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Abstract

Using a novel approach, we derive “shadow unrealized profit scores” as well as “shadow input-output prices” for each year and bank in the Turkish banking sector from 2002 to 2011. We demonstrate that these scores operationalize the Hicksian concept of “monopolistic quiet life.” We show that the Turkish banking sector came closer to the “**zero profit condition**” over time. Similarly, the variances of “shadow prices” exhibit a significant decline over our sample period, indicating a closer approximation to the “**law of one price**”. We conclude that there are differences in profit efficiency between banks with different ownership types and sizes. In particular, state-owned banks display the lowest inefficiency while foreign-owned banks the highest. Finally we find total asset and branch network sizes are positively related to profit efficiency, implying important scale and scope economies.

JEL Classifications: G21, D20, C14

Keywords: Turkish banking, profit efficiency, competition, shadow prices, Weak Axiom of Profit Maximization, Data Envelopment Analysis

ملخص

باستخدام نهج جديد، نستمد "ظل الأرباح غير المحققة"، وكذلك "ظل أسعار المدخلات والمخرجات" عن كل سنة وبنك في القطاع المصرفي التركي 2002-2011. علينا أن نظهر أن هذه الحسابات تفعل مفهوم Hicksian من مبدأ "حياة هادئة الاحتكارية." علينا أن نظهر أن القطاع المصرفي التركي جاء أقرب إلى "حالة الربح الصفرى" مع مرور الوقت. وبالمثل، فإن الفروق من "أسعار الظل" تظهر انخفاضا كبيرا خلال فترة عينة لدينا، مما يدل على تقريب إلى "قانون السعر الواحد". نستنتج أن هناك اختلافات في كفاءة الربح بين البنوك مع أنواع الملكية والأحجام مختلفة. وعلى وجه الخصوص، وعرض البنوك المملوكة للدولة بأقل مستوى من عدم الكفاءة في حين أن البنوك المملوكة للأجانب على أعلى مستوى. وأخيرا نجد ان مجموع الأصول والأحجام شبكة الفروع ترتبط بشكل إيجابي مع كفاءة الربح، مما يعني مقياس مهم.

1. Introduction

Extensive financial reform and liberalization programs aimed at increasing competition and performance in banking have been initiated in various emerging economies in recent years. In many cases, however, reform efforts undertaken in adverse macro-economic conditions and within the context of underdeveloped legal and regulatory frameworks have been followed by financial crises. Subsequently, the focus on reform in emerging economies has shifted towards improving supervisory and regulatory standards to ensure financial stability while promoting competition and efficiency. Furthermore, in the wake of the current global financial crisis, the interactions between regulations, competitive performance and stability of foreign banks' performance in emerging markets have attracted renewed attention from both researchers and policy makers.

This paper aims to contribute to this literature by analyzing the evolution of banking sector performance in Turkey, which went through a significant restructuring process in the aftermath of the country's financial crisis of 2000-2001. Given the new regulatory framework and new market conditions, which are marked by increased concentration and foreign bank participation, the drive to achieve higher efficiency in the sector is expected to be stronger. Accordingly, this study focuses on the following research questions: i) How did the competitive structure evolve over the period? ii) How were the various segments of the sector – e.g. universal banks vs. niche players – affected? iii) Is there any evidence of differential performance between public vs. private and foreign vs. domestic banks? iv) Did mergers and acquisitions improve efficiency? vi) What was the impact of the global crisis on the competitive conduct of the banks?

This study makes a number of policy-oriented contributions to the literature on the link between banking performance, and banking reform and ownership change in emerging markets. It provides a comprehensive analysis of the impact of financial regulatory reform and restructuring on banking performance in Turkey, which has been an under-researched emerging market, unlike other larger markets such as India and China. The few recent studies on Turkish banking have not undertaken a comprehensive analysis of the reformed regulatory environment and the changes in ownership structures, nor have they looked into the implications of these for competitive conduct (see, for instance, Aysan and Ceyhan, 2008; Assaf et al., 2013).

By way of preview, it has been found that in general Turkish banks have become more competitive. Our results show that there are differences in profit efficiency performances between banks with different ownership types and sizes. State-owned banks display the lowest inefficiency while foreign-owned banks the highest and total asset and branch network sizes are positively related to profit efficiency. As regards the impact of foreign acquisitions on efficiency, we find that foreigners acquired relatively better performing banks but the post-acquisition performance improvement was comparable to that of non-acquired banks**.** There is some evidence indicating that this improvement is more marked for loan making than for deposit taking and that wholly owned foreign banks predominate in niche activities.

The remainder of the paper is organized as follows. Section 2 presents the related literature on financial sector regulation and banking efficiency performance. Section 3 provides a review of the Turkish banking industry. Section 4 discusses the methodology employed, and Section 5 provides the empirical results. Section 6 offers a summary.

2. Literature Review

There is an extant literature on the impact of financial regulation on banking competition, performance and stability. A sub-set of this literature focuses on testing empirically the validity of claims of positive impacts on banking efficiency of financial reforms in emerging markets. Several studies report efficiency gains due to liberalization programs undertaken in various emerging and transition countries including Turkey (Zaim, 1995; Isik and Hassan, 2003), Thailand (Leightner and Lovell, 1998), Hungary (Hasan and Marton, 2003), Central and Eastern European (CEE) countries

(Bonin, Hasan, and Wachtel, 2003; Brissimis, Delis, and Papanikolaou, 2008), India (Ataullah and Le, 2006), and Egypt (Fethi, Shaban, and Weyman-Jones, 2010). However, several other studies have failed to report on efficiency gains as the result of financial reforms. Havrylchyk (2006) demonstrates that Polish banking efficiency did not improve during the transition process. For the CEE countries, Kasman and Yildirim (2006) find no continuous improvement in banking efficiency over the transition period. Fu and Heffernan (2009) report that the cost X-efficiency decreased significantly as China reformed its banks.1 Moreover, as a number of studies illustrate, the efficiency impact of the reform process may not be immediately visible or uniform over time. Efficiency may decline at first, due to adjustment costs prior to improving. Burki and Niazi (2009), for example, show that efficiency declined initially in Pakistan before improving in later stages of the reform process. Similarly, for Taiwan, Hsiao et al. (2010) find the efficiency of banks decreased during restructuring but increased in the post-reform period. For the Turkish liberalization experience, both Isik and Hassan (2002) and Yildirim (2002) demonstrate that the banking system did not achieve sustained efficiency gains and efficiency decreased later on when macro-economic instability deepened. For the Indian reform process, Zhao et al. (2010) show that while efficiency improved during the initial deregulation stage, the overall trend in efficiency was negative due to the later re-regulation which imposed higher costs.

In addition, adjustment costs and speeds during reform and restructuring may differ based on different ownership types. State-owned banks may continue to operate differently than privately-owned banks if political interventions in their lending decisions are not contained. On the other hand, their large branch networks may give them scale advantages in addition to local monopoly status as well as access to cheaper sources of funds in the form of captive deposits. Domestic banks may operate more efficiently than foreign-owned banks as they do not suffer from "organizational diseconomies to operating or monitoring an institution from a distance" and barriers such as differences in language, regulatory and supervisory structures. Alternatively, some foreign-owned banks can overcome these cross-border disadvantages and operate more efficiently than domestic banks (Berger et al., 2000, p.25). As reform proceeds, foreign-owned banks may be better prepared to respond to changes because they have access to international markets as well as better investment and risk management skills.

Several studies have investigated these issues empirically. For Turkey, it has been reported that the impact on efficiency was not uniform across ownership types, and privately-owned banks and foreign owned banks in particular benefited more (Isik and Hassan, 2002; Isik and Hassan, 2003; and Yildirim, 2002). Aysan and Ceyhan (2008), on the other hand, report that while the sector achieved performance improvement after the restructuring process in the period following the 2000-2001 crisis, there was no significant effect of foreign ownership on efficiency.2 In China, Fu and Heffernan (2009) report the drop in efficiency was higher in the case of joint stock banks than state-owned ones. For Pakistan and India, Burki and Niazi (2009) and Zhao et al. (2010), respectively, show the speed as well as the direction of adjustments varied across ownership types. Burki and Niazi (2009) note that while privately-owned and foreign-owned banks performed better than state-owned banks, the dominance of foreign-owned banks weakened later in the reform process. Banker et al. (2010) also report systematic cross-sectional differences in productivity gains across banks due to regulatory changes in Korea. They find that financially sound or strategically privileged banks benefited more. As regards the effects of long-term ownership on banking performance, foreign-owned banks are generally found to perform better than domestic banks in the context of the transition experiences of CEE countries (see, for instance, Hasan & Marton, 2003; Bonin et al., 2003; Kasman and Yildirim, 2006; Havrylchyk, 2006).

[1] Cost x-efficiency measures the extent to which a bank's actual cost approximates to a best-practice firm's cost for producing an identical output bundle under comparable conditions.

[2] However, the study excludes state-owned banks and does not take into account the foreign acquisitions that took place during later periods.

It is difficult to empirically establish, however, the presumed positive performance effects of privatizations and foreign acquisitions. It is likely that banks that perform better may have been chosen for privatization programs or may have become targets for acquisitions with no subsequent improvement in efficiency. In Croatia, for instance, Kraft et al. (2006) demonstrate that privatizations did not immediately impact efficiency; new private and privatized banks were not the most efficient. Havrylchyk (2006) notes that better performance of foreign banks in Poland was fully due to the better performance of greenfield banks and that foreign banks acquired the more efficient banks but did not enhance their efficiency. Berger et al. (2005) analyze the static effects of different types of bank ownership (long-run performance effects related to constant domestic, foreign, or state ownership) together with the selection effects and dynamic effects of changes in ownership in Argentina. They show that state-owned banks had worse long-term performance. In terms of dynamic changes, there was little difference after domestic mergers and acquisitions or foreign acquisitions while privatizations improved performance. Similarly, Williams and Nguyen (2005) find that while state-owned banks underperformed, privatizations improved performance in South East Asia. The results also suggest that the potential efficiency benefits associated with foreign ownership may take longer to materialize. Lin and Zhang (2009) establish that banks undergoing foreign acquisition or public listing had better pre-event performance, but that these ownership changes did not produce significant performance effects in China.

