	0.00	17.78
$Ln(FEES)^2$	$(lny3)^2$	β_{33}	-0.005**	0.00	-2.49
Ln(LOANS)Ln(OEA)	(lny1)(lny2)	β_{12}	-0.120***	0.01	-16.60
Ln(LOANS)Ln(FEES)	(lny1)(lny3)	β_{13}	0.045***	0.00	11.06
Ln(OEA)Ln(FEES)	(lny2)(lny3)	β_{23}	-0.037***	0.01	-5.91
$Ln(P_{OPEX}/P_{FUNDS})^2$	$(lnw1)^2$	δ_{11}	0.149***	0.01	18.50
$Ln(P_{OPEX}/P_{FUNDS})$Ln(LOANS)	(lnw1)(lny1)	ϕ_{11}	0.001	0.01	0.24
$Ln(P_{OPEX}/P_{FUNDS})$Ln(OEA)	(lnw1)(lny2)	ϕ_{12}	-0.001	0.01	-0.13
$Ln(P_{OPEX}/P_{FUNDS})$Ln(FEES)	(lnw1)(lny3)	ϕ_{13}	-0.019**	0.01	-2.55
T	T	θ_1	0.028*	0.02	1.79
T-square	T^2	θ_{11}	-0.0003*	0.00	-1.70
PD	PD	ς	0.399	0.29	1.40
T $Ln(P_{OPEX}/P_{FUNDS})$	T lnw1	$\grave{\eta}_1$	-0.006**	0.00	-2.40
T Ln(LOANS)	T lny1	χ_1	0.004*	0.00	1.90

[63] This chapter has specifically aimed at investigating the impacts of regulatory reforms on cost inefficiency over time and on the efficiency performance of different ownerships. Therefore, we needed a model where the exogenous environmental factor can be incorporated as a covariate of the inefficiency model and then estimate this extended model in a one-step estimation framework. To the author's knowledge, panel data model estimators do not allow one to model the exogenous factors as covariates of inefficiency, preventing us from adopting these approaches. Thus, we used the ML estimation method and treated our dataset as pooled data, yet we sought to account for possible differences in technology among various ownerships and over time by incorporating risk factors, asset quality, and time trends into the deterministic part of the stochastic cost frontier model. Moreover, in Chapter 7, in which we empirically examine the effects of the regulatory reforms on bank competition, we will employ panel data estimators.

T Ln(OEA)	T lny2	χ_2	-0.002	0.00	-0.90
T Ln(FEES)	T lny3	χ_3	-0.004**	0.00	-2.48
PD Ln(P_{OPEX}/P_{FUNDS})	PD lnw1	ϑ_1	0.108**	0.05	2.36
PD Ln(LOANS)	PD lny1	ρ_1	-0.055	0.04	-1.24
PD Ln(OEA)	PD lny2	ρ_2	-0.044	0.04	-1.14
PD Ln(FEES)	PD lny3	ρ_3	0.086**	0.04	2.44
LLP	LLP	τ_2	1.531***	0.10	14.95
EAR	EAR	τ_1	-0.900***	0.11	-8.50
Inefficiency model		**Parameter**	**Coefficient**	**Std. errors**	**z-stats.**
Intercept	constant	ϕ_0	0.368	0.31	1.21
DB	DB	ϕ_1	-0.762**	0.30	-2.54
FB	FB	ϕ_2	-1.204***	0.46	-2.62
T	T	ϕ_3	-0.271***	0.09	-2.93
T*DB	T*DB	ϕ_4	0.019	0.03	0.68
T*FB	T*FB	ϕ_5	0.024	0.05	0.44
PD	PD	ϕ_6	10.969***	2.71	4.05
PD*DB	PD*DB	ϕ_7	4.683*	2.84	1.65
PD*FB	PD*FB	ϕ_8	-0.282	1.56	-0.18
PD*T	PD*T	ϕ_9	-0.622***	0.20	-3.15
PD*T*DB	PD*T*DB	ϕ_{10}	-0.330*	0.18	-1.84
PD*T*FB	PD*T*FB	ϕ_{11}	0.014	0.10	0.14
T^2	T^2	ϕ_{12}	0.015**	0.01	2.45
CRS_94	CRS_94	ϕ_{13}	0.677**	0.27	2.53
CRS_TWIN	CRS_TWIN	ϕ_{14}	1.170**	0.50	2.36
CRS_GLOBAL	CRS_GLOBAL	ϕ_{15}	0.566	0.35	1.60
FB_ENTRY	FB_ENTRY	ϕ_{16}	-0.247	0.35	-0.71
Variance parameters for compound error		**Parameter**	**Coefficient**	**Std. errors**	**z-stats.**
Gamma		γ	0.969***	0.007	131.39
Sigma-squared		σ^2	0.218***	0.044	4.90

Note: Number of observations:860; Log likelihood function= 383.048. $\sigma^2 = \sigma_v^2 + \sigma_u^2, \gamma = \sigma_u^2/\sigma^2$; ***,**,* significant at 1%,5%,10% respectively.

Before interpreting the estimated parameters in Table 5.5, we check the robustness of the model by undertaking a series of hypothesis tests concerning the nature of the cost frontier

model and the consistency of the cost function with its theoretical features using Wald tests. Lower levels of significance on the translog are quite common thanks to the presence of the quadratic and interactive terms. Therefore, tests undertaken on more than one parameter at a time are usually more reliable. These hypothesis tests control (1) the adequacy of a more restrictive Cobb-Douglas functional form, (2) the existence of technological change, (3) the existence of non-neutral and scale augmenting technology change, (4) the significance of a policy shift impact, (5) the significance of a policy shift impact on output composition and input mix, (6) if the production technology is homothetic, and (7) the overall significance of the inefficiency model. The null hypotheses of each of the above are shown as follows:

- Hypothesis (1): The second-order coefficients in the translog cost function are zero, and therefore the Cobb-Douglass functional form is adequate to represent data.
- Hypothesis (2): All coefficients involving the time trend (T) are equal to zero, hence there is no technical change related to time.
- Hypothesis (3): The interactions between the T and the input prices and output quantities are equal to zero and therefore there is no non-neutral and scale augmenting technical change and time does not have an impact on output composition and input mix.
- Hypothesis (4): All coefficients involving the policy shift dummy (PD) are zero, and thus the shift of policy focus has no effect on the estimated efficient cost function.
- Hypothesis (5): The interaction between the PD and the input prices and output quantities are zero, i.e. the shift in the policy has no effect on output mix and input composition.
- Hypothesis (6): The production technology is homothetic and thus the interactive terms of input prices and output quantities are equal to zero.
- Hypothesis (7): All coefficients in the inefficiency model are jointly zero and thus the variables are not relevant in explaining cost inefficiency.

Table 5.6 Tests of hypotheses for estimated parameters of the translog cost function

Null hypothesis (H_0)	Critical value χ^2	Decision (at the 1% significant level)
(1) $\beta_{11} = \beta_{22} = \beta_{33} = \beta_{12} = \beta_{13} = \beta_{23} = \delta_{11} = \phi_{11} = \phi_{12} = \phi_{13} = \theta_{11} = \grave{\eta}_1 = \chi_1 = \chi_2 = \chi_3 = \vartheta_1 = \rho_1 = \rho_2 = \rho_3 = 0$	5152.10	Reject
(2) $\theta_1 = \theta_{11} = \grave{\eta}_1 = \chi_1 = \chi_2 = \chi_3 = 0$	125.75	Reject
(3) $\grave{\eta}_1 = \chi_1 = \chi_2 = \chi_3 = 0$	25.31	Reject
(4) $\varsigma = \vartheta_1 = \rho_1 = \rho_2 = \rho_3 = 0$	34.05	Reject
(5) $\vartheta_1 = \rho_1 = \rho_2 = \rho_3 = 0$	18.98	Reject
(6) $\phi_{11} = \phi_{12} = \phi_{13} = 0$	14.06	Reject
(7) $\phi_1 = \ldots = \phi_{12}$	66.22	Reject

Notes: Tests of hypotheses involves imposing restrictions on the parameters; that is, parameters of the estimated translog cost function are equal to zero. The tests are based on the Wald test.

Based on the results of the various hypothesis tests above, we reject the hypothesis that the second-order coefficients in the translog cost function are zero and hence we reject the Cobb-Douglas and conclude that the translog fits the data more appropriately. We also reject the null hypothesis test that there is no technological change associated with time and there is no non-neutral and scale augmenting technical change present in the model. The policy-shift is also found to be relevant in having impact on costs and on output mix and input composition. The production technology is not homothetic. We also reject the null hypothesis test that all coefficients in the inefficiency model are jointly zero and thus confirm that the inefficiency correlates are relevant in explaining cost inefficiency.

We also undertake the regularity tests whether our estimated translog cost frontier function possess the properties of a cost function. Since linear homogeneity and symmetry conditions were imposed prior to estimation and non-negativity of costs were already checked during data input we only test for monotonicity condition. The results of the test monotonicity conditions, requiring that observation-specific cost elasticity of outputs and inputs must be positive, are summarised in Table 5.7. However, we note a few violations in monotonicity conditions, although these violations represent a small percentage of the total

observations. Such minimal violations are common in the literature yet large number of violations raise concerns on the soundness of empirical results (Kumbhakar et al., 2015). We therefore confirm that the estimated translog cost function satisfies the regulatory conditions required by theory.

Table 5.7 Monotonicity conditions of estimated translog cost function

		Mean	Number of violations of monotonicity conditions (i.e. cost elasticity <0)	Violations represent % of total observations
Cost elasticity with respect to outputs	LOANS	0.583	2	0.2%
	OEA	0.325	26	3.0%
	FEES	0.077	75	8.7%
Input price elasticities	P_{FUNDS}	0.336	61	7.1%
	P_{OPEX}	0.664	6	0.7%

We will now simultaneously discuss the estimated parameters of the translog cost frontier in Table 5.5 and the estimated average cost elasticities of outputs and input prices in Table 5.7. It can be inferred from the estimated cost frontier that most of the regressors associated with the LOANS, OEA and FEES as well as the normalised input price are significant at the 5% significance level and have expected signs. The ln (FEES), β_3, is the only output variable that is not statistically significant, yet other FEES related variables are strongly significant. This might be due to the multicollinearity issues related with such a large number of explanatory variables. The elasticity of LOANS is almost two times higher than the elasticity of OEA and is almost seven and half times larger than the elasticity of FEES, emphasising the low cost associated with the investment in securities and generation of off-balance sheet services.

Following Baltagi & Griffin (1988) and Altunbas et al. (1999), the impact of technical change on the cost function can be measured by the partial derivatives of the estimated cost function (5.1) with respect to time trend (T), as follows:

$$\frac{\partial lnTC}{\partial T} = \theta_1 + \theta_{11}T + \sum_{j=1}^{3} \chi_j \, lnY_{jit} + \sum_{m=1}^{2} \delta_m \, lnP_{mit} \tag{5.4}$$

Equation (5.4) can be decomposed into three components, identifying the effect of: (1) pure technical change, $\theta_1 + \theta_{11}T$; (2) scale augmenting technical change, $\sum_{j=1}^{3} \chi_j \, lnY_{jit}$; and (3) non-neutral technical change, $\sum_{m=1}^{2} \delta_m \, lnP_{mit}$. Pure technical change shows reductions in total costs obtainable holding constant the efficient scale of production necessary to produce any specific mix of outputs and the shares of each of the inputs in total cost. Scale augmenting technical change shows how changes in the efficient scale of operations affect total costs. If χ_j>0 for all j, the scale of production minimising average cost for a given output mix is decreasing over time. Third, non-neutral technical change explains how changes in unit input price affect total costs. If $\delta_m > 0$ for all m, the share of the cost of input m in total cost is increasing over time.

To answer our second research question, we investigate the estimated cost function parameters of T and T^2 since they show the economic characteristics of the production technology. The coefficient of the first-order time trend, θ_1, is 0.028 (significant at 10%), whilst the coefficient of quadratic time trend, θ_{11}, is -0.0003 (significant at 10%).[64] This result suggests that Turkish banks have still not fully benefited from any cost reductions stemming from pure technical progress during the sample period. Although the negative estimate of the quadratic time trend indicates that technological regress is slowing down over time, technological progress is not realised during the study period.[65] This pattern partly stems from changes in regulatory policies, the heavy penetration of foreign banks realised after 2005, and the improvement of quality of service. As Zhao et al. (2010) point out for the case of India, it is possible that banks faced difficulties as they had to adjust to a high and rigid cost structure inherited from the financial repression period to the new operating environment of the financial deregulation period. In addition, prudential re-

[64] Lower levels of significance on the translog function models are common due to the presence of the quadratic and interactive terms (Zhao et al., 2010).
[65] The efficient cost function is estimated to have a maximum value with respect to pure technical change. Yet our result indicates that (0.028/2*0.0003=46.6) there is no parallel shift within the study period.

regulations aimed at fostering stability and minimising excessive risk-taking also impose higher costs. The finding that Turkish banks experienced technical regress with a likely decreasing pace over time might signal that they did not still manage to adjust to the new operating environment initiated by the deregulatory policies, which then worsened with the implementation of tighter prudential and supervision norms. This phenomenon is in fact pointed out by some empirical studies on Turkey. For example, Isik & Hassan (2002a) and Kasman (2002) suggest that Turkish banks enjoyed high profits in the 1990s thanks to the excess demand of the public sector, which enabled them to overlook technical advances, so that many of them did not feel the pressure to minimise costs, arguably culminating in technological regress. As Levine (1996) and Claessens & Van Horen (2014) point out, foreign banks with greater know-how and superior technologies can lead to improvements in a domestic banking sector's technological development. Yet the negligible presence of foreign banks in the Turkish banking sector until the second half of the 2000s (see Section 2.3) is probably also a relevant reason for experiencing technical regress. In addition, although foreign banks expanded their activities when Turkish authorities deregulated the banking sector, they nevertheless engaged in trade financing or gave out loans to well-established or credit worthy firms, rather than expanding or entering into retail banking and lending to SMEs. Therefore, they have arguably had very little impact on commercial banking with respect to managerial skills and technical infrastructure (Fukuyama and Matousek, 2011). Parallel to this argument, a recent study investigating the impacts of foreign entry on the cost and profit performance in host country's banking sector finds that the performance of the banking industry significantly improves when foreign banks provide domestic banks with assistance in retail banking and internal control respectively (Li et al., 2016). In other words, they potentially transfer technology and management skills and these spillovers enable the domestic bank to improve their production technology. Given the fact that foreign banks in Turkey have largely engaged in trade financing or given out loans to well-established or credit worthy firms, they arguably may not contribute significantly to the technological infrastructure of the banking sector. The result of technical regress of Turkish banks might reflect the improvement of quality of service over time. This is because production of high quality financial products and services requires extra costs, and cost based models might label such banks as cost inefficient unless the quality of output produced is accounted for in efficiency estimations (Deyoung and Nolle, 1996). Apparently, there is evidence regarding the effort Turkish banks have shown to improve their quality of output and services. For example, the

existing traditional banks of the Turkish banking industry have found themselves in a more intense competitive environment in the early years of banking deregulation; this in turn forced them to increase the quality of their services to strengthen their competitive viability (Isik and Hassan, 2003a; Yavas et al., 1997). In addition, there has been a significant increase in the adoption of internet banking services and in the number of Turkish banks offering internet banking to increase the quality of services (Ozdemir and Trott, 2009; Sanli and Hobikoğlu, 2015). Furthermore, the literature also suggests that foreign banks tend to produce their financial services with higher quality (Isik and Hassan, 2002b); given the heavy penetration of foreign banks into the Turkish banking sector in particular after 2005, this in turn might contribute to the continuation of the perceived technical regress trend.

With respect to non-neutral technical change, the coefficient $\grave{\eta}_1$ is negative and significant, this in turn indicates that the estimated efficient cost share of other non-interest operating costs reduces relative to borrowed funds over time. This is due largely to the consequence of the progressive reduction in excessive branches and employees of banks, in particular for state banks, started early on with the implementations of deregulation policies. Conversely, the coefficient of the price of borrowed funds is positive and significant,[66] indicating a corresponding increase in the share of interest costs in total costs. Although this is partly a direct consequence of the decline in the non-interest operating cost share, it does also indicate that Turkish banks have been exposed to the high cost of deposit funding, which was the case after the deregulation of deposit rates (see Section 2.3).[67] As for the possible scale-augmenting technical change, χ_1 is positive and insignificant, while χ_2 and χ_3 are negative yet only χ_3 is significant. The overall minimum efficient production scale increases over time (i.e. $\chi_1+\chi_2+\chi_3>0$) but this is attributable only to the production of fee based income, as their coefficient of time variation, χ_3, is negative and significant. This reflects the fact that larger banks (state and domestic private banks in the Turkish banking

[66] Linear homogeneity of one degree in input prices was imposed prior to estimation by dividing TC (total observed cost) and w_1 (price of non-interest operating cost) by w_2 (price of borrowed funds) before taking logs. The coefficient of time trend with borrowed funds (w_2) is ???

[67] See Section 4.2.2 and the positive interaction of LOANS with T in the frontier (albeit significant) which can also back up the increase in the cost of production over time.

case) have engaged more in off balance sheet business, leading to a reduction in the cost of production of non-core banking activities over time (See Appendix 5.1).

Table 5.8 Output elasticities and scale economies

	Pre-2001 period (All banks)	**Post-2001 period (All banks)**	**Full sample (All banks)**
CE_{LOANS}	0.650	0.511	0.581
CE_{OEA}	0.200	0.459	0.330
CE_{FEES}	0.106	0.047	0.076
Economies of scale	**1.046**	**0.983**	**1.013**

Notes: Economies of scale is given by $1/(CE_{LOANS}+ CE_{OEA}+ CE_{FEES})$

Cost efficiencies not only are affected by technological progress but also by scale economies. Economies of scale measure the relative change in a bank's total cost for a given proportional change in all its outputs. Table 5.8 reports economies of scale in the Turkish banking industry with reference to the cost elasticities of outputs evaluated at the means. We observe that Turkish banking sector exhibits scale economies in the pre-2001 period as the sum of the cost elasticity with respect to all outputs is less than one,[68] while it shows diseconomies of scale in the post-2001 period. This might indicate that large banks have not enjoyed a cost advantage over the smaller banks in the post-2001 period.

With regards to the impact of policy shift does not come as a one-off additional regulatory cost, when the regulatory policy focus changed from stimulating competition to emphasising prudential re-regulation as the insignificant coefficient of the dummy variable PD (ς = 0.396). Instead, it has affected the change in banks' input mix and output composition. This in turn may mirror that banks did not undertake groundwork for the policy change. This might be because the shift to the stability-oriented regulatory reforms was not consultative and gradual; instead, they started to be implemented right after the twin crises rather than being announced in advance by the authorities (see Section 2.5).

[68] Similar finding is also obtained by Kasman (2002).

Therefore, banks could not take a proactive approach to the policy change. The opposite phenomenon is observed in the Indian banking sector where the banking authorities implemented banking reforms by adopting a gradual and consultative approach, which in turn enabled banks to be forward-looking and thus prepared themselves well in advance for regulatory changes (Zhao et al., 2010). The estimated cost share of non-interest operating cost to loanable funds increases as a result of the shift in policy focus, since ϑ_1 is positive and significant. As discussed in Section 2.6, the increase in operating expenses might stem from increasing incremental compliance costs arising from banks' efforts to adapt to the changes in the regulatory framework. The shift in policy focus seems to influence output composition in particular, inducing them to focus on their traditional business model of short-term lending and investment in government debt securities and Treasury bonds. This is because the loans (ρ_1) and the other earning assets (ρ_2) are negative yet only the latter is significant. This indicates an increase in the other earnings' optimal scale of production, which might be due to the shift to the stability-oriented re-regulations post-2001, leading banks to invest in less risky activities such as government securities and lending to well-established and credit-worthy firms (see Section 2.6). The positive and significant coefficient of FEES, ρ_3, indicates a reduction in its optimal scale of production because of the shift in policy focus. This can be due to the introduction of a tighter prudential re-regulation and supervision framework, which in turn should have lowered the best performers' risk appetite.

Turning to the control variables, the negative and significant coefficient of the equity asset ratio (EAR) suggests that higher equity ratios and thereby lower insolvency risks reduce the risk premium the bank has to pay, which in turn reduces the cost of borrowing (Berger and Mester, 1997). Given the fact that Turkish banks have always had the CAR above the minimum standards set by the authorities, demonstrated them as safe entities by lowering the insolvency ratio (see Section 2.6). The loan loss provisions coefficient on the other hand (LLP) have a positive and significant sign, indicating that lower expected loans quality is associated with higher bank cost, probably due to an increase in the cost of borrowing. This result might also be due to the fact that the twin crises led to outstanding increases in the NPLs ratio, which in turn forced banks to increase their provisions at high costs.

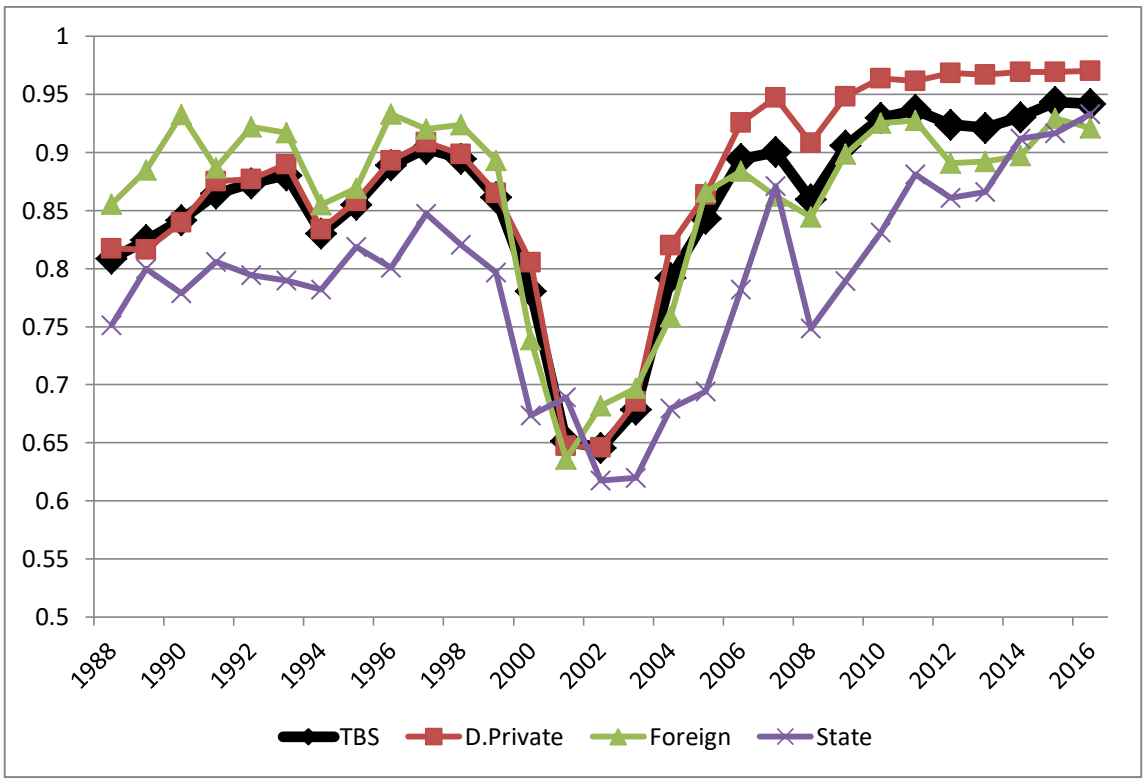
5.5.1 Discussing the characteristics of cost efficiency

Turning to the characteristics of inefficiency, the test on the joint significance of the inefficiency effects (Table 5.6) suggests that inefficiency determinants are relevant in explaining cost inefficiency. This is also backed up by the statistically significant value of inefficiency, $\gamma = \sigma_u^2/\sigma^2$=0.969 which is significant at 1% level.[69] The characteristics of the estimated cost efficiencies, i.e. the average efficiency levels in industry and per ownership category, are presented in Figure 5.1. In addition, the partial effects of the coefficients of the determinants of inefficiency are presented in Table 5.9.[70] The latter practice is adopted because the estimation presented in Table 5.5 only provides information on the direction of the effect of estimated inefficiency correlates on cost inefficiency. Therefore, to investigate the magnitude of the influence of these estimates on cost inefficiency, we also report the estimated marginal effects of each of the determinants of cost efficiency.

[69] In case of a low and not significant inefficiency estimate, γ, it is concluded that inefficiency is not relevant in contributing to the distance of the efficient frontier and thus all variations are owing to randomness and so OLS can be implied to the estimation.

[70] We use LIMDEP to calculate each marginal effect as $\frac{\partial(Cost\ efficiency)}{\partial E_{it}}$ based on Eq. (5.1): it is evaluated at the mean of each variable and interpreted as % change of cost efficiency due to a per unit change in inefficiency correlates. A positive sign suggests the determinants of inefficiency in Eq. (5.1) positively affect cost efficiency.

Figure 5.1 Average efficiency levels in industry and per ownership category



The average estimated cost efficiency of the Turkish banking industry over the study period denotes a general non-monotonic pattern over time. Overall, the efficiency gains are realised in the period between 1988 and 1997, although this improvement is temporarily interrupted by the 1994 financial crisis which marginally led to a 0.59% drop in cost efficiency (see Table 5.9). This improvement goes hand-in-hand with the deregulation reforms and the technological regress making it easier for average banks to catch-up the best performing banks, in turn culminating in an increase in average cost efficiency levels of the banking industry during this period. Isik and Hassan (2003a), in investigating the impacts of financial deregulation on bank performance in Turkey, also find that productivity growth was mainly driven by efficiency increases; namely, inefficient banks are able to catch up with the best performers rather than technical progress. Between 1998 and 2002, Turkish banks experienced a catastrophic drop in their cost efficiency levels, which can be explained by various factors. First, the Turkish economy was adversely affected by the financial crises that broke out in Russia and Asian countries in the late-1990s, aggravating domestic economic activities and culminating in problems with loan repayments. Moreover, as discussed in 2.4, Turkish banks were prone to maturity risks,

which led to serious imbalances on the balance sheets of banks and resulted in the failure of five private banks in 1999.

In addition, as expounded earlier, Turkey faced twin crises in 2000 and 2001, leading to further bank failures and downsizing in the banking sector. Worsening economic conditions also doubled non-performing loans. Finally, the sudden implementation of regulatory reforms consisting of restructuring process and prudential re-regulations imposed additional regulatory costs. As it can be seen in Table 5.9, the partial effect of the policy shift led to a drop of around 9% and 13% in the cost efficiency of state banks and domestic private banks respectively. After bottoming out, cost efficiency rebounds as of 2002 and shows a steep increase up to 2006/07 before experiencing a slump in 2008 due to the global financial crisis, leading to a 0.46% drop in cost efficiency (see Table 5.9). This recovery probably stemmed from the regulatory development and sustained economic performance of Turkey after 2002 which had a positive impact on the banking sector and increasing confidence in the financial system in general. The efficiency rebounds as of 2009 and increases marginally up to 2011, but this increase is not consistent throughout the rest of the study period. This is part of a more general convex pattern in cost efficiency as denoted by the coefficient of the quadratic time trend (see Table 5.9), indicating that improvement in performance slows down over time. Overall, average industry efficiency increases from 83.98% in 1988-2001 to 87.03% in 2002-2016. This could be due to both the shift in policy focus per se and by the fact that this enabled Turkish banks to benefit more from technological advancements under the new regulatory environment.

Table 5.9 Marginal effects of the determinants of cost efficiency

Marginal Effects	Parameter	Partial effects	Standard error	t-value
DB	ϕ_1	0.0064	0.0028	2.3000
FB	ϕ_2	0.0100	0.0039	2.5800
T	ϕ_3	0.0023	0.0008	2.7300
T*DB	ϕ_4	-0.0002	0.0003	0.6600
T*FB	ϕ_5	-0.0002	0.0005	0.4500
PD	ϕ_6	-0.0935	0.0307	3.0400
PD*DB	ϕ_7	-0.0404	0.0238	1.7000
PD*FB	ϕ_8	0.0024	0.0132	0.1800
PD*T	ϕ_9	0.0052	0.0020	2.5700
PD*T*DB	ϕ_{10}	0.0028	0.0015	1.9100
PD*T*FB	ϕ_{11}	-0.0001	0.0009	0.1400
T^2	ϕ_{12}	-0.0001	0.0001	2.2500
CRS_94	ϕ_{13}	-0.0057	0.0022	2.5900
CRS_TWIN	ϕ_{14}	-0.0099	0.0039	2.5400
CRS_GLOBAL	ϕ_{15}	-0.0048	0.0030	1.5800
FB_ENTRY	ϕ_{15}	0.0021	0.0029	0.7200

It is also interesting to discuss to what extent various ownerships have reacted differently to the changes in policy focus. At the beginning of the sample period, both foreign banks ($\phi_2<0$) and domestic private banks ($\phi_1<0$) have significantly higher cost efficiency than public banks, a result in line with the previous findings of Isik & Hassan (2002) and Demir et al. (2005). Foreign banks' performance reflects the expected superior management skills and higher quality customer base (Fukuyama and Matousek, 2011; Isik and Hassan, 2002b), which enable them to better exploit the increasing functional autonomy and operational freedom of deregulation. In addition, domestic private and foreign banks' superior efficiency generally is presumably due to their relatively smaller sizes, which might have been optimal, especially at times of macroeconomic and financial instability. Although both foreign and domestic banks outperform state banks at the beginning, they do not seem to achieve significant progress over time, as indicated by the insignificant

coefficients (ϕ_4 and ϕ_5). This may suggest that private banks might have failed to adopt cost-reducing technology in reaction to the competitive pressures unleased by deregulation. Yet the state banks whose operating conditions were initially relatively weak compared to private banks, likely due to the cost structure and scale problems inherited from the pre-deregulation period (ϕ_0), seem to improve their position (ϕ_3) during the period 1988-2001. This indicates that they could also benefit from the deregulated regulatory environment. Moreover, some studies investigating efficiency in the Turkish banking sector draw similar conclusions, stating that state banks manifested superior technical efficiency improvements during the 1990s (Yildirim, 2002; Zaim, 1995).

