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Dervis Ahmet Akinci
Roman Matousek
Nemanja Radić
Chris Stewart

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MONETARY POLICY AND BABKING SECTOR:

Lessons from Turkey

Dervis Ahmet Akinci[1]*

Roman Matousek[2]

Nemanja Radić[3]

Chris Stewart[4]

Abstract

We find evidence that monetary policy influenced bank lending in Turkey in the period 1991 – 2007 both directly through the money lending channel and indirectly through the bank lending channel. The bank lending channel is shown to depend on two bank characteristics, namely liquidity and capital. We also find that both capital and GDP growth have plausible positive and significant long-run effects on bank loan growth, whereas inflation, bank size and, in particular, efficiency do not have a significant equilibrium relationship with loan growth. This latter result is despite our finding that the efficiency of all Turkish banks improved over the period. It is also evident that domestic banks are, unexpectedly, found to be more efficient, on average, than foreign banks. We discovered no evidence of significant dynamics or fixed-effects in the growth of loans and so prefer to use the pooled OLS estimator over the fixed-effects and Arellano and Bond estimators. We therefore caution against assuming the existence of fixed-effects and dynamics in such models as this may adversely affect inference.

Keywords: bank lending channel, efficiency, panel data, Turkey

[1] Banking Regulation and Supervision Agency, Ataturk Bulvari, 191/C, Kavaklidere, Ankara, Turkey. E-mail: aakinci@bddk.org.tr

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[2] Centre for EMEA Banking, Finance and Economics, London Metropolitan Business School, London Metropolitan University, 84 Moorgate, London, EC2M 6SQ. Tel: 020-7320-1569. E-mail: r.matousek@londonmet.ac.uk

[3] London Metropolitan Business School, London Metropolitan University, 84 Moorgate, London, EC2M 6SQ. Tel: 020-7320-1550. E-mail: n.radic@londonmet.ac.uk.

[4] London Metropolitan Business School, London Metropolitan University, 84 Moorgate, London, EC2M 6SQ. Tel: 020-7320-1651. E-mail: c.stewart@londonmet.ac.uk.

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1. Introduction

The stability and efficiency of the Turkish banking system was considerably undermined by two severe financial crises in the early 1990s and in the period 1999-2001. Since the banking sector is the backbone of the Turkish economy, the Government realised that a sound and efficient banking sector requires an adequate macro- and micro-economic environment in which to operate, that will be consistent with, and help promote, the widening financial activities of commercial banks.

Several research studies have recently been published on the performance and efficiency of the Turkish banking system, see, for example, Ozkan-Gunay and Tektas (2008), Aysan and Ceyhan (2008), Demir et al. (2007), Demir et al. (2005), among others. The present paper contributes to this ongoing research by providing a detailed overview of the development of the Turkish banking system in last twenty years. In particular, we analyse bank performance over the period 1991-2007. Our unique dataset enables us to identify actual or potential problems in the Turkish banking system and individual banks. Such information is valuable in the process of further banking consolidation and restructuring. In addition, it contributes to the current discussion about the competitiveness and efficiency of the Turkish banking sector in the context of the EU enlargement process. If there is significant inefficiency among banks there may be room for structural changes, increased competition, mergers and acquisitions.

The paper contributes to policy makers and bank management by analysing the impact of the liberalisation and restructuring process of the banking sector in Turkey. Further, it provides policy recommendations for Turkey where significant challenges in banking consolidation remain.

Throughout the study we show the following: Firstly, we find that monetary policy has a direct impact upon bank loans in Turkey through the money lending channel. Secondly, we provide evidence that the bank lending channel (BLC) depends on bank characteristics (liquidity and capital in the case of Turkey) as has been shown by recent empirical studies for transition economies, e.g. Matousek and Sarantis (2009). Thirdly, banks' liberalisation and restructuring processes in the early 1990s and 2001 had the expected effect on the Turkish banking system in terms of improved performance (increased efficiency). Our results contrast with the findings published by Ozkan-Gunay and Tektas (2008), Demir et al. (2007), among others. Fourthly, we assess the hypothesis that foreign banks should be more efficient than domestic banks (Isik and Hassan (2002), Mercan and Yolalan, (2000)). This hypothesis is in line with the results from transition economies see, for example, De Haas and Van Lelyveld (2006). Our findings are not consistent with this hypothesis, indicating that domestic banks are, on average, more efficient than foreign banks. Fifthly, we show that bank efficiency is not an important determinant in the BLC or of the growth of bank loans more generally in Turkey. Finally, we find that while there are dynamics in the levels of the data they are not evident in their first differences and so we do not favour inference from the Arellano and Bond (1991) panel estimator. We further find an absence of significant fixed-effects which suggests that our first difference specification likely removes any fixed-effects that are present in the levels of the data. Hence, we favour inference from the pooled OLS estimator. We note that previous research on the BLC using panel data that assumes the presence of dynamics and fixed-effects in the first differenced data may not, therefore, be using the most appropriate estimators for inference. We suggest that future research in this area gives full consideration to the most appropriate estimator to be used in any particular application.