3. Overview of the Turkish banking sector

Macro-economic imbalances and financial sector fragility characterized the Turkish economy in the 1990s. From 1990 to 2000 growth measured in terms of GDP ranged from -5.5% to 9.3% with an average of 4.7% (BDDK, 2010, p.6). The fact that the Turkish liberalization process, initiated in 1980, was undertaken prior to solving the public sector's financing needs and developing an effective supervisory and regulatory infrastructure, was the underlying source of problems in the sector.

Despite its substantial nominal growth between 1990 and 2000, the sector's real growth was volatile due to high inflation. On average it was only 8.1 per cent measured in terms of total assets. More importantly, the share of loans in total assets declined to 33% in 2000 from 47% in 1990 as the banking system came to depend on financing the government's borrowing requirements which became very lucrative (BDDK, 2010, p.12). In the process, the sector was increasingly exposed to interest rate and foreign exchange risks, had low asset quality and an insufficient capital base. Capital adequacy dropped to 8.2% in 1999 while bad to gross loans ratio continuously increased and reached 11.1% (BDDK, 2010, p.14).

Subsequent to a number of financial crises of varying severity and short-lived stabilization attempts since 1980, finally an exchange rate-based stabilization program was introduced in December 1999 to control inflation, correct macroeconomic fundamentals and strengthen the increasingly fragile financial system. 3 While the program achieved some initial success, the country suffered a liquidity crisis in November 2000 and a major attack on the Turkish lira in February 2001. In April a new program was announced, and in May the International Monetary Fund (IMF) approved augmenting the stand-by arrangement.

The banking sector suffered losses due to an inability to control interest rate risk in the first crisis. The second crisis ushered in additional losses since many banks had borrowed in foreign currency only to lend in Turkish liras without obtaining any hedging protection. As of December 2001, the losses of the sector reached 6.1% of assets and effectively wiped out its already insufficient financial capital (BDDK, 2010, p.29). Therefore, in May of 2001 a bank restructuring program embedded in a new economic reform package was introduced. The banking program had four major components: resolution of banks under the Savings Deposit Insurance Fund (SDIF); financial and

[3] The most serious one was in 1994 during which 3 small banks were closed and a full coverage deposit insurance system was introduced in order to restore financial market stability.

operational restructuring of state-owned banks; recapitalization of privately-owned banks; and legal and institutional measures aimed at improving the regulatory and supervisory framework as well as efficiency and competition in the sector.

A new standby agreement was signed with the IMF in February 2002. It envisioned restructuring the banking sector, improving public sector finances and instituting legal changes for supporting structural reforms. Accordingly, the authorities continued with the process of reforming the financial regulatory and supervisory framework with the support of international organizations. A limited deposits insurance system was introduced in 2004, replacing the previous full coverage system. The governance of publicly-owned banks has been reformed and independent boards of directors have been appointed for them. A new Banking Act in accordance with EU directives and international principles and standards was prepared by the Banking Regulation and Supervision Agency and enacted by the parliament in November 2005.

In this process, due to the removal of financially weak banks and M&A s, the number of banks, branches and employees decreased, and concentration levels increased. From 1999 to 2003, the total number of banks decreased from 81 to 50 while the asset share of the top-10 banks increased to 82.3% from 67.5% (BDDK, 2010, p.76). Simultaneously, total branch numbers in the sector declined to 6,029 from 8,298 while personnel numbers fell to 130,000 from 174,000 (BDDK, 2010, p.77). The resolution of banks controlled by SDIF involved the revocation of banking licenses, the merging of a bank with a state-owned one and sale to Turkish or foreign investors. The remaining banks were combined and re-organized as an asset management institution (*Birlesik Fon Bankasi AS*). In June and July of 2001, legal arrangements were introduced to encourage mergers and acquisitions, and some business groups consolidated the banks they controlled. In particular, the number of branches and personnel of publicly owned banks was slashed dramatically; from 2001 to 2003, the number of branches and personnel decreased by 33% and 50%, respectively (BDDK, 2010, p.41).

The recovery from the crisis involved considerable growth performance. Further, both asset quality and capital levels in the sector improved (See Figure 1). The asset quality, particularly of publicly owned banks, improved dramatically over time. Despite the noteworthy deterioration in the asset quality of foreign owned banks with the onset of the global financial crisis, the sector average of 2.7% at the end of 2011 was substantially lower than that of 12.6% of Central and Eastern European (CEE) and 5% of developed countries (Global Financial Stability Report, 2012). As regards capital adequacy, while there was a wide variation in the levels at the beginning, the adequacy ratios converged towards the end. Notwithstanding the observed decline over time, the capital adequacy of 15.51% at the end of 2011 was close to that of 16.4% of CEE and 14.6% of developed countries (Global Financial Stability Report, 2012).

Loans' share in total assets increased mainly due to economic growth and increased demand for consumer loans and mortgages. From 2002 to 2007, the commercial banking industry's assets grew about 3.8 times in terms of US dollars. Simultaneously, foreign penetration, which had previously been negligible, increased considerably. In addition to foreign investors acquiring banks from SDIF, some foreign banks increased their stakes in the sector by acquiring either controlling shares in Turkish banks or making strategic partnership agreements. The majority of these cases involved acquirers from European countries and were completed by the end of 2007. As of December 2011, Turkish private ownership was 32.6 percent while non-residents' share grew to 40.4 percent of the total banking sector's assets (BDDK, 2012).

The foreign entrants were different than the ones that entered in the 1980s which had targeted mainly foreign-trade-related activities and did not compete with domestic banks in traditional banking products (Akgüç, 1989; Atiyas and Ersel, 1994). The new entrants were attracted to the improving macro-economic and institutional environment and "the consequent bankability of Turkey's large and fast-growing population," and they set about aggressively expanding their

market shares (Norton, 2007). Taking advantage of favorable conditions in domestic and the international markets, foreign banks expanded both their branch networks across the country and helped their strategic partners introduce new products. Industry participants argue that foreign bank entry has been especially effective in increasing competition in financing small and medium sized enterprises and consumer as well as mortgage lending (Norton, 2007).

Economic growth slowed in 2007 due to adverse international market developments and political developments at home. Also, feeling the impact of the global crisis, from late 2008 onwards the Turkish banking system faced difficulties in raising funds internationally. Nonetheless, the sector proved to be resilient as it was not exposed to toxic assets and traditional domestic deposits constituted its main source of funds. Even with an increase in non-performing loans in 2008 and 2009, the sector did not need any capital injections thanks to higher profitability which helped increase capital levels. Figure 2 presents the profitability performance of the sector as measured by Return on Average Equity (ROAE) and revenue components across different ownership types.

Publicly owned banks were the best performers in terms of ROAE throughout the period we cover. Foreign banks performed better than privately-owned Turkish banks up until the onset of the crisis. During the crisis the profitability of both publicly and privately-owned Turkish banks, after a brief recovery in 2009, continuously deteriorated. Still, the average profitability of 21% for the whole sector in 2008-2011 compares favorably with those of 4.9% of CEE and 5.7% of developed countries (Global Financial Stability Report, 2012). As regards the components of overall profitability, foreign banks seemed to be worse than the other two groups in controlling their operational costs which drove down their overall profitability despite their better performance in terms of Net Interest Margin (NIM) and non-interest income.

4. Methodology

4.1 Shadow Profit Maximization

In data envelopment analysis (DEA), the efficiency of a firm is measured by comparing its observed input–output bundle with a reference point on the frontier. Radial measures of technical efficiency are either input- or output-oriented. In a radial input-oriented model, one seeks maximum equi-proportionate reduction in all the inputs of a firm that would be possible without violating the feasibility of its output bundle. In the output-oriented approach, on the other hand, the objective is to expand all outputs by the same factor without using any additional input. When the technology exhibits non-constant returns to scale, the two approaches yield different measures of efficiency. In the case of constant returns to scale, although the efficiency measures are identical, the reference bundles for comparison are different. In a typical empirical application, one has to choose between an input-oriented and an output oriented model. On the other hand, in those rare cases when input and output prices are available, choosing an orientation can be dispensed with and a profit maximizing model can be implemented. In this case, the reference bundle will be the one that maximizes profit, and an inefficient firm attains full efficiency by simultaneously altering its inputs and outputs as needed. Indeed there are well-known approaches in the DEA literature that allow for changes in both inputs and outputs in order to obtain the efficient projection of an inefficient input–output bundle even without the benefit of prices. Fare et al.'s (1985) hyperbolic efficiency approach measures the maximum scalar by which all outputs can be expanded and all inputs can be contracted at the same time. Chambers et al. (1996) introduced the directional distance function and the corresponding Nerlove–Luenberger measure of efficiency. Here one seeks to increase all outputs and reduce all inputs by the same proportion. In both of these approaches, however, a *single* parameter determines how the output bundle is expanded and the input bundle is contracted. In other words, neither Fare et al. (1985) nor Chambers et al. (1996) allow the reference bundle to show an increase in any input or a decrease in any output compared to observed input–output bundle of the firm. Yet, when the firm maximizes profits the optimal bundle can show either an increase or a decrease in any input or output so long as the resulting profit is higher. Determining

the profit-maximizing bundle of inputs and outputs requires data on the prices faced by the firm under evaluation. The model developed by Ray (2007), that we are implementing, dispenses with this necessity and shows how *endogenously* determined *shadow prices* of inputs and outputs of a firm can be used in place of actual prices to obtain the optimal projection of its observed input–output bundle where its *shadow profit is maximized*. *Therein lies its significance*. Furthermore, as Ray (2007) demonstrates, this novel approach amounts to an application of the Weak Axiom of Profit Maximization (WAPM) formulated by Varian (1984). For further details and refinements, the reader is referred to Ray (2007) and Ray et al. (2012).