With regards to the change in policy focus, it seems that this shift negatively affects all ownership types but to different degrees. Specifically, both state and domestic private banks suffer the worse reduction in efficiency; this is because the marginal effects ϕ_6 and ϕ_7 are negative and significant, indicating that the worsening for domestic private banks is larger than that of state banks. This may also state that the shift in policy focus imposed higher costs on private banks than state banks. On the other hand, the positive coefficient of foreign banks, ϕ_8, might indicate that they have initially adapted to the shift better than domestic banks, yet the insignificant result prevents us from drawing this conclusion. The disadvantage caused by the shift in policy focus, however, decreases over time during the post-2002 period for both state and domestic private banks ($\phi_9>0$, $\phi_{10}>0$). It seems that the positive and significant coefficient (ϕ_{10}) indicates that domestic private banks achieve higher cost efficiency compared to state banks over time. This might be attributed to the fact that domestic private banks are strongly recapitalised in the aftermath of the domestic twin crises (Altunbaş et al., 2009; Fethi et al., 2012; Fukuyama and Matousek, 2011) and this clearly equipped them better - in particular private banks - to sustain tighter prudential regulatory changes.

With respect to foreign banks, since their coefficient interacting with the policy shift dummy and time trend is not significant, this may suggest that they do not seem to achieve significant progress over time. This can be due to the fact that the presence of foreign banks was minuscule until 2005 and then accelerated via acquisition of domestic private banks by foreign banks. Therefore, these banks are relatively new and hence it may take time for these new foreign banks to adapt themselves to domestic policy measures. Moreover, as highlighted before, domestic banks had strongly capitalised following the

domestic twin crises, which in turn have prevented them from the negative impacts of the global financial crisis. Yet foreign banks, whose headquarters are located mostly in Europe,[71] are more likely to have been adversely affected by the crisis. In addition, the coefficient of the FB_ENTRY dummy suggests that the heavy penetration of foreign banks since 2005 appears to have no significant impact on cost efficiency, as indicated by the positive but not significant value of ϕ_{16}. This result might be due to fact that the penetration of foreign banks have been realised in the form of acquisitions; that is, they have taken over domestic banks instead of establishing de novo institutions, which in turn might have reduced the impact on cost efficiency. This finding is also consistent with empirical evidence suggesting that when domestic banks are more efficient than foreign banks, efficiency gains from foreign banks penetrated through the acquisition of a domestic bank are likely to be limited (Clarke et al., 2003). Thus, since in our case we find that domestic private banks and in later periods state banks outperformed these foreign banks that entered to Turkish banking sector after 2005 via acquisition, this may in turn imply that their efficiency impact is likely to be limited. As expounded in Section 3.4, this mode of entry is found to be less efficient and employs a lower level of technologies compared to greenfield banks, contributing to the insignificant impact (Havrylchyk, 2006).

The general efficiency trend during the study period (see Figure 5.1) indicates that foreign banks appear to be more efficient in an environment where functional autonomy and operation freedom is increasing. It appears that they have lost their advantages with the change in policy focus, which might be attributable to the differences in the quality of the institutions and similarity between home and host country institutional quality (Lensink et al., 2008). Moreover, domestic banks were strongly recapitalised in the aftermath of the domestic twin crises (Altunbaş et al., 2009; Fethi et al., 2012; Fukuyama and Matousek, 2011), this may in part explain the finding that these banks outperform foreign banks in the post-2002 period. Another general efficiency trend indicates that private ownership outperforms public ownership in the Turkish banking sector, arguably driven by higher performance of foreign banks in the pre-2001 and domestic private banks in the post-2001 periods. It is noteworthy that state banks are slow to adapt to the changes in regulatory shifts, since highlighted above they are the worst performers in the early stages of policy

[71] See Chapter 2.

shifts, possibly stemming from their larger sizes and principal-agent problems slowing down the adjustment process. Yet it appears that once they adapt to the changes, they improve their position at a faster rate.

5.6 Conclusion

Employing an unbalanced panel dataset covering state, domestic private and foreign commercial banks over the period 1988-2016, this chapter has empirically examined the effects of the deregulation and prudential re-regulation framework on the characteristics of cost structure and on the ownership-cost efficiency relation of Turkish commercial banks. The empirical results indicate that pure cost technology worsens during the sample period yet at a slowing rate. This is possibly due to the rigid cost structures inherited from the pre-reform period as well as abundant profit opportunities in the 1990s thanks to the excess demand of the public sector, which in turn enabled banks to overlook technical advances that could have reduced production costs. Although Turkish banks have yet to benefit from technological progress, they have experienced some improvements as they have better adjusted to the new regulatory environment and take advantage of the new opportunities. It is noteworthy that the banking authorities' decision to shift to the prudential re-regulations was not cautious and gradual. This in turn imposed significant costs on Turkish banks, contributing to the catastrophic drop in cost efficiency experienced in the early 2000s. Moreover, banks have changed their input mix and output composition to accommodate further the changes in the regulatory environments; this signals that the best practices among banks have not made all the necessary adjustments to their production process.

The results also suggest that the deregulation and prudential re-regulation framework affect the ownership-cost efficiency relationship differently. At the initial stages of deregulation, bringing new opportunities and operational freedom, private banks - in particular foreign banks - had higher cost efficiency than public banks, which can be attributable to the fact that they were subjected to less political intervention and had ownership advantages. Yet it appears that state banks improved their positions over time, presumably due to lessening political pressure as a result of deregulatory policies, while others could not carry on seizing the benefits of deregulation. The shift in policy focus was costly for all ownerships but for domestic banks in particular. However, we observe that domestic private banks appear to adapt better to the new regulatory environment and hence experienced the best

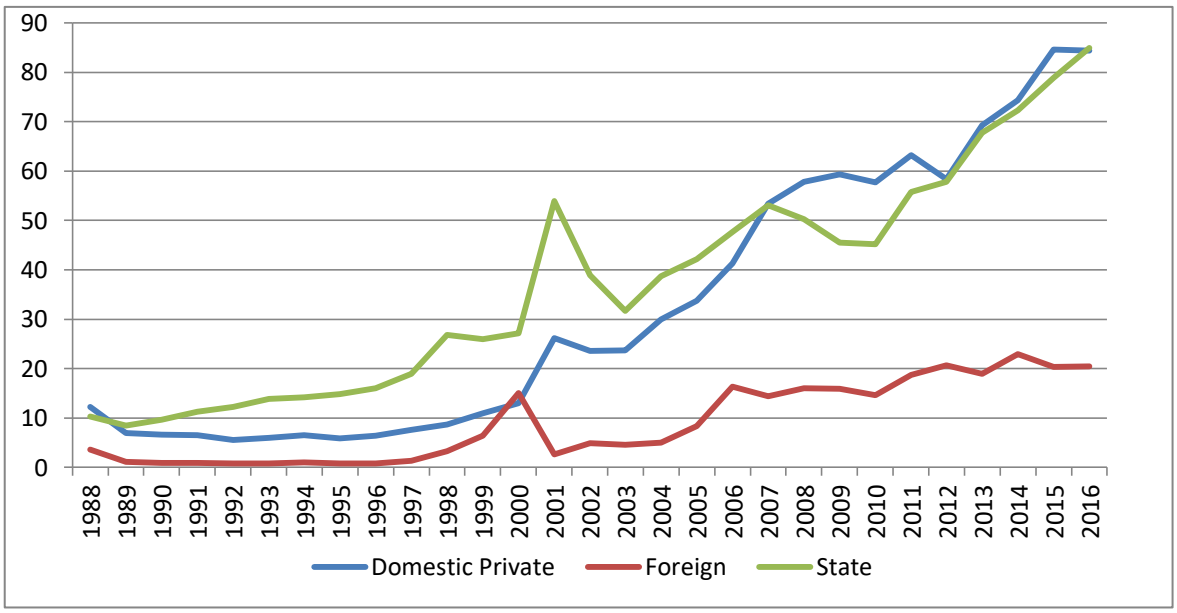
efficiency improvements over time. On the other hand, foreign banks do not seem to achieve significant progress over time. Furthermore, they adapt worse than public banks to new policy measures so that towards the end of the sample period they presented the lowest cost efficiency scores. Furthermore, the heavy penetration of foreign banks since 2005 has not affected cost efficiency significantly.

The results of this study in general compare with those of other studies on the Turkish banking sector, yet none of these studies merge the period before and after 2001 with the exception of Fukuyama and Mataousek (2011) who use the non-parametric method, in contrast to our empirical approach, preventing them from disclosing the real influence of the policy shift on general cost efficiency and ownership. Similar to the previous literature, our study also confirms that deregulation policies contributed to the efficiency of the sector (Ertugrul and Zaim, 1999; Isik and Hassan, 2003a; Zaim, 1995), yet this study finds that this improvement could not be sustained over time, as pointed out by different studies (Denizer et al., 2007; Isik and Hassan, 2002b; Yildirim, 2002). Furthermore, the sudden policy shift that imposed regulatory costs on banks initially rendered adverse impacts on efficiency, yet banks appear to adapt quickly to the changes in the regulatory environment culminating in efficiency improvements over time (Davutyan and Yildirim, 2015; Fukuyama and Matousek, 2011; Özkan-Günay et al., 2013). Our results differ from these studies by stating that efficiency is part of a more general convex pattern, indicating that the improvement in efficiency slows down over time, indicating that banks have yet to adjust fully to the new regulatory environment. In terms of ownership-efficiency, this study finds that although private banks and in particular foreign banks outperformed public banks at the initial stages of deregulation (Isik and Hassan, 2003a), the latter improved their position at a slightly faster rate. Some studies' findings that state banks were more technical efficient than private banks during the 1990s might support our finding (Isik and Hassan, 2002a; Yildirim, 2002). The studies looking into the ownership-efficiency relationship in the post-2001 period mostly find that foreign banks outperformed domestic banks (Assaf et al., 2013). Yet we find that foreign banks have lost their advantages over time, in particular after the global financial crisis. In addition, their penetration has not contributed to the cost efficiency of the banking sector. Fukuyama and Matausek (2011) could not confirm that foreign banks are on the average more efficient then domestic banks, which may give some support to our findings. Lastly, there are not many papers we can compare with our conclusion regarding the trend in production technology. A study

covering the pre- and post-deregulation period finds that Turkish banks utilised their resources poorly, i.e. they could have produced more with given inputs (Denizer et al., 2007), which to some extent supports our finding that deregulation did not stimulate improvement in production technology. A similar finding also suggests that the technology of domestic banks did not improve over the early post-liberalisation period (Isik and Hassan, 2003a). Our finding suggesting that although Turkish banks have not experienced technological progress after the policy shift in 2001 but have partly benefited from technological improvements over time, at first glance appears to be contrasting. Yet since these studies only focus on the post-2001 period when we also find some improvement in the production technology, it is not straightforward to state these different conclusions as a contradiction.

The policy recommendations are that deregulation reforms can improve efficiency levels, particularly once political intervention is lessened on state banks as they seem to improve their performance, signalling that they do not need to be privatised for them to be efficient. Deregulation reforms did not encourage banks to improve their technology of production and banks did not gain sustainable efficiency gains. However, once these reforms are accompanied by stability-oriented reforms, average cost efficiency increases and banks benefit from production technology. Most importantly, regulatory reforms should be consultative and implemented gradually so that banks can equip themselves before the implementation of reforms, enabling them to quickly adapt to the changes. This in particular could be crucial for foreign banks that are arguably more sensitive to the changes in the regulatory environment of the host country.

Appendix 5.1 Trend in real mean values of fee based income (Millions TRY)



Appendix 5.2 Comparison of ML estimates for 1988-2002 and 1988-2004 period

Ln(TC/P_{FUNDS})	**LnTC**	**Parameter**	**1988-2002**	**1988-2004**
Intercept	constant	α_0	0.15023	0.20944
Ln(P_{OPEX}/P_{FUNDS})	lnw1	δ_1	.65942***	.83313***
Ln(LOANS)	lny1	β_1	.87629***	.99309***
Ln(OEA)	lny2	β_2	.37917***	.24450***
Ln(FEES)	lny3	β_3	-0.02937	-0.05506
$Ln(LOANS)^2$	$(lny1)^2$	β_{11}	.02975***	.02771***
$Ln(OEA)^2$	$(lny2)^2$	β_{22}	.08909***	.09464***
$Ln(FEES)^2$	$(lny3)^2$	β_{33}	-0.00344	-0.00352
Ln(LOANS)Ln(OEA)	(lny1)(lny2)	β_{12}	-.12794***	-.13486***
Ln(LOANS)Ln(FEES)	(lny1)(lny3)	β_{13}	.04641***	.04950***
Ln(OEA)Ln(FEES)	(lny2)(lny3)	β_{23}	-.04243***	-.03881***
$Ln(P_{OPEX}/P_{FUNDS})^2$	$(lnw1)^2$	δ_{11}	.15237***	.16932***
Ln(P_{OPEX}/P_{FUNDS})Ln(LOANS)	(lnw1)(lny1)	ϕ_{11}	0.00449	0.01447

$Ln(P_{OPEX}/P_{FUNDS})Ln(OEA)$	(lnw1)(lny2)	ϕ_{12}	.02847**	0.00323
$Ln(P_{OPEX}/P_{FUNDS})Ln(FEES)$	(lnw1)(lny3)	ϕ_{13}	-.03671***	-.03702***
T	T	θ_1	.03575*	.08660***
T-square	T^2	θ_{11}	.00441***	.00189***
T $Ln(P_{OPEX}/P_{FUNDS})$	T lnw1	$\dot{\eta}_1$	-.02287***	-.01899***
T Ln(LOANS)	T lny1	χ_1	-0.00069	-0.00231
T Ln(OEA)	T lny2	χ_2	-.01430***	-.01110***
T Ln(FEES)	T lny3	χ_3	.00855***	.00493**
DB	DB	ψ_1	-.11167***	-.08289***
FB	FB	ψ_2	-.20298***	-.14809***
LLP	LLP	τ_2	2.06134***	2.11203***
EAR	EAR	τ_1	-.65355***	-.68118***
Gamma		Γ	1.76920***	2.29313***
Sigma-squared		σ^2	.26549***	.29731***

The Turkish economy suffered from hyper-inflation between 2002-2004, leading firms, including banks, to adopt inflation accounting. The results in Appendix 5.2 shows that inflation accounting adopted by banks between 2002 and 2004 may not affect the consistency of dataset over time; this is partly because only one, $\phi_{12,}$ out of 27 coefficients lost some degree of significance while the sign of it has not changed. Yet it is not straightforward to explore the effect of the inflation accounting on the size of the coefficients.

Appendix 5.3 shows the estimation results (in terms of size, sign and significance level) of the model denominated in US dollar and in Turkish Lira as seen below. Only one coefficient's significance level changes in this case.

Appendix 5.3. Comparison of ML estimates of TRY and US denominated variables

Ln(TC/P_{FUNDS})	**LnTC**	**Parameter**	**Estimated parameters of the TRY denominated data** (CPI 1998)	**Estimated parameters of the USD denominated data**
Intercept	constant	α_0	1.23186***	1.16914***
Ln(P_{OPEX}/P_{FUNDS})	lnw1	δ_1	.74590***	.74981***
Ln(LOANS)	lny1	β_1	.67569***	.67620***
Ln(OEA)	lny2	β_2	.29845***	.29973***
Ln(FEES)	lny3	β_3	0.07479	0.0788
$Ln(LOANS)^2$	$(lny1)^2$	β_{11}	.03429***	.03345***
$Ln(OEA)^2$	$(lny2)^2$	β_{22}	.07911***	.07936***
$Ln(FEES)^2$	$(lny3)^2$	β_{33}	-.00533**	-.00561***
Ln(LOANS)Ln(OEA)	(lny1)(lny2)	β_{12}	-.11643***	-.11643***
Ln(LOANS)Ln(FEES)	(lny1)(lny3)	β_{13}	.04452***	.04672***
Ln(OEA)Ln(FEES)	(lny2)(lny3)	β_{23}	-.03801***	-.03943***
$Ln(P_{OPEX}/P_{FUNDS})^2$	$(lnw1)^2$	δ_{11}	.15256***	.15166***
Ln(P_{OPEX}/P_{FUNDS})Ln(LOAN	(lnw1)(lny1)	ϕ_{11}	0.00177	-0.00067
Ln(P_{OPEX}/P_{FUNDS})Ln(OEA)	(lnw1)(lny2)	ϕ_{12}	0.00362	0.00461
Ln(P_{OPEX}/P_{FUNDS})Ln(FEES)	(lnw1)(lny3)	ϕ_{13}	-.01941**	-.01702**
T	T	θ_1	.02929*	.03359**
T-square	T^2	θ_{11}	-0.00025	-0.00024
PD	PD	ς	0.38553	0.33862
T Ln(P_{OPEX}/P_{FUNDS})	T lnw1	$\dot{\eta}_1$	-.00795***	-.00719**

T Ln(LOANS)	T lny1	χ_1	0.00314	0.00325
T Ln(OEA)	T lny2	χ_2	-0.00096	-0.00094
T Ln(FEES)	T lny3	χ_3	-.00464**	-.00487**
PD Ln(P_{OPEX}/P_{FUNDS})	PD lnw1	ϑ_1	.13490***	.13813***
PD Ln(LOANS)	PD lny1	ρ_1	-0.02856	-0.02296
PD Ln(OEA)	PD lny2	ρ_2	-.06928*	-.07040**
PD Ln(FEES)	PD lny3	ρ_3	.08840***	.09057***
DB	DB	ψ_1	0.01476	0.01221
FB	FB	ψ_2	-.05442*	-.05770**
LLP	LLP	τ_2	1.58525***	1.58240***
EAR	EAR	τ_1	-.93970***	-.94699***
Inefficiency model		**Parameter**		
Intercept	constant	ϕ_0	0.41092	0.42355
T	T	ϕ_1	-.25485***	-.26403***
T^2	T^2	ϕ_2	.01490***	.01544***
DB	DB	ϕ_3	-.79303***	-.76664***
FB	FB	ϕ_4	-.61614*	-0.59401
T*DB	T*DB	ϕ_5	0.01933	0.01477
T*FB	T*FB	ϕ_6	0.00361	0.00074
PD	PD	ϕ_7	10.7768***	11.0158***
PD*DB	PD*DB	ϕ_8	5.83283*	6.16727*
PD*FB	PD*FB	ϕ_9	-1.68798	-1.72752
PD*T	PD*T	ϕ_{10}	-.61988***	-.63587***
PD*T*DB	PD*T*DB	ϕ_{11}	-.40256**	-.42427**

PD*T*FB	PD*T*FB	ϕ_{12}	0.08994	0.09374
CRS_94	CRS_94	ϕ_{13}	.63508***	.66044***
CRS_TWIN	CRS_TWIN	ϕ_{14}	1.05089**	1.07588**
CRS_GLOBAL	CRS_GLOBAL	ϕ_{15}	0.39824	0.41878
Variance parameters for compound error		**Parameter**	**Coefficient**	**Coefficient**
Gamma		γ	.96935***	.97065***
Sigma-squared		σ^2	.19749***	.20220***

Chapter 6
Measuring Competition in Banking

6.1 Introduction

The previous chapter investigated how the regulatory reform process and foreign bank penetration have affected the efficiency of Turkish banks. The empirical results showed that efficiency had a non-monotonic trend over the sample period. In particular, though deregulation led to some improvements in efficiency, this contribution did not last long. Stability-oriented reforms, on the other hand, initially imposed high regulatory costs, causing efficiency losses. These reforms started a development process in efficiency shortly after their implementation, yet the gains appeared to lose pace over time. Therefore, it is natural to wonder how these reforms affected the competition in Turkish banking sector. We also find that heavy foreign bank penetration that started in 2005 appears to have had no discernible impact on the efficiency of the banking sector, which might indicate that their entry may not affect the competitive structure of the banking sector. To investigate further how regulatory reforms and foreign bank entry affects the competitive structure of Turkish banking sector, we next test the impact of regulatory reforms and foreign banks entry on the intensity of competition in the Turkish banking sector.

The rest of the chapter is organised as follows. This chapter aims to provide a concise review of the different approaches employed to measure competition in general and the banking sector in particular. Therefore, Section 6.3 reviews the traditional Industrial Organisation (IO) approaches based on the Structure-Conduct-Performance (SCP) paradigm. Section 6.4 turns to the New Empirical Industrial Organisation (NEIO) approaches used to measure competition. Moreover, Section 6.5 focuses on the NEIO approaches based on the static market assumption, while Section 6.6 elaborates on the methods - the Boone indicator and the persistence of profits- used to measure dynamic competition. All subsections firstly introduce methods, summarise relevant empirical studies, and finally highlight their strengths and weaknesses. Section 6.7 concludes.

6.2 Measuring competition in banking

Competition in banking has always been a contentious issue (Vives, 2001). Advocates of competition highlight its beneficial effects on banks' performance, productive efficiency, international competitiveness, and innovation (King & Levine 1993a, 1993b; Demirgüç-Kunt & Maksimovic 1998; Vives 2001; Claessens & Laeven 2004; Levine 2004). Moreover, some also posit that increased competition in banking can result in lower prices for financial products and greater access to finance for smaller firms in particular, resulting in the entry of more firms and higher growth for younger firms (Beck et al., 2004; Cetorelli and Strahan, 2006). Overall, these arguments endorse the existence of a healthy degree of rivalry to stimulate improvements in banking. Yet the opponents of competition, on the other hand, postulate that these perceived benefits have to be weighed against the risks of potential instability stemming from increased competition. They argue that higher competition is likely to lead banks to take excessive risks, which in turn induce instability in the financial sector with negative repercussions on the overall economy (Carlson et al., 2011; Hakkio and Keeton, 2009). Therefore, they conclude that the notion that competition is unambiguously beneficial for banking should be approached with caution. In the light of these two opposing views, the evaluation of competition in banking has become crucial for policymakers and regulators.

The literature investigating the competitive features of markets, including in banking, is divided in two main streams: the structural and the non-structural approach. The former largely relies on the SCP paradigm to make inferences on the degree of competition in an industry. On the other hand, the non-structural approach seeks to model the dynamic interrelation between firms and the contestability of markets to explain pricing behaviour. We will now elaborate on these approaches.

6.3 Structural approaches

Structural approaches posit that competition is a complex phenomenon and hence the degree of competition cannot be easily and directly observable. Therefore, these approaches rely on the SCP paradigm, associating market structure with the pricing conduct of market participants to investigate the intensity of competition in a market. More specifically, this paradigm suggests that, assuming a market is characterised by a state of

long-run equilibrium, the structural characteristics of the market affect the conduct of market participants, and this conduct in turn determines their performance. This assumption therefore allows one to draw indirect inferences on the unobserved competitive conduct of market participants by interpreting the relationship between observed market structure and performance variables. Yet to date there is no consensus as to whether the perceived positive relationship between market structure and performance reflects collusion or efficiency, leading economists to propose different interpretations.

i. Market power hypotheses

The traditional SCP paradigm developed by Bain (1951), relying on the traditional IO theory of the firm, associates market concentration with the pricing conduct of firms operating in manufacturing industries in the 1940s and 1950s. The fundamental features of these industries were that they had high fixed costs, a handful of competitors, high barriers to entry, and stringent exit conditions due to high sunk costs. In other words, these industries had a smaller number of firms (oligopolistic competition) and limited contestability. Bain (1951) investigated the relation between market structure and the performance of these firms and found a statistically significant relationship between them. He accordingly hypothesised that a smaller number of incumbent firms operating under limited entry threat make their pricing decisions to realise joint profit maximisation, leading them to engage in collusion, price leadership, or other tacit pricing arrangements. These anti-competitive behaviours in turn allow them to set prices higher than the competitive norms and hence yield abnormal profits.

On the other hand, the relative market power (RMP) hypothesis proposed by Shepherd (1982) postulates an alternative interpretation to the SCP paradigm by suggesting a one-way causality running from exogenous market structure to realised performance. He argues that the positive relationship between concentrated markets (with few, large firms) and profits might be due to the firms earning larger market shares by offering well-differentiated products, not necessarily due to collusion as suggested by the SCP. In other words, only firms with large market shares and well-differentiated products can exercise market power by setting prices at uncompetitive levels and consequently making abnormal profits. That is, although this hypothesis agrees on the causality running from structure to performance, the interpretation of the relationship is different from the SCP hypothesis.

However, both of these hypotheses deem the markets as imperfect with regard to their competitive structures as firms can exploit their market power, yielding monopoly profits. Therefore, some form of regulation might be needed to limit the exploitation of market power. The Chicago School suggests that the intervention of regulators to the market induces less competition rather than more. They instead point out that a positive correlation between market structure and performance may not be driven from collusive behaviour or exploitation of market power. Instead, this positive link may arise from the fact that larger firms are likely to operate more efficiently and hence make higher profits. Therefore, these views give rise to the development of alternative interpretations of the SCP paradigm.

ii. Efficient structure hypotheses

The efficient structure hypotheses proposed in its X-efficiency and scale efficiency forms offer an alternative explanation to the relationship between market concentration and performance. The X-efficiency hypothesis argues that the positive correlation between concentration and profits could spring from superior operating efficiency and production technology, rather than non-competitive behaviour put forward by the market power (MP) hypotheses (Demsetz, 1974; Peltzman, 1977; Smirlock et al., 1984; Rhoades, 1985; Evanoff & Fortier, 1988). This is because firms that are more efficient are likely to gain larger market shares and have higher profits, as the lower production costs of efficient firms enable them to reduce price and compete with less efficient banks for market share. Therefore, the market structure (concentration) is not exogenous as assumed by the MP hypotheses, but instead it is determined endogenously. This approach accordingly posits a positive correlation running from conduct (efficiency) to performance (profits) and then to market structure (concentration) which is the reverse of the prediction of the SCP.

The other alternative interpretation of the ES hypotheses is based on scale efficiency. It essentially posits that firms may possess equally good management and technological skills but some can manage to produce at a more efficient scale, enabling them to reduce their unit production costs and hence realise higher profits. Since these scale efficient firms are likely to gain larger market shares due to realising abnormal profits and consequently making the market more concentrated. Accordingly, the causality is again reversed

compared with the MP hypotheses, yet the interpretation is slightly different from the X-efficiency hypothesis.

iii. Testing the SCP paradigm

The alternative interpretations of the SCP paradigm have produced a vast body of empirical research seeking to resolve this inconclusive causality issue. Many of these empirical studies rely on a single-equation model to test the SCP paradigm, where a measure of market structure and other relevant variables possibly affecting the performance of a firm are regressed on a performance measure. We now elaborate on methodological issues, where alternative measures of market structure and performance and the alternative model specifications with reference to the SCP hypothesis are reviewed.

To evaluate the competitive features of an industry through a single-equation model based on the SCP paradigm, one firstly needs to define measurements of market structure and performance. Traditionally, empirical studies tend to characterise the market structure by the size distribution of firms, indicating that different sizes of firms may affect competitive conditions differently. Given that this research focuses on the banking sector, the size of a bank can easily be acquired from a balance sheet (total assets or deposits), then one can define the banking market by the size of total banking sector assets or deposits. This method of deriving a proxy for market structure is simple to calculate, yet a rather crude measure because this proxy gives only one concentration indicator for the banking system. However, it is well known fact that many banks engage in different businesses such as mortgage loans, consumer loans, off-balance sheet activities, credit cards, and so on. Therefore, this feature of banks requires empirical analysts to account for market share information on these specific market segments, and its changes over time. However, since one cannot easily obtain the share of a bank in a specific market, many empirical studies rely on aggregated data such as total assets, loans, and deposits and derive proxies for market structure using methods such as *n*-bank concentration ratio (CR_n) and Herfindahl-Hirschman Index (HHI) to reflect the concentration levels of industries.

The CR_n index is the sum of market shares of top *n*-banks in the sector, a relatively easy to measure index compared with HHI. But this simplicity comes at a cost. This is because the method does not take any account of the remaining banks, whose share distribution can

have profoundly different implications. Furthermore, the lack of theoretical foundations suggesting a specific number of banks to calculate the index led researchers to make arbitrary cut-offs. This in turn is likely to induce inconsistent comparisons of the concentration ratios of different samples. For example, even if the CR_5 calculated for the banking industry of country A is bigger than calculated CR_5 for country B, this result may be reversed if the CR_3 or CR_{10} ratios are compared. In particular, the higher the difference in the number of banks between the samples, the more likely are inconsistencies in the comparison of the indexes calculated using different numbers of banks.

To handle these potential shortcomings one can employ the more data-intensive HHI that uses the market share information of each bank. The HHI index is defined as the sum of the squared market shares of all banks in the industry, which in turn gives greater weight to the banks having larger market shares. The index goes from 0 to 1 with higher values indicating higher concentration levels. The more the ratio increases, the more unequal are the shares of the banks in the market or as the number of banks drops. Therefore, this index reflects differences in market share inequality and numbers of competitors and it has been widely used in the enforcement of antitrust laws in banking (Bikker and Haaf, 2002). Further, it is argued that HHI can overcome the shortcomings of the CR_n index as it is less sensitive to changes in the number of banks and to the inequality in market shares among the different banks. Yet this method has also been subjected to criticisms in the theoretical literature. It is argued that although the number and size of banks differ significantly between markets, one can get the same HHI values (Davies, 1980). Furthermore, it is postulated that the HHI value can significantly decrease once a small firm enters into an oligopolistic industry, even though this entrance is not expected to induce a really significant drop in the degree of concentration (Hart, 1975). Given that banking markets tend to have oligopolistic competition, this handicap may lead to inconsistency in empirical results. Consequently, although these shortcomings lead researchers to develop different methods to measure concentration levels, these two methods (CR_n and HHI) have been widely utilised in the empirical studies due to their relative ease of calculation.