The paper is structured as follows: Section 2 provides information about the Turkish banking system. Section 3 reviews current studies on the BLC and bank efficiency. The fourth section outlines the estimation methodology and measuring cost efficiency in the banking industry. Section 5 discusses the results while Section 6 concludes and provides policy recommendations.

2. Banking Sector and Macroeconomic Settings

Turkey entered 1980 with a major stabilisation and liberalisation programme after a period of prolonged economic crisis during the late 1970s. Besides its immediate objective of restoring macroeconomic stability, the programme’s long-term goal was to fundamentally transform the Turkish economy into a market-based open economy.

The Turkish economy was characterised by high and chronic inflation and volatile real output growth performance due to the economy relying on short-term financial flows as a major source of external financing. The Central Bank was under Government control and monetary policy was subordinate to fiscal policy in an environment with a high public sector borrowing requirement.

A crawling-peg type exchange rate regime was introduced to act as a nominal anchor and monetary expansion was strictly linked to foreign currency inflows. With the liberalisation of capital account transactions and the removal of restrictions on holding foreign currency, foreign markets have become an important resource for banks to raise funds along with deposit collection. Increasing currency substitution in the economy was driven by high inflation expectations. Delays in reform activities, adverse developments in international financial markets and financing needs of the public sector as well as the widening current account deficit led to a general loss of credibility for the disinflation program towards the end of 2000. Substantial capital outflows and sharp increases in domestic borrowing rates magnified the financing difficulties faced by state banks as well as some private banks. A systemic crisis was already underway and reached its peak in November 2000 causing significant erosions in bank capital. The authorities' attempts to calm the markets failed. Escalating political tensions and loss of credibility in the exchange rate regime triggered another crisis in February 2001 upon which the authorities had to abolish the crawling-peg regime and leave the Turkish Lira to float freely. The crisis proved to be one of the most severe and financial markets almost came to a standstill as the Lira depreciated sharply. Overnight interest rates reached four digit figures and the Istanbul stock exchange collapsed. A number of banks had already become practically insolvent while some others were on the brink of it. Spreading into the real sector, the crisis led to a record contraction in economic activities.

The Turkish banking sector proved to be the main beneficiary of the financial liberalisation process given its traditional dominance in the system. Tables 1 and 2 provide various basic indicators on the Turkish banking industry over the period 1980-2007. The launched reforms led to a large number of new bank entries, both domestic and foreign, which in turn increased competition in the banking sector and enhanced banking activities in terms of resources and placements. Total bank assets tripled, loans almost tripled, while deposits saw a near four-fold increase by the end of 1990. An increase in the number of branches and employees reflects the rapid growth of the banking sector under the post-1980s policy environment. Banks also started to establish subsidiaries and branches abroad.

Another important result of the reform process was the banks achievement of rapid technological transformation and well-qualified human resources to the extent that, by the late 1990s, Turkish banks became some of the most sophisticated in the region, see Denizer (2000). This enabled banks to increase their service and product scale (as well as quality) and engage in new areas of financial products. The number of small and medium size banks involved in wholesale banking with a few branches increased while market shares of larger private banks declined under free interest rate and flexible foreign exchange rate policies. Wholesale banks mainly concentrated on foreign trade financing, leasing, factoring, forfeiting, short-term lending, and fund raising from international financial markets (BAT, 2008).

However, these positive structural developments in the Turkish banking system were overshadowed by some rather disturbing issues. Initial stabilisation efforts of the early 1980s were short-lived and were followed by a rather populist attitude. Public deficits increased and inflation rates soared towards the late 1980s. Substantial deposit withdrawals and serious liquidity problems forced the government to intervene and liquidate three insolvent small banks, announce a full deposit insurance scheme and provide liquidity support to the affected banks.