4.2 The non-parametric methodology

Consider a data set for N firms from an industry. Let y^j be the m-element output vector and x^j the corresponding n-element input vector of firm j (j=1, 2…N). Assuming convexity of the technology, free disposability of inputs and outputs, and variable returns to scale, an inner approximation to the unobserved production possibility set of this industry is

$$S= \quad \{(x,y): x \geq \sum_{1}^{N} \lambda_j x_j;\ y \leq \sum_{1}^{N} \lambda_j y_j; \sum_{1}^{N} \lambda_j = 1; \lambda_j \geq 0; (j = 1,2,..N)\} \qquad (1)$$

The efficient input-oriented projection of any observed input–output bundle (x^0, y^0) is

$(\theta^0 x^0, y^0)$ where

$\theta^0 = \min \theta: (\theta x^{0,} y^0) \in S$ (2)

θ^0 is the input oriented technical efficiency measure.

Similarly, the output-oriented efficient projection is $(x^0, \varphi^0 y^0)$ where

$\varphi^0 = \max \varphi: (x^0, \varphi y^0) \in S$ (3)

$1/\varphi^0$ is the output oriented technical efficiency measure.

We note that the selection of (2) or (3) involves a prior judgment about whether expanding outputs or contracting inputs is more important in a given context.

For Fare et al.'s (1985) hyperbolic efficiency approach, the efficient projection of (x^0, y^0) is

$(1/\delta^0 x^0, \delta^0 y^0)$ which is obtained from the hyperbolic distance function

$\delta^0 = \max \delta: (1/\delta x^0, \delta y^0) \in S$ (4)

For an efficient projection δ^0 must be greater than or equal to unity. We note that input reduction and output expansion is done simultaneously.

Another measure of efficiency involving simultaneous input output changes is the Nerlove-Luenberger measure operationalized by Chambers et al. (1996).

$\beta^0 = \max \beta: \{(1-\beta) x^0, (1+\beta) y^0\} \in S$ (5)

In both (4) and (5), however, a *single* parameter determines how both inputs and outputs change. Note further that because (x^0, y^0) is an element of S, δ equal to unity is always a feasible solution in (4). Hence, at the optimal solution $\delta^0 \geq 1$ holds. Similarly $\beta^0 \geq 0$ holds in (5). That is, in both of these models each and every output may only increase and each and every input may only decrease. In other words these two models do *not allow* input or output *substitution* based on *relative price* advantageousness.

Now suppose one had information on the output and input prices for the firm under review. Specifically, assume that p^0 and w^0 were the output and input price vectors, respectively. In that case, the optimal projection of the observed input output bundle would be $(x^0{}_*, y^0{}_*)$ satisfying the inequality

$P^{0t}\, y^0_* - w^{0t}\, x^0_* \geq P^{0t}\, y^0 - w^{0t}\, x^0 \quad \forall\, (x, y) \in S$ (6)

Define $\pi^0_* \equiv P^{0t}\, y^0_* - w^{0t}\, x^0_*$ and $\pi^0 \equiv P^{0t}\, y^0 - w^{0t}\, x^0$. Clearly, the first expression represents the optimal and the second the actual profit levels. Thus their difference $\Delta^0 = \pi^0_* - \pi^0$ will be a *measure of the unrealized profit of the firm*. It is worth noting that in order to get to the profit-efficient projection the firm does not increase all of its outputs or decrease all of its inputs by the same proportion. In fact, it will practice substitution between inputs as well as outputs. In other words, it may increase or reduce individual inputs or outputs appropriately so long as the resulting bundle maximizes profit.

Varian's (1984) Weak Axiom of Profit Maximization (WAPM) argues that if the input–output bundle of a particular firm evaluated at the prices it faces yields a lower profit than what could be earned if it had chosen the observed input–output bundle of some other firm in the sample, then the firm under consideration could not be maximizing profit.

Lacking the necessary price information, Ray (2007) does not take that approach. Instead the endogenously determined shadow prices are used to look for the input–output bundle that maximizes profit over the entire production possibility set S at those prices. Consider output price vector u^0 and input price vector v^0 such that at these shadow prices the observed input–output bundle (x^0, y^0) yields zero profit.

$u^{0t}\, y^0 - v^{0t}\, x^0 = 0$ (7)

The next step involves determining the optimal bundle (x^*, y^*) such that

$P^* \equiv u^{0t}\, y^* - v^{0t}\, x^* \geq u^{0t}\, y - v^{0t}\, x \quad \forall\, (x, y) \in S$ (8)

The maximum profit P* provides a measure of the overall inefficiency of the firm producing y^0 from x^0. One problem that remains, however, is that one can change the shadow prices of inputs and outputs by any given proportion and P* also changes by the same proportion without violating the requirement of zero profit at the observed input–output bundle. As a result, the maximum unrealized shadow profit P* would be unbounded. One way to overcome this problem is to normalize the shadow prices separately so that

$u^{0t}\, y^0 = v^{0t}\, x^0 = 1$ (9)

The shadow profit maximization for the firm under evaluation can now be formulated as

Min P $\{P, u^{0t}, v^{0t}\}$ subject to:

$P \geq u^{0t}\, y^j - v^{0t}\, x^j$; (j=1, 2…N)

$u^{0t}\, y^0 = 1$;

$v^{0t}\, x^0 = 1$; (10)

$u^{0t} \geq 0$; $v^{0t} \geq 0$; P unrestricted.

The dual of this linear programming problem consists of

Max $\varphi - \theta$ $\{\varphi, \theta, \lambda_j\ j=1, 2…N\}$ subject to:

$$\sum_1^N \lambda_j y_j \geq \varphi y_0;$$

$$\sum_1^N \lambda_j x_j \leq \theta x_0;$$ (11)

$$\sum_1^N \lambda_j = 1;$$

$\lambda_j \geq 0$; φ and θ unrestricted.

It is important to stress the main choice variables, i.e. the λ_j, are used in constructing the "composite" banks which are successful in the WAPM sense. Namely such 'banks' obtained by combining observed banks in proportions indicated by the relevant λ_j, generate the largest profit using the shadow prices which are best for the bank that is being evaluated. Thus, in such cases by invoking the WAPM we conclude that the bank under consideration cannot be maximizing profit and is therefore inefficient. On the other hand, if such a "composite" bank cannot be constructed, by WAPM the bank is unsurpassed and thus efficient.

Note that (11) combines features of both the output and the input-oriented radial models for a variable returns to scale technology. In fact, by setting θ equal to unity, we get the measure of the firm's output-oriented *inefficiency*, (φ^0- 1). Similarly, when φ is preset at unity, the model yields the firm's input-oriented *inefficiency*, (1- θ^0). Clearly, the optimal value of the objective function will be at least as large as both (φ^0- 1) and (1- θ^0). Thus, the optimal value of the objective function in (11) can be interpreted as a generalized measure of the inefficiency of a firm which is no lower than the average of its output- and input-oriented technical inefficiencies. It should be stressed no matter what the input and output prices actually are, the optimal value of (φ^*- 1) in (11) shows the proportionate increase (decrease) in the revenue without changing the output mix. Similarly, (1- θ^*) shows the proportionate decrease (increase) in the cost with the input mix unchanged. When revenue increases ($\varphi^*>1$) and cost falls ($\theta^*<1$) both contribute to an increase in profit. But even when cost increases, so long as revenue increases even more ($\varphi^*>\theta^*$), profit would increase. The same will be true when ($\varphi^*<1$) and revenue falls but ($\theta^*<\varphi^*$) so that cost falls even more. For further details and refinements the reader is referred to Ray (2007) and Ray et al. (2012).

In terms of this application we note that (10) allows for the computing of shadow prices (u^0, v^0) for the inputs and outputs used by each bank for every year in our sample. In this way, by computing the variance of, for example, the shadow price for interest expenses for that year, we can track how close one comes to the "**law of one price.**" Obviously a variance that falls over time would indicate increasing competition. Similarly, solving (10) repeatedly would yield the size of the optimal profit (P) for each bank during each year in our sample. For each firm, both revenue and cost is normalized to one and thus profit is normalized to zero. Thus via (6) P is also a measure of the unrealized profit of the firm as a ratio on outlays or costs since $v^{0t} x^0 = 1$ holds. In other words, P is a measure of potential deviation from "zero profit" for each bank in each year. Therefore, by averaging over all banks during a given year, we get an estimate of how close the banking industry comes to the "**zero profit**" condition. Again, a falling average over the years would imply increasing competition. Lastly, it is worth stressing that P, our primary measure of unrealized profit, can be seen as an indicator of "profitable activities not pursued by management" and equivalently "extent of quiet life pursued by management". Taking this into account and recalling Hicks's (1935, p.8) dictum about "a quiet life being the best of all monopoly profits", we can establish another logical basis for using the size of unrealized profits to measure deviations from perfect competition.