Alternative measurements, assumed to overcome the limitations of these two methods, have also been offered to proxy market structures in banking. Some researchers employed the number of firms in the market, since they argue that entry and exit tend to take much longer to realise than do changes in market share (Bikker and Haaf, 2002). On the other

hand, others include the number of firms in the calculation of a concentration index, as they argue that this number reflects to some extent the conditions of entry into particular industry (Hall and Tideman, 1967).[72] In addition to these alternative measures, other concentration measures, such as U-index proposed by Davies (1980) and the Hause Indices developed by Hause (1977), have also been offered, highlighting the significance of concentration stemming from their ability to reflect the structural features of a market (see Bikker & Haaf (2002)).

Once the market structure measure is chosen, one needs to identify a bank performance indicator. Most empirical studies employ either price or profit measures as a proxy for performance. The studies using the price of particular banking products and services argue that they can reflect the extent of a bank's market power as this translates exactly in the setting of prices at uncompetitive levels (Berger and Hannan, 1989). Moreover, it is argued that if Hicks (1935)'s Quiet Life (QL) hypothesis holds, then the positive correlation between profit and market structure is partially offset by the cost increases stemming from lower cost efficiency, possibly resulting in a weaker relationship between profits and market structure (Gilbert, 1984). In these circumstances, prices would be a much more accurate predictor of performance. Yet obtaining clear and reliable price information for various banking products is often very difficult and one needs to account for the associated costs of production as explanatory variable. In addition, the price of a single banking product might be deceptive given the multi-product nature of a bank's output and the possibility of cross subsidisation and the use of different pricing strategies across markets (Goddard et al. 2001; Evanoff & Fortier 1988). Similarly, an increase in prices might result from characteristics other than concentration, like product differentiation and research and development. In other words, banks with well-differentiated and high quality products and services can set higher prices and make abnormal profits (Shepherd, 1982b). Therefore, as an alternative to price, other researchers use profitability measures as a proxy for performance. Profit measures used as indicators of performance vary in the empirical literature. Some use aggregate profit rates, while others use the return on assets or the return on equity ratios to capture the profitability of a bank. These measures generally enable one to consolidate all product profits and losses

[72] It is hypothesised that the higher the number of banks in a banking industry, the easier it gets for new banks to penetrate into the market.

into one figure and also allow them to overcome the cross subsidisation problem discussed above (Molyneux and Forbes, 1995).

Having discussed the market structure and performance measures, we now examine the most widely employed SCP model specifications used to test the Market Power and Efficient Structure hypotheses. These empirical model specifications are usually static cross-section comparisons or are short-run in nature and assume that the market is characterised by a state of long-run equilibrium (Berger et al., 2004). Researchers tend to use simple ordinary least squares (OLS) to estimate the following type of single-equation model specified to account for variation in bank performance with a range of bank and market specific variables:

$$\pi_{ir} = \alpha + \alpha_1 CR_r + \alpha_2 MSR_{ir} + \alpha_3 \sum BS_{ir} + \alpha_4 \sum MS_r + u_{ir} \qquad (6.1)$$

In Equation (1.1) π_{ir} is the chosen profit measure for bank *i* in market *r*; CR_r is a measure of concentration in market *r*; MSR_{ir} is the market share of bank *i* in market *r*; BS_{ir} and MS_{ir} are respectively vectors of bank-specific and market specific variables hypothesised to have an impact of bank performance. Finally; u_{ir} is the error term.

A positive and statistically significant coefficient on $\mathrm{CR_r}$ (α_1), *ceteris paribus*, indicates that banks operating in a concentrated market are expected to earn higher profits due possibly to the collusion confirming the traditional SCP hypothesis. Alternatively, this positive and significant finding might reflect the exploitation of market power. In this case, banks operating in a concentrated market are able to exercise their market power and hence they can charge higher prices while paying lower rates of interest to depositors, resulting in higher profits (Berger and Hannan, 1998). This interpretation thus corroborates the RMP hypothesis. To this point, we have not considered the market share of the bank. In cases where the coefficient on $\mathrm{MSR_{ir}}$ (α_2) is significant and positive and if this leads to the loss of the explanatory power of the coefficient on $\mathrm{CR_r}$ (α_1) by making it zero or negative, this can be interpreted as evidence that bank profit is positively correlated with firm size instead of concentration. This therefore either lends support to the exercise of market power because larger banks might exercise greater market power and obtain abnormal

profits (Shepherd, 1986), or to the efficient structure hypothesis because high concentration endogenously reflects the market share gains of efficient banks (Berger et al., 2004).

To shed light on the alternative interpretations of the SCP paradigm issue, Berger (1995) attempted to account for bank efficiency measures (x-efficiency and scale efficiency) by incorporating these measures into the equation (6.1) and thus allow concentration and market share to be functions of these efficiency measures. In other words, properly accounting for efficiency via x-efficiency and scale efficiency measures allows market share and concentration to reflect solely market power effects. This new specification can be shown as the following single-equation regression model:

$$\pi_{ir} = \alpha + \alpha_1 CR_r + \alpha_2 MSR_{ir} + \alpha_3 XE_{ir} + \alpha_4 SE_{ir} + \alpha_5 \sum BS_{ir} + \alpha_6 \sum MS_r + u_{ir} \quad (6.2)$$

In equation (6.2) XE_{ir} is a bank-specific x-efficiency measure, and SE_{ir} is a bank-specific scale efficiency measure. This fuller model specification, interpreted by looking into the sign and significance of the coefficients between α_1 and α_4, allows one to find out which of the alternative SCP hypotheses hold. Among the first works using this specification is Berger (1995), who investigated the competitive features of US banking and found positive and significant coefficients on MSR_{ir} and XE_{ir}, supporting the relevance of both market power and efficiency on bank profitability. He accordingly interpreted these results that larger banks exercise their market power partly because they offer differentiated products (α_2) and that more efficient banks (irrespective of size) acquire higher profits due to their superior management ability and production technology (α_3). On the other hand, his results also imply that concentration, CR_{ir}, and scale efficiency, SE_{ir}, do not seem to have an impact on the profitability of banks. Yet the author points out that the results are generally weak and varied by market type, in turn lending limited support for two of the four hypotheses.

As reviewed above, empirical studies tend to rely on a single-equation model to evaluate competitive features in banking. Yet it is also possible to specify and estimate a simultaneous-equations model of the SCP paradigm. For example, comparison of single-

equation and multi-equation estimation techniques suggest that the failure of the single-equation methods to account for simultaneity bias casts doubts on the single-equation studies of the SCP paradigm (Peltzman, 1984). Therefore, one can specify a multi-equation SCP model to circumvent the potential simultaneity bias that may arise from a single-equation SCP model.

iv. Discussion of relevant empirical literature

We now give a brief synopsis of the findings of the relevant empirical literature testing the SCP paradigm, focusing in particular on the banking sector. Early empirical banking studies mostly tested the traditional SCP paradigm. A survey of the early U.S. banking literature undertaken by Gilbert (1984) lends support on the traditional SCP hypothesis. This is because most of the reviewed studies (32 out of 44) tend to find market structure to be a positive yet minuscule influence on bank profitability, which is attributed to collusion or other forms of non-competitive behaviour among banks. Similarly, Short (1979), investigating the relationship between bank concentration and profitability in a sample of banks from Canada, Western Europe and Japan, also finds a positive yet relatively small coefficient of the concentration variable, indicating that relatively large changes in concentration are required to reduce profit rates by one percentage point. Other studies focusing on the U.S. banking sector in the 1980s and 1990s find that the banks operating in more concentrated markets were able to charge prices higher than the competitive norm and were more likely to exhibit greater price rigidity (Hannan and Berger, 1991; Neumark and Sharpe, 1992). Unlike previous works, these findings are more in line with RMP hypothesis.

Since the early empirical findings were ambiguous and provided a weak correlation between market concentration and profitability, the efficient structure hypothesis suggests that banks with greater efficiency can result in increased profitability and higher market shares. For example, some studies suggest that concentration measures have only very weak relationships with the measures of profitability once the market share of banks is included (Berger et al., 2004; Berger and Hannan, 1998). They ascribe this finding to the higher efficiency of larger banks or to the ability of larger banks to exploit their market power to set prices at uncompetitive levels; that is, it is difficult to determine whether

efficiency or monopoly power is at work. This fuller model specification brought about alternative model specifications to elaborate on the inconsistency in interpretations.

To shed light on this conflict and obtain robust results, some studies suggest including direct measures of efficiency (X-efficiency and scale efficiency), and let concentration and market shares to be a function of these efficiency indicators (e.g., Berger, 1995; Frame & Kamerschen, 1997). The application of this suggestion into the US banking case lends support to both the RMP and X-efficiency hypotheses, yet it was acknowledged that the results were in general weak and varied by market type, i.e. neither the ES nor the SCP hypothesis is of great importance in explaining bank performance. It can be concluded that these empirical results are overall rather weak and do not lend much support to the relation between concentration and profitability as a valid predictor of the competitive conduct of firms.

v. Shortcomings of the SCP paradigm

The SCP paradigm has been subjected to a lot of criticism, from the assumptions underpinning it to the ambiguity of its policy implications. One criticism is that this paradigm is static in nature and is only applicable if the market is in long-run equilibrium. However, there is no guarantee that a profit variable observed at any point represents an equilibrium value, leading one to question the collusion inference drawn from the positive relationship between market structure and performance. Moreover, even if the market were in long-run equilibrium, other forms of equilibrium suggest a different relationship between market concentration and pricing conduct. For example, the contestability theory argues that when entry and exit are sufficiently free, incumbent firms can compete aggressively with one another in order to deter entry of new firms even if the existing market is concentrated (Baumol, 1982; Claessens and Laeven, 2004). The empirical work of Shaffer & DiSalvo (1994) tests this theory by looking at the conduct of two banks in south central Pennsylvania in the period 1970-1986. Their results indicate that the banks were actively competing under the duopoly market condition rather than colluding. Similarly, Coccorese (2005) investigates the conduct of single-branch Italian banks operating as monopolists in the local market between 1988 and 2005. He finds that despite their noteworthy size and significant market share, these banks were not colluding to exploit their monopoly power due to the existence of nearby competition. The argument

goes that the credible threat of potential entry can exert pressure on incumbents and they behave competitively to deter entry. Therefore, it is possible to conclude that the structural characteristics of the banking market are irrelevant in determining competitive conduct and instead the entry and exit conditions determine competitive behaviours.

Another criticism is that not only is the relationship between market structure and conduct uncertain, but also the direction of causality is ambiguous as the SCP paradigm suffers from endogeneity issues. This is because market structure may not be exogenous as assumed by the SCP paradigm; instead, it may be endogenously determined by the performance of banks, making the causality link run in both directions. This criticism is raised by Demsetz (1973), arguing that the observed positive relationship between market structure and the performance of firms by the SCP models may not necessarily stem from collusion or exploitation of market power. Instead, this result may be due to efficiency differentials among firms as argued by the Efficient-Structure hypothesis. This argument posits that the cost advantages of efficient firms enable them to increase their market shares and gain higher profits as they have lower production costs, enabling them reduce price and compete with less efficient firms for market share. The cost advantage of efficient firms become the driving force behind the process of market concentration, and if efficient firms dominate the market due to their cost advantages, then one may observe an increase in market concentration and profitability simultaneously.

Another criticism of the SCP paradigm is that the industry specific features of the banking industry (asymmetric information, switching cost, network externalities, reputation, etc.) could lead to an ambiguous association between market structure and competitive outcomes (Carletti, 2008; Northcott, 2004). For example, the presence of asymmetric information obtained by banks during the lending relationship may have opposite effects on the relationship between market structure and performance. On the one hand, banks operating in a concentrated market can behave competitively in the presence of asymmetric information. This is because the ex-post proprietary information on borrowers obtained through lending enables these banks to exploit the information in subsequent periods. Therefore, to acquire informational advantages over peers, these banks charge lower interest rates to compete for new borrowers (the “learning by lending” concept, see

Dell'Ariccia, 2001).[73] On the other hand, the information accumulated through lending allow established banks to distinguish more effectively between good and bad borrowers, compared to new lenders which are likely to fund the bad projects. Then, as banks compete with each other, adverse selection induces an endogenous fixed cost for new lenders and limits the number of competitors in a banking market in equilibrium (Dell'Ariccia, 2001). Therefore, the overall impact of the presence of information asymmetry on competitive conduct is ambiguous. The presence of switching costs can affect market structure and contestability. A good but opaque borrower may not be able to show its creditworthiness to a new lender and changing lender incurs additional physical costs (known as switching costs (Vives, 2001)). These circumstances in turn lock the borrower to a specific bank. This locked-in effect creates an endogenous barrier and provides a certain degree of market power to the specific bank over new lenders, which in turn force the borrower to pay interest rates above the competitive level (Diamond, 1971). Another factor affecting market structure and competitive features is network externalities. For example, although setting up an extensive branch network is costly, having a large branch network increases the likelihood of finding more customers. Therefore, the banks with large networks are more likely to gain market power which enables them to demand higher prices compared to competitors with smaller networks (Gehrig, 1996). Moreover, some banks tend to share e-bank service networks when the threat of new entry is high. The intuition behind the sharing agreements is to avoid ferocious post-entry competition and foreclose any potential entrants (Carletti, 2008).

Overall, the SCP paradigm fails to circumvent the endogeneity issue and does not consider factors such as market contestability. In addition, as discussed above, the existence of information asymmetry, network externalities, and switching costs can endogenously change market contestability. A growing body of empirical studies also argue that bank performance measures are more likely to be influenced by macroeconomic factors, the legal institutional framework, and regulatory environment rather than market structure (Claessens and Laeven, 2004). To circumvent the potential drawbacks of the structural approaches, non-structural methods, the so-called NEIO, relying directly on conduct, were developed in the 1980s. We now briefly introduce this approach.

[73] Banks obtain private information from some of their clients through the lender-borrower relationship and this proprietary information can be exploited in later periods.

6.4 Non-structural approaches

The structural approaches relying on the SCP posit that understanding of market structure underpins all pricing decisions made by firms from which one can make indirect inferences on the nature of competition. Yet some researchers raise doubt about the reliability of this paradigm as the general contestability of the market and entry/exit barriers can have direct influence on the competitive conduct of firms. The point that competition is a matter of behaviour and not of structure is also at the core of the theory of contestable markets postulated by Baumol (1982), who notes how the potential threat of entry and competition from new firms will be enough to induce competitive conduct on the incumbents. If access to technology is equal and there are no significant barriers to entry and exit, incumbents are forced to behave competitively to prevent entry. Therefore, the new methods, so-called non-structural approaches, seek to collect empirical evidence on the nature of competition by observing conduct directly.

The non-structural approaches can be classified based on their underlying assumptions. The first generation of non-structural approaches based on the oligopoly theory derive a measure of competition from the (static) theory of the firm under equilibrium conditions and basically employ some form of price mark-up over a competitive benchmark. These models include the Panzar-Rosse H-statistic, conjectural variations and the Lerner index. On the other hand, the second generation of non-structural approaches rely on empirical examination of the dynamics of markets and hence they are more in line with the Austrian (dynamic) conception of competition. These models include the persistence of profits and the Boone indicator. This is a deviation from the static and cross-sectional methodology that is common in much of the literature based on the SCP paradigm, the Panzar-Rosse method, and the conjectural variations approach (Goddard et al., 2011).

6.4.1 The Panzar-Rosse H-statistics

One of the most widely employed methods used to measure the degree of competition in early empirical studies is the Panzar-Rosse model (PR) developed by Panzar and Rosse (1987). The theory underlying the PR model is that depending on the competitiveness of an industry (oligopolistic, competitive, and monopolistically competitive markets), the

revenue of a profit maximising firm will change differently in response to changes in input prices. In other words, this method is based on the empirical observation of the elasticities of total revenue to the changes in input prices. The identification of competitiveness of an industry is derived by calculating the sum of elasticities of the revenue with respect to all input prices. The sum of elasticity, the so-called H-statistic, lies between -∞ and +1. The larger the transmission of cost changes into revenue changes, the more intense the competition is in a market.

Based on the explicit assumption of profit maximising behaviour of firms and assuming that the market is in the long-run equilibrium, under perfect competition the increase in input prices is expected to lead to an equiproportionate increase in the revenue of a firm. This is because an increase in the cost of production will increase the market price by exactly the same proportion, so that each firm continues to make a normal profit in the long run. Therefore, in perfect competition, the elasticity of revenue with respect to input prices (known as H-statistics) is equal to one. Under monopoly conditions, an increase in input prices causes a reduction in a monopolist's total revenue, as the monopolist operates on the price elastic portion of the demand curve. Therefore, in monopoly conditions, the elasticity of revenue with respect to input prices is negative or less than one. Under monopolistic competition, an increase in input prices will lead to a less than proportionate increase in total revenue. Thus, the H-statistic lies between zero and one for monopolistic competition. The PR H-statistics and relevant competitive environments are summarised in Table 6.1.

Table 6.1 Panzar-Rosse H-statistics and competitive environments

H-statistics	Competitive environment
$H < 0$	Monopoly or collusive oligopoly
$0 < H < 1$	Monopolistic competition
$H = 1$	Perfect competition

The PR H-statistic is modelled by estimating the reduced form revenue equation that can be written as follows:

$$\ln R_{it} = \alpha + \sum_{m=1}^{M} \beta_m n_{mit} + \lambda Z_{it} + \varepsilon_{i,t} \tag{6.3}$$

where $\ln R_{it}$ is the log of gross revenue of bank i in year t, n_{mit} is the price of input factor m for bank i in year t, Z_{it} corresponds to firm-specific and macro-economic exogenous control variables assumed to affect the revenue structure and $\varepsilon_{i,t}$ is a random disturbance term. The sum of estimated elasticities of revenue with respect to each input price gives H-statistics, which is a measure of competitive conduct:

$$H - statistics = \sum_{m=1}^{M} \beta_m \tag{6.4}$$

where m=1….M is the number of inputs included in the model.

The PR H-statistic has the appeal of simplicity due to the advantages in terms of data requirements. This method measures the competitive behaviour of firms through a reduced form revenue equation, which can be estimated by a simple single equation linear model requiring only input prices and revenues variables. Namely, although it focuses on the competitive conduct in the output market, one does not need to obtain any output prices and quantity information, which are relatively difficult to acquire in the banking sector. Moreover, one does not need to make any assumption on the definition of the market; namely, it is robust with respect to any implicit market definition (Shaffer, 2004). Further, since it only requires bank-level data and allows for bank-specific differences in production function, this facilitates cross-country studies (Claessens and Laeven, 2004).

Despite these advantages, the PR H-statistic has several shortcomings, leading a significant drop in its popularity in empirical studies. First, this measure neglects dynamics in the market and non-pricing strategies. Second, the valid interpretation of the results for the models of perfect and monopolistic competition require the market in which firms operate to be in long-run equilibrium at each point in time when the data are observed (Panzar and Rosse, 1987). This can be a critical issue in cross-sectional cases in particular, since a large number of heterogeneous firms operating within a single-industry is strong evidence of disequilibrium, undermining the validity of PR H-statistic results (Bikker et al., 2012). The

use of panel data fixed effects formulation might handle to control the unobservable heterogeneity across firms. However, the validity of the H-statistic depends on the static equilibrium assumption and this assumption can be violated in the panel data case if adjustment towards market equilibrium is partial and not instantaneous[74] (Goddard and Wilson, 2009). Third, the economic interpretation of the magnitude[75] of the H-statistic (apart from the long-run competitive equilibrium value of 1) is ambiguous, making it difficult to draw conclusions from cross-sample comparisons. In other words, it cannot be interpreted as a continuous function of the intensity of competition; namely that the degree of competition does not reduce (increase) with the reduction (rise) in the magnitude of H-statistics. Finally, the PR model assumes that firms are price-takers in the input market, yet some banks might exercise monopoly power when alternative savings products are not available, which in turn negatively affect econometric identification. It has been shown that if banks exercise market power on the input price by setting the deposit interest rates lower than competitive levels, this intervention is likely to yield higher values of the H-statistic and hence disguise market power on the output side (Shaffer, 2004).

The simplicity and less stringent data requirement has made the PR model a popular method to investigate competition in banking industries despite the potential shortcomings discussed above. Early applications of the PR model mainly focus on developed countries (Shaffer, 1982; Nathan and Neave, 1989; Molyneux, Lloyd-Williams and Thornton, 1994; Molyneux, Thornton and Michael Llyod-Williams, 1996; De Bandt and Davis, 2000; Bikker and Haaf, 2002; Casu and Girardone, 2006; Staikouras and Koutsomanoli-Fillipaki, 2006; Goddard and Wilson, 2009, among others). Most of these papers reveal that monopolistic competition is the pervasive market structure in the banking sector of developed countries. Only a few studies find evidence in favour of monopoly: for example, Italy from 1986-99 (Molyneux, Lloyd-Williams and Thornton, 1994), Japan from 1986-88 (Molyneux et al., 1996b), for small banks in France and Germany from 1992-96 (due partially to their advantages in the local markets) (De Bandt and Davis, 2000), and perfect

[74] Employing recent advances in dynamic panel data modelling might overcome the cases when adjustment towards market equilibrium in response to factor input price shocks is not instantaneous (Goddard and Wilson, 2009).

[75] Another criticism suggests that neither the sign nor the magnitude of H-statistics can be used to identify market power, since the study shows that the sign of H-statistics can be positive, even under conditions of substantial market power (Shaffer and Spierdijk 2015).

competition, such as Italy from 1998-2004 (Goddard and Wilson, 2009) and Korea during 1997-2000 (Park, 2009). It is argued that failure to reject the null hypothesis of monopoly in certain cases may arise from model misspecification bias, namely that when there is a partial, not instantaneous, adjustment towards long-run equilibrium in response to input price shocks, one should have a dynamic structure rather than the conventional static reduced form revenue equation (Goddard and Wilson, 2009). Recent studies tend to apply the PR model to developing countries and transition economies (Claessens and Laeven, 2004b; Gelos and Roldós, 2004; Al-Muharrami, Matthews and Khabari, 2006; Yeyati and Micco, 2007; Schaek, Cihak and Wolfe, 2009; Williams, 2012; Apergis, 2015, among others). The results of these studies show that the market structure of the majority of countries can be characterised by monopolistic competition, which is similar to the findings in the studies of developed countries. The studies assessing competition in the Turkish banking sector by using PR H-statistics also find that Turkish banks show monopolistic competition, which is a compatible result with other studies (Günalp and Çelik, 2006).

6.4.2 The conjectural variations approach

While both the SCP and the PR model are reduced-form analyses, the conjectural variations (CV) approach is a structural approach encompassing demand and supply relationships. The CV approach is based on oligopolistic behaviour that has long recognised that major firms operating in concentrated markets can compete with one another. Price and output decisions of profit-maximising firms affect market equilibrium and hence can affect the behaviour of competitors due to interdependence. What each firm believes is its rivals' response to its own actions will be is known as *conjectural variations*. Thus, it is not market structure to determine competitive behaviour, but the price and output decisions made by firms in anticipation of the potential or likely reactions of their competitors.

The empirical foundations of the CV approach are attributed to the pioneering work of Iwata (1974), Bresnahan (1982) and Lau (1982). The estimation of the structural model requires estimating a system of equations including a demand function, a cost (supply) function, and a specification of the interdependence of market participants (the degree of

collusion). One then can make inferences on the degree of competition in the market by assessing the estimated interdependence of market participants.

In the case of N-firms, homogenous-products and quantity-setting oligopoly, P is the market price, q_i is the i-th firm's output, $Q = \sum_{i=1}^{n} q_i$ is the total industry output, then the market demand is given by:

$$P = P(Q, z; \delta) \tag{6.5}$$

where z is a set of exogenous variables such as income and substitutions affecting demand, and δ is a set of unknown parameters to be estimated, and the cost function can be written as:

$$C_i = C_i(q_i, w_i; \beta) \tag{6.6}$$

where C is the i-th firm's cost, w_i is the input prices of the i-th firm; β is a vector of unknown parameters to be estimated.

The profit maximisation condition of firm i can be written as:

$$Max\ \Pi_i = P(Q, z; \delta)q_i - C_i(q_i, w_i; \beta) \tag{6.7}$$

When it is assumed that the decision-making variable for firms is the quantity of output, solving the profit maximisation condition for firm i can be shown as:

$$\frac{d\Pi_i}{dq_i} = p + f'(Q)\left(\frac{dQ}{dq_i}\right)q_i - C_i'(q_i) = 0 \tag{6.8}$$

which can be re-written as follows:

$$p + f'(Q)(1 + \lambda_i)q_i - C_i'(q_i) = 0 \tag{6.9}$$

where $f'(Q)$ is the inverse of the slope of the market demand curve, $\lambda_i = d\sum_{j \neq i}^{n} q_j / dq_i$ is the conjectural variation of firm i with respect to all other firms in the industry, showing the change in output of all other firms anticipated by firm i in response to an initial change

in its own output dq_i. The marginal cost of firm i is $C_i'(q_i)$. The value of λ_i ranges between -1 and $\sum_{j\neq i}^{n} q_j/q_i$, and it is related with different degrees of market collusion. For example, under perfect competition, an increase in output by firm i has no impact on market price and quantity, so that, $\frac{dQ}{dq_i}=1+\lambda_i=0$; $\lambda_i=-1$. In the case of Cournot-Nash equilibrium, a firm does not anticipate retaliation from other firms in response to its increase of output, so that an increase in output by firm i leads to an increase of the market output by the same amount, i.e. $\frac{dQ}{dq_i}=1+\lambda_i=1$ and hence $\lambda_i=0$. Under perfect collusion, where firms act like a cartel or pure monopoly, a firm anticipates a full retaliation from the remaining firms to protect their market share, and thereby an increase in output by firm i by one unit induces an increase in the market output by $\frac{Q}{q_i}$ units, namely $\frac{dQ}{dq_i}=1+\lambda_i=\frac{Q}{q_i}$; $\lambda_i=\sum_{j\neq i}^{n} q_j/q_i$.

Equation (6.10) can also be rearranged as:

$$\frac{p-C_i'(q_i)}{p}=\frac{1}{\eta}\theta_i \tag{6.11}$$

where $\frac{p-C_i'(q_i)}{p}$ is the well-known Lerner index, a measure of a firm's market power, proposed by Lerner (1934). This measure reflects to what extent market power enables firms to set a price above marginal costs. It relies on the assumption that under perfect competition price equals marginal cost and hence a measure of the degree to which price exceeds marginal cost gives a beneficial measure of market power.

In equation (6.12), the perceived elasticity of demand composes of two elements: $\eta = -(p/Q)*(\partial Q/\partial p)$, defined as the market price elasticity of demand for output; and $\theta_i = (1+\lambda_i)(q_i/Q)$ is associated with the degree of collusion in the industry. Since the value of λ_i ranges between -1 and $\sum_{j\neq i}^{n} q_j/q_i$, we can find corresponding values of θ_i which takes a value between 0 and 1. Under perfect competition, $\lambda_i=-1$, and thereby $\theta_i=0$, where price is equal to marginal cost. Under Cournot-Nash equilibrium, $\lambda_i=0$ and hence $\theta_i=qi/Q$; and in the case of perfect collusion, $\lambda_i=\sum_{j\neq i}^{n} q_j/q_i$ means $\theta_i=1$, where firms maximise joint profit. The interpretations of the conjectural variation parameters can be summarised in the Table 6.2.

Table 6.2 Conjectural Variation parameters with different equilibrium

Competitive environment	CV parameter, λ_i	Degree of collusion, θ_i
Perfect competition	-1	0
Cournot-Nash equilibrium	0	qi/Q
Perfectly collusive oligopoly or pure monopoly	$\sum_{j \neq i}^{n} q_j / q_i$	1

A major advantage of the CV approach is that compared to the reduced form analysis of the SCP paradigm and the PR H-statistic, this approach is not subjected to equilibrium restrictions and it is a structural approach modelling the explicit demand, cost and profit-maximising conditions faced by firms. The estimation of the degree of competition is acquired from the nature of the equilibrium among firms. This approach therefore not only gives the measure of competition but also provides information on the sources of the estimated competitive conduct. Another advantage is that compared to the SCP paradigm and the PR model, the estimated conjectural variation parameters can be treated as a continuous function of competition since it measures the actual deviation of marginal cost from competitive pricing (Shaffer, 2000). This in turn allows one to explore factors associated with the variation of the estimated competitive conduct, such as investigating the effect of policy changes on competition. However, this approach is not free from criticisms. It is a data intensive approach and requires choosing an appropriate functional form for the structural demand and supply equations. Moreover, this approach identifies competitive conduct by investigating the strategic response of a rival to the changes of a firm's output, yet it ignores the subsequent response of this firm to the changes of the output of its rivals. It is argued that it therefore undermines the feedback mechanism of firms, given that the dynamic response can be a significant factor in determining the competitive conduct (Church and Ware, 2000).