4.3 Sequential DEA

In constructing frontiers for each year, we depart from typical DEA applications in which the evaluation of the frontier for a particular year, say 2005, uses as a reference set all observations for units in the same year. Instead we calculate the successive frontiers for each year using, as a reference set, all observations for units in all years up to and including the year in question. This approach was proposed by Tulkens and Vanden Eeckaut (1995) who also coined the term *sequential DEA*. It has been applied to both banking data (Grifell-Tatjé and Lovell, 1999; Pastor, 1999) and non-banking data (Lim and Lovell, 2009). So the frontier for 2002 uses as a reference set all observations for banks from that year, whereas the frontier for 2003 uses as a reference set all observations for banks from 2003 and 2002. This approach builds "learning" into the construction of the frontier and is tantamount to saying "what was possible in the past remains possible in the

future". In other words, it posits any transformation possibilities between inputs and outputs that could be observed in 2004 are replicable in 2011 while allowing for improved possibilities, due to accumulated knowledge of the technology, in 2011. In a banking context it is particularly appropriate in situations where lessons drawn from past experience are not forgotten. Since the events and practices leading to the 1994 and 2000-01 crises are still fresh, we believe it is a highly relevant modeling strategy for our application.

4.4 Definition of inputs and outputs

While there exists little agreement about what banks produce, three main approaches to the definition of inputs and outputs can be identified (Humphrey, 1985; Berger and Humphrey, 1992): 'the intermediation approach', 'the user cost approach', and 'the production approach'. The intermediation approach assumes that banks collect funds, deposits and purchased funds, and intermediate these funds into loans and other assets. The user cost approach involves classifying financial goods into input and output categories according to their 'user costs' or signs of their derivatives in a bank profit function which is estimated empirically. According to the production approach, banks are understood to produce deposits and loans using capital, labor and materials. Berger and Humphrey (1997) state that the production approach is preferable when evaluating the efficiencies of branches of financial institutions while the intermediation approach is preferable for evaluating the entire financial institution, as it concerns the overall costs of banking, i.e. interest and non-interest expenses. In addition, Ferrier and Lovell (1990) argue that the intermediation approach is preferable when analyzing the economic viability of banks. Accordingly, the intermediation approach is adopted in this study.

Specifically, cost and revenue items from the income statement are employed as inputs and outputs following a profit-oriented approach. The two inputs are defined as interest expenses and non-interest expenses, while the two outputs are defined as interest income and non-interest income. Non-interest income includes net fees and commission income, dividend income, net trading profit and other operating income. This specific model has a number of virtues. First, as a parsimonious model it helps improve the discriminatory power of DEA which declines when the number of inputs and outputs increases in comparison to the number of DMUs being analyzed. Second, it incorporates the non-traditional activities of banks since efficiency measures are proven to be sensitive to the inclusion of measures of non-traditional activities, and the importance of such activities in bank revenues has become critical in recent years (Rogers, 1998; Clark and Siems, 2002). Finally, since cost and revenue items are employed as inputs and outputs, the derived efficiency measure can be interpreted as profit efficiency incorporating the unmeasured differences in output or bank service quality. Berger and Mester (1997) note that the profit efficiency measure "accounts for the additional revenue earned by high quality-banks, allowing it to offset their additional costs of providing the higher service levels" (p. 902). Leightner and Lovell (1998) and Drake et al. (2006), among others, apply the profit-oriented approach to the definition of inputs and outputs.

5. Empirical analysis

5.1 Sample and data sources

The sample includes all commercial banks operating in Turkey from 2002 to 2011. Annual bank level financial data were accessed through the electronic data inquiry system of the Banks Association of Turkey. Three small foreign-owned banks that left the system early in the sample period were excluded.4 The final sample is an unbalanced sample of 29 commercial banks with 279 bank-year observations. It covers 26 of the 32 commercial banks that were in operation in 2011 and corresponds to about 99% of the total assets of the commercial banking sector in that year. Table 1 displays descriptive statistics on the input-output variables used in our study.

[4] Two of these banks had only one observation while the third one had only two.

5.2. Zero profit condition

As discussed previously, the Ray (2007) model we use derives a measure of unrealized profit for each bank-year in our sample (Table 2). Since in each case the cost is normalized to one, the inefficiency figure is to be interpreted as a multiple of the "average" bank's cost for that year. So for 2005, inefficiency is about 10 times average normalized cost, and in 2010 it falls to about 1.7 times that magnitude. However for 2011, which is the last year for which data is available, inefficiency rises very significantly to almost 5 times "average cost". We argue that the measure can be viewed as an indicator of "opportunities not pursued" or "extent of quiet life" chosen by management. Therefore we would expect a negative correlation between the unrealized and realized or actual profits of our banks. Table 3 shows the correlations between ***unrealized*** and two common measures of ***actual*** profits: Net Income to Assets and Net Income to Total Expenditures for our sample period. The relevant correlations are negative for every year and in 13 of the 20 cases, they are statistically significant.

Figure 3 presents the graph of average and median profit inefficiency while Figure 4 presents the convergence over time in average profit inefficiency. There is a readily observable unrealized profit or inefficiency increase from 2002 to 2006. We are inclined to think of it as adjustment to the new market environment and the regulatory changes discussed above. It can be argued that once the banking system implemented the necessary regulatory and ownership changes and adjusted to the new market environment; profit inefficiency started falling in 2007 and reached the second lowest level of the sample period in 2010. Furthermore, we observe that once the transition was completed, the performance of individual banks converged substantially, also implying an improvement in the competitive conduct in the sector. However, inefficiency rose again in 2011. We note that our inefficiency estimate measures "unrealized profit on outlay". In a sense, it measures "missed opportunities" or "worthwhile prospects not pursued". From this perspective, it is tempting to ascribe the increase of inefficiency in 2011 to the ongoing and deepening effects of the global financial crisis.[5] In other words, these lingering effects might have dampened the "animal spirits" of Turkey's bankers. In addition, the measures taken by policy makers to curb credit growth in response to a widening current account deficit in recent years put the sector's profitability under pressure.

Table 4 Panel A and Panel B formalize these insights by performing t-tests comparing the inefficiency levels for the selected years. We observe that negative t-values reflect falling and positive ones rising profit inefficiency between the indicated starting-ending years. We use 2002 to 2004 - the first 3 years of reform with 2009 to 2011 - the last 3 years in our sample period. Not surprisingly, comparisons involving 2011 do not reflect a fall, whereas those involving 2010 and 2009 do, especially when 2004 - a year with a substantial inefficiency associated with post reform adjustments - is taken as base year. We hasten to add that when we use 2006 - the year with the largest post reform adjustments induced inefficiency - as the base year, the results indicate statistically significant declines.

5.3 The Law of One Price

In addition to zero profit, economic theory predicts that increased competition will result in reduced price variability across producers, known as "the law of one price". Usually researchers do not have access to actual prices. While investigating the impact of deregulation on Austrian banks, Ali and Gstach (2000) were the first to use "shadow" prices to perform such a test.

Table 5 displays the test results based on two price variability measures (Conover's squared rank scores and variance) between the selected beginning and ending years. The shadow profit maximization model (10) generates shadow prices for our inputs as well as outputs. These are

[5] Also, the decrease in inefficiency decelerated from -55% in 2007/8 (6.724 vs 3.038) to -35% in 2008/9 (3.038 vs 1.983) and to -16% in 2009/10 (1.983 vs 1.675).

relative prices and can be interpreted as valuations of the corresponding input and output variables. The optimization logic treats the bank under consideration preferentially in assigning these values. As a result, unless normalized such shadow prices are not comparable across units. Therefore we normalize the input prices and the output prices to sum to one. Then we compute the variance and the squared rank scores of these shadow prices for each input and each output. The cost of this normalization is the loss of one degree of freedom. As a result, the test scores for interest expense and non interest expense are identical. The same holds true for the two outputs.

We perform an F test which assumes a Gaussian distribution to see whether the variance of shadow prices differs between the beginning and ending years. However, the distribution of shadow prices commonly deviates from the Gaussian and tends to be non-symmetric. Consequently in testing whether the spread of the price distributions decreased over our sample period, we use the Conover test of differences in squared rank scores as well, Conover (1980). The test procedure is based on the squared ranks of absolute deviations from their respective means. As such, our test is robust against deviations of the relevant shadow price distributions from the Gaussian. The Conover test statistic itself is asymptotically normal i.e. Gaussian.

For each input and output variable we compare the obtained shadow price vector of the beginning year with the corresponding vector of the ending year. As in our "zero profit" tests we use 3 starting years (2002, 2003, and 2004) and 3 final years (2009, 2010, and 2011). Our findings displayed in Table 5 contain considerable evidence favoring a "convergence to the law of one price" or equivalently an increased competition interpretation. For instance, the Conover rank statistics indicate a significant decrease in both input and output price variability for every case except 2004-2009 interest expenses. Even for that case, the F test indicates a significant decline in variance. Finally, the non-symmetric nature of our shadow prices suggests that the generally stronger results of the Conover tests – compared to F scores - are more robust.

5.4 Profit inefficiency across different ownership types

Table 6 presents the summary statistics on profit inefficiency while Figure 5 and Figure 6 display the evolution of mean profit inefficiency over time across three ownership types as well as for domestic and foreign-owned banks, respectively. On average, state-owned banks dominate both foreign-owned and privately-owned Turkish banks. The underlying reason for foreign ownership to be associated with higher inefficiency might be related to the motivations and strategies of foreign banks that entered the Turkish market in the aftermath of the 2000-01 crisis. Primarily attracted by the high growth prospects of the sector, they aggressively tried to capture market shares by investing in branch networks and offering new services and products. This strategy might be rational in view of the empirical evidence that a larger market share is associated with better foreign bank performance (Williams, 2003; Claessens and van Horen, 2012). In the process, it seems that they forgo profitability in return for increasing market shares (DeYoung and Nolle, 1996).

There is a noteworthy improvement of foreign owned banks' performance in the period 2008-2010 relative to privately-owned Turkish banks and domestically-owned banks. This finding might suggest that foreign-owned banks were relatively better able to deal with the deterioration in the financial market conditions during this period due to their better access to international financial markets and the existence of internal capital markets that multinational banks operate across countries (de Haas, & van Lelyveld, 2010).

The above comparative statistics, however, fail to take into account the role of size and branch networks in bank performance. While state-owned banks are substantially larger and have a wide branch network across the country, foreign-owned banks exhibit greater variation in these respects which should affect their business models and their performance. The observed drive of new entrants towards enlarging branch networks also points to the critical role of size.

For these reasons, in the following analysis we classify all the banks into four quartiles based on their total asset size and number of branches and compare the profit inefficiencies across the four groups. Table 7 shows that profit inefficiency decreases continuously as total bank size increases and branch network widens. According to the ANOVA tests, the differences in inefficiency between the size and branch networks are significant with F=21.86 (probability value=.000 and F=13.75 (probability value=.000), respectively.

We perform the same exercise for foreign-owned banks exclusively to identify the relationship between asset sizes, branch networks and profit inefficiency (Table 8). The concentration of foreign-owned banks in the smallest size and branch network quartiles is notable. The implication is that smaller foreign banks, in particular, do not have the necessary scale to compete effectively in the sector.[6]

5.5 Impact of the foreign acquisitions

We compared the efficiency performance of banks that were acquired by foreign banks during pre- and post-acquisition years to gauge the impact of the acquisitions in two ways. First, we calculated average profit inefficiency of banks that did not undergo any organizational change from 2002 to 2011 and then used these averages as benchmarks to assess the performance of acquired banks. In our sample, there are 12 acquisitions: Denizbank, EurobankTekfen, Finansbank, Fortis, ING, and T-bank - where control passed to acquirers - plus Akbank, Şekerbank, Turkish Bank, TEB, Garanti, Yapi-Kredi, which were partial acquisitions. We also have 7 banks which remained under Turkish ownership throughout 2002-2011: Ziraat, Vakif, Halk, Isbank, Anadolu, Alternatif and Tekstil. Following customary procedure, we used a three-years window around the year of acquisition (year 0) in order to control for pre-event efficiency performances in the targets, to allow for delays in the realization of merger benefits and the recovery of operational costs (see, Resti, 1998; Rhoades, 1998). Table 9 presents the development of profit inefficiencies in the targets relative to sector benchmarks. It is noteworthy that except for three outliers, foreign banks targeted relatively better performers but in the post-acquisition period, the targets' performance approached that of the benchmark; in other words, they lost their competitive advantage.

An alternative way of assessing the success or failure of such acquisitions would involve comparing the pre- versus post-performance of acquired institutions with that of non-acquired institutions across a suitable cutoff year. Post-acquisition improvement in the former and none in the latter would be evidence in favor of the efficiency-enhancing capacity of foreign takeovers

Comparing the post-acquisition average inefficiencies to the pre-acquisition ones revealed, in general, that efficiency increased in the post-acquisition period. More specifically, in 5 out of 6 cases where control switched to foreigners, inefficiency declined; in 4 of the other 6 cases where foreigners acquired minority stakes only, again there was a decrease in average inefficiency. If we treat each case as an independent binary trial with a 50% chance of success in reducing inefficiency, we get 9 successes in 12 trials. For such an experiment, if one rejects the null of pure chance, the probability of error is 0.0192. While this experiment provides evidence in favor of improvement in the post-acquisition period, it does not establish causation. For that purpose, we compared the pre- and post-2005[7] performance of the 7 banks that remained under domestic control. We found that average efficiencies increased for 6 of them post-2005; using 2006 as a dividing year yielded the same result. Here too rejecting the null of pure chance has an error probability of less than 0.01. Therefore, we conclude that both types of banks – namely domestic banks acquired by foreign investors as well as those that remained under domestic control throughout the sample period -

[6] Indeed, the difficulties faced by smaller foreign banks competing with the largest players in Turkey were regarded by industry observers as the reason for the exit of Millennium, the small Turkish subsidiary of Portugal's BCP, at the end of 2010 (Alexander, 2011).

[7] Most takeovers occurred during 2005 and 2006.

improved their performance after 2005 and 2006. This means we cannot ascribe the post-acquisition performance improvement of acquired banks to superior new management.

5.6 Analysis of Banking Behavior

Our DEA methodology assigns banks, which are successful according to Varian's WAPM[8], as a referent to unsuccessful banks. This feature can be very useful for analysis as well as planning purposes especially in situations such as the present one in which detailed micro-level information is lacking. The optimization methodology ensures that referents will have structural similarities, making emulation by unsuccessful banks easier (Thanassoulis, 2000).

Table 10 lists the referents for each of our 28 banks during 2007-2011. We restrict our presentation to 2007-2011 because ownership changes were largely finalized by 2007 and also it is the most recent period inclusive of the global financial crisis. Each matrix element shows the number of times a column bank has been a referent to a row bank. For instance, Akbank[9] has been a referent to itself 9 times, to Alternatif 5 times …. to Garanti 10 times …We note that a bank being a referent to itself indicates "success" in achieving maximum profitability in the WAPM sense; no other bank can achieve a larger profit using the shadow prices appropriate for the bank in question, in this case Akbank. Finally, the matrix elements can exceed 5 (number of periods) due to sequential DEA.

The number of branches usually indicates the type of banking practiced, specialist or niche vs. retail oriented. Although one can think of exceptions, in general niche banks with few branches tend to be wholesale or oriented to corporate and private banking, whereas retail oriented banks with an extensive branch network tend to target both consumers and businesses. In addition, a branch network usually implies access to "cheap" deposits. We use "<= 20" as the cutoff branch number for niche banking and classify 7 institutions (Arap Turk, Bank Mellat, Deutsche, Habib Bank, RBS, Turkish and West LB) as practicing wholesale banking. For 5 out of those 7 banks, the majority of the referents tend to be other wholesale banks. For instance, from 2007 to 2011 a total of 11 referents have been assigned to RBS and 7 of them are other wholesale banks; for Habib Bank, 11 out of 12 referents are wholesale. Setting Turkey aside, our sample includes 4 banks with controlling owners from the MENA region: Arap Turk, Bank Mellat, Habib Bank and T-bank. Except for T-bank, the banks in this group tend to almost exclusively be each others' referents. In addition, Arap Turk and Habib each act twice as referents to RBS. We surmise that those figures indicate the banks in question are closely involved in financing trade and investment between MENA countries and Turkey. In this context, we should point out to the existence of Islamic banks in Turkey, e.g. Al Baraka. However, since they are regulated separately, such institutions are not part of our sample. Ongena and Yuncu (2011) is the sole paper we know of providing comparative information on the size distribution and sectoral composition of a large sample of firms and all of their banking relationships - both with Islamic and non-Islamic institutions. They report only 2% of the firms in their extensive and quite representative database have dealings with Islamic banks.

Setting a minimum of 100 as the number of branches required for retail oriented banking, our sample contains 14 (Akbank, Denizbank, Finansbank, Fortis, HSBC, ING, Şekerbank, TEB, Ziraat, Garanti, Halk, Iş, Vakiflar and YapiKredi) such institutions. For all 14 of them, more than half of their referents are other retail banks. For example, of the 14 referents assigned to Garanti, all are retail; for YapiKredi 12 out of 13 referents are retail.

Thus, of our 28 banks, 7 are neither "niche" nor "retail" since they have more than 21 but less than 100 branches. These are: Alternatif, Anadolu, Tekstil, EurobankTekfen, Citi, Fibabank, and T-bank.

[8] Using of course shadow prices instead of unavailable actual ones.

[9] We treat each bank-year combination as a different unit. Thus in deriving the frontier for 2011, Akbank_2011 and Akbank_2009 can be two separate referents for say Alternatif_2011. If Akbank_2009 is assigned as referent to Alternatif _2010 in the derivation of the 2010 frontier, this is reported as Akbank being a referent to Alternatif thrice (Akbank_2011, Akbank_2009 twice).

Of these 7 institutions, the first 3 are a legacy of the pre-2001 crisis style of Turkish banking when each industrial group used its own bank in order to access "cheap" deposits. They lack the necessary scale and scope and are held for their franchise value to be sold when suitable. Citi is in a category by itself. As the Turkish subsidiary of the global Citibank, it was formally established in 1975 to serve corporate customers and wealthy individuals and started to operate as a branch in 1981. Not surprisingly, HSBC, the other major global bank with a Turkish presence, acts as referent to Citi in 7 out of a total 12 cases.

6. Conclusions

This study analyzed profit efficiency in the Turkish banking industry by taking into account the restructuring in the sector and ownership changes. Using a recently devised method by Ray (2007) and Ray et al. (2012), we derive "shadow unrealized profit scores" for the quasi totality of Turkish banks from 2002 to 2011. We explain how these scores measure the size of an unrealized profit due to actions not taken by bank management. As such they gauge the extent of what Hicks called "monopolistic quiet life". Thus they can be viewed as deviations from the zero profit condition that characterizes perfect competition. It follows that declining deviations would imply convergence to "**zero profit**".

Comparisons based on the "unrealized profit scores" reveal that the Turkish banking industry came closer to the "**zero profit condition**" over time. Our method also generates "shadow input-output prices". Comparing the variances and the squared ranks of these prices reveals a significant decline in variability over our sample period. We argue such declining variability indicates convergence to the "**law of one price**". Further analysis of our findings leads us to conclude that there are differences in profit efficiency between banks with different ownership types and sizes. In particular, state-owned banks display the lowest inefficiency while foreign-owned banks the highest. Total asset and branch network sizes are positively related to profit efficiency indicating the importance of scale and scope effects. As regards the impact of foreign acquisitions on efficiency, we find that foreigners acquired relatively better performing banks but the post-acquisition performance improvement was comparable to that of non-acquired banks. Finally, we present evidence of wholly owned foreign banks predominating in niche and wholesale banking.