The CV approach as a measurement of competitive conduct has been widely applied in banking studies. Most of the work applying this approach assumes a homogenous-product and quantity-setting oligopoly model and estimates the CV parameter on quantities: for

example, for the United States, Shaffer and Di Salvo, Shaffer (1989); for Canada, Shaffer (1993); for Norway, Berg and Kim (1994); for the Netherlands, Toolsemea (2002); for Japan, Uchida and Tsutsui (2005); and for Thailand, Mahathanaseth & Tauer (2012). Fewer studies assume a heterogeneous-product price setting oligopoly model: for example, for Portugal, Barros and Modesto (1999) and Canhoto (2004); for Hong Kong, Wong et al. (2007); for Italy, Coccorese (2005); for Thailand, Mahathanaseth and Tauer (2012); and for Turkey, Aydemir (2013, 2014). Overall, the majority of the studies using the CV approach tend to show that banks' conduct is imperfectly competitive but far from collusive. This in turn indicates the presence of interdependence among banks and it can be inferred that the prevailing market condition is oligopolistic competition. Although strong collusion is rejected by many studies, there are a few studies accepting the existence of strong collusion (Berg and Kim (1994), Mahathanaseth and Tauer (2012), Canhoto (2004), and Aydemir (2013, 2014)). These studies show the existence of significant market power in the relevant countries. In the case of the Turkish banking sector in particular, the estimation results suggest that Turkish banks exercised collusive pricing in the deposit market between 2002 and 2011 and in the loan market in 1988 to 2009, indicating that the banking sector is conducive to a lack of competition.

6.5 The persistence of profits approach

The first generation NEIO approaches assume that competitive forces eliminate any observed abnormal profits quickly and thereby there will be no permanent differences among firms' profit levels in the long-run. Therefore, it can be inferred that any conduct and performance measures observed at any point in time represent equilibrium. Brozen (1971), however, contradicts this assertion and points out that the measures observed at any point in time may not represent equilibrium values. This is because incumbents can enjoy regulatory protection or boast capability to deter imitation or prevent entry. Therefore, this deterioration in competition can result in economic profits at any point in time and, moreover, some firms can sustain these abnormal profits, even in the long-run (Goddard et al., 2011).

There is a broad literature testing the dynamic view of competition and these methods are expected to circumvent potential drawbacks driven by the static market view. One method is the persistence of profits (POP) approach, which recognises the possibility that markets

can be out of equilibrium at the moment when the data are observed (Goddard et al., 2013). The POP hypothesis introduced and operationalised by Mueller (1977, 1986) is based on two fundamental conditions. First, free entry and exit in each product area are expected to rapidly eliminate any abnormal profits. Second, regardless of their initial values, all firms' profit rates tend to converge towards the average long-run equilibrium profit level of the industry. It is argued that the second condition, suggesting a swift elimination of abnormal profits, is weaker than the second condition. This is because free entry and exit are likely to reduce abnormal profits quickly as incumbents lose their market share and power due to the entry. Yet the convergence of profits to the same average long-run equilibrium may be realised slowly or in extreme cases not occur at all, creating differences in firm-level long-run average profit rates. In other words, bank profits can continue to persist in the real world of banking (Amidu and Harvey, 2016; Berger et al., 2000; Goddard et al., 2013). This is arguably because, against these two axioms, some incumbent firms might exploit other advantages stemming from, for instance, regulatory protection (e.g. patents, tariffs, licences), information asymmetry and greater efficiency, which can help hinder imitation and block entry. If so, these firms profits can persist from year to year, and differences in firm-level long-run mean profit rates can be prolonged over time (Goddard et al., 2013, 2011; Mueller, 1977).

The theoretical model investigating the degree of persistence of profitability is basically based on an autoregressive model (AR) of firm profitability. Most of the previous POP studies estimate a first-order autoregressive model, AR(1), for the profit rate. That is, they assume that the current year's profit level is affected by the previous year's profit level. This AR model specification is, in fact, a reduced form of a system of two equations justified by Geroski & Jacquemin (1988). The first equation suggests that the difference between current and previous years' profits is being affected by current and past entry; this is because while actual entry lowers the market share of incumbents, the potential entry threat prompts incumbents to take costly pre-emptive actions (e.g. price cutting, advertising, etc.) (Goddard et al., 2013, 2011). The second equation posits that current entry is being determined by previous years' profits, as newcomers are more likely to take these into account before deciding whether to enter or not into a market (Goddard and Wilson, 1999). That is, these two equations account for the impact of entry (both actual and threatened) on the dynamics of profit. However, even if one can obtain observations of actual entry, the full effect of entry on profits is understated since the threatened entry

variable is unobservable (latent) (De Bandt and Davis, 2000; Goddard and Wilson, 2009). Therefore, one needs to apply a method enabling circumvention of the latent variable issue. The method offered to handle this issue is to re-parameterise these two equations into a reduced form model incorporating observations of profits over time, in which entry is effectively a latent variable (Geroski and Jacquemin, 1988; Goddard et al., 2011; Goddard and Wilson, 1999). This transformation is detailed hereafter.

First, the change in the normalised profit rate[76] of bank *i* between years *t* and *t-1*, shown as $\Delta\pi_{i,t}$, is assumed to be a function of the threat stemming from current entry in year *t* or past entry that directly affects bank *i*'s profitability, shown as $N_{i,t-m}$ where *m=0, 1, ..., ∞*; and an idiosyncratic error component, shown as $\varepsilon_{i,t}$:

$$\Delta\pi_{i,t} = \theta_i + \sum_{m=0}^{\infty} \theta_m N_{i,t-m} + \varepsilon_{i,t} \tag{6.13}$$

In Eq. (6.13), the coefficients θ_m, measuring the effect of $N_{i,t-m}$ on $\Delta\pi_{i,t}$, are assumed to be the same for all banks operating on the market. Moreover, entry is supposed to be a function of past realisations of bank i's standardised profit rate and an error component, shown as $v_{i,t}$:,

$$N_{i,t} = \mu + \sum_{m=1}^{\infty} \delta_m \pi_{i,t-m} + \nu_{it} \tag{6.14}$$

In Eq. (6.14) the coefficients δ_m, measure the effect of the past realisation of bank *i*'s standardised profit rate ($\pi_{i,t-m}$) on entry ($N_{i,t}$). This impact is assumed to be the same for all the banks. Once Eq. (6.14) is substituted into Eq. (6.13) and re-parameterised, this transformation results in an auto-regressive model for bank *i*'s standardised profit rate:

$$\pi_{i,t} = \tilde{\pi}_i + \sum_{m=1}^{\infty} \lambda_m \pi_{i,t-m} + u_{i,t} \tag{6.15}$$

[76] Fluctuations and/or macroeconomic changes are likely to cause extensive variations in the profit rates of banks. Since the banking sector is more susceptible to business cycles and regulatory and economic changes, one needs to account for these differences to avoid the negative implications on the econometric analysis (Bektas, 2007; Glen et al., 2001). The common method applied in the literature to circumvent this pitfall is to express the profit rates of all banks within each country, $\pi_{i,t}$, as a deviation from the cross-sectional mean profit rate in year *t*.

where $u_{i,t}$ is an idiosyncratic error component. It is common to apply a first-order auto-regressive (AR(1)) specification. Higher orders tend to induce insignificant lagged variables under short time-dimensions and to mitigate any endogeneity issues which would possibly stem from inclusion of more lagged dependent variables (Bektas, 2007; Chronopoulos et al., 2015; Goddard et al., 2011). Moreover, it is also found that incorporating lagged variables beyond one year barely changes the general pattern of the estimation results, as the profits above the industry average tend to last no longer than a year (Geroski and Jacquemin, 1988; Maruyama and Odagiri, 2002). The AR (1) specification in Eq. (6.15) results in:

$$\pi_{i,t} = \tilde{\pi}_i + \lambda_1 \pi_{i,t-1} + u_{i,t} \tag{6.16}$$

In Eq. (6.16) $\pi_{i,t}$ and $\pi_{i,t-1}$ are normalised profit rates for bank *i* in period *t* and *t-1* respectively, and $\tilde{\pi}_i$ demonstrates bank *i*'s long-run normalised profit rate. The adjustment of normalised profit rates shown in Eq. (6.16) is interpreted because of the interaction between profitability and entry, as suggested in the contestable markets literature (Baumol, 1982; Breshnan and Reiss, 1991). Eq. (6.16) is employed to estimate the short-run persistence of profits. That is, the estimated value of λ_1 reflects the profit persistence that can be interpreted as an indicator of the intensity of competition or as a measure of the speed of adjustment of short-run profits. In other words, this value reflects the intensity of competition or speed of adjustment to the mean profit of the market. If $\lambda_1 = 0$, there is no relation between $\pi_{i,t-1}$ and $\pi_{i,t}$, indicating the presence of perfect competition in the industry, since abnormal profit is a temporary short-run phenomenon and it disappears rapidly. If $0<\lambda_1<1$, there is a positive relation between $\pi_{i,t-1}$ and $\pi_{i,t}$, providing evidence of persistence of profits in the short-run. This is because the elimination of abnormal profits through competition is not realised rapidly, and banks are able to sustain a notable portion of their excess profits. If λ_1 is high, or close to one, then short-run profits are persistent and competition is thus deemed to be weak. If this is small, or close to zero, then it can be inferred that short-run profits are quickly eroded and hence competition is deemed to be fierce.

It is also possible to investigate the speed of convergence of abnormal profits towards the average long-run profit levels. The contestable market theory suggests that the force of competitive threat or contestability is expected to induce a significant and rapid

convergence of supra-normal profits towards the mean profit rates. Yet this convergence process does not always work as the theory suggests. This is because the convergence mechanisms are not always untying the leading firms, which has been confirmed by cross-country studies (Geroski and Jacquemin, 1988; Mueller, 1990) as well as single-country studies (Goddard and Wilson, 1999; Schohl, 1990; Yurtoglu, 2004). The maximum speed of convergence towards industry means profit level is accordingly realised when $\lambda_1 = 0$ in the univariate AR(1) process shown in Eq. (6.16). If this is true, firm i's long-run projected profit, $\bar{\pi}_{i,p}$, is constant over time and equal to average (equilibrium) profit level $\bar{\pi}_{i,p} = \pi_{i,t} = \pi_{i,t-1}$. Therefore, Eq. (6.16) is used to obtain the long-run profit:

$$\bar{\pi}_{i,p} = \tilde{\pi}_i + \lambda_1(\bar{\pi}_{i,p}) + \vartheta_{i,t} \tag{6.17}$$

where

$$\bar{\pi}_{i,p} = \frac{\tilde{\pi}_i}{(1 - \lambda_1)} \tag{6.18}$$

Given the condition of $-1<\lambda_1<1$, $\pi_{i,t}$ converges towards $\bar{\pi}_{i,p}$ as t increases and thus $\bar{\pi}_{i,p}$ reflects the long-run profit rate of the industry. The $(1 - \lambda_1)$ component in the partial adjustment model indicates the speed of adjustment. The higher value of the $(1 - \lambda_1)$ component signifies that transfer of the previous year's profit level to the current year is less likely to be realised and the profit from the past does not affect current profit significantly. Under this circumstance, the previous year's profits cannot be sustained over the following year due partly to the competitive environment. Therefore, the convergence or the speed of adjustment towards the mean profit of the industry is quite fast.

The empirical studies testing the persistence of profits hypothesis for the banking industries mainly focus on the following three research questions. First, do competitive forces successfully dissipate abnormal profits in the short-run? Second, are all firms profits levels converged quickly towards long-run average profit rate? Third, what characteristics (bank-specific, industry-specific, macroeconomic, or country specific) account for the observed differences in persistent profitability and for the speed of the convergence towards the average industry profit level? These questions are of interest for regulators in particular, as they not only need to know whether profits persist, but also which policy

tools and when these tools are needed to be introduced to ensure a competitive environment.

In the first stage of the POP analysis, empirical studies have tested whether excess profits persist from year to year. This literature relies mostly on time-series variation of bank-specific or industry-level profit rate data and draws inferences regarding the intensity of competition. Some of the early cross-country studies find evidence of profit persistence despite intensifying competition in the European banking over between 1992 and 1998 (Goddard et al., 2004a, 2004b). Similarly, Goddard et al. (2013) found evidence of the persistence of profits from one year to the next in eight EU member countries between 1992 and 2007. They also found that the persistence tends to become weaker due to the expected increase in the banking competition following the integration of EU financial markets with the introduction of the Euro in 1999 and the implementation of the Financial Services Action Plan. Another comprehensive cross-country study by Goddard et al. (2011) covering national banking sectors in 65 countries over the period of 1997-2007 found that the persistence of profits seems to be stronger for banks in developed countries than for those in developing countries. They argue that a higher rate of growth in GDP per capita indicates that business opportunities driven by higher economic growth tend to increase competition and thereby weaken the ability of incumbent banks to persistently make excess profits. Another cross-country study investigating the persistence of profits in the Sub-Saharan Africa finds moderate persistence of profitability, denoting that departures from perfectly competitive market structures might not be that large in developing countries (Flamini, McDonald and Schumacher, 2009). Yet the study by Amidu and Harvey (2016) casts doubt on the finding of the previous study as this study finds a high level of profit persistence in the African banking sector, which tend to converge at a very slow pace to the norm.

The evidence from single-country studies also confirms the existence of persistence of profits, yet the level of persistence changes based on the country. For instance, a study investigating the Greek banking sector over the period 1985-2001 shows that profitability persists to a moderate extent (Athanasoglou, Brissimis and Delis, 2008). Agostino, Leonida and Trivieri (2005), investigating the Italian banking sector over the period 1997-2000, find that profit persistence is attributed to ownership concentration, indicating that the bigger shares are held by specific banks. Another study focusing on the Turkish

banking sector finds that the persistence of profits became stronger after the global financial crisis (Yildirim, 2015). In general, the reviewed literature concludes that bank profits continue to persist at different levels in various countries. These studies largely attribute the existence of persistence to the impediments to product market competition, resulting in market power in output markets, and informational opacity, resulting in market power in input markets. It is argued that without market power, abnormal profits would be dissipated quickly as new firms penetrate into the market, imitate the products or processes of innovative leading firms, bid for profitable customers, or bid up the price of managerial talent (Berger et al., 2000).

In the second stage of the POP analysis, studies question whether abnormal profits converge to norm profits eventually and, if so, what is the speed of this convergence. Theory suggests that competitive forces eventually eliminate profit differentials among different firms in the long-run (Mueller, 1977). This is because if a firm enjoys excess profits then competitors penetrate into the market and offer similar products at lower costs until the profitability in the industry is equal to the competitive rate. On the other hand, if a firm has profits below average, investors move to a new market with higher profits and the firm with profit under average is eliminated if corrective measures are not introduced, restoring at least normal profits. Yet the empirical findings show that this convergence may not occur immediately or possibly even at all. For instance, a recent comprehensive cross-country study investigating the national banking industries of 65 countries confirms that although competitive forces are effective in eroding abnormal profits in the long-run, the speed of convergence to the norm is not instantaneous and tends to differ among countries (Goddard et al., 2013). The study attributes this finding to the market power of some banks stemming from informational opacity and their ability to block entry, allowing these banks to sustain a notable portion of their supra-normal profits from year to year. Similarly, the studies analysing the profit persistence and the speed of convergence of the banking sectors in Africa find a high level of profit persistence and a relatively low-level speed of convergence to the long-run average industry profit level (Amidu and Harvey, 2016; Sarpong-Kumankoma et al., 2018). Some single-country studies also confirm the fact that the convergence towards the same long-run average profit rate is realised, but this convergence also takes time. For example, deregulatory policies enacted during the 1990s appears to have induced profits to converge towards long-run average profitability levels in US banking (Chronopoulos et al., 2015). Knapp, Gart and Chaudhry (2006), for example,

investigate the profit persistence in a sample of US banks and suggest that profits take about five years to converge towards mean industry norms.

On the other hand, there are also studies find that profits do converge immediately, or profits do persist even in the long-run, rejecting the hypothesis that there is eventual convergence towards the same long-run profit rate for all firms. A study finding evidence on the immediate convergence of profits focuses on the Turkish banking sector over the period 1989-2003 and concludes that in the long-run the persistency of profits does not exist in the Turkish banking sector because the long-run average profit rate is very close to zero (Bektas, 2007). The studies finding evidence on the persistence of long-run profits tend to focus on non-banking industries. One study focusing on the banking sector of five large Western European countries and the United States over the period 1993–2014 finds evidence on the persistence of profits in the long-run for all six countries before the financial crisis in 2008 (Gugler and Peev, 2018). In a non-bank single-country case undertaken for Japan, Maruyama & Odagiri (2002) estimated the long-term profit rates of 357 Japanese manufacturing firms using the 1964-1997 profit-rate data and found that the top one-sixth initially most profitable firms estimated to earn higher-than-average long-run profit rates persisted with these profits, even in the long-run. This study also highlights that although increasing competitive pressure led to reductions in the profits of the most profitable firms over time, the force of competitive threat or contestability was far from perfect. A similar finding clearly rejecting the hypothesis that there is eventual convergence towards the same long-run profit rate for all firms is found by Goddard & Wilson (1999) based on a UK dataset containing profit data for 335 firms. Overall, these studies attribute these findings to the sustained efforts to the incumbents to innovate, which in turn enable them to impose entry and mobility barriers, resulting in less contestable markets.

The studies reviewed above highlight the significance of investigating whether abnormal profits converge to the norm. In addition to this point, recent studies also focus on the potential factors explaining the persistence of profits. This has been a crucial issue, particularly for the banking sector. This is because the industry has been undergoing constant regulatory changes (e.g. regulation, deregulation, prudential reregulation, restructuring, consolidation) and a complete change in the characteristics of banking business (e.g. increasing non-traditional activities, developing technological infrastructure)

since the 1980s. These changes in turn might affect the market power of banks differently and hence profit rates may slowly converge to the industry norm, or not converge in some extreme cases. This conclusion is crucial from an anti-trust, regulatory and supervisory point of view, since understanding the determinants of persistence not only give insights into whether competitive equilibrium can be achieved without intervention, but which intervention is required to achieve a competitive outcome.

The third stage focuses on the studies investigating the determinants of the persistence of profits in the banking sector. Some of these studies tend to place their attention on merely bank-specific and/or industry-specific factors, while others also take into consideration the impact of recent regulatory changes, institutional developments, and macro-economic factors on the profit persistence in the banking sector. Therefore, it can be inferred that many possible factors likely to influence the persistence of profits of banks have been used in the literature. We now briefly review the key determinants of bank profit persistence based on four categories: bank-specific, macroeconomic, industry-specific, regulatory, and institutional-external governance.

First, the key bank-specific factors assumed to determine the profit persistence are bank size, earning management, operating efficiency, bank age and innovation. The effect of bank size appears to be non-linear, because while it can have a negative impact, due possibly to the bureaucratic bottleneck and managerial inefficiencies suffered by banks as they become 'too large' (Amidu and Harvey, 2016), it can have a positive impact on the persistence due to the economics of scale (Flamini et al., 2009). Earning management is assumed to protect insiders' private control benefits by reducing outsider interference and appear to contribute to the persistence of profits while older banks are more likely to persist their profits as they accumulate a lot of know-how and experience, which in turn enable them to charge higher interest rates (Amidu and Harvey, 2016). Operating efficiency appears to have a positive relationship with profit persistence in the banking sector of four SSA countries (Sarpong-Kumankoma et al., 2018). They attribute this finding to the fact that the more efficient banks are able to maintain a lower cost to income ratio, which in turn enhances their profitability (Sarpong-Kumankoma et al., 2018). Another possible factor explaining the profit persistence is innovative activities such as ATM's, mobile banking, internet/online banking, etc. On the one hand, adoption of new technologies or the offering of new services can generate market power stemming from

impediments to product market competition and informational opacity, which in turn enables the innovators to sustain their abnormal profits over time (Berger et al., 2000). These activities can also replace labour intensive methods with automated processes, reducing operational costs and thereby increasing profitability (Sumra et al., 2011). On the other hand, banks incur high infrastructure costs and high advertising expenses to adopt the new technologies or promote these new products or services; however, it takes time for customers to accustom to the new technological services and they require a certain level of education to use, these in turn might affect profitability negatively (Akhisar et al., 2015).

Second, the key macroeconomic factors tested in the literature are GDP growth, inflation, and financial crisis. The GDP growth measures, introduced to control general economic development, seem to have a negative relationship with the persistence of profits (Goddard et al., 2011). This is arguably due to increasing business opportunities driven by economic growth, lowering the opportunity cost of entering into the banking sector and hence reducing entry barriers. The impact of inflation on profit persistence is ambiguous. On the one hand, one study suggests that banks increase their interest rate margins to deal with the negative effects of increasing inflation, which in turn lead to the persistence of profits (Amidu and Harvey, 2016). On the other hand, another study finds that inflation appears to exert little or no influence on profit persistence (Goddard et al., 2011). The financial crisis in 2008 appears to induce an increase in profit persistence, which would be the result of a number of ad hoc policy implementations (such as taxpayer-funded bailouts of large failing banks) that seems to prioritise stability over competition during the crisis period (Chronopoulos et al., 2015).

Third, the key industry specific factors considered in the literature are ownership concentration, the level of concentration, and the intensity of competition in the banking sector. The ownership concentration hypothesis positing whether and to what extent ownership concentration and shareholder identity affect profit persistence has been tested for a sample of 331 Italian banks for the period 1997–2000 (Agostino et al., 2005). The study confirms the hypothesis that the bigger the fraction of shares held by banks or foundations, the higher the profit persistence. The industry concentration measure proxied by the average Herfindahl–Hirschman Index appears to have a positive relationship with the persistence of profits, which is attributed to the collusion hypothesis positing that explicit or implicit cooperation among incumbents, resulting in higher rates on loans and

lower interest rates on deposits (Goddard et al., 2011, 2001). On the other hand, the concentration does not contribute to the bank profit persistence in the banking sector of four SSA countries, suggesting that the overall impact of concentration on persistence is uncertain (Sarpong-Kumankoma et al., 2018). The degree of competition, proxied by the Panzar-Rosse H-statistics and the Boone indicator, appears to exert a negative impact on the persistence of bank profit, suggesting that more intense competition weakens the ability of incumbents to sustain their profits (Amidu and Harvey, 2016; Goddard et al., 2011).

Fourth, the studies focusing on the determinants of profit persistence also consider the regulatory developments and the institutional and external governance factors as possible determinants. The erection or enforcement of legal barriers to entry associates positively with profit persistence, suggesting that successful banks that are protected by entry barriers are better able to sustain their profitability over time (Goddard et al., 2011). However, the same study also finds that other regulatory factors (activity restrictions, capital regulation, and financial freedom) appear to have little or no significant impact on profit persistence. Another study focusing on the regulatory factor finds that deregulation eliminating the federal restrictions on interstate banking in the US banking sector resulted in reduced profit persistence, yet deregulatory policies are found to have resulted in an increase in profit persistence when they allowed banks to diversify across business segments (Chronopoulos et al., 2015). The institutional development and external governance factors such as economic freedom, transparency, law quality, bureaucratic quality, and institutional development appears to promote competition and this tends to reduce the persistence of profits (Amidu and Harvey, 2016; Goddard et al., 2011; Sarpong-Kumankoma et al., 2018).

Overall, it can be concluded from the reviewed studies that there are considerable variations in the factors affecting profit persistence in different countries and their influence may change based on the country. The degree of profit persistence provides insights into the effectiveness of competition policies and the differences observed in their determinants indicate the need for tailor-made responses in different countries.

6.6 The Boone indicator

A more recently developed measure of competition, taking into account dynamics in market and non-pricing strategies, is proposed by Boone (2008) and has become known as the Boone indicator (BI) in the literature. The BI is based on the idea that competition rewards efficiency and punishes inefficiency. It starts from the notion that more efficient banks (i.e. banks with lower marginal costs) gain market share or increase profits at the expense of less efficient counterparts. The indicator relies on this reallocation effect from inefficient banks to efficient ones, as Boone (2008) shows that this effect is monotonically increasing in the degree of competition.[77] In other words, the higher the intensity of competition, the greater the reallocation of market shares or profits from less efficient to more efficient banks, and vice versa. The BI theoretically supports the empirical findings of Stiroh and Strahan (2003) who found that increased competitive pressure leads to a substantial reallocation of assets towards more efficient banks.

The intensity of competition is estimated from the following profit equation:

$$ln\pi_i = \mu + \beta lnmc_i + \nu_i \tag{6.19}$$

where π_i stands for the profit of bank i and mc_i denotes the marginal cost of bank i, which is a proxy for efficiency. The coefficient β is the BI and it is the elasticity of profits with respect to marginal cost, used as a measure of the degree of competition. In theory, this indicator is expected to be negative, as it reflects the fact that lower marginal costs (higher efficiency) are associated with higher profits. In other words, higher profits are achieved by more efficient banks. In addition, the magnitude of β reflects the degree of competition so that the more negative β indicates a higher level of competition as the effect of reallocation is stronger.

Instead of using a log/log specification as in Eq. (6.20), it is also possible to estimate profits and marginal costs in levels. This allows one to use negative profit levels and

[77] Boone (2008) considers two factors resulting in an increase in competition. One of the factors is a fall in entry barriers, enabling new banks to enter the market and hence the more competitive the sector should be. The other factor is the more aggressive interaction among incumbents. As long as the reallocation condition holds, the BI remains valid.

possibly eliminate the selection bias. However, the log specification, though ignoring negative profit values, enables one to interpret coefficient β as elasticity. Moreover, (Boone et al., 2013) show that results are weakly sensitive to the exclusion of the negative profit values as this does not generate a bias in the estimates of PE. Therefore, most of the empirical studies tend to use a log/log specification.

Some studies introduced modifications to the model in Eq. (6.21). First, it is associated with the computation of the marginal cost that cannot be observed directly. This variable has been approximated by the ratio of average variable costs to total income (or total assets) (Boone et al., 2004; Schaeck and Cihák, 2010). Since this approximation is likely to be distorted by the impact of scale economies, the observation-specific estimates of marginal costs, which are arguably more precise and in line with theory, has been derived by estimating a translog cost function (van Leuvensteijn et al., 2011). This practice also allows one to focus on segments of the banking sector such as the loan market where no direct observations of individual cost items are accessible. Second, efficient banks may prefer to transfer lower costs either into higher profits or into lower output prices to attain market share. Therefore, some studies employ the market share as a dependent variable to take the second possibility into account. This is because these studies argue that in a more competitive market banks are more likely to transfer efficient gains into lower output prices, which in turn increase their market shares (Tabak et al., 2012; van Leuvensteijn et al., 2013).

The BI has a number of appealing properties. First, it overcomes the shortcomings of traditionally used concentration-based measures of competition (such as CRn, HHI index, Lerner index, etc.), as these measures can sometimes incorrectly suggest a fall in competition when the interaction among banks becomes more aggressive. That is, when competition becomes more intense, profits or market share are reallocated from inefficient banks to efficient banks. In this case, some banks may even go bankrupt as a result of the increased competition and leave the market. This raises concentration in the market, yet it cannot be interpreted as a fall in competition. Therefore, relying on these measures may result in misleading inferences as high concentration is deemed to be sign of a lack of competition. This is particularly crucial given the fact that recent literature has concluded that concentration is a poor proxy for competition in banking (Berger et al., 2004; Casu and Girardone, 2006; Claessens and Laeven, 2004). Second, the BI can be obtained by

estimating a simple single-equation linear econometric specification and it does not require imposing any restrictive assumptions, unlike the Panzar and Rosse H-statistics requiring that the market must be in the long-run equilibrium. Third, the relationship between profit and cost is both continuous and monotonic, and hence higher competition implies that the value of β is larger in absolute terms (more negative). That is, while the identification of a situation from the PR H-statistics is ambiguous, the BI is monotonically related to competition. Fourth, estimating the BI requires data only on profits (or market shares) or costs and it can be easily calculated for a limited number of observations, which therefore makes it suitable for studies on developing countries where data can be a challenge. Moreover, if the costs are proxied by average costs this method does not need information on prices. Fifth, instead of considering an entire banking market, this method allows one to evaluate competition for different ownerships of banks and for several specific product markets such as the loan market. This in turn not only enables one to focus on which bank output is prone to more or less competitive pressure, but also it is possible to compare which bank type faces more competition (Tabak et al., 2012). Finally, the BI may be time dependent - namely one can measure competition on annual basis - which in turn allows tracking down the evolution of competition over time.

The BI, which is a relatively new approach used to measure competition, has been subjected to criticisms. First, this approach focuses solely on the relationship between profitability and marginal costs affected by competition, hence disregarding other aspects. For instance, efficient gains might not be translated into lower prices or higher profits in the short-run. This is because a bank may prefer to invest these gains (innovation, extend branch-network, etc.) to deal with competition in the future. Moreover, if an incumbent is faced with the threat of entry, it may adopt strategies to deal with competition (raise service quality, offer well-design products, etc.) instead of reducing prices. In such cases, if the incumbent offers the most highly demanded products, the increase in the incumbent's costs because of these strategies are likely to be compensated by profitability increasing above the rise in its costs. Theoretically, this case would turn the prediction of Boone's (2008) model upside down. In other words, the β coefficient might be positive when banks are competing on quality, making the identification impossible (Tabak et al., 2012).[78]

[78] It is argued that as the market grows as a whole banks may increase their marginal costs to capture additional demand by the quality channel (Tabak et al., 2012).

Second, another criticism of Boone's (2008) model is related to firm size. This model assumes that the most efficient firm must become the biggest firm with respect to market share and thereby, owing to its efficient level, it must make the greatest profit level. Yet it is argued that in reality, big firms are not necessarily the most efficient firm and hence it is possible to obtain a non-negative β parameter (Schiersch and Schmidt-Ehmcke, 2010). Lastly, the BI might have the limitation of being an estimate and hence is surrounded by a degree of uncertainty (van Leuvensteijn et al., 2011).