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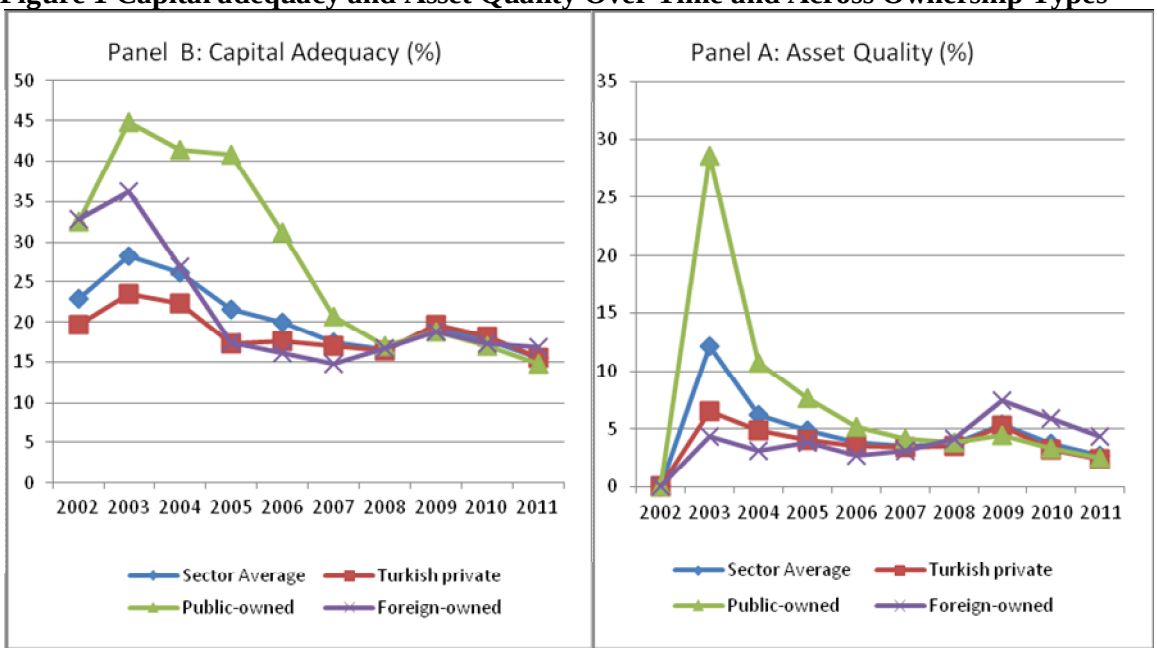
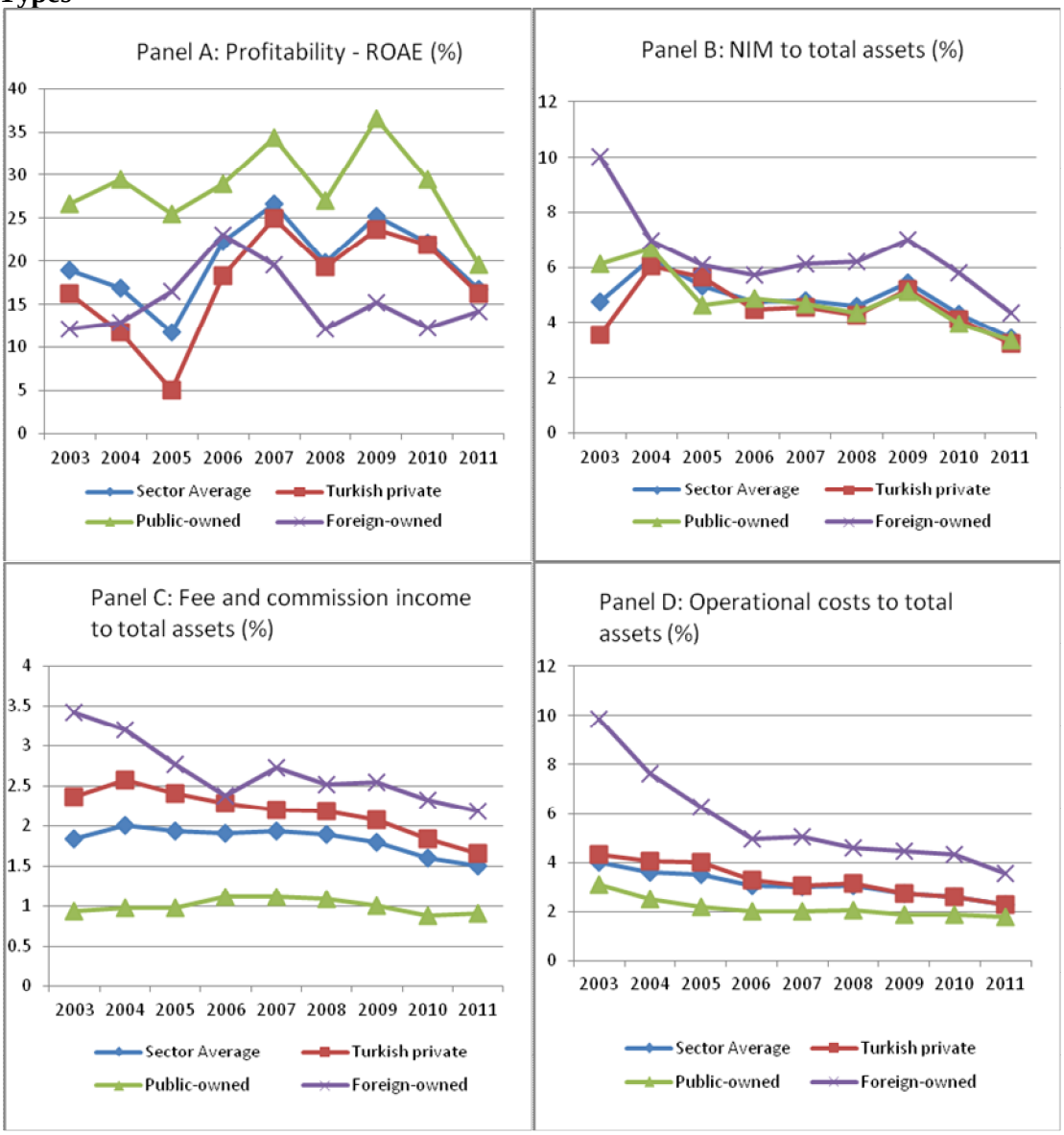
Figure 1 Capital adequacy and Asset Quality Over Time and Across Ownership Types



Source: Own calculations. Data are from BDDK, 2012.

Figure 2: Evolution of Profitability and Its Components Over Time and Across Ownership Types



Source: Own calculations. Data are from BDDK, 2012.

Figure 3: Mean and Median Profit Inefficiency

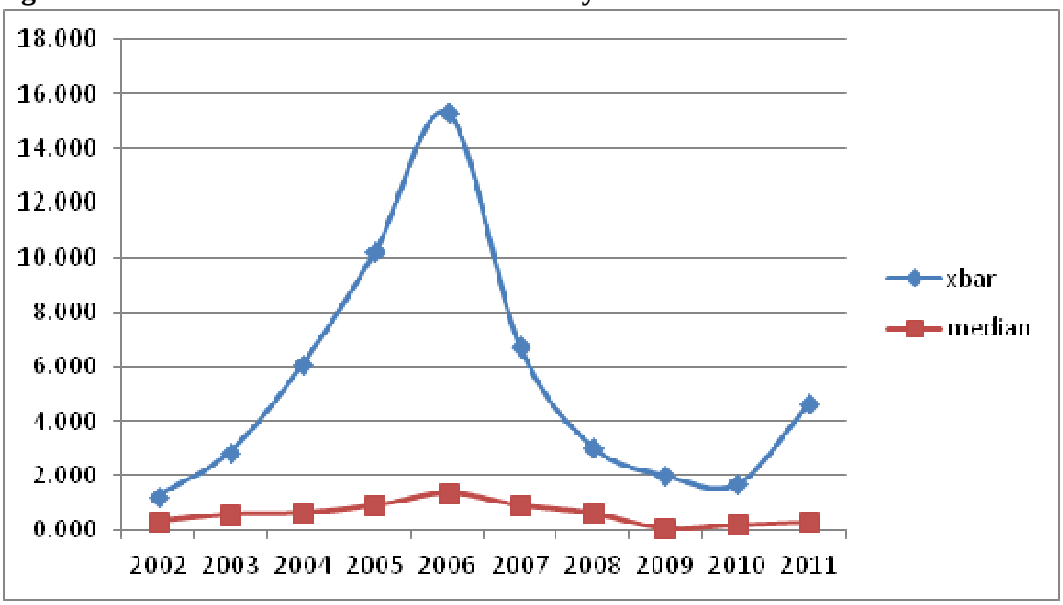


Figure 4: Evolution of Average Profit Inefficiency Over Time

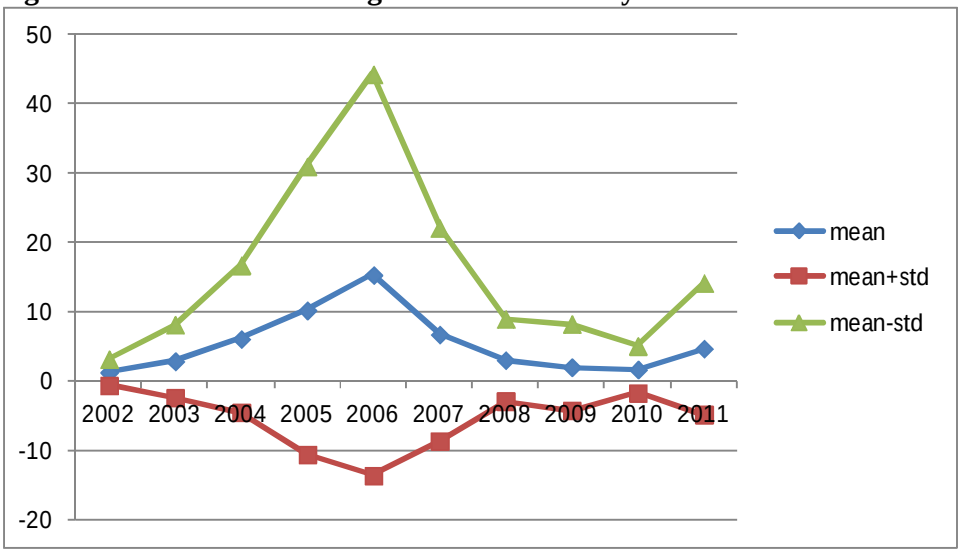


Figure 5: Evolution of Profit Inefficiency Over Time Across Three Ownership Types