The BI, a new approach used to measure competition in empirical banking studies, has been gaining popularity among empirical studies. Researchers tend to adopt two or more measures of competition since the empirical results based on different competition measures can give different results. On the one hand, some studies measuring competition in cross-country and country specific cases using different models found conflicting and inconclusive results. For example, Delis (2012) used the BI as well as the Lerner index and CR3 to investigate market power in the banking industries of 84 countries across the world. This study suggests that competitive conditions are likely to improve more in countries which have advanced institutions and a high level of institutional development. This study also investigates to what extent this result is sensitive to the methods used to measure competition. It concludes that the results of the BI are in line with the results on the Lerner index, but the results on the CR3 are qualitatively and quantitatively different. Xu, van Rixtel and van Leuvensteijn (2016) used conventional indicators such as the Lerner index, PR H-statistics as well as BI to measure competitive conditions in China over the period 1966-2008. This study argues that conventional methods might not assess bank competition in China's context correctly, largely due to the existence of interest rate regulations. It instead suggests that the BI, whose theoretical foundation is the concept of relative profit difference, is likely to result in a correct measurement of competition under both binding deposit and loan interest rate regulations. Liu, Molyneux and Wilson (2013) investigate to what extent different competition measures yield similar results. This study finds that the measures of competition derived using the Lerner index is significantly correlated with the ones derived by using the H-statistics and the POP. Yet the competition measures obtained from the estimation of the BI do not show any significant correlation with other competition measures, indicating that different methods may lead to inconsistent evaluation of competition. It can be inferred from these studies that different

measures do not provide the same information about competition, and thereby catch different aspects of competition (Degryse et al., 2009).

On the other hand, some studies estimating multiple models to test the robustness of the results show that different models could yield similar results. For instance, Clerides, Delis and Kokas (2015) used the BI, Lerner index and the efficiency-adjusted Lerner index to measure competitive conditions for a large number of countries for the period 1997-2010. This study finds that these three methods produced similar patterns of competition over time, indicating that different methods can also yield similar results. In addition, this study also finds that competition differs across regions and income groups, and competition tends to be higher in developed countries compared to low-income countries, consistent with Delis (2012). Mirzaei and Moore (2014) examine the determinants of competition in a cross-country study case, where competition is measured by using the Lerner index and the BI. The study finds that the results are robust to alternative measures of competition. Therefore, the review of the above results indicates that the models used to measure competition can yield contradictory and inconclusive results across countries, within countries, and over time. This is arguably because as each method employed to estimate the competition has different theoretical underpinnings, assumptions and employs different data, thus it is not surprising that they sometimes yield conflicting results. Selection of the model largely depends on the purpose of a study, research questions, data availability and nature of data, i.e. bank level or industry level. Nevertheless, this does not mean that for some cases different indices can point to similar results regarding the level and pattern of competition observed or explanatory variables of some other variable. Thus, the literature suggests adopting a multiple model approach, which not only can contribute to the robustness of the results, but also can provide complementary results given that the models allow for different analysis of the dynamics of competition.

6.7 Conclusion

The significant role of the banking sector in an economy makes competition among banks an important and timely policy issue. Many empirical studies therefore seek to assess the determinants and implications of competition in the banking sector. Yet one first needs to measure the level and/or evolution of competition. In this chapter, we outlined the variety of ways used to measure banking sector competition. The literature on the measurement of

competition centres on two principal methods: structural and non-structural approaches. The structural approach, based on the SCP paradigm, infers the level of competition from the structure of an industry. The likelihood of collusion becomes higher in markets with fewer banks and high barriers to entry and exit. The structural approach has been subjected to criticism due to concerns over its conceptual framework and interpretation. First, it cannot identify the intensity of competition in the industry. Second, the framework fails to establish a clear causality between structure and performance. Third, the structure measure is unable to reflect market contestability. Lastly, the model fails to account for crucial banking characteristics influencing the competitive mechanism. Therefore, it can be concluded that this approach provides only limited information concerning market competitiveness. Non-structural approaches, which have their roots in the NEIO literature, instead attempt to measure the degree of competition directly by observing the pricing behaviour of banks in the market. These measures are thereby independent of the structure of the market. They can be grouped into two categories. The first-generation measures are based on the neoclassical model of oligopoly. This includes the Lerner index, the conjectural variation approach, and the Panzar and Rosse H-statistics. The second-generation measures adopt a dynamic approach of competition associated with the Austrian School's notion of competition. The BI and the POP model can be associated with the second-generation of works. It should be noted that each non-structural method is based on different assumptions and hence measures different things. The Lerner index investigates the average degree of pricing power in the banking market. The CV model assesses rivals' reactions if a bank in the market raises its output by 1%. The PR H-statistics evaluates the transmission of changes in input prices to bank revenue. The BI relies on the notion that efficient banks are more highly rewarded in a more competitive banking sector. The POP model tests whether competition eliminates any abnormal profit quickly and bank profit rates converge rapidly towards their long-run equilibrium levels. Therefore, the measures of competition cannot be deemed as perfect substitutes. Each of these methods has its practical and theoretical advantages as well as its shortcomings. The Lerner index is a beneficial indicator of individual market power, yet it is not the best measure of competition. This is arguably because the average degree of market power may increase, reduce, or stay stable, even if individual Lerner indices decrease owing to the reallocation effect from inefficient to efficient banks. The PR H-statistics can be a useful indicator of competition in a static perspective. Yet it requires a strong assumption (long-run equilibrium, demand elasticity must be higher than one, etc.) that cannot always be realised

and tested. The BI accounts for the dynamic aspects of competition yet it may be unable to identify the degree of competition in the short-run. The POP model requiring sufficient time series banking data has led to the rather limited use of this method in empirical banking studies. Therefore, it can be concluded that different measures of competition should be used as each accounts for an aspect of competition. This research adopts this multiple-model approach for the robustness and completeness of empirical results and employ the BI and the POP models for our empirical study of the impact of the regulatory reforms on competition in the Turkish banking sector. The detailed justification for the choice of these models in favour of the extensively used first-generation non-structural methods will be given in the following chapter.

Chapter 7

The Impact of Regulatory Reforms on the Competition of Turkish Banks

7.1 Introduction

This chapter aims to assess the evolution of competition on the lending market during the regulatory reform period and to find out whether the degree of competition becomes stronger when the policy focus shifts after 2001. This study contributes to the literature on competition in the Turkish banking sector in several respects. First, this study focuses on the lending market rather than examining competition in the entire banking sector. The underlying reasons are that the loans market is the largest and most significant segment of the banking sector in Turkey. As of 2016, almost 70% of total earning assets are composed of total loans, in line with the primary financial intermediation role of commercial banks. Moreover, the deregulatory reforms are aimed at liberalising interest rates on deposits and loans, indicating that this segment was the primary target of the reforms. Furthermore, the recent wave of foreign bank penetration is expected to improve competitive conditions in the lending market, which has not been explicitly accounted for in the Turkish banking literature. Finally, the number of studies investigating the competitive dynamics of this segment is scarce, calling for more empirical evidence.

Second, as explained in Chapter 6, this study estimates two complementary models, the POP and the BI, instead of the Panzar-Rosse model that has been widely used in the literature (Günalp and Çelik, 2006; Macit, 2012; Repkova and Stavarek, 2014). To our knowledge, only two studies on Turkey use the BI in their empirical research, yet they focus on the post-2001 period, which we will expand by including the pre-2001 period to capture the pre- and post-reform periods. The POP model to investigate the competitive dynamics in the lending market has never been used for the case of Turkey. Among other things, this model allows us to include a dummy variable for capturing the recent wave of foreign bank penetration. This will be the first attempt at explicitly accounting for the influence of foreign bank entry on the competitive dynamic of the lending market.

Third, our rich panel dataset over the period 1988-2016 captures both the pre- and post-reform periods. This not only enriches the reliability of estimation results and quality of empirical analysis, but also gives us a more effective mean of examining the policy effects

on competition. This improves the quality of the resulting policy suggestions and tackles the limitations of earlier empirical studies based on insufficient data.

The rest of the chapter is organised as follows. Section 7.2 presents the methodology adopted for the empirical estimation. Section 7.3 introduces variables and dataset. Section 7.4 presents the estimation results of the POP and BI models and Section 7.5 concludes.

7.2 Methodology

As expounded in Chapter 6, we choose to rely on the POP and BI models as they circumvent many of the drawbacks of alternative approaches. In short, they are both dynamic models and one can measure the degree of competition over time and can also analyse the impact of regulatory changes on competition. Furthermore, they both assume interdependence between banks that react to competitive pressures stemming from regulatory changes and thus enable one to measure banks' responsiveness to reform policies. In addition, these models allow one to evaluate competition for different ownerships of banks and for several specific product markets such as the loan market, instead of considering an entire banking market. This not only enables one to focus on which bank output is prone to more or less competitive pressure but it is also possible to compare which bank type faces more competition (Tabak et al., 2012).

Additional motivations for the selection of the POP and BI models are their underlying theories, making them appropriate choices for our analysis. More specifically, the underlying theory of the POP model suggests that if entry and exit are sufficiently free, excess profits enjoyed by incumbent banks attract new entries, which in turn would eliminate any abnormal profits and then converge them towards the same long-run average. However, if these excess profits tend to persist from year to year, then there might be entry barriers or banks might be exploiting monopoly power. Accordingly, this model is a suitable choice for our case, since Turkish banking authorities have been implementing reforms involving the removal of restrictions on entry and the increase of the range of permissible activities, which are expected to eliminate any abnormal profits. Therefore, the persistence of profitability becomes less likely with increased competition driven by the reforms. With regards to the BI model, its underlying theory indicates that competition increases via two channels. First, it increases when bank products become closer

substitutes and banks interact more aggressively, and second when entry costs decline to facilitate the entry of new banks (van Leuvensteijn et al., 2011). The theory behind this model is that competition enhances the performance of efficient banks and impairs the performance of inefficient firms under both regimes of stronger substitution and amid lower entry costs, which is mirrored in their respective profits or market shares (Boone, 2008). Therefore, the reforms undertaken by Turkish banking authorities have removed the entry restrictions which in turn are expected to decline entry costs. In addition, they have also created a level playing field among different banks, which is likely to stimulate the substitutability of products. Moreover, the reforms have aimed to improve the competition and efficiency of banks, thus creating an environment suitable to explore the relationship between competition and efficiency. The BI model is thus an appropriate choice for our study.

7.2.1 Empirical specification and estimation method of the persistence of profits model

The literature employing the POP model usually specifies a first-order autoregressive (AR(1)) model of banks' profitability (e.g. Bektas, 2007; Kaplan and Celik, 2008; Goddard *et al.*, 2011; Pervan, Pelivan and Arnerić, 2015). These studies tend to define profitability based on the type of competition being measured. For instance, to reflect a broader view of competition encapsulating a whole banking sector, profitability is measured as either the return on equity or the return on assets. The evidence of persistence of profitability is then interpreted as a signal of the intensity of competition (Glen et al., 2003).

Since we focus on the loan market, we follow (Zhao et al., 2010) and utilise a partial adjustment AR(1) model where profit is measured as the gap between loan price and marginal cost, while controlling for macro and industry level external shocks. In addition to the practical advantages expounded in Section 7.1, this approach has empirical advantages when compared to widely adopted AR(1) models. This is arguably because this analysis directs the unspecified structural model of the POP literature to the profit maximising behaviour of banks. More specifically, in the AR(1) process the normalised profit rate of bank *i* between year *t-1* and *t* represent the profitability. Yet the partial adjustment AR(1) approach obtains the measures of profitability from the gap between

loan price and marginal cost, which in turn gives this model a stronger theoretical basis for the empirical representation of competitive dynamics (Zhao et al., 2010).

Assuming that credit intermediation still represents the primary activity of Turkish banks and these banks are price-setting profit maximisers, loan profitability is defined as the loan overcharge, which is calculated as the ratio of the price of loans to their marginal cost. The gap between loan price and marginal cost reflects banks' perception of changes in the competitive environment. In the absence of competition, banks will overcharge by setting loan prices above marginal cost. The magnitude of this overcharge depends on the perceived elasticity of demand these banks face, which is a decreasing function of the degree of competition in the loan market. The higher the elasticity of demand for a profit-maximising bank, the closer loan price will be to marginal cost and vice versa. This implies that persistence of profitability becomes less likely with increased competitive pressures. On the other hand, if there is perfect competition in the market, this implies that the elasticity of demand is infinite and banks will set loan price equal to marginal cost, making the loan overcharge equal to one. This indicates that competition eliminates any abnormal loan overcharge quickly and bank profits converge rapidly towards their long-run equilibrium values.

Considering the marginal cost as the benchmark price under perfect competition, the adjustment of the loan overcharge (LOC) to unity implies the dynamic evolution from imperfect competition to perfect competition. Therefore, we formulate our partial adjustment AR(1) model of loan price overcharge by following Zhao et al. (2010), as follows:

$$(\ln LOC_{\mathrm{it}} - \ln LOC_{\mathrm{i(t-1)}}) = \lambda\left(\ln LOC_{it}^{*} - \ln LOC_{\mathrm{i(t-1)}}\right) + u_{it} \qquad (7.1)$$

In equation (7.1), LOC_{it} is the loan overcharge[79] of bank *i* at time *t*, defined as the ratio of imputed performing loan price[80] over their marginal cost,[81] $LOC_{\mathrm{i(t-1)}}$ is the overcharge at

[79] The loan overcharge is estimated on performing loans. This allows us to account for the riskiness of bank loan portfolios. Since we employ the imputed price of performing loans, we take into account the aggregate mean interest rate and disregard the effect of non-price loan characteristics, e.g. different maturity structures, different amounts, etc., on the interest rate charged on loans. However, since we are interested in the change

time *t-1*. LOC_{it}^{*} represents the loan overcharge realised under perfect competition. That is, it is unity and hence it becomes zero when taking logs. u_{it} is the idiosyncratic error term, assumed to be $u_{it} \sim$ iid (0, σ^2). The parameter λ in Eq. (7.1) represents the speed of adjustment towards the optimum loan overcharge (LOC_{it}^{*}) realised under perfect competition. The adjustment parameter λ is expected to take a value between zero and one. Moreover, the larger the value of λ is the faster the adjustment speed to perfectly competitive loan prices, while lower values of λ reflects a less competitive environment as the adjustment towards perfect competition is slow. Yet in a case where $\lambda = 1$ it implies that the change in loan pricing mirrors the optimum change and hence a case of perfect competition since the loan overcharge is equal to the optimum loan overcharge.

To answer our research questions concerning the impact of regulatory reforms and foreign bank penetration on the dynamics of competition, we introduce a bilateral policy shift (PD) and foreign bank penetration (FB_Entry) dummy. As defined earlier in Section 5.4, the whole regulatory reform process in Turkish banking can be divided into two stages: in the first stage policies focused on deregulation aiming at increasing competition (1988-2001), and in a second stage (post-2001), policies have focused on strengthening the stability of banks via implementing prudential re-regulations. This dummy is therefore set equal to 1 for the period 2002-2014, while it takes a value of 0 for 1988-2001. The dummy is created to compare the periods before and after 2001, when the main regulatory changes took place. On the other hand, FB_Entry stands for the bilateral heavy foreign bank penetration dummy. As discussed in Section 5.4, heavy penetration of foreign banks took place after 2005; this dummy is set equal to 1 for the period 2005-2016, while it takes a value of 0 for 1988-2004. Our model specification reads as follows:

---

of the ratio of loan price over marginal cost rather than the exact level of loan price, this limitation would lead to a serious effect on our findings. A similar approach was adopted by (Zhao et al., 2010).

[80] The imputed price of performing loans is calculated as the ratio of interest income on loans to total performing loans.

[81] Marginal costs are not directly observable, thus one needs to obtain them indirectly. Schaeck and Cihak (2010) approximate a firm's marginal costs by the ratio of average variable costs to total income. Yet we opt to estimate the marginal costs for each bank in the sample from the estimation of Eq. (5.1). The estimation procedure of these will be explained in Appendix 7.1.

$$(\ln LOC_{\mathrm{it}} - \ln LOC_{\mathrm{i(t-1)}}) = \lambda\left(\ln LOC_{it}^{*} - \ln LOC_{\mathrm{i(t-1)}}\right) + \gamma PD\left(\ln LOC_{it}^{*} - \ln LOC_{\mathrm{i(t-1)}}\right) + \varphi FB\_Entry\left(\ln LOC_{it}^{*} - \ln LOC_{\mathrm{i(t-1)}}\right) + \mathrm{u_{it}} \quad (7.2)$$

where γ is the adjustment parameter representing the speed of adjustment of the overcharge to unity and takes a value between 0 and 1. γ measures the change in the speed of adjustment between 1998-2001 and 2002-2016, and $0 < \lambda + \gamma < 1$. An estimated $\gamma < 0$ will indicate a slower speed of adjustment towards perfectly competitive loan prices in 2002-2016 (and vice versa). In other words, the change in policy focus has led to weaker competition. If $\gamma$is not significant, this indicates that there is no significant change in the level of competition between the two periods. φ represents the speed of adjustment of the overcharge towards unity and is expected to be $0 < \varphi < 1$. The interaction term between FB_entry and $\left(\ln LOC_{it}^{*} - \ln LOC_{\mathrm{i(t-1)}}\right)$ gives us the speed of adjustment between 1998-2004 and 2005-2016 and $0 < \lambda + \varphi < 1$. If the coefficient φ is negative this indicates a slower adjustment speed towards perfectly competitive loan prices in 2005-2016 (and vice versa). This also means that the heavy penetration of foreign banks has led to a decline in competition. If the φ coefficient is not significant, this indicates that there is no significant change in the level of competition between the two periods.

As defined above, the optimum loan overcharge, $\ln LOC_{it}^{*}$, reflects the loan overcharge of perfect competition where the loan price is equal to marginal cost, thus $\ln LOC_{it}^{*}$ is unity and once the log of this variable is taken we get zero. Therefore, substituting this in Eq. (7.1), and rearranging this equation results in:

$$\ln LOC_{\mathrm{it}} = \alpha \ln LOC_{\mathrm{i(t-1)}} + \delta PD \ln LOC_{\mathrm{i(t-1)}} + \mu FB\_Entry \ln LOC_{\mathrm{i(t-1)}} + \mathrm{u_{it}} \quad (7.3)$$

where $\alpha = 1 - \lambda$, $\delta = -\gamma$, $\mu = -\varphi$. In Eq. (7.3) α is the persistence parameter since it measures the persistence of $\ln LOC_{\mathrm{i(t-1)}}$ into $\ln LOC_{\mathrm{it}}$. A significant and negative δ means a significantly positive γ, which in turn would indicate a reduction in the persistence of the loan overcharge in the period 2002-2016 compared to 1988-2001 (and vice versa). This in turn could imply an increase in the intensity of competition due to the shift in policy focus. Put differently, α reflects the persistence of the overcharge during the pre-reform period,

while $\alpha + \delta$ measures the post-reform persistence of loan overcharge. If δ is not significant, then there is no change in the persistence and hence no change in competition between the two periods. On the other hand, a significant and negative μ means a significantly positive φ, which in turn would indicate a reduction in the persistence of the loan overcharge in the period 2005-2016 compared to 1988-2004 (and vice versa). This in turn could imply an increase in the intensity of competition due to the heavy penetration of foreign banks. Put differently, α reflects the persistence of the overcharge during the pre-reform period, while $\alpha + \mu$ measures the post-reform persistence of loan overcharge. If μ is not significant, then there is no change in the persistence and hence no change in competition between the two periods. As a priori we expect that the heavy foreign bank penetration experienced after 2005 is likely to result in improvements in the competitive conditions of the Turkish banking sector, because to protect their market shares against these newcomers that are likely to have superior information technologies and management skills incumbent banks would respond competitively.

To complete our model, we also take into account macroeconomic and industry level external shocks that could potentially influence changes in the loan overcharge in the model. Therefore, our complete estimable POP model is specified as follows:

$$\ln LOC_{\mathrm{it}} = \alpha \ln LOC_{\mathrm{i(t-1)}} + \delta PD \ln LOC_{\mathrm{i(t-1)}} + \mu FB\_Entry ln LOC_{i(t-1)} + \tau RGDP + \omega TD + \mathrm{u_{it}} \quad (7.4)$$

where RGDP stands for real GDP growth rate. It is expected that high economic growth increases business opportunities, hinders business and credit risk, and hence renders a lower loan overcharge. On the other hand, slowing economic growth limits business opportunities, enhances business and credit risks, and potentially increases default risks, resulting in an increase in loan overcharge (Flamini et al., 2009). Therefore, we expect a negative association between real GDP growth and the loan overcharge. TD represents time dummies incorporated into the model, which takes one in year *t* and otherwise zero. This captures exogenous external industry and macro-level variables, namely growth of demand for banks loans, competitive pressures on the banking sector imposed by non-banking financial institutions, monetary and macroeconomic shocks, opacity of informational environment in the loan market, etc. It is argued that these variables could

result in asymmetric changes in costs and the profit maximising price and hence need to be controlled for (Zhao et al., 2010). Moreover, as it will be explained below, our preferred estimation methods, difference and system generalised method of moments (GMM), require that the autocorrelation test and the robust estimates of the coefficient standard errors assume no correlation across banks in the case of idiosyncratic disturbances, an assumption which is likely to be hold when one incorporates time dummies into the model (Roodman, 2009a).

Having data over time for the same banks in turn allows us to scrutinise dynamic relationships, something that cannot be done with a single cross-section and also enables us to control for unobserved individual heterogeneity. The estimable model we presented in Eq. (7.4) is a dynamic panel data model, specifying that the dependent variable for a bank depends in part on its values in previous years. Since we model lagged dependent variables as well as their interactions with policy shift and a foreign bank entry dummy as explanatory variables, this in turn is expected to result in an endogeneity problem. More specifically, one immediate problem in applying OLS in this dynamic model is that the lagged dependent variables will be correlated with the unobserved individual effect in the error term, which result in "dynamic panel bias" (Nickell, 1981). To circumvent this potential endogeneity issue, the literature suggests two ways (Roodman, 2009a). One way is to transform the data to remove the unobserved individual effects, other way is to instrument the lagged dependent variable and other similarly endogenous variables with variables assumed to be uncorrelated with the unobserved individual effects. The former approach aims to remove the unobserved individual effects out of the error term by incorporating dummies for each individual. Although these transformations draw the unobserved individual effects from the model, they cannot fully eliminate the dynamic panel bias since the transformed lagged dependent variable and transformed error are still correlated after these transformations. The latter approach applies either a mean deviation or first difference transformation. The mean deviation transformation approach also cannot fully eliminate bias; that is, IV estimation employing lags is not possible because the lags of the dependent variable are embedded in the transformed error term, therefore using them as an instrument of the lagged dependent variable would not allow this bias to disappear (Judson and Owen, 1999). By contrast, although the first-difference estimator is also inconsistent, IV estimators of the first-difference model using appropriate lags of the

dependent variable as instruments result in consistent parameter estimates (Cameron and Trivedi, 2005).

The IV estimation of the first-difference dynamic panel model is proposed by Anderson and Hsiao (1981), where the second-order lag of the dependent variable, assumed to be uncorrelated with the transformed error term, is used as an instrument for the first difference of the lagged dependent variable. Then they estimate a first differenced two-stage least squares approach. However, it is argued that even if all the available instruments are used, this method is not as efficient as a GMM approach. For example, more efficient IV estimators can be acquired by employing additional lags of the dependent variable as an instrument, the estimator is then called the Arellano-Bond estimator following the seminal paper of Arellano and Bond (1991), who elaborated on the implementation of the estimator and suggested tests of the crucial assumption that error terms are serially uncorrelated.

The Arellano-Bond estimator has been used to obtain two different IV estimators. First, the two-stage least square estimator, also called the one-step estimator. Since the model is overidentified, a more efficient estimation is possible by employing an optimal GMM, also called the two-step estimator. Many empirical studies have used the one-step estimator as simulation studies have reported very little efficiency gains from the two-step estimator. Furthermore, this estimator underestimates standard errors, specifically in the presence of a large number of instruments. The problem with standard errors in the two-step estimator is largely inevitable when the sample is small. However, a correction to standard errors, yielding more accurate standard errors, has been suggested by Windmeijer (2005). The author found that the two-step estimator with accurate standard errors has performed better than the robust one-step estimator in terms of lower bias and standard errors, and thus the two-step GMM estimator is considered as a superior approach than the one-step GMM.

The Arellano-Bond estimator utilises an IV estimator relying on the assumption that the second-order, third-order, etc. lagged dependent variables are not correlated with the first-differenced error term, enabling the lags of the dependent variables to be used as instruments in the first-differenced dynamic panel models. Yet several studies suggest employing additional moment conditions to acquire an estimator with improved precision and better finite-sample features (Cameron and Trivedi, 2005). Specifically, Arellano and

Bover (1995) and Blundell and Bond (1998) use moment conditions from both a first-difference equation and levels equation as instruments, therefore there are more instruments and this is likely to result in more efficiency in estimation. Moreover, the system GMM arguably reduces potential biases in finite samples, yet consistency of the estimator relies on both the validity of the assumption that the error term is free of second-order autocorrelation and the validity of instruments (Goddard et al., 2011).

One needs to undertake some specification tests to ensure that the GMM estimators are consistent. First, specification tests check whether there is a serial correlation in errors. More specifically, it is assumed that error terms are serially uncorrelated, but since a lagged dependent variable is included, we expect to have a first-order serial correlation, yet there should not be a second-order serial correlation because the moment conditions would be invalid in this case (Cameron and Trivedi, 2005). The Sargan test has been widely used to control if there is a serial correlation in errors, which has a null of no serial correlation and follow a standard normal distribution. For the first-order serial correlation test, we expect to reject the null, while the second-order correlation test should be accepted. Second, specification tests control overidentifying restrictions. It is important that instruments are exogenous and one should test if the model is overidentified using the Sargan test. If the model is just-identified the GMM estimation will pick the parameters, making the correlation between the instrument and the error term (the moment condition) equal to zero. Finally, one should also consider the issue of having too many instruments. This is because there are potentially a large number of instruments when time period increases. More specifically, the difference and system GMM estimators can create conditions prolifically, where the number of instruments counts quadratic in the time dimension of the panel dataset (Roodman, 2009a). Therefore, a large number of instruments might actually increase bias since the finite sample may lack adequate information to estimate such a large matrix properly. For example, in a simulation study based on difference GMM regression shows that dropping the number of instruments from 28 to 13 reduced the average bias in the two-step estimate of the parameter of interest by 40% (Windmeijer, 2005). Similarly, another simulation study based on a system GMM regression reports that increasing the number of instruments from five to ten resulted in an increase in the actual value of the parameter of interest by 7.5% (Roodman, 2009b). Therefore, it is suggested to report the number of instruments and to test the robustness of results to reducing it.

7.2.2 Empirical modelling and estimation technique of the Boone indicator

As mentioned earlier in the thesis, the BI model measures the impact of efficiency on performance (van Leuvensteijn et al., 2011). With regards to model specification, a review of the empirical literature on banking competition reveals that marginal cost is used as a proxy for efficiency of banks while profit or market share is employed as a proxy for performance (Brissimis et al., 2014; Delis, 2012; Schaek and Cihák, 2008; van Leuvensteijn et al., 2011; Xu et al., 2014). Moreover, when the literature focuses on analysing competition in the entire banking market, profits are used to measure performance; when it focuses on analysing the loan market, market shares are utilised to measure performance.

As indicated earlier, since this chapter focuses on analysing the dynamics of competition in the Turkish loan market, we follow van Leuvensteijn et al. (2011) in formulating our BI model, using marginal cost as a proxy for bank efficiency and market share of loans as a proxy for bank performance. A crucial advantage of using marginal costs is that it allows us to focus on segments of the banking market such as the loan market, where no direct observations of individual cost items are available. Since this study aims to investigate competition in the loan market of the Turkish banking sector, this approach is expected to lead to more precise results. Using market shares instead of profits as a dependent variable are more consistent with the theory suggesting that efficiency gains induce lower output prices, which in turn increase market share. Furthermore, this effect would be stronger in more competitive markets since efficiency would increase market share more than in non-competitive markets (Boone, 2008). In addition, market share values are always positive whereas profit values might be negative at times. Therefore, given the log-log structure of the BI model, using market shares would shield us from sample bias (van Leuvensteijn et al., 2011). As such, we specify our estimable log-log model,[82] tracking competition changes between 1988 and 2016, as follows:

[82] This specification allows us to handle the heteroscedasticity problem.

$$\ln MS_{\mathrm{it}} = \alpha + \sum_{t=1}^{T} \beta_t TD_t lnMC_{it} + \sum_{t=1}^{T-1} \vartheta_t TD_t + \mathrm{u_{it}} \tag{7.5}$$

In Eq. (7.5) TD_t are time dummies, taking one in year *t* and otherwise zero, and are introduced to account for elements common to all banks in the sector and specific to each year; $\mathrm{MS_{it}}$ stands for market share of loans of bank *i* in year *t*, measured as the share of each bank's performing loans to the total industry loan; $\mathrm{MC_{it}}$ is the marginal cost of bank *i* in year *t*, not directly observable, thus we derived them with similar procedures adopted during the POP estimation and will be explained in the Appendix 7.1; $\mathrm{u_{it}}$ is error term, with $\mathrm{u_{it}} \sim iid(0, \sigma^2)$. The vector of parameters β_t represents the BIs, which are estimated for every year. Since it is time dependent it measures annual competition, allowing use to track down its evolution over time. The coefficient β is expected to be negative ($\beta < 0$), since the market shares increase for banks with lower marginal costs. Therefore, an increase in competition enhances the market share of a more efficient bank relative to a less efficient one. A larger negative value of β hence indicates more intense competitive conditions in banking sector (van Leuvensteijn et al., 2011). Nevertheless, the literature also finds positive values of β, indicating that the higher a bank's marginal costs, the more market share it gains. It is argued that in the case of a positive β, either the banking sector has an extreme level of collusion or the banks are competing on quality (Kasman and Kasman, 2015).