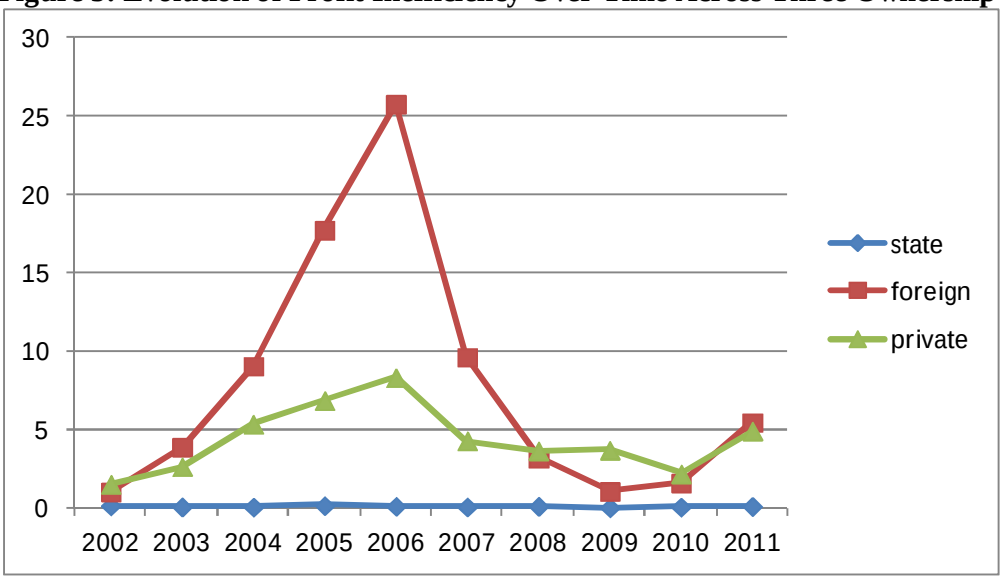


Figure 6: Evolution of Profit Inefficiency Over Time: Foreign-Owned Vs. Domestic Banks

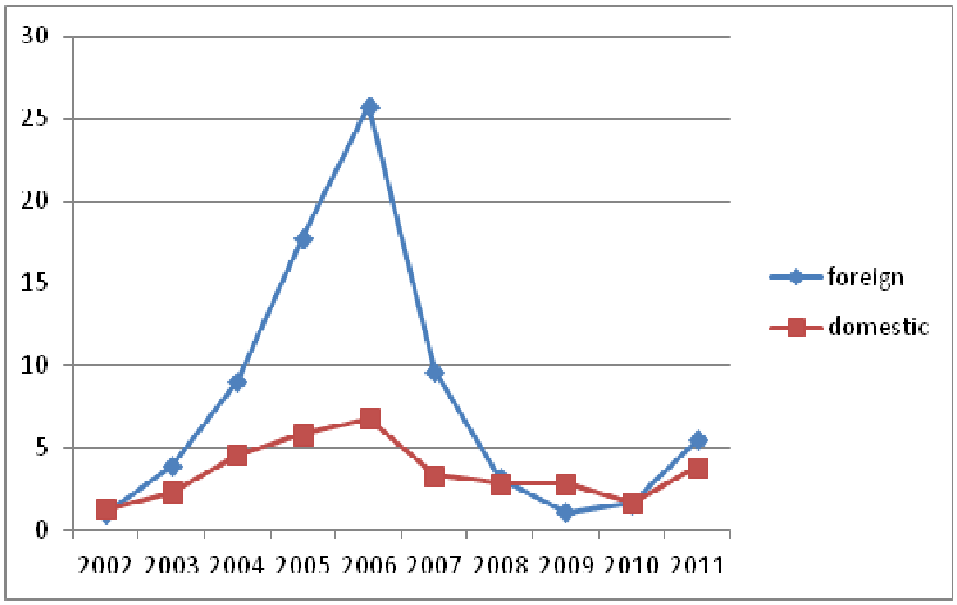


Table 1: Summary Statistics on Input and Output Measures

		mean	p50	sd	min	max
2002	int exp.	1044748.0	170909.0	1904558.0	783.0	8463503.0
	non. int exp.	299769.2	129472.0	402077.2	1179.0	1532751.0
	int inc.	1456268.0	325800.0	2581629.0	4346.0	1.17e
	non int inc.	237876.7	65274.0	361399.6	536.0	1354690.0
2003	int exp.	698070.8	124129.4	1272051.0	556.0	5973951.0
	non. int exp.	270956.1	106117.6	366984.9	1203.2	1243711.0
	int inc.	975131.3	189145.4	1831078.0	3553.7	8923562.0
	non int inc.	299570.4	123038.6	450933.1	815.3	1698387.0
2004	int exp.	574325.8	145517.6	930625.5	360.2	4138186.0
	non. int exp	271920.8	134294.2	346733.2	1346.4	1172065.0
	int inc.	996801.8	268015.7	1577771.0	2716.7	6980838.0
	non int inc.	202931.0	80815.7	296902.4	427.4	1250504.0
2005	int exp.	552584.1	135240.7	855481.9	339.8	3542242.0
	non. int exp	331550.1	137685.7	509675.4	1502.0	2401317.0
	int inc.	954455.9	281064.8	1415534.0	1609.0	5541128.0
	non int inc.	226184.5	105544.6	312611.9	558.7	1216372.0
2006	int exp.	735193.0	128796.1	1092212.0	678.5	3848147.0
	non. int exp	309985.9	164504.1	390223.6	1040.7	1274172.0
	int inc.	1161020.0	298229.6	1688565.0	1458.4	6017285.0
	non int inc.	245886.7	102388.4	333718.3	396.0	1196944.0
2007	int exp.	903068.6	239056.6	1277017.0	437.7	4428963.0
	non. int exp	351177.9	188414.5	437810.6	1027.3	1607595.0
	int inc.	1414500.0	471972.7	1929303.0	3133.6	6569323.0
	non int inc.	288188.3	88355.3	449934.9	24.1	1714877.0
2008	int exp.	1085592.0	432721.9	1431054.0	988.9	4953108.0
	non. int exp	413974.6	273578.4	466840.9	1042.4	1507202.0
	int inc.	1682913.0	788169.2	2113709.0	4336.9	7146006.0
	non int inc.	268955.7	84885.9	401362.3	735.0	1396927.0
2009	int exp.	779337.6	219052.5	1111128.0	512.8	4081548.0
	non. int exp	388247.0	189830.6	447651.3	1096.0	1352218.0
	int inc.	1532002.0	476651.4	2060579.0	3524.7	7126915.0
	non int inc.	296718.3	105598.9	450005.4	486.8	1535179.0
2010	int exp.	655470.4	193755.7	941087.8	343.3	3318248.0
	non. int exp	419538.8	191617.1	484716.3	1005.0	1510659.0
	int inc.	1312682.0	375500.6	1765928.0	2214.7	5844088.0
	non int inc.	333863.3	82580.8	481636.8	469.3	1560852.0
2011	int exp.	762053.8	238484.7	1021725.0	325.8	3614550.0
	non. int exp	427773.5	197520.1	478102.6	990.2	1486494.0
	int inc.	1378163.0	417403.3	1758247.0	2071.4	5852737.0
	non int inc.	308497.1	47176.7	451082.2	923.2	1537851.0
All years	int exp.	772781.4	170909.0	1207229.0	325.8	8463503.0
	non. int exp	345189.9	148703.0	431124.6	990.2	2401317.0
	int inc.	1272084.0	321360.5	1871744.0	1458.4	1.17e
	non int inc.	269504.3	86705.0	397309.3	24.1	1714877.0

Notes: real figures in 2002 prices. int. inc: interest income;, non. int. inc: non-interest income; int. exp.: interest expense; non. int exp.: non-interest expense.