With regards to the estimation technique of the BI model, we use the Generalised Method of Moments (GMM) approach. This is because higher market shares are likely to reduce marginal costs due to scale economies. This indicates that larger market shares are likely to go hand in hand with lower marginal costs, implying that marginal costs might be endogenous (van Leuvensteijn *et al.*, 2011). Therefore, to account for this potential endogeneity issue we use the GMM approach with an instrumental variable, the one- and two-year lagged value of the explanatory variable, marginal cost. Two specification tests following the estimation will be implemented to ensure that the GMM estimators are robust. First, the Hansen J-test used to test overidentification for all instruments is applied (Hayashi, 2000). The joint null hypothesis of this test is that the instruments are valid instruments, namely uncorrelated with the error term. Therefore, rejection of this hypothesis would challenge the validity of the instruments. Second, the Kleibergen and

Paap (2006) likelihood test is undertaken to test the relevance of excluded instrument variables. The null hypothesis suggests that the equation is underidentified. Therefore, rejection of this hypothesis implies that the model is identified. In addition to these specification tests, we also ensure that standard errors are heteroscedasticity and autocorrelation robust by setting the bandwidth in the estimation at two periods and applying the Newey-West kernel suggested by van Leuvensteijn *et al.* (2011).

7.3 Variables and data

To carry out our empirical analysis, we estimate two models: the POP and the BI. As mentioned before, estimation of these models requires marginal cost variables, which are not directly observable. Therefore, instead of using average variable cost as a proxy for marginal costs, we used the estimates of the translog cost frontier model presented in Eq. (5.1) to derive the marginal costs (see Appendix 7.1). This derivation method is arguably more precise and more closely in line with theory (van Leuvensteijn et al., 2011). Since we already defined the variable used in the estimation of the translog cost function in Section 5.3, we now focus on the other variables of the POP and BI models.

For the POP model, the loan overcharge is measured by the ratio of price of loans to marginal costs of loans. Since the price of loans also cannot be directly observable, we compute this by dividing the interest income on loans reported in the income statement to performing loans. Performing loans are simply calculated by deducting non-performing loans from gross loans, this in turn is expected to control for loan quality due to the heterogeneity in the quality of loans among banks and high NPLs ratio during the crises. With regards to the BI model, the market shares of performing loans are calculated by dividing each bank's performing loan portfolio in a specific year by the industry total loan portfolio for the specific year. It is argued that market shares have comparative advantages against profits. This is because market shares are always positive, while the range of profits might sometimes be negative. Therefore, the log linear specification of the BI would exclude the negative values and the estimation results could be distorted by sample bias since inefficient, loss-making banks would have to be ignored (van Leuvensteijn et al., 2011). GDP growth rate is obtained from the World Bank database. Descriptive statistics of the key variables are presented in Table 7.1.

We obtain our data from the unconsolidated financial statements and annual reports of banks, which have been made available by the Bank Association of Turkey (BAT). We use a panel dataset consisting of annual bank-level data for commercial banks in the Turkish banking industry during the period 1988-2016.[83] Due to closures, mergers, acquisitions, and new entrants the numbers of banks has changed over time, resulting in an unbalanced dataset with 51 banks having operated or currently operating during the sample period. Unlike any other studies investigating the efficiency of Turkish banks, the period of analysis runs from 1988 to 2016, allowing us to investigate the long-term impacts of structural changes (foreign banks entry) and policy shifts on the dynamics of competition in the Turkish commercial banking sector. We refer to Section 5.3.1 to avoid repetition concerning the challenges in the construction of our dataset. All the bank-level data are in millions Turkish Lira and are adjusted to real values using the CPI index with 1998 as the base year.

Table 7.1 Descriptive statistics of the key variables (1988-2016)

	Loan overcharge	Price of loans	Marginal cost of loans
1988	1.250346	0.37585	0.301131
1992	1.914412	0.41586	0.387127
1996	1.331456	0.312339	0.260732
1999	1.200432	0.438336	0.448055
2001	0.820166	2.278573	4.801245
2005	1.01439	0.147952	0.166498
2009	1.405448	0.157384	0.113527
2013	1.42523	0.087631	0.063835
2016	1.540688	0.10533	0.070922

[83]Similar to the previous empirical chapter on the banking efficiency, we exclude Islamic banks, development and investment banks, foreign banks operating as a single branch, and banks under the deposit insurance fund since we assume that these banks have different structures as well as objectives (see Section 5.3.1 for more details).

Table 7.1 shows that the trend in the price and marginal cost of loans follows a similar pattern. It should be noted that there is a significant jump in 2001, largely due to the twin crises increasing costs and reduction in loans during the crises. It appears that the price and marginal cost of loans are relatively lower in the post-2001 period. With regards to loan overcharge, after an increase in the early period, this value shows a decreasing trend from 1992 to 2001. Yet after this year, the mean values have constantly increased until the end of our sample data, which might indicate that banks have been exercising market power, allowing them to set loan prices over the norm values.

7.4 Estimation results

7.4.1 Estimating the persistence of profits

The first estimation approach we adopt is the Arellano-Bond difference GMM estimator, using the lagged levels of the differenced lagged dependent variable as instruments. For robustness, this study also estimates the Blundell-Bond system GMM estimator, augmenting the former by adding a level equation instrument utilising lagged differences. Both estimators are run in their more asymptotically efficient two-step forms, with Windmeijer-corrected standard errors. In addition, we carried out four different specifications on the models, with and without time dummies, to examine how sensitive our estimation to the number of instruments was. In addition, although we have N that is larger than T, a fundamental requirement in dynamic panel models, due to our research questions we need to take a relatively long time span (29 years) into consideration. Therefore, to avoid instrument proliferation,[84] as suggested by Rodman (2009a), we restrict the number of lags to one to limit the number of instruments used.

Table 7.2 reports estimates of the persistence of loan overcharge coefficients in Eq. (7.4) by four different model specifications. The models produce consistent results: the second-order correlation tests suggest that the estimations are appropriately specified and we pass the overidentifying restrictions test necessary for consistency. The changes in the number of instruments do not induce significant changes in coefficients within the models. The

[84] The difference and system GMM estimators can create moment conditions prolifically, with the instrument count quadratic in the time dimension of the panel T, which in turn is likely to culminate in a bias in finite samples (Rodman, 2009).

estimated coefficients on the one-period lag of the overcharge is α for 1988-2001 and $\alpha + \delta$ for 2002-2016. As expected, this study finds that all αs are positive and significant. However, all the estimated δs are highly insignificant, implying that the regulatory reforms introduced as of 2002 had no discernible impact on the competitiveness of the Turkish commercial banking sector.[85] In other words, this finding also implies that the elimination of abnormal loan overcharge via competition is by no means instantaneous and banks are able to retain a significant portion of their abnormal loan overcharges from year to year. A possible explanation might be that prudential regulations are multi-faceted, i.e. they impose a series of policies on banks such as tighter restrictions on bank activities, greater capital regulation stringency, strengthening of official supervisory power, and market-based monitoring. As expounded in Section 3.5, individual policies might induce different impacts on the competitive structure of the banking sector. Since we are unable to account for the multi-faceted nature of prudential regulations due to data limitation, each regulation's impact might have cancelled the other out.

There is only one study investigating the impact of restructuring reforms on the competition of the whole Turkish banking sector (Yildirim, 2014). Firstly, this study investigates the whole banking sector and also adopts a different approach to capture the effect of regulatory changes. It divides 2002-2011 into two sub-periods and compares the average persistence coefficients between them, and hence the change in coefficients is expected to reflect changes in competitive pressure due to regulatory reforms. Similar to our finding, this study concludes that there was no significant change in competitive conditions following implementation of the post-2002 regulatory reforms. Moreover, this study's persistence coefficient is much lower (0.46), while our estimated persistence parameters are quite high, probably since we are looking specifically at the convergence of price towards marginal cost and hence we set a higher benchmark on the convergence process. Moreover, higher persistence coefficients are obtained by studies focusing on developing countries that are more likely to have less competitive banking sectors than developed countries (Poshakwale and Qian, 2011). Our finding contradicts the previous studies by using time series analysis and adopting unit root tests to assess the persistence of

[85] We consider different scenarios where policy shift dummy variables moved from 2001 to 2002 due to the possible lagged effect of the impact of the reforms and foreign bank penetration. The result was robust to different cut-off points in the policy shift dummy (PD).

profits in the Turkish banking sector (Bektas, 2007; Kaplan and Celik, 2008). Any controversy is likely to arise from different methodology and estimation approaches.

In line with our other research question, this study also investigates whether the heavy penetration of foreign banks into the Turkish banking sector since 2005 has improved competitive conditions. The estimated parameters derived from four models, μs, indicate that although negative estimators would indicate a drop in the persistence of loan overcharge due to the penetration of foreign banks, mirroring an increase in competitive conditions, all estimators are not significant, implying that their penetration has actually not had a discernible impact on competitiveness in the sector. This study contradicts the hypothesis that foreign bank entry is likely to contribute competitive structure by forcing domestic banks to lower their costs (Clarke et al., 2003). Yet a similar finding is also found by Yildirim (2014). A possible explanation is that these foreign banks have entered the Turkish banking sector through acquisition (takeover) of mid-sized domestic private banks and not via establishing new greenfield entities. As expounded in Section 3.5, greenfield banks are more likely to be more competitive than takeover banks (Dell'Ariccia and Marquez, 2004; Claeys and Hainz, 2007). Moreover, greenfield banks are more likely to import superior screening technologies, which in turn would force domestic banks to be more competitive to protect their market shares against these banks. Another possible explanation is that foreign banks tend to follow their customers or prefer to extend loans to large, profitable and informational transparent corporates (Dell'Ariccia and Marquez, 2004; Peria and Mody, 2004). Yet, the share of SMEs credit has been growing in the Turkish banking sector. For example, after a decline during the global financial crisis, SMEs' credits increased more than three times between 2009 and 2014 (Terzi, 2015). Therefore, due to the increasing importance of SMEs lending, foreign bank entry may not result in improvements in competition in the lending market.

Table 7.2 Results of the estimation of the persistence of profits model

Parameter		Arellano-Bond Difference GMM		Blundell-Bond System GMM	
		With time dummies (1)	Without time dummies (2)	With time dummies (3)	Without time dummies (4)
		Estimates	Estimates	Estimates	Estimates
$\ln LOC_{t-1}$	α	0.549***	0.589***	0.767***	0.811***
		(0.128)	(0.116)	(0.209)	(0.092)
$PD^{*}\ln LOC_{t-1}$	δ	0.029	0.032	-0.087	0.015
		(0.136)	(0.125)	(0.437)	(0.127)
$FB\_Entry^{*}\ln LOC_{t-1}$	μ	-0.017	-0.071	-0.239	-0.073
		(0.143)	(0.112)	(0.302)	(0.077)
RGDP	τ	0.035	0.001	0.035	0.004
		(0.021)	(0.005)	(0.039)	(0.004)
Number of instruments		55	29	84	58
AR test (p-value)					
ord 1		0.006	0.004	0.021	0.002
ord 2		0.882	0.523	0.819	0.563
Sargan test (p-value)		0.387	0.056	0.999	0.651

Note: Eq. (7.4) is estimated using the Arellano-Bond and Blundell-Bond GMM approaches (SD in parenthesis). AR test is the p-value for the test for first- and second-order autocorrelation, respectively. Sargan test is the p-value for the Sargan test for the validity of the over-identifying restrictions. The coefficients of time dummies for the model (1) and (3) are not shown in the table since the number of time dummies are quite large (29). Superscripts ***, **, and * imply significance at 1%, 5% or 10% levels, respectively.

7.4.2 Estimating the Boone indicator

To double-check the robustness of the POP model results, we present the estimation results of the complementary BI model in this section. The BI model of Eq. (7.5) expects a negative association between marginal costs and market share through "reallocation process", benefitting efficient banks. In general, although there is no benchmark for the level of coefficients, the more negative the coefficients are, the stronger competition must

be. As expounded in Section 7.2.2, due to the potential endogeneity of marginal cost with market shares, we estimate Eq. (7.5) using the GMM approach with instrumental variables (GMM-IV). Two models are estimated using this method. First, the model with 1-year lagged values is an exactly identified equation (number of explanatory variables are equal to number of instruments), therefore the GMM-IV estimator is merely the standard two-stage least square (2SLS) estimator. Second, the model with two-year lagged values is an overidentified equation, thus GMM-IV estimates will be more efficient than 2SLS estimates. Following the estimations of these two models, we undertake hypothesis tests to ensure consistency. We used kernel-based Heteroscedastic and Autocorrelation Consistent (HAC) variance estimators to correct standard errors. The model with two-year lag passes the Hansen-J test, indicating that instruments are not correlated with error term, yet it fails to pass the Kleibergen-Paap LR test, implying that the model is underidentified. The model with one-year lag passes the Kleibergen-Paap LR test, but since it is an exactly identified equation, the Hansen J-test is reported as 0.00. This indicates that our preferred model can be the one with one-year lag estimated with 2SLS. However, we also undertake a Hausman test to control whether the potential endogeneity of marginal cost exists in our preferred model. The critical value of this test is 0.110, thus we fail to reject the null hypothesis. This result implies that the specified endogenous regressors can actually be treated as exogenous. Therefore, we also estimate the model in Eq. (7.5) using a fixed-effects (without IV) estimator with robust standard error for comparison and robustness.

All three estimation results are presented in Table 7.3. It appears from the table that point estimates change very little between the models. The table shows that not all estimations are significant and towards the end of sample period they also tend to become positive values instead of the expected negative values. Firstly, we carry out a Wald test to control whether the successive annual estimates over time do not differ significantly from zero. The test result chi2(28) = 215.16 (*p*-value 0.000) indicates that, generally speaking, they are significantly different from zero. In addition, non-significant estimations are also obtained by other studies (see van Leuvensteijn *et al.*, 2011). The positive estimates, which might signal either an extreme level of collusion or that banks are competing on quality, indicate that banks faced a less competitive environment during these years. Similar to our findings, Kasman and Kasman (2015), investigating competition in the Turkish banking sector during 2002-2012 using the BI, also get positive values for their estimates around 2011. Moreover, Aydemir (2013), who investigates if collusion exists in the Turkish

banking sector, finds that the eight largest Turkish banks actually colluded in the loan market from 1988 to 2009, which is likely to explain the positive coefficients we obtained.

The pattern of BI estimates of fixed-effects (FE) and 2SLS are depicted in Figure 7.1. It appears from the figure that the results from two estimators in general show similar trends. Once we investigate the estimated indiators over time, it can be inferred that competition shows a non-monotonic trend over time, requiring more in-depth analysis. That is, there are significant differences in competition on a yearly basis, indicating that competition levels have changed dramatically over time. The figure indicates that competition tends to decrease in the early years of the sample despite the implementation of deregulatory policies. This finding might partly be attributed to the dominant role of state banks,[86] possibly aggravating competition in the loan market (van Leuvensteijn et al., 2011). However, estimated coefficients of the Boone model indicate that competition shows an increasing trend between 1992 and 1996, with the exception of a drop in 1994 due possibly to the domestic financial crisis in this year. Yet competition experienced a drop for two years after this increasing trend. This drop might partly be attributed to the fact that during this period[87] banks tended to invest their resources in government securities due to lucrative returns, which in turn reduced loanable funds available for private sector lending. The figure reveals that, according to FE results, competition tends to show a significant increasing trend from 1998 to 2006, while this trend carries on until 2008, according to the 2SLS estimation. After these years, 2006 for FE and 2008 for 2SLS, the Turkish banking sector witnesses a less competitive environment in the loans market. This finding is due in part to the decreasing market shares of domestic private commercial banks after 2005, which are found to be generally more competitive than state and foreign banks. In particular, after the global financial crisis foreign banks have been less competitive in the loan market due to their risk-taking behaviour and global risk exposures (Ansari, 2013). A similar finding, i.e. less competitive environment in the loan market after 2008 in Turkish banking sector, is also found by (Kasman and Kasman, 2016; Macit, 2012; Yildirim, 2014).

[86] See Table 2.2 in Section 2.6.
[87] See Table 2.5 in Section 2.6.

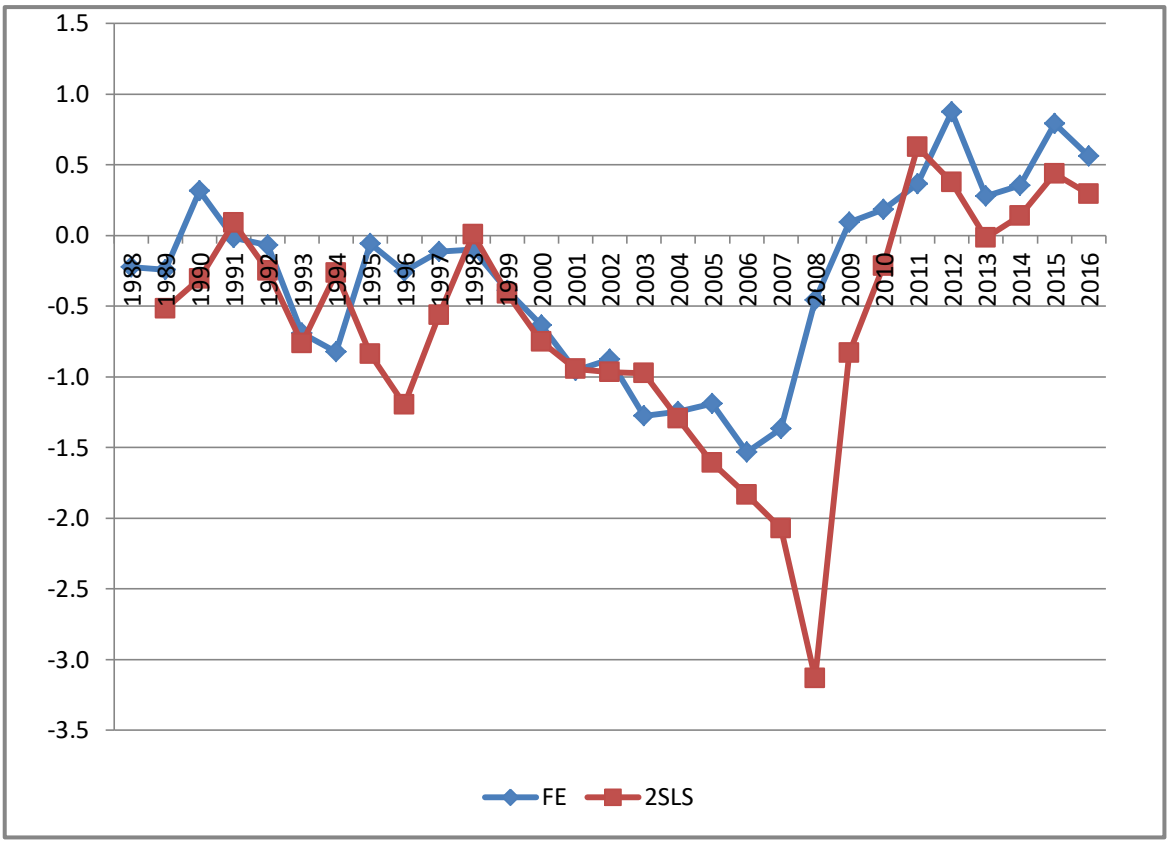
When this result is compared with the POP model estimations, both competition measurement methods result in similar findings. More specifically, competition in the loan market shows a non-monotonic trend over time. This trend might indicate that on average deregulatory reforms and concomitant prudential regulations have not led to sustainable gains for competition over time. Therefore, this implies that the reform package does not appear to have a significant impact on competition, as found by our POP model estimation. Moreover, heavy foreign bank penetration via acquisition experienced since 2005 has not led to significant improvements in competition, which is also consistent with our POP model estimation. It can therefore be inferred that despite the implementation of regulatory reforms and foreign penetration, the level of competition did not increase.

Table 7.3 Results of the estimation of the Boone indicator model (1988-2016)

	FIXED EFFECTS		2SLS		GMM-IV	
Year	Estimates	SD	Estimates	SD	Estimates	SD
1988	-0.224	-0.545	0	(omitted)	0	(omitted)
1989	-0.243	-0.322	-0.520	-0.641	0	(omitted)
1990	0.315	-0.279	-0.307	-0.395	-0.110	-0.342
1991	-0.018	-0.051	0.091	-0.415	-0.177	-0.334
1992	-0.069	-0.099	-0.249	-0.280	-0.106	-0.289
1993	-0.694	-0.464	-0.762	-0.508	-0.369	-0.412
1994	-0.823**	-0.259	-0.266	-0.895	0.224	-0.423
1995	-0.057	-0.214	-0.840	-0.750	-0.148	-0.349
1996	-0.254	-0.247	-1.198	-0.845	-0.585	-0.640
1997	-0.116	-0.459	-0.565	-0.381	-0.679*	-0.345
1998	-0.101	-0.216	0.007	-0.602	-0.257	-0.274
1999	-0.392*	-0.165	-0.412	-0.231	-0.422	-0.222
2000	-0.634***	-0.175	-0.754***	-0.182	-0.652***	-0.180
2001	-0.955***	-0.100	-0.945***	-0.117	-0.801***	-0.092
2002	-0.875***	-0.054	-0.967***	-0.085	-0.896***	-0.063
2003	-1.276***	-0.241	-0.975***	-0.120	-0.836***	-0.098
2004	-1.247***	-0.183	-1.297***	-0.188	-0.988***	-0.164
2005	-1.189***	-0.208	-1.608***	-0.264	-1.290***	-0.197
2006	-1.533***	-0.281	-1.837***	-0.356	-1.556***	-0.294
2007	-1.366**	-0.412	-2.072***	-0.448	-1.536***	-0.365
2008	-0.459	-0.547	-3.132	-2.575	-0.193	-0.676
2009	0.094	-0.461	-0.831	-0.682	-0.569	-0.537
2010	0.183	-0.383	-0.217	-0.499	-0.032	-0.333
2011	0.363	-0.335	0.624	-0.723	-0.111	-0.358
2012	0.875	-0.514	0.378	-0.431	0.396	-0.359
2013	0.276	-0.489	-0.018	-0.493	-0.050	-0.361
2014	0.355	-0.455	0.138	-0.407	0.142	-0.318
2015	0.790*	-0.378	0.436	-0.459	0.376	-0.385
2016	0.559	-0.401	0.295	-0.402	0.121	-0.359
Kleibergen-Paap LM statistic (*p*-val)		-		(0.006)		(0.881)
Hansen J-test (*p*-val)		-		(0.000)		(0.236)

Note: Superscripts ***, **, and * imply significance at 1%, 5% or 10% levels, respectively. Coefficients of time dummies have not been shown.

Figure 7.1 The annual Boone indicators, 1988-2016



7.5 Conclusion

This chapter empirically analyses the influence of regulatory reforms and recent foreign bank entry on competition in the Turkish banking sector using panel data spanning from 1988-2016. The study investigates competition in the loan market, as it is the largest and most significant segment of the banking sector. Two dynamic competition measurement approaches, the POP and BI models, have been employed, enabling us to investigate the effects of reforms as well as foreign bank entry on competition in the credit market.

The POP model results show that, firstly, there is evidence of persistent loan overcharge by Turkish banks, which is higher compared with banks in developed countries. Secondly, regulatory reforms implemented after 2001 have not led to significant improvements in the competitive structure of the Turkish banking sector. Finally, the heavy foreign bank

penetration that has been experienced since 2005 has not had a discernible impact on competition in the lending market.

The empirical results from the complementary competition model, the estimated annual Boone indicators, yield consistent results and shed more light on the evolution of the competitive dynamics during the sample period. The annual indicators show that competition in the loan market follows a non-monotonic pattern over time, suggesting that there is no sustainable improvement in competition over time. More specifically, the estimated indicators suggest an improvement in competition between 1998 and 2008, but this is not sustained in the post-2008 period since competition in the lending market plummets thereafter. Therefore, on average, regulatory reforms do not result in sustainable competition gains. Foreign bank entry and its impact also provide a similar picture. That is, their penetration partly contributed the improvements in competition, yet this trend does not persist over time.

The results of this study appear to be consistent with the findings of other studies on Turkish banking and developing countries. Yildirim (2014) finds that the overall level of competition in the Turkish banking sector did not increase despite restructuring and increased foreign bank entry. Kasman and Kasman (2016) find that Turkish banking witnessed a less competitive environment in the lending market after 2008. In the broader context of the literature on banking reforms and competition, Poshakwale and Qian (2011) find that the POP estimation suggests that reforms had no significant impact on the competitiveness in the lending market of the Egyptian credit market. Delis (2012) finds that financial reforms improve competition in developed countries with sound regulatory institutions, while competition is sluggish in developing countries with low institutional development. The author thus suggests that the success of reforms aiming at improving the competition of banking sectors depends on a certain level of institutional development.

Before concluding, it should be noted that our two chosen models are not without their limitations. The estimated loan overcharge parameters and the annual indicators do not have particular benchmarks that would be used to judge the optimum level of competition. Nevertheless, this drawback does not influence our results, since this study investigates the relative measures over time and hence the impacts of policy measures over time can be examined. Another limitation highlighted in the literature is that these approaches do not

take into account the discrepancies in bank product quality, loan-processing speed, and delivery of service, which all appear to be generic limitations for all competition measuring approaches. Therefore, despite their limitations, these approaches appear to confirm the results on competition and enable us to answer our research questions.

Appendix 7.1. Derivation of marginal cost from the translog cost frontier

The marginal costs for performing loans can be obtained by taking the first derivative of the total costs, TC, in Eq. (5.1) with respect to the performing loans (Y_1) as follows:

$$MC_{it} = \frac{\partial \ln TC_{it}}{lnY_{1it}}$$

$$= \frac{TC_{it}}{Y_{1it}} \left[\beta_{1it} + 2 \times \beta_{11} lnY_{1it} + \sum_{k=1,..,K;k\neq 1} \beta_{1k} lnY_{kit} + \varphi_{11} \ln\left(\frac{W_{1it}}{W_{2it}}\right) + \chi_1 T + \rho_1 PD \right]$$

Chapter 8
Summary and conclusions

8.1 Research summary and findings

Turkish banking authorities adopted banking deregulation reforms to improve competition with the expectation of increasing efficiency and better allocating financial resources. Yet the implementation of deregulatory reforms without establishing proper regulation of the banking system contributed to domestic financial fragilities since the early 1980s, leading the authorities to start a process of banking restructuring and prudential re-regulations in the aftermath of the twin-crises of 2000-2001. The new policy focus was aimed at strengthening the foundations of the banking system to ensure the smooth functioning of Turkish banks. The aim of this thesis has been to analyse the evolution of regulatory reforms over the period 1988-2016 and to evaluate their effectiveness on performance and competition in the lending market. The reform process can be divided in two periods, preceding and following the twin crises: until 2001 reforms focussed on banking deregulation in order to stimulate competition; from 2002 prudential re-regulation was at the centre of the reform process with the objective of fostering stability (Bakır and Öniş, 2010). The main objective of this thesis has been to gain a thorough understanding of the effect of these reforms on the performance, ownership and competition of the Turkish banking sector. In addition, the recent wave of heavy penetration of foreign banks has enabled us to investigate their impact on the performance of banks and on the competitive dynamics of the sector.

This thesis has specifically examined the following three research questions:

1. What is the impact of a deregulation-prudential regulation policy framework on banks' efficiency, cost characteristics, and on the relations between cost efficiency and ownership?

2. What are the effects of this policy framework on the intensity of competition in the loan market?

3. Does the recent wave of foreign bank penetration improve cost efficiency and competition in the lending market?

In our empirical analyses, we use a panel dataset of 51 banks, including state, domestic private and foreign commercial banks, for the period 1988-2016. The bank level data is compiled from the unconsolidated financial statements of banks. They have either been in operation in each year during the sample period or operated in at least four consecutive years within this period in the Turkish banking sector.

With regards to the stochastic cost frontier analysis the results indicate pure cost technological regress over the sample period, yet this worsening appears to slow down over time. This could in part mirror the difficulties faced by banks to adjust to a high and rigid cost structure inherited from the pre-deregulation period to the new operating environment. Moreover, successive governments found it easier to finance its borrowing requirements from domestic banks by means of government securities in the 1990s in particular. As a result, high real interest rates, coupled with financial arbitrage opportunities, prompted banks to focus on government deficit funding. Therefore, banks focused on seizing this opportunity rather than improving their productivity. The prudential re-regulations started to be implemented right after the devastating domestic twin-crises which arguably contributed to the technological regress. This is partly because it imposed a significant regulatory cost on banks. In addition, it further influenced the change in output composition and input mix of banks. It can thus be inferred that sudden implementation of re-regulations might hinder banks in preparing for these policies.

Turning to characteristics of efficiency, this reflects a non-monotonic pattern over time, with efficiency gains in the early stages of deregulation and prudential re-regulation processes. This could be explained both by the change in reforms and the technological regress, which might enable average banks to catch-up with the best performing banks, increasing the average efficiency of banking sector. In addition, the average efficiency scores in the post-2002 are much higher than the pre-2002 period, which in turn might highlight the importance of combining deregulation reforms with a sound regulatory framework.

Turning to the determinants of efficiency, this study finds that different ownerships tend to react differently to the changes in the regulatory framework. More specifically, at the beginning of the sample, private, domestic and foreign banks appear to benefit from operational freedom and functional autonomy derived from deregulation compared to state banks. Yet they lose their advantage over time compared to state banks, indicating that the latter are initially well equipped to adapt. The implementation of tighter policy reforms appears to adversely affect all ownerships. Yet state banks, and in particular domestic private banks, seem to adapt to the new regulatory environment better than foreign banks as their efficiency improves over time, while the latter could not achieve significant progress. Finally, this study finds that heavy foreign bank entry after 2005 does not appear to have a significant effect on the efficiency of banking sector, which is partly attributed to their mode of entry realised in the form of acquisition rather than greenfield.