Table 2: Summary Statistics on Profit Inefficiency

Year	mean	median	Std. Dev.	Min	max	No
2002	1.2392	0.3450	1.8915	-1.03E-16	7.5690	27
2003	2.8627	0.5806	5.2725	-8.13E-17	23.6285	31
2004	6.0866	0.6291	10.6205	6.16E-17	38.6908	30
2005	10.2046	0.8953	20.7947	-1.44E-16	96.6288	30
2006	15.3118	1.3448	28.9571	4.21E-17	138.9342	29
2007	6.7243	0.8960	15.3733	-1.31E-16	73.0703	28
2008	3.0378	0.6249	5.9241	3.63E-17	24.8340	26
2009	1.9829	0.0598	6.2372	-3.47E-17	31.2719	26
2010	1.6751	0.1890	3.3907	-1.48E-16	13.1589	26
2011	4.6619	0.2852	9.4844	-9.49E-17	34.6024	26
All years	5.5146	0.5365	14.2025	-1.48E-16	138.9342	279

Table 3: Correlations between Actual and Unrealized Profits

N=	Correl.	NI/Assets	Tval	NI/TotExp	Tval
27	2002	-0.61	-3.88***	-0.41	-2.23**
31	2003	-0.49	-3.04***	-0.69	-5.13***
30	2004	-0.28	-1.53	-0.64	-4.44***
30	2005	-0.16	-0.88	-0.05	-0.29
29	2006	-0.54	-3.30***	-0.61	-4.02***
28	2007	-0.47	-2.72***	-0.69	-4.87***
26	2008	-0.20	-0.98	-0.33	-1.70
26	2009	-0.44	-2.41**	-0.32	-1.65
26	2010	-0.21	-1.03	-0.53	-3.10***
26	2011	-0.63	-3.95***	-0.49	-2.77***

Notes**: *** ** indicates the corresponding correlation coefficient is significantly different from zero at 1%. ** indicates the corresponding correlation coefficient is significantly different from zero at 5%

Table 4: Comparing Inefficiency Levels

Panel A: Base years: 2002-2004

Years	T values	Years	T values	Years	T values
2002 vs 2011	1.806*	2002 vs 2010	0.575	2002 vs 2009	0.583
2003 vs 2011	0.862	2003 vs 2010	-1.026	2003 vs 2009	-0.569
2004 vs 2011	-0.530	2004 vs 2010	-2.152**	2004 vs 2009	-1.790*

Panel B: Base Year: 2006

Years	T values	Years	T values	Years	T values
2006 vs 2011	-1.872*	2006 vs 2010	-2.517***	2006 vs 2009	-2.417***

Notes: (*10%), (**5%), (***1%) imply the null of equal profit inefficiency for the two years can be rejected at the indicated significance level, in favor of a smaller ending period inefficiency.

Table 5: Law of One Price

Beginning-Ending years (# of banks)	Shadow prices for inputs		Shadow prices for outputs	
	Interest expense	Noninterest expense	Interest income	Noninterest income
2002 (27) vs. 2009 (26)	-2.10**	-2.09**	-3.09***	-3.09***
	1.68	*1.68*	*2.08***	*2.08***
02 (27) vs. 10 (26)	-2.50***	-2.42***	-4.34***	-4.34***
	*1.87**	*1.87*	*3.72****	*3.72****
02 (27) vs. 11 (26)	-3.08 ***	-2.91 ***	-3.70***	-3.70***
	1.64	*1.64*	*2.42****	*2.42****
03 (31) vs. 09 (26)	-2.80 ***	-2.81***	-4.34***	-4.34***
	*2.08***	*2.08***	*2.58****	*2.58****
03 (31) vs. 10 (26)	-2.96 ***	-2.93 ***	-5.06***	-5.06 ***
	*2.38****	*2.38 ****	*4.61****	*4.61****
03 (31) vs. 11 (26)	-3.62***	-3.52***	-4.35 ***	-4.35 ***
	*2.03***	*2.03***	*3.00****	*3.00****
04 (30) vs. 09 (26)	-1.05	-1.07	-4.22***	-4.22***
	*1.96***	*1.96***	*2.55****	*2.55 ****
04 (30) vs. 10 (26)	-2.67***	-2.65***	-4.92 ***	-4.91***
	*2.17***	*2.17***	*4.55****	*4.55****
04 (30) vs. 11 (26)	-3.54***	-3.44***	-4.26***	-4.26***
	*1.91**	*1.91**	*2.96****	*2.96****

Notes: Negative test statistics indicate declining price variability between the two years. For each cell the first number is the Conover Z score and the *second the F test score.* (*10%), (**5%), (***1%) imply the null of equal price variability between the two years can be rejected at the indicated significance level in favor of a smaller ending period variability.

Table 6: Summary Measures of Profit Inefficiency Across Three Ownership Types

	mean	median	Std. Dev.	min	max	No
state	0.1284	0.0888	0.1322	0	0.5377	30
foreign	7.9923	0.4442	19.4400	0	138.9342	121
private	4.4347	0.9543	8.4009	0.0002	37.2337	128
Total	5.5146	0.5365	14.2025	-1.48E-16	138.9342	279

Table 7: Profit Inefficiency Classified According to Asset Size and Branch Network

	Mean	Std. Dev.	Freq.
Panel A: Total asset size			
smallest asset size quartile (Q1)	15.6891	24.7637	70
next to smallest asset size quartile (Q2)	5.3527	6.5231	70
next to largest asset size quartile (Q3)	0.8011	0.6347	69
largest asset size quartile (Q4)	0.1481	0.1429	70
Panel B: Branch network			
smallest branch network quartile (Q1)	11.6331	24.5168	70
next to smallest branch network quartile (Q2)	9.5378	10.3336	69
next to largest branch network quartile (Q3)	0.8035	0.6242	70
largest branch network quartile (Q4)	0.1414	0.1425	70

Table 8: Profit Inefficiency Classified According to Asset Size and Branch Network: Foreign-Owned Banks Only

	Mean	Std. Dev.	Freq.
Panel A: Total asset size			
smallest asset size quartile (Q1)	13.7915	26.7123	56
next to smallest asset size quartile (Q2)	5.4788	8.2563	33
next to largest asset size quartile (Q3)	0.4357	0.3633	32
largest asset size quartile (Q4)			
Panel B: Branch network			
smallest branch network quartile (Q1)	11.2285	25.1244	65
next to smallest branch network quartile (Q2)	8.9527	10.1467	25
next to largest branch network quartile (Q3)	0.4865	0.3771	26
largest branch network quartile (Q4)	0.1498	0.1103	5

Table 9: Relative Profit Inefficiency in The Pre- and Post Acquisition Periods in The Target Banks

	-3	-2	-1	0	1	2	3
TEB	-0.15334	-1.56315	-2.33058	-10.0715	-19.282	-6.41169	-0.02664
Fortis	-0.50371	-1.78466	-3.71799	-11.0958	-20.0813	-6.56109	-0.09905
Yapi-Kredi	-0.8002	-2.06201	-4.28953	-11.6821	-21.0139	-7.26603	-0.82943
Garanti	-0.46048	-2.30259	-4.57959	-11.9932	-21.1111	-7.44295	-0.91196
Finansbank	-1.92626	-4.36497	-11.9669	-21.2379	-7.2146	-0.76841	-0.32648
Denizbank	-0.61844	-3.58041	-11.564	-20.5748	-6.7242	-0.61525	-0.36565
EurobankTekfen	12.16978	7.693246	-5.46548	1.664201	5.867434	5.612949	8.1231
Sekerbank	-3.7881	-11.6945	-20.7656	-6.49434	-0.15817	-0.07415	-0.09654
T-bank	12.74926	13.09257	15.88383	19.31476	12.89433	6.422094	8.144989
Akbank	-4.89308	-12.0898	-21.215	-7.46649	-0.96214	-0.36602	-0.6759
ING	-3.67352	-11.0575	-20.0051	-6.54043	-0.29834	na	na
Turkishbank	24.71783	13.57061	25.45226	23.74621	30.88354	12.41128	29.51029
average	-1.86857	-5.61107	-11.1594	-11.9063	-10.7606	-3.6882	-0.41646

Notes: Average excludes three outlier banks, namely, EurobankTekfen, T-bank and Turkishbank.

Table 10: Analyzing Bank Behavior: 2007-2011

Ownership	branch_no		Akbank	Arap Türk	Mellat	Deniz	Deutsche	Habib	HSBC	RBScot	Ziraat	Garanti	Halk	WestLB AG	Yapi_Kredi
F	927	Akbank TAŞ	9								4	2			
P	63	Alternatif Bank AŞ	5				2				4				1
P	88	Anadolubank AŞ	5			1			1		2				1
F	6	Arap Türk Bankası AŞ	2	3				3	1					1	
F	3	Bank Mellat			6		1	2			2		2		
F	37	Citibank AŞ	5						7						
F	588	Denizbank AŞ	5			1			2		3				2
F	1	Deutsche Bank AŞ	2		1		5		2						
F	59	Eurobank Tekfen AŞ	1								6	3	1		
F	21	EX.MILL/Fibabanka AŞ	2												
F	522	Finans Bank AŞ	5			2					1				
F	269	FORTIS	4												
F	1	Habib Bank Limited		1				9		1			1		
F	330	HSBC Bank AŞ	4			1			4						1
F	322	ING Bank AŞ	3								2				
F	272	Şekerbank TAŞ	6			1									2
P	44	Tekstil Bankası AŞ	5								2				1
F	3	The Royal Bank of Scotland NV	2	2			1	1	2	2				1	
F	20	Turkish Bank AŞ	4			1					1				
F	27	Turkland Bank AŞ	5												2
F	507	Türk Ekonomi Bankası AŞ	5								2				1
S	1458	T. C. Ziraat Bankası AŞ	3					1			5		2		
F	914	Türkiye Garanti Bankası AŞ	10								3				1
S	771	Türkiye Halk Bankası AŞ	7								5		2		
P	1201	Türkiye İş Bankası AŞ	9								3	1	1		1
S	680	Türkiye Vakıflar Bankası TAO	6								5	2	1		
F	1	WestLB AG	2				2	1	1	1	1				1
F	907	Yapı ve Kredi Bankası AŞ	8				1		2		1				1

Notes: F: foreign irrespective of participation level, P: private, S: state Period: 2007-2011. Each matrix element shows # of times column bank has been a referent to a row bank. Example: Akbank has been a referent to itself 9 times, to Alternatif 5 times….to Garanti 10 times… The matrix elements can exceed 5 i.e. the number of periods, due to sequential DEA. Namely the 2011 set includes 2011, 2010, 2009, 2008, 2007, 2002; or the 2008 set includes 2007…..2002 etc. Ownership statuses like Private or Foreign reflect the situation in 2011.