The results of the POP model suggest that the elimination of abnormal profits via competition in the Turkish banking sector is not instantaneous. Turkish banks are able sustain a considerable portion of their abnormal profits from year to year due arguably to the impediments to competition, such as increasing concentration in the aftermath of the restructuring period and offering innovative services. In addition, tighter prudential norms on average did not have a discernible impact on competition in the lending market between 2002 and 2016. This result is consistent with the findings of the stochastic frontier analysis suggesting pure cost technological regress and unsustainable efficiency gains during the same period. In addition, foreign bank penetration does not lead to a more competitive lending market. This result might partly be due to their mode of entry realised via acquisition and their lending strategy focusing largely on transparent large corporates. To crosscheck these findings, this study also analyses the dynamics of competition by employing a BI model. This model allows us to estimate annual competition measures and hence allow for the evolution of competition over time. The annual BI coefficients suggest a non-monotonic trend in competition over time. More specifically, there are some periods when competition in the lending market increased and also decreased for some years. For example, it is observed the longest and most consistent increase in competition from 1998 to 2008, yet this trend changed after 2008 and competition showed a drastic decline thereafter. Therefore, this study also suggests that, on average, tighter prudential norms do not lead to a significant increase in the competition in the lending market. Moreover, foreign banks heavily entered into the banking sector as of 2005 and it appears that their

penetration might have had positive impacts on competition in the early stages of entry. However, since competition declines after 2008, suggesting that, on average, their penetration has not had a discernible impact on competition in the lending market.

8.2 Implications for policies

To widen policy implications of our empirical findings, this section seeks to compare the findings of this thesis with empirical evidence based on countries experienced similar banking reforms and structural changes. First, Turkish banking authorities imposed strict prudential re-regulation reforms right after the devastating domestic twin-crises; therefore, this sudden implementation of the reforms in turn imposed heavy regulatory costs and not gave necessary time for banks to prepare well in advance for the regulatory changes, arguably contributing to the efficiency losses and hampering technological improvements. Indeed, the evidence from Indian banking reforms suggests that authorities should adopt a consultative and gradual approach in the implementation of prudential re-regulations (Zhao et al., 2010). This enables banks to undertake necessary groundwork for the forthcoming policy changes so that these re-regulations may not necessarily come at the technological improvements and competitive environment. Second, empirical evidence suggests that the success of regulatory reforms aiming to improve competition in banking sector depends on a certain level of institutional developments (Delis, 2012). Since our empirical findings imply that the regulatory reforms could not have a discernible impact on competition in the lending market, the authorities should therefore aim to improve the regulatory and supervisory institutions to promote competition. Finally, our empirical finding suggests that the heavy penetration of foreign banks has not led to a significant impact on cost efficiency and competitive environment in the Turkish banking sector. Similarly, empirical evidence from Central and Eastern European banking sectors, also experienced large number of foreign bank entries, shows that competition is stronger if entry of foreign banks occurs through a greenfield investment rather than by acquisition of an existing domestic bank (Claeys and Hainz, 2006). Furthermore, greenfield banks tend to outperform the foreign banks entered via acquisition (Thi and Vencappa, 2008). Therefore, we can infer from that Turkish banking authorities should encourage new foreign investors to enter to the banking sector as greenfield banks to contribute both competition and efficiency.

8.3 Limitations and suggestions for future research

This thesis has sought to provide an investigation of the banking sector reforms in Turkey and their impact on efficiency, ownership, and competition. Yet there are some limitations that we acknowledge which also could serve as the foundations for future research. First, this thesis is a single country study, so its results are less easily generalised to other countries. Nevertheless, research could be expanded by an analysis involving a cross-country comparison consisting of other emerging market economies, providing an opportunity to generalise the results on a more international basis. Second, individual deregulation and prudential re-regulation policies might lead to different impacts on bank performance and competition. Unfortunately, data limitations prevented us from taking this into account, making us treat both reforms as general categories. Once survey data on banking reforms are available for Turkey, this issue should be taken into account to capture the effects of individual deregulation and prudential re-regulation policies.

References

Abiad, A., Detragiache, E., Tressel, T., 2010. A new database of financial reforms. IMF Staff Papers 57, 281–516.

Afriat, S.N., 1972. Efficiency estimation of production functions. International Economic Review 13, 568–598.

Aghion, P., Howitt, P., 2012. Endogenous Growth Theory, MIT Press. Cambridge, MA.

Agostino, M., Leonida, L., Trivieri, F., 2005. Profits persistence and ownership: evidence from the Italian banking sector. Applied Economics 37, 1615–1621.

Ahrend, R., Arnold, J., Murtin, F., 2009. Prudential Regulation And Competition In Financial Markets, Economics Department Working Papers No.735. OECD.

Aigner, D., Lovell, C.A.K., Schmidt, P., 1977. Formulation and estimation of stochastic frontier production function models. Journal of Econometrics 6, 21–37.

Aigner, D.J., Chu, S.F., 1965. On estimating the industry production function. The American Economic Review 58, 826–839.

Akın, A., Bayyurt, N., Zaim, S., 2013. Managerial and technical inefficiencies of foreign and domestic banks in Turkey during the 2008 global crisis. Emerging Markets Finance & Trade 49, 48–63.

Aktan, B., Masood, O., 2010. The state of competition of the Turkish banking industry: an application of the Panzar-Rosse model. Journal of Business Economics and Management 11, 131–145.

Al-Muharrami, S., Matthews, K., Khabari, Y., 2006. Market structure and competitive conditions in the Arab GCC banking system. Journal of Banking & Finance 30, 3487–3501.

Alchian, A.A., 1965. Some economics of property rights. II Politico 30, 816–829.

Allen, F., Gale, D., 2004. Competition and financial stability. Journal of Money, Credit and Banking 36, 453–480.

Allen, L., Saunders, A., 1992. Bank window dressing: theory and evidence. Journal of Banking and Finance 16, 585–623.

Alper, C.E., Öniş, Z., 2004. The Turkish banking system, financial crises and the IMF in the age of capital account liberalization: a political economy perspective. New Perspectives on Turkey 30, 25–54.

Alper, C.E., Öniş, Z., 2003. Financial globalization, the democratic deficit and recurrent crises in emerging markets: the Turkish experience in the aftermath of capital account liberalization. Emerging Markets Finance and Trade 39, 5–26.

Alper, C.E., Öniş, Z., 2002. Soft Budget Constraints, Government Ownership Of Banks And Regulatory Failure: The Political Economy Of The Turkish Banking System In The Post-Capital Account Liberalization Era, Department of Economics Working Papers No. 02-02. Bogazici University, Istanbul.

Altınkemer, M., 2005. Recent experiences with capital controls: is there a lesson for Turkey? Central Bank Review 5, 1–38.

Altunbaş, Y., Goddard, J., Molyneux, P., 1999. Technical change in banking. Economics Letters 64, 215–221.

Altunbaş, Y., Kara, A., Olgu, O., 2009. Turkish Banking: Banking Under Political Instability and Choronic High Inflation, 1st ed. Palgrave Macmillian, London.

Amidu, M., Harvey, S.K., 2016. The persistence of profits of banks in Africa. Review of Quantitative Finance and Accounting 47, 83–108.

Andersen, T.B., Tarp, F., 2003. Financial liberalization, financial development and economic growth in LDCs. Journal of International Development 15, 189–209.

Anderson, T.W., Hsiao, C., 1981. Estimation of dynamic models with error components. Journal of the American Statistical Association 76, 598.

Angelini, P., Cetorelli, N., 2003. The effects of regulatory reform on competition in the banking industry. Journal of Money, Credit and Banking 35, 663–684.

Ansari, J., 2013. A new measure of competition in Indian loan markets. International

Journal of Finance & Banking Studies 2, 60–77.

Apergis, N., 2015. Competition in the banking sector: new evidence from a panel of emerging market economies and the financial crisis. Emerging Markets Review 25, 154–162.

Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. The Review of Economic Studies 58, 277.

Arellano, M., Bover, O., 1995. Another look at the instrumental variable estimation of error-components models. Journal of Econometrics 68, 29–51.

Arsoy, A.P., Gucenme, U., 2009. The development of inflation accounting in Turkey. Critical Perspectives on Accounting 20, 568–590.

Asaftei, G., 2008. The contribution of product mix versus efficiency and technical change in US banking. Journal of Banking & Finance 32, 2336–2345.

Asmild, M., Zhu, M., 2016. Controlling for the use of extreme weights in bank efficiency assessments during the financial crisis. European Journal of Operational Research 251, 999–1015.

Assaf, G.A., Matousek, R., Tsionas, E.G., 2013. Turkish bank efficiency: Bayesian estimation with undesirable outputs. Journal of Banking & Finance 37, 506–517.

Athanasoglou, P.P., Brissimis, S.N., Delis, M.D., 2008. Bank-specific, industry-specific and macroeconomic determinants of bank profitability. Journal of International Financial Markets, Institutions and Money 18, 121–136.

Atiyas, I., Ersel, H., 1994. The impact of financial reforms: the Turksih experience, in: Caprio, G.J., Atiyas, I., Hanson, J.A. (Eds.), Financial Reform: Theory and Experience. Cambridge University Press, New York.

Aydemir, R., 2013. Competition and collusion in the Turkish banking industry. Emerging Markets Finance and Trade 49, 31–40.

Aysan, A.F., Ceyhan, S.P., 2006. Globalization of Turkey's Banking Sector: Determinants

of Foreign Bank Penetration in Turkey, MPRA Paper 5489. University of Munich.

Bain, J.S., 1951. Relation of profit rate to industry concentration: American manufacturing, 1936-1940. The Quarterly Journal of Economics 65, 293–324.

Bakır, C., Öniş, Z., 2010. The regulatory state and Turkish banking reforms in the age of post-Washington consensus. Development and Change 41, 77–106.

Balkan, E., Yeldan, A.E., 1998. Financial Liberalization in Developing Countries: The Turkish Experince, in: Medhara, R., Fanelli, J. (Eds.), Financial Liberalization in Developing Countries. Macmillan, London.

Baltagi, B.H., Griffin, J.M., 1988. A general index of technical change. Journal of Political Economy 96, 20–41.

Barajas, A., Steiner, R., Salazar, N., 2000. Foreign Investment in Colombia's Financial Sector, in: Claessens, S., Jansen, M. (Eds.), The Internationalization of Financial Services: Issues and Lessons for Developing Countries. Kluwer Academic Publishers, Boston.

Barth, J., Caprio, G., Levine, R., 2006. Rethinking Bank Regulation: Till Angels Govern. Cambridge University Press, Cambridge.

Barth, J.R., Caprio, G., Levine, R., 2004. Bank regulation and supervision: what works best? Journal of Financial Intermediation 13, 205–248.

Barth, J.R., Lin, C., Ma, Y., Seade, J., Song, F.M., 2013. Do bank regulation, supervision and monitoring enhance or impede bank efficiency? Journal of Banking & Finance 37, 2879–2892.

Battese, G.E., Coelli, T.J., 1995. A model for technical inefficiency effects in a stochastic frontier production function for panel data. Empirical Economics 20, 325–332.

Battese, G.E., Coelli, T.J., 1993. A stochastic Frontier Production Function Incorporating a Model for Technical Inefficiency Effects. Working Papers in Econometrics and Applied Statistics No.69. Department of Econometrics, University of New England.

Battese, G.E., Coelli, T.J., 1992. Frontier production functions, technical efficiency and

panel data: With application to paddy farmers in India. Journal of Productivity Analysis 3, 153–169.

Battese, G.E., Coelli, T.J., 1988. Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. Journal of Econometrics 38, 387–399.

Battese, G.E., Corra, G.S., 1977. Estimation of a production frontier model: with application to the pastoral zone of eastern Australia. Australian Journal of Agricultural Economics 21, 169–179.

Bauer, P.W., Berger, A.N., Humphrey, D.B., 1993. Efficiency and Productivity Growth in US Banking, in: Fried, H.O., Lovell, C., Schmidt, S.S. (Eds.), The Measurement of Productive Efficiency: Techniques and Applications. Oxford University Press.

Baumol, W.J., 1982. American economic association contestable markets : an uprising in the theory of industry structure. The American Economic Review 72, 1–15.

Beck, T., De Jonghe, O., Schepens, G., 2013. Bank competition and stability: cross-country heterogeneity. Journal of Financial Intermediation 22, 218–244.

Beck, T., Demirgüç-Kunt, A., Levine, R., 2006. Bank concentration, competition, and crises: First results. Journal of Banking and Finance 30, 1581–1603.

Beck, T., Demirgüç-Kunt, A., Maksimovic, V., 2004. Bank competition and access to finance: international evidence. Journal of Money, Credit, and Banking 36, 627–648.

Beck, T., Levine, R., 2004. Stock markets, banks, and growth: correlation or causality. Journal of Banking and Finance 28, 423–442.

Bektas, E., 2007. The persistence of profits in the Turkish banking system. Applied Economics Letters 14, 187–190.

Berg, Sigbjørn Atle, Førsund, F.R., Jansen, E.S., Berg, Sigbjorn Atle, Forsund, F.R., 1992. Malmquist indices of productivity growth during the deregulation of Norwegian banking, 1980-89. The Scandinavian Journal of Economics 94, 211–228.

Berger, A.., Bonime, S.D., Covitz, D.M., Hancock, D., 2000. Why are bank profits so

persistent? The roles of product market competition, informational opacity, and regional/macroeconomic shocks. Journal of Banking & Finance 24, 1203–1235.

Berger, A.N., 2007. International comparisons of banking efficiency. Financial Markets, Institutions & Instruments 16, 119–144.

Berger, A.N., 1995. The profit-structure relationship in banking--tests of market-power and efficient-structure hypotheses. Journal of Money, Credit and Banking 27, 404–31.

Berger, A.N., Demirgüç-Kunt, A., Levine, R., Haubrich, J.G., 2004. Bank concentration and competition: an evolution in the making. Journal of Money, Credit and Banking.

Berger, A.N., Demsetz, R.S., Strahan, P.E., 1999. The consolidation of the financial services industry: Causes, consequences, and implications for the future. Journal of Banking and Finance 23, 135–194.

Berger, A.N., DeYoung, R., Genay, H., Udell, G.F., 2000. Globalization of financial institutions: evidence from cross-border banking performance. Brookings-Wharton Papers on Financial Services 3, 23–158.

Berger, A.N., Hannan, T.H., 1998. The efficiency cost of market power in the banking industry: a test of the "Quiet Life" and related hypotheses. Review of Economics and Statistics 80, 454–465.

Berger, A.N., Hannan, T.H., 1989. The price-concentration relationship in banking. The Review of Economics and Statistics 71, 291.

Berger, A.N., Humphrey, D.B., 1997. Efficiency of financial institutions: International survey and directions for future research. European Journal of Operational Research.

Berger, A.N., Mester, L.J., 2003. Explaining the dramatic changes in performance of US banks: technological change, deregulation, and dynamic changes in competition. Journal of Financial Intermediation 12, 57–95.

Berger, A.N., Mester, L.J., 1997. Inside the black box: what explains differences in the efficiencies of financial institutions? Journal of Banking & Finance 21, 895–947.

Berglöf, E., Roland, G., 1997. Soft budget constraints and credit crunches in financial

transition. European Economic Review 41, 807–817.

Bikker, J.A., Haaf, K., 2002. Competition, concentration and their relationship: An empirical analysis of the banking industry. Journal of Banking and Finance 26, 2191–2214.

Bikker, J.A., Shaffer, S., Spierdijk, L., 2012. Assessing competition with the Panzar-Rosse model: the role of scale, costs, and equilibrium. Review of Economics and Statistics 94, 1025–1044.

Bliss, R.R., Flannery, M.J., 2002. Market discipline in the governance of U.S. bank holding companies: monitoring vs. influencing. European Finance Review 6, 361–396.

Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics 87, 115–143.

Bonin, J.P., Hasan, I., Wachtel, P., 2005. Bank performance, efficiency and ownership in transition countries. Journal of Banking & Finance 29, 31–53.

Boone, J., 2008. A new way to measure competition. The Economic Journal 118, 1245–1261.

Boone, J., Griffith, R., Harrison, R., 2004. Measuring Competition, in: Presented at the Encore Meeting 2004.

Boone, J., van Ours, J.C., van der Wiel, H., 2013. When is the price cost margin a safe way to measure changes in competition? De Economist 161, 45–67.

Boratav, K., Yeldan, E., 2006. Turkey, 1980-2000: Financial Liberalization, Macroeconomic (In)-Stability, And Patterns of Distribution, External Liberalization, Stabilization, and the Labor Market in Brazil, CEPA and The New School for Social Research. Oxford University Press.

Boubacar, D., 2016. Foreign bank entry and bank competition in africa: an inverted u-shaped relation. Journal of Developing Areas 50, 289–308.

Boyd, J.H., Chang, C., Smith, B.D., 1998. Moral hazard under commercial and universal

banking. Journal of Money, Credit and Banking 30, 426–468.

Boyd, J.H., De Nicolo, G., 2005. The theory of bank risk taking and competition revisited. The Journal of Finance 60, 1329–1343.

Bresnahan, T.F., 1982. The oligopoly solution concept is identified. Economics Letters 10, 87–92.

Brissimis, S.N., Delis, M.D., Iosifidi, M., 2014. Bank market power and monetary policy transmission. International Journal of Central Banking 10, 173–214.

Brissimis, S.N., Delis, M.D., Tsionas, E.G., 2010. Technical and allocative efficiency in European banking. European Journal of Operational Research 204, 153–163.

Brock, P.L., Rojas Suarez, L., 2000. Understanding the behavior of bank spreads in Latin America. Journal of Development Economics 63, 113–134.

BRSA, 2009. From Crisis to Financial Stability: Turkey Experience, Banking Regulation and Supervision Agency Working Paper, 2nd Ed., Banking Regulation and Supervision Agency of Turkey.

BRSA, 2002. Banking Restructuring Program Progress Reports (I-VII). Banking Regulation and Supervision Agency of Turkey.

BRSA, 2001. Towards a Sound Turkish Banking Sector, Banking Regulation and Supervision Agency of Turkey.

Burdisso, T., D'Amato, L., 1999. Prudential Regulations, Restructuring and Competition: the Case of the Argentine Banking Industry, CRBA Working Paper 10, Central Bank of Argentina.

Cameron, A.C., Trivedi, P.K., 2005. Microeconometrics: Methods and Application. Cambridge University Press, New York.

Canhoto, A., Dermine, J., 2003. A note on banking efficiency in Portugal, new vs. old banks. Journal of Banking & Finance 27, 2087–2098.

Carhart, M.M., Carpenter, J.N., Lynch, A.W., Musto, D.K., 2002. Mutual fund survivorship. Review of Financial Studies 15, 1439–1463.

Carletti, E., 2008. Competition And Regulation In Banking, in: Thakor, A.V., Boot, A.W.A. (Eds.), Handbook Of Financial Intermediation And Banking. Elsevier Science.

Carlson, M.A., Thomas, K., Kurt, L., 2011. Distress in the financial sector and economic activity. The B.E. Journal of Economic Analysis & Policy 11, 1–31.

Casu, B., Deng, B., Ferrari, A., 2017. Post-crisis regulatory reforms and bank performance: lessons from Asia. The European Journal of Finance 23, 1–28.

Casu, B., Ferrari, A., Zhao, T., 2013. Regulatory reform and productivity change in Indian banking. Review of Economics and Statistics 95, 1066–1077.

Casu, B., Girardone, C., 2006. Bank competition, concentration and efficiency in the single european market. The Manchester School 74, 441–468.

Casu, B., Girardone, C., Molyneux, P., 2015. Introduction To Banking, 2nd ed. Pearson Education Limited.

Caves, R.E., 1990. Lessons from privatization in Britain. State enterprise behavior, public choice, and corporate governance. Journal of Economic Behavior and Organization 13, 145–169.

Cetorelli, N., Strahan, P.E., 2006. Finance as a barrier to entry: bank competition and industry structure in Local U.S. markets. The Journal of Finance 61, 437–461.

Charnes, A., Cooper, W.W., Rhodes, E., 1981. Evaluating program and managerial efficiency: an application of data envelopment analysis to program follow through. Management Science 27, 668–697.

Charnes, A., Cooper, W.W., Rhodes, E., 1978. Measuring the efficiency of decision making units. European Journal of Operational Research 2, 429–444.

Chen, X., Skully, M., Brown, K., 2005. Banking efficiency in China: application of DEA to pre- and post-deregulation eras: 1993–2000. China Economic Review 16, 229–245.

Chortareas, G.E., Girardone, C., Ventouri, A., 2012. Bank supervision, regulation, and efficiency: Evidence from the European Union. Journal of Financial Stability 8, 292–302.

Chronopoulos, D.K., Liu, H., McMillan, F.J., Wilson, J.O.S., 2015. The dynamics of US bank profitability. European Journal of Finance 21, 426–443.

Church, J.R., Ware, R., 2000. Industrial Organization : A Strategic Approach. Irwin McGraw Hill.

Claessens, S., Demirgüç-Kunt, A., Huizinga, H., 2001. How does foreign entry affect domestic banking markets? Journal of Banking & Finance 25, 891–911.

Claessens, S., Klingebiel, D., 2001. Competition and scope of activities in financial services. The World Bank Research Observer 16, 19–40.

Claessens, S., Laeven, L., 2004. What drives bank competition? some international evidence. Journal of Money, Credit and Banking 36, 563–583.

Claessens, S., Van Horen, N., 2014. Foreign banks: trends and impact. Journal of Money, Credit and Banking 46, 295–326.

Claeys, S., Hainz, C., 2006. Acquisition Versus Greenfield: The Impact of The Mode of Foreign Bank Entry on Information And Bank Lending Rates, Working paper series 653, European Central Bank.

Clark, J.A., Siems, T., 2002. X-efficiency in banking: looking beyond the balance sheet. Journal of Money, Credit, and Banking 34, 987–1013.

Clarke, G., Cull, R., Peria, M., 2003. Foreign bank entry: experience, implications for developing economies, and agenda for further research. The World Bank Research Observer 18, 25–59.

Clarke, G.R.G., Cull, R., Shirley, M.M., 2005. Bank privatization in developing countries: a summary of lessons and findings. Journal of Banking and Finance 29, 1905–1930.

Clerides, S., Delis, M.D., Kokas, S., 2015. A new data set on competition in national banking markets. Financial Markets, Institutions & Instruments 24, 267–311.

Coccorese, P., 2005. Competition in markets with dominant firms: A note on the evidence from the Italian banking industry. Journal of Banking & Finance 29, 1083–1093.

Coelli, T., Perelman, S., Romano, E., 1999. Accounting for environmental influences in

stochastic frontier models : with application to international airlines. Journal of Productivity Analysis 11, 251–273.

Coelli, T., Rao, D., O'Donnell, C., Battese, G., 2005. An Introduction To Efficiency And Productivity Analysis, 2nd ed. Springer, New York.

Das, A., Ghosh, S., 2006. Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period. Review of Financial Economics 15, 193–221.

Davies, S., 1980. Measuring industrial concentration: an alternative approach. The Review of Economics and Statistics 62, 306.

Davutyan, N., Yildirim, C., 2015. Efficiency in Turkish banking: post-restructuring evidence. The European Journal of Finance 1–22.

De Bandt, O., Davis, E.P., 2000. Competition, contestability and market structure in European banking sectors on the eve of EMU. Journal of Banking & Finance 24, 1045–1066.

Degryse, H., Havrylchyk, O., Jurzyk, E., Kozak, S., 2012. Foreign bank entry, credit allocation and lending rates in emerging markets: Empirical evidence from Poland. Journal of Banking and Finance 36, 2949–2959.

Degryse, H., Kim, M., Ongena, S., 2009. Microeconometrics Of Banking: Methods, Applications, and Results. Oxford University Press, USA.

Delis, M.D., 2012. Bank competition, financial reform, and institutions: The importance of being developed. Journal of Development Economics 97, 450–465.

Delis, M.D., Molyneux, P., Pasiouras, F., 2011. Regulations and productivity growth in banking: Evidence from transition economies. Journal of Money, Credit and Banking 43, 735–764.

Dell'Ariccia, G., 2001. Asymmetric information and the structure of the banking industry. European Economic Review 45, 1957–1980.

Dell'Ariccia, G., Marquez, R., 2004. Information and bank credit allocation. Journal of

Financial Economics 72, 185–214.

Dell'Ariccia, G., Marquez, R., Friedman, E., 1999. Adverse selection as a barrier to entry in the banking industry. Rand Journal of Economics 30.

Demetriades, P.O., Luintel, K.B., 1996. Financial development, economic growth and banking sector controls: evidence from India. The Economic Journal 106, 359–374.

Demir, F., 2004. A failure story: Politics and financial liberalization in Turkey, revisiting the revolving door hypothesis. World Development 32, 851–869.

Demir, N., Mahmud, F.S., Babuscu, S., 2005. The technical inefficiency effects of turkish banks after financial liberalization. The Developing Economies 3, 396–411.

Demirguc-Kunt, A., Detragiache, E., 2000. Monitoring banking sector fragility: A multivariate logit approach. The World Bank Economic Review 14, 287–307.

Demirguc-Kunt, A., Detragiache, E., 1998. The determinants of banking crises in developing and developed countries. IMF Staff Papers 45, 81–109.

Demirgüç-Kunt, A., Detragiache, E., 1998. Financial liberalization and financial fragility (No. 1917), IMF Working Paper.

Demirguc-Kunt, A., Huizinga, H., 1999. Determinants of commercial bank interest margins and profitability : some international evidence. The World Bank economic review 13, 379–408.

Demirgüç-Kunt, A., Laeven, L., Levine, R., 2004. Regulations, market structure, institutions, and the cost of financial intermediation. Journal of Money, Credit and Banking 36, 593–622.

Demirgüç-Kunt, A., Maksimovic, V., 1998. Law, finance, and firm growth. Journal of Finance 53, 2107–2137.

Demsetz, H., 1974. Toward a Theory of Property Rights, in: Classic Papers in Natural Resource Economics. Palgrave Macmillan UK, London, pp. 163–177.

Demsetz, H., 1973. Industry structure, market rivalry, and public policy. The Journal of Law & Economics 16, 1–9.

Denizer, C., 1997. The Effects of Financial Liberalization and New Bank Entry on Market Structure and Competition in Turkey, World Bank Policy Research Working Paper 1839, World Bank.

Denizer, C. a., Dinc, M., Tarimcilar, M., 2007. Financial liberalization and banking efficiency: evidence from Turkey. Journal of Productivity Analysis 27, 177–195.

Denizer, C., Dinc, M., Tarimcilar, M., 2000. Measuring Banking Efficiency In The Pre- and Post Liberalisation Environment: Evidence From The Turkish Banking System, World Bank Working Paper.

Deyoung, R., Nolle, D.E., 1996. Foreign-owned banks in the United States: earning market share or buying it? Journal of Money, Credit and Banking 28, 622–636.

Diamond, P.A., 1971. A model of price adjustment. Journal of Economic Theory 3, 156–168.

Djankov, S., La Porta, R., Lopez-de-Silanes, F., Shleifer, A., 2002. The regulation of entry. The Quarterly Journal of Economics 117, 1–37.

Elliehausen, G.E., 1998. The Cost Of Banking Regulation: A Review Of The Evidence, Board of Governors of the Federal Reserve System Washington 20551.

Elyasiani, E., Mehdian, S., 1995. The comparative efficiency performance of small and large US commercial banks in the pre- and post-deregulation eras. Applied Economics 27, 1069–1079.

Ertugrul, A., Selcuk, F., 2001. A brief account of the Turkish economy: 1980–2000. Russian East European Finance Trade 37, 6–28.

Ertugrul, A., Zaim, O., 1999. Economic crises and efficiency in Turkish banking industry. METU Studies in Development 26, 99–116.

Evanoff, D.D., Fortier, D.D., 1988. Reevaluation of the structure-conduct-performance paradigm in banking. Journal of Financial Services Research 1, 277–294.

Evanoff, D.D., Israilevich, P.., 1991. Productive efficiency in banking. Econometric Perspectives 15, 11–32.

Fama, E.F., 1980. Agency problems and the theory of the firm. Journal of Political Economy 88, 288–307.

Fethi, M.D., Shaban, M., Weyman-Jones, T., 2012. Turkish banking recapitalization and the financial Crisis: an efficiency and productivity analysis. Emerging Markets Finance & Trade 48, 76–90.

Filippini, M., Hrovatin, N., Zorić, J., 2008. Cost efficiency of Slovenian water distribution utilities: An application of stochastic frontier methods. Journal of Productivity Analysis 29, 169–182.

Flamini, V., Mcdonald, C., Schumacher, L., 2009. The Determinants of Commercial Bank Profitability in Sub-Saharan Africa, International Monetary Fund WP/09/15, Washington, DC.

Frame, W.S., Kamerschen, D.R., 1997. The profit-structure relationship in legally protected banking markets using efficiency measures. Review of Industrial Organization 12, 9–22.

Freixas, X., Rochet, J.C., 2008. Microeconomics Of Banking, 2nd ed. The MIT Press, Cambridge, Massachusetts.

Fukuyama, H., Matousek, R., 2011. Efficiency of Turkish banking: two-stage network system. Variable returns to scale model. Journal of International Financial Markets, Institutions and Money 21, 75–91.

Ganioglu, A., 2008. Understanding banking sector reforms in Turkey: assesing the roles of domestic versus external actors. Journal of Southern Europe and the Balkans 10, 363–376.

Gehrig, T., 1996. Natural oligopoly and customer networks in intermediated markets. International Journal of Industrial Organization 14, 101–118.

Gelos, R.., Roldós, J., 2004. Consolidation and market structure in emerging market banking systems. Emerging Markets Review 5, 39–59.

Geroski, P.A., Jacquemin, A., 1988. The persistence of profits: a European comparison. The Economic Journal 98, 375.

Gilbert, R.A., 1984. Bank market structure and competition: a survey. Journal of Money, Credit and Banking 16, 617.

Gilbert, R.A., Wilson, P.W., 1998. Effects of deregulation on the productivity of Korean banks. Journal of Economics and Business 50, 133–155.

Girardone, C., Molyneux, P., Gardener, E.P.M., 2004. Analysing the determinants of bank efficiency: the case of Italian banks. Applied Economics 36, 215–227.

Glass, A.J., Kenjegalieva, K., Weyman-Jones, T., 2014. Bank performance and the financial crisis: evidence from Kazakhstan. Applied Financial Economics 24, 121–138.

Glass, A.J., Saggi, K., 1998. International technology transfer and the technology gap. Journal of Development Economics 55, 369–398.

Glen, J., Lee, K., Singh, A., 2003. Corporate profitability and the dynamics of competition in emerging markets: A time series analysis. The Economic Journal 113, 465–484.

Glen, J., Lee, K., Singh, A., 2001. Persistence of profitability and competition in emerging markets. Economics Letters 72, 247–253.

Goddard, J., Liu, H., Molyneux, P., Wilson, J.O.S., 2013. Do bank profits converge? European Financial Management 19, 345–365.

Goddard, J., Liu, H., Molyneux, P., Wilson, J.O.S., 2011. The persistence of bank profit. Journal of Banking and Finance 35, 2881–2890.

Goddard, J., Molyneux, P., Wilson, J., 2001. European Banking: Efficiency, Technology and Growth. John Wiley, London.

Goddard, J., Molyneux, P., Wilson, J.O.S., 2004a. Dynamics of growth and profitability in banking. Journal of Money, Credit and Banking 36, 1069–1090.

Goddard, J., Molyneux, P., Wilson, J.O.S., 2004b. The profitability of european banks: a cross-sectional and dynamic panel analysis. The Manchester School 72, 363–381.

Goddard, J., Wilson, J.O.S., 2009. Competition in banking: a disequilibrium approach. Journal of Banking & Finance 33, 2282–2292.

Goddard, J., Wilson, J.O.S., 1999. The persistence of profit: a new empirical interpretation. International Journal of Industrial Organization 17, 663–687.

Gollop, F.M., Roberts, M.J., 1983. Environmental regulations and productivity growth: the case of fossil-fueled electric power generation. Journal of Political Economy 91, 654–674.

Gong, B.H., Sickles, R.C., 1992. Finite sample evidence on the performance of stochastic frontiers and data envelopment analysis using panel data. Journal of Econometrics 51, 259–284.

Grabowski, R., Rangan, N., Rezvanian, R., 1994. The effect of deregulation on the efficiency of U.S. banking firms. Journal of Economics and Business 46, 39–54.

Greene, W.H., 1990. A Gamma-distributed stochastic frontier model. Journal of Econometrics 46, 141–163.

Griffin, R.C., Montgomery, J.M., Rister, M.E., 1987. Selecting functional form in production function analysis. Western Journal of Agricultural Economics 12, 216–27.

Gugler, K., Peev, E., 2018. The persistence of profits in banking: an international comparison. Applied Economics 50, 5996–6009.

Günalp, B., Çelik, T., 2006. Competition in the Turkish banking industry. Applied Economics 38, 1335–1342.

Hadad, M.D., Hall, M.J.B., Kenjegalieva, K.A., Santoso, W., Simper, R., 2011. Banking efficiency and stock market performance:an analysis of listed Indonesian banks. Review of Quantitative Finance and Accounting 37, 1–20.

Hakkio, C.S., Keeton, W.R., 2009. Financial stress: what is it, how can it be measured, and why does it matter? Economic Review Federal Reserve Bank of Kansas City 5–50.

Hall, M., Tideman, N., 1967. Measures of concentration. Journal of the American Statistical Association 62, 162–168.

Hannan, T.H., Berger, A.N., 1991. The rigidity of prices: evidence from the banking industry. Source: The American Economic Review 81, 938–945.

Hart, O.D., 1983. The market mechanism as an incentive scheme. The Bell Journal of Economics 14, 366–382.

Hart, P.E., 1975. Moment distributions in economics: an exposition. Journal of the Royal Statistical Society 138, 423–434.

Hasan, I., Marton, K., 2003. Development and efficiency of the banking sector in a transitional economy: Hungarian experience. Journal of Banking & Finance 27, 2249–2271.

Hause, J.C., 1977. The measurement of concentrated industrial structure and the size distribution of firms. Annals of Economic and Social Measurement 6, 73–107.

Havrylchyk, O., 2006. Efficiency of the Polish banking industry: foreign versus domestic banks. Journal of Banking & Finance 30, 1975–1996.

Havrylchyk, O., Jurzyk, E., 2011. Profitability of foreign banks in Central and Eastern Europe. Economics of Transition 19, 443–472.

Hawkins, J., Mihaljek, D., 2001. The Banking Industry In The Emerging Market Economies: Competition, Consolidation And Systemic Stability: An Overview, BIS Papers 4, Bank for International Settlements.

Hayashi, F., 2000. Econometrics. Princeton University Press, Princeton.

Hellmann, T.F., Murdock, K.C., Stiglitz, J.E., 2000. Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough? American Economic Review 90, 147–165.

Hermes, N., Lensink, R., 1996. Financial Development and Economic Growth: Theory and Experinces from Developing Countries. Routledge, London.

Hermes, N., Meesters, A., 2015. Financial liberalization, financial regulation and bank efficiency: a multi-country analysis. Applied Economics 47, 2154–2172.

Hicks, J.R.R., 1935. Annual survey of economic theory: the theory of monopoly. Econometrica 3, 1–20.

Huang, C.J., Liu, J., 1994. Estimation of a non-neutral stochastic frontier production

function. The Journal of Productivity Analysis 180, 171–180.

Hughes, J.P., Mester, L.J., 2013. Who said large banks don't experience scale economies? Evidence from a risk-return-driven cost function. Journal of Financial Intermediation 22, 559–585.

Humphrey, D.B., Pulley, L.B., 1997. Banks' responses to deregulation: profits, technology, and efficiency. Journal of Money, Credit and Banking 29, 73–93.

Isik, I., Hassan, M.K., 2003a. Financial deregulation and total factor productivity change: An empirical study of Turkish commercial banks. Journal of Banking & Finance 27, 1455–1485.

Isik, I., Hassan, M.K., 2003b. Efficiency, ownership and market structure, corporate control and governance in the Turkish banking industry. Journal of Business Finance and Accounting 30, 1363–1421.

Isik, I., Hassan, M.K., 2002a. Technical, scale and allocative efficiencies of Turkish banking industry. Journal of Banking & Finance 26, 719–766.

Isik, I., Hassan, M.K., 2002b. Cost and profit efficiency of the Turkish banking industry: an empirical investigation. The Financial Review 37, 257–279.

Iwata, G., 1974. Measurement of conjectural variations in oligopoly. Econometrica 42, 947.

Jensen, M.C., Meckling, W.H., 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. Journal of Financial Economics 3, 305–360.

Jondrow, J., Knox Lovell, C. a., Materov, I.S., Schmidt, P., 1982. On the estimation of technical inefficiency in the stochastic frontier production function model. Journal of Econometrics 19, 233–238.

Judson, R.A., Owen, A.L., 1999. Estimating dynamic panel data models: a guide for macroeconomists. Economics Letters 65, 9–15.

Kaplan, M., Celik, T., 2008. The persistence of profitability and competition in the Turkish banking sector. Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi 30,

157–167.

Kasman, A., 2002. Cost efficiency, scale economies, and technological progress in Turkish banking. Central Bank Review 1, 1–20.

Kasman, A., Kasman, S., 2016. Bank size, competition and risk in the Turkish banking industry. Empirica 43, 607–631.

Kasman, S., Kasman, A., 2015. Bank competition, concentration and financial stability in the Turkish banking industry. Economic Systems 39, 502–517.

Kay, J., Vickers, J., Mayer, C., Ulph, D., 1988. Regulatory reform in Britain. Economic Policy 3, 285–351.

Kay, J.A., Thompson, D.J., 1986. Privatisation: a policy in search of a rationale. The Economic Journal 96, 18–32.

Keeley, M.C., 1990. Deposit insurance, risk, and market power in banking. The American Economic Review 80, 1183–1200.

Kenjegalieva, K., Simper, R., Weyman-Jones, T., Zelenyuk, V., 2009. Comparative analysis of banking production frameworks in Eastern European financial markets. European Journal of Operational Research 198, 326–340.

Kenjegalieva, K.A., Simper, R., Weyman-Jones, T.G., 2009. Efficiency of transition banks: inter-country banking industry trends. Applied Financial Economics 19, 1531–1546.

King, R.G., Levine, R., 1993a. Finance and growth: Schumpeter might be right. Quarterly Journal of Economics 108, 717–738.

King, R.G., Levine, R., 1993b. Finance, entrepreneurship and growth: theory and evidence. Journal of Monetary Economics 32, 513–542.

Kleibergen, F., Paap, R., 2006. Generalized reduced rank tests using the singular value decomposition. Journal of Econometrics 133, 97–126.

Knapp, M., Gart, A., Chaudhry, M., 2006. The impact of mean reversion of bank profitability on post-merger performance in the banking industry. Journal of Banking & Finance 30, 3503–3517.

Kumbhakar, S., Lovell, C., 2000. Stochastic Frontier Analysis, 1st ed. Cambridge University Press, Cambridge.

Kumbhakar, S., Sarkar, S., 2003. Deregulation, ownership, and productivity growth in the banking industry: evidence from India. Journal of Money, Credit, and Banking 35, 403–424.

Kumbhakar, S.C., 1990. Production frontiers, panel data, and time-varying technical inefficiency. Journal of Econometrics 46, 201–211.

Kumbhakar, S.C., Ghosh, S., McGuckin, J.T., 1991. A generalized production frontier approach for estimating determinants of inefficiency in U.S. dairy farms. Journal of Business and Economic Statistics 9, 279–286.

Kumbhakar, S.C., Lozano-Vivas, A., 2005. Deregulation and productivity: The case of Spanish Banks. Journal of Regulatory Economics 27, 331–351.

Kumbhakar, S.C., Wang, H., Horncastle, A.P., 2015. A practitioner's guide to stochastic frontier aproach. Cambridge University Press.

Laeven, L., Levine, R., 2007. Is there a diversification discount in financial conglomerates? Journal of Financial Economics 85, 331–367.

Lau, L.J., 1982. On identifying the degree of competitiveness from industry price and output data. Economics Letters 10, 93–99.

Leightner, J.E., Lovell, C.A.K., 1998. The impact of financial liberalization on the performance of Thai banks. Journal of Economics and Business 50, 115–131.

Lensink, R., Meesters, A., Naaborg, I., 2008. Bank efficiency and foreign ownership: Do good institutions matter? Journal of Banking & Finance 32, 834–844.

Lerner, A.P., 1934. The concept of monopoly and the measurement of monopoly power. The Review of Economic Studies 1, 157–175.

Levine, R., 2005. Finance And Growth: Theory And Evidence, in: Aghion, P., Durlauf, S.N. (Eds.), Handbook Of Economic Growth. Elsevier B.V.

Levine, R., 1996. Foreign banks, financial development, and economic growth. Journal of

Economic Literature 35.

Levy, B., 1987. A theory of public enterprise behavior. Journal of Economic Behavior & Organization 8, 75–96.

Li, Y., Uchida, K., Xu, T., Wu, Z., 2016. The impact of foreign entry on Chinese banks. Review of Development Economics 20, 74–86.

Lieu, P., Yeh, T., Chiu, Y., 2005. Off-balance sheet activities and cost inefficiency in Taiwan's Banks. The Service Industries Journal 25, 925–944.

Liu, H., Molyneux, P., Wilson, J.O.S., 2013. Competition In Banking: Measurement And Interpretation, in: Bell, A.R., Brooks, C., Prokopczuk, M. (Eds.), Handbook of Research Methods and Applications in Empirical Finance. Edward Elgar Publishing, Cheltenham.

Liu, J., Tone, K., 2008. A multistage method to measure efficiency and its application to Japanese banking industry. Socio-Economic Planning Sciences 42, 75–91.

Lozano-Vivas, A., 1998. Efficiency and technical change for Spanish banks. Applied Financial Economics 8, 289–300.

Lozano-Vivas, A., Pasiouras, F., 2010. The impact of non-traditional activities on the estimation of bank efficiency: International evidence. Journal of Banking & Finance 34, 1436–1449.

Machlup, F., 1967. Theories of the firm: marginalist, behavioral, managerial. The American Economic Review 57, 1–33.

Macit, F., 2012. Recent evidence on concentration and competition in Turkish banking sector. Theoretical and Applied Economics 8.

Manlagñit, M.C. V., 2011. Cost efficiency, determinants, and risk preferences in banking: A case of stochastic frontier analysis in the Philippines. Journal of Asian Economics 22, 23–35.

Maruyama, N., Odagiri, H., 2002. Does the 'persistence of profits' persist?: a study of company profits in Japan, 1964–97. International Journal of Industrial Organization

20, 1513–1533.

Matoušek, R., Taci, A., 2004. Efficiency in banking: empirical evidence from the Czech Republic. Economic Change and Restructuring 37, 225–244.

Maudos, J., Fernandez de Guevara, J., 2007. The cost of market power in banking: Social welfare loss vs. cost inefficiency. Journal of Banking and Finance 31, 2103–2125.

Maudos, J., Fernandez de Guevara, J., 2004. Factors explaining the interest margin in the banking sectors of the European Union. Journal of Banking and Finance 28, 2259–2281.

Maudos, J., Solís, L., 2011. Deregulation, liberalization and consolidation of the Mexican banking system: Effects on competition. Journal of International Money and Finance 30, 337–353.

McKinnon, R.I., 1973. Money And Capital In Economic Development, Brookings Institution, Washington, D.C.

Meeusen, W., van den Broeck, J., 1977. Efficiency estimation from Cobb-Douglas production functions with composed error. International Economic Review 18, 435–44.

Mester, L.J., 1996. A study of bank efficiency taking into account risk-preferences. Journal of Banking & Finance 20, 1025–1045.

Mester, L.J., 1992. Traditional and nontraditional banking: An information-theoretic approach. Journal of Banking and Finance 16, 545–566.

Micco, A., Panizza, U., Yañez, M., 2007. Bank ownership and performance. Does politics matter? Journal of Banking & Finance 31, 219–241.

Mirzaei, A., Moore, T., 2014. What are the driving forces of bank competition across different income groups of countries? Journal of International Financial Markets, Institutions and Money 32, 38–71.

Mishkin, F.S., 1999. Lessons from the Asian crisis. Journal of International Money and Finance 18, 709–723.

Molyneux, P., Altunbaş, Y., Gardener, E.P.M., 1996a. Efficiency In European Banking. John Wiley, London.

Molyneux, P., Forbes, W., 1995. Market structure and performance in European banking. Applied Economics 27, 155–159.

Molyneux, P., Lloyd-Williams, D.M., Thornton, J., 1994. Competitive conditions in european banking. Journal of Banking & Finance 18, 445–459.

Molyneux, P., Thornton, J., Michael Llyod-Williams, D., 1996b. Competition and market contestability in Japanese commercial banking. Journal of Economics and Business 48, 33–45.

Moreno, R., Villar, A., 2005. The Increased Role of Foreign banks: Entry in Emerging Markets (No. 23), Banking for International Settlements (BIS) Paper.

Mueller, C.D., 1977. The persistence of profits above the norm. Economica 44, 369–380.

Mueller, D.C., 1990. The Dynamics of Company Profits: An International Comparision., 1st ed. Cambridge University Press, Cambridge.

Mwega, F., 2011. The competitiveness and efficiency of the financial services sector in Africa: a case study of Kenya. African Development Review 23, 44–59.

Nathan, A., Neave, E.H., 1989. Competition and contestability in Canada's financial system: empirical results. The Canadian Journal of Economics 22, 576.

Neumark, D., Sharpe, S.A., 1992. Market structure and the nature of price rigidity: evidence from the market for consumer deposits, Source: The Quarterly Journal of Economics.

Nickell, S., 1981. Biases in dynamic models with fixed effects. Econometrica 49, 1417–1426.

Nickell, S.J., 1996. Competition and corporate performance. Journal of Political Economy 104, 724.

Northcott, C.A., 2004. Competition In Banking: A Review Of The Literature, Staff Working Papers 04-24. Bank of Canada.

Noy, I., 2004. Financial liberalization, prudential supervision, and the onset of banking crises. Emerging Markets Review 5, 341–359.

Odekon, M., 2002. Financial liberalization and investment in Turkey. Briefing Notes in Economics 53.

OECD, 2009. Competition And Financial Markets, Key Findings 2009, Organisation For Economic Co-Operation And Development.

OECD, 2006. Competition And Regulation In Retial Banking, DAF/COMP(2006)33, Organisation For Economic Co-Operation And Development.

Öniş, Z., Bakır, C., 2007. Turkey's political economy in the age of financial globalization: the significance of the EU anchor. South European Society and Politics 12, 147–164.

Ozdemir, S., Trott, P., 2009. Exploring the adoption of a service innovation: A study of Internet banking adopters and non-adopters. Journal of Financial Services Marketing 13, 284–299.

Özkan-Günay, E., Günay, Z., Günay, G., 2013. The impact of regulatory policies on risk taking and scale efficiency of commercial banks in an emerging banking sector. Emerging Markets Finance and Trade 49, 80–98.

Ozkan-Gunay, E.N., Tektas, A., 2006. Efficiency analysis of the Turkish banking sector in precrisis and crisis period: a DEA approach. Contemporary Economic Policy 24, 418–431.

Panzar, J.C., Rosse, J.N., 1987. Testing for "Monopoly" equilibrium. Journal of Industrial Economics 35, 443.

Park, K.H., 2009. Has bank consolidation in Korea lessened competition? The Quarterly Review of Economics and Finance 49, 651–667.

Pasadilla, G.O., Milo, M., 2005. Effect Of Liberalization On Banking Competition, DP 2005-03. Philippine Institute for Development Studies.

Pasiouras, F., Tanna, S., Zopounidis, C., 2009. The impact of banking regulations on banks' cost and profit efficiency: Cross-country evidence. International Review of

Financial Analysis 18, 294–302.

Pazarbasioglu, C., 2005. Accession To The European Union: Potential Impacts On The Turksih Banking Sector, in: Hoekman, B., Togan, S. (Eds.), Turkey: Economic Reform & Accession To The European Union. The International Bank for Reconstruction and Development / The World Bank, Washington, DC.

Peltzman, J., 1984. The Multifiber Arrangement And Its Effects On The Profit Performance Of The US Textile Industry, in: Baldwin, R.E., Krueger, A.O. (Eds.), The Structure And Evolution Of Recent U.S. Trade Policy. The University of Chicago Press, Chicago.

Peltzman, S., 1977. The gains and losses from industrial concentration. Journal of Law and Economics 20, 229–63.

Peria, M.S.M., Mody, A., 2004. How foreign participation and market concentration impact bank spreads: evidence from Latin America. Journal of Money, Credit and Banking.

Pervan, M., Pelivan, I., Arnerić, J., 2015. Profit persistence and determinants of bank profitability in Croatia. Economic Research-Ekonomska Istraživanja 28, 284–298.

Pitt, M.M., Lee, L.F., 1981. The measurement and sources of technical inefficiency in the Indonesian weaving industry. Journal of Development Economics 9, 43–64.

Poshakwale, S.S., Qian, B., 2011. Competitiveness and efficiency of the banking sector and economic growth in Egypt. African Development Review 23, 99–120.

Reifschneider, D., Stevenson, R., 1991. Systematic departures from the frontier: a framework for the analysis of firm inefficiency. International Economic Review 32, 715.

Repkova, I., Stavarek, D., 2014. Concentration and competition in the banking sector of Turkey. Economic Interferences 16, 625–640.

Rhoades, S.A., 1985. Market share as a source of market power: Implications and some evidence. Journal of Economics and Business 37, 343–363.

Rice, T., Strahan, P.E., 2010. Does credit competition affect small-firm finance? Journal of Finance 65, 861–889.

Richmond, J., 1974. Estimating the efficiency of production. International Economic Review 15, 515–521.

Rodrik, D., 1990. Premature Liberalization, Incomplete Stabilization: The Ozal Decade In Turkey, NBER Working Paper 3300, National Bureau of Economic Research.

Roodman, D., 2009a. How to do xtabond2: an introduction to difference and system GMM in Stata. Stata Journal 9, 86–136.

Roodman, D., 2009b. A note on the theme of too many instruments. Oxford Bulletin of Economics and Statistics 71, 135–158.

Rossi, M., 1999. Financial Fragility And Economic Performance In Developing Economies: Do Capital Controls, Prudential Regulation And Supervision Matter?, IMF Working Papers, IMF Working Papers 99/66, International Monetary Fund.

Ruggiero, J., 1999. Theory and methodology. efficiency estimation and error decomposition in the stochastic frontier model : a Monte Carlo analysis. European Journal of Operational Research 115, 555–563.

Sanli, B., Hobikoğlu, E.H., 2015. Development of internet banking as the innovative distribution channel and Turkey example. Journal of Internet Banking and Commerce 20, 343–352.

Sappington, D.E.M., Sidak, J.G., 2003. Incentives for anticompetitive behavior by public enterprises. Review of Industrial Organization 22, 183–206.

Sarpong-Kumankoma, E., Abor, J., Aboagye, A.Q.Q., Amidu, M., 2018. Differences in bank profit persistence in Sub-Saharan Africa. African Journal of Economic and Management Studies 9, 512–522.

Schaeck, K., Cihák, M., 2010. Competition, Efficiency, and Soundness in Banking : An Industrial Organization Perspective, Discussion Paper 2010-68S. Tilburg University, Center for Economic Research.

Schaek, K., Cihák, M., 2008. How Does Competition Affect Efficiency And Soundness In Banking? New Empirical Evidence, ECB Working Paper No. 932, European Central Bank.

Schaek, K., Cihak, M., Wolfe, S., 2009. Are competitive banking systems more stable? Journal of Money, Credit and Banking 41, 711–734.

Schargrodsky, E., Federico, S., 1998. Regulation, Concentration and Competition in Financial Intermediation, Business School Working Paper, Mimeo Universidad Torcuato Di Tella.

Schargrodsky, E., Sturzenegger, F., 2000. Banking regulation and competition with product differentiation, in: Journal of Development Economics. North-Holland, pp. 85–111.

Schiersch, A., Schmidt-Ehmcke, J., 2010. Empiricism Meets Theory: Is The Boone-Indicator Applicable?, DIW Discussion Papers 1030, German Institute for Economic Research.

Schmidt, K.M., 1997. Managerial incentives and product market competition. The Review of Economic Studies 64, 191–213.

Schohl, F., 1990. Persistence of profits in the long run: A critical extension of some recent findings. International Journal of Industrial Organization 8, 385–404.

Sealey, C.W., Lindley, J.T., 1977. Inputs, outputs, and a theory of production and cost at depository financial institutions. The Journal of Finance 32, 1251–1266.

Shaffer, S., 2004. Patterns of competition in banking. Journal of Economics and Business 56, 287–313.

Shaffer, S., 2000. Industrial Organisation - A Strategic Approach, McGraw-Hill. Elsevier.

Shaffer, S., 1993. A test of competition in Canadian banking. Journal of Money, Credit and Banking 25, 49.

Shaffer, S., 1983. A nonstructural test for competition in financial markets. Economics Letters 12, 349–353.

Shaffer, S., Spierdijk, L., 2015. The Panzar–Rosse revenue test and market power in

banking. Journal of Banking & Finance 61, 340–347.

Shaw, E., 1973. Financial Deepening In Economic Development. Oxford University Press, New York.

Shepherd, W.G., 1986. Tobin's q and the structure-performance relationship: comment. The American Economic Review 76, 1205–1210.

Shepherd, W.G., 1982a. Economies Of Scale And Monopoly Profits, in: Craven, J. V. (Ed.), Industrial Organization, Antitrust, And Public Policy. Kluwer Nijhoff, Boston.

Shepherd, W.G., 1982b. Causes of increased competition in the U.S. economy, 1939-1980. The Review of Economics and Statistics 64, 613.

Shirley, M., Walsh, P., Patrick, W., 2001. Public Versus Private Ownership: The Current State Of The Debate, Policy Research Paper 2420, World Bank.

Shleifer, A., 1998. State versus private ownership. The Journal of Economic Perspectives 12, 133.

Shleifer, A., Vishny, R.W., 1994. Politicians and firms. The Quarterly Journal of Economics 109, 995–1025.

Short, B.K., 1979. The relation between commercial bank profit rates and banking concentration in Canada, Western Europe, and Japan. Journal of Banking & Finance 3, 209–219.

Simar, L., Wilson, P.W., 2007. Estimation and inference in two-stage, semi-parametric models of production processes. Journal of Econometrics 136, 31–64.

Simpasa, A.M., 2013. Increased foreign bank presence, privatisation and competition in the Zambian banking sector. Managerial Finance 39, 787–808.

Smirlock, M., Gilligan, T., Marshall, W., 1984. Tobin's q and the structure-performance relationship. The American Economic Review 74, 1051–1060.

Staikouras, C.K., Koutsomanoli-Fillipaki, A., 2006. Competition and concentration in the new European banking landscape. European Financial Management 12, 443–482.

Stefano, S., Nicoletti, G., 2003. Regulation, Productivity And Growth: OECD Evidence, Policy Research Working Paper 2944, World Bank.

Stevenson, R.E., 1980. Likelihood functions for generalized stochastic frontier estimation. Journal of Econometrics 13, 57–66.

Stiglitz, J.E., Jaramillo-Vallejo, J., Park, Y.C., 1993. The role of the state in financial markets, in: Annual Conference on Development Economics Supplement. pp. 19–61.

Stiroh, K.J., Strahan, P.E., 2003. Competitive dynamics of deregulation: evidence from U.S. banking. Journal of Money, Credit and Banking 35, 801–828.

Tabak, B.M., Fazio, D.M., Cajueiro, D.O., 2012. The relationship between banking market competition and risk-taking: Do size and capitalization matter? Journal of Banking & Finance 36, 3366–3381.

Terzi, N., 2015. Financial inclusion and Turkey. Academic Journal of Interdisciplinary Studies 4, 269–276.

Thakor, A., Boot, A., 1993. Self-interested bank regulation. American economic review 83, 206–212.

Thi, N.-A.V., Vencappa, D., 2008. Does the Entry Mode of Foreign Banks Matter for Bank Efficiency? Evidence from the Czech Republic, Hungary, and Poland, Working Paper No. 925, William Davidson Institute.

Unite, A.A., Sullivan, M.J., 2003. The effect of foreign entry and ownership structure on the Philippine domestic banking market. Journal of Banking & Finance 27, 2323–2345.

van Leuvensteijn, M., Bikker, J.A., van Rixtel, A.A.R.J.M., Sørensen, C.K., 2011. A new approach to measuring competition in the loan markets of the euro area. Applied Economics 43, 3155–3167.

van Leuvensteijn, M., Sorensen, K.C., Bikker, J.A., van Rixtel, A.A.R.J.M., 2013. Impact of bank competition on the interest rate pass-through in the Euro area. Applied Economics 45, 1359–1380.

Vickers, J., 1995. Concepts of competition. Oxford Economic Papers 47, 1–23.

Vives, X., 2001. Competition in the changing world of banking. Oxford Review of Economic Policy 17, 535–547.

Williams, J., 2012. Efficiency and market power in Latin American banking. Journal of Financial Stability 8, 263–276.

Windmeijer, F., 2005. A finite sample correction for the variance of linear efficient two-step GMM estimators. Journal of Econometrics 126, 25–51.

Winston, C., 1998. U.S. industry adjustment to economic deregulation. Journal of Economic Perspectives 12, 89–110.

Xu, B., Rixtel, A. Van, Leuvensteijn, M. van, 2014. Measuring Bank Competition In China: A Comparison Of New Versus Conventional Approaches Applied To Loan Markets, BIS Working Papers 422. Bank for International Settlements.

Xu, B., van Rixtel, A., van Leuvensteijn, M., 2016. Measuring bank competition under binding interest rate regulation: the case of China. Applied Economics 48, 4699–4718.

Yavas, U., Bilgin, Z., Shemwell, D.J., 1997. Service quality in the banking sector in an emerging economy: A consumer survey. International Journal of Bank Marketing 15, 217–223.

Yeldan, A.E., 1997. Financial liberalization and fiscal repression in Turkey: policy analysis in a CGE model with financial markets. Journal of Policy Modeling 19, 79–117.

Yeyati, E.L., Micco, A., 2007. Concentration and foreign penetration in Latin American banking sectors: impact on competition and risk. Journal of Banking & Finance 31, 1633–1647.

Yildirim, C., 2015. Liberalization, post-crisis restructuring and internationalization in Turkish banking. Turkish Studies 16, 253–279.

Yildirim, C., 2014. Competition in Turkish banking: impacts of restructuring and the global financial crisis. The Developing Economies 52, 95–124.

Yildirim, C., 2002. Evolution of banking efficiency within an unstable macroeconomic environment : the case of Turkish commercial banks. Applied Economics 34, 2289–2301.

Yildirim, H.S., Mohanty, S.K., 2010. Geographic deregulation and competition in the U.S. banking industry. Financial Markets, Institutions & Instruments 19, 63–94.

Yurtoglu, B.B., 2004. Persistence of firm-level profitability in Turkey. Applied Economics 36, 615–625.

Zaim, O., 1995. The effect of financial liberalization on the efficiency of Turkish commercial banks. Applied Financial Economics 5, 257–264.

Zardkoohi, A., Fraser, D.R., 1998. Geographical deregulation and competition in U.S. banking markets. The Financial Review 33, 85–98.

Zhao, T., Casu, B., Ferrari, A., 2010. The impact of regulatory reforms on cost structure, ownership and competition in Indian banking. Journal of Banking and Finance 34, 246–254.