In the second half of the 1990s the government was forced to radically consolidate and reshape the banking sector. As a result of these changes, the banking sector not only rapidly recovered from the crisis but also jumped to the highest expansion path in its history in terms of number of banks, branches, and employees in the second half of the 1990s. Record levels were attained in 1999 regarding the number of banks and employment in the sector, while the number of branches reached its peak in 2000. The surge was also reflected in asset and deposit volumes both of which more than doubled from 1995 to 2000. Declining market concentration in terms of assets, which likely points to a reduction in market power and increase in competition, and private banks overtaking state banks in terms of asset share were among the other notable developments of this period. The authorities introduced an ambitious three-year (2000-2002) disinflation program at the end of 1999 which envisaged various structural reforms and the adoption of tight fiscal and monetary policies. As part of the program's financial reform measures, a new banking law was enacted and a new independent regulatory body, namely the Banking Regulation and Supervision Agency (BRSA), was established.

Delays in the programmed reform activities, adverse developments in international financial markets and heavy financing needs of the public sector as well as the widening current account deficit led to a general loss of credibility for the disinflation program towards the end of 2000. Substantial capital outflows and sharp increases in domestic borrowing rates magnified the financing difficulties faced by state banks as well as some private banks. A systemic crisis was already underway and reached its peak in November 2000 causing significant erosions in bank capital. In May 2001, the government announced a comprehensive program with support from the IMF. Overall, the program's measures targeted the economy's resilience to external shocks, bringing down inflation, reducing the public sector's debts, ensuring financial discipline, completion of financial reforms, and the reinforcement of the banking system. The latter, known as the Banking Sector Restructuring Program, proved to be the vital part of the overall program. It was designed to include a wide range of measures (with further additions as needed going forward) in each of the following main priority areas: i) financial and operational restructuring of state-owned commercial banks, ii) prompt resolution of banks that were taken over by the Savings Deposit Insurance Fund, iii) strengthening of the financial position of private banks and, iv) improvement of the regulatory and supervisory framework in line with international (and EU) standards. The ultimate objective was to eliminate distortions in financial markets and promote an efficient, globally competitive and sound banking sector.

The banking law was renewed in 2005 and required new regulations with procedures subsequently introduced. In effect, the regulatory and supervisory framework of the banking sector is being almost fully compliant with the related EU legislation and the internationally recognized principles, standards and applications. At the same time, institutional infrastructure and human resources of the BRSA have been strengthened further along with its autonomous regulatory and supervisory powers.

3. Literature review

3.1 Lending Channel

In the economic literature and among practitioners, there has been a renewed interest in analysing the role of banks in the monetary transmission mechanism and, in particular, the bank lending channel (BLC). According to the bank lending channel, changes in monetary policy shift banks' loan supply schedules. The BLC is due to a combination of a binding lending constraint and a deposit market constraint. When the central bank squeezes liquidity from the system, banks are forced to shift from reservable or insured funds to nonreservable or uninsured sources of funds. The bank lending view rests on the idea that banks with weak balance sheets find it difficult to raise uninsured funds due to prohibitive agency costs in the deposit market (Kishan and Opiela, 2006). Stein (1998) argues that uninsured funds are also potentially subject to adverse selection problems and credit rationing. Consequently, these banks lose funds for loans and are thus forced to reduce lending to their bank-dependent clients.

The implication of the BLC is that the response of bank loans to shifts in monetary policy differs depending upon a bank's characteristics or strengths of their balance sheets. In general, the lending behaviour of banks with weak balance sheets should be more sensitive to monetary shocks than that of banks with strong balance sheets. The existing literature has emphasised three major bank characteristics, or measures of balance sheet strength, that could affect the response of bank loans to a shift in monetary policy. First, asset size (Kashyap and Stein, 1995 and 2000; Kishan and Opiela, 2000); second, bank capitalisation (Peek and Rosengren 1995; Kishan and Opiela, 2000 and 2006); third, liquidity (Kashyap and Stein, 2000).

Seminal papers on the existence of the bank lending channel, using disaggregated data on banking firms, were produced for the US. Kashyap and Stein (1995) found that the growth of bank loans for the sub-segment of small commercial banks was the most responsive to monetary policy. A further study by Kashyap and Stein (2000) divided banks not only by asset size but also by liquidity. They showed that the smallest most illiquid banks were most responsive to monetary policy. Kashian and Opiela (2000) support the previous research by dividing banks both by size and capital strength. Kashian and Opiela (2006) investigate the asymmetric effects of monetary policy on the loan behaviour of low-capital and high-capital banks and their results are consistent with the lending channel predictions, but only for the post-Basel period. In general, studies for US banks provide supportive evidence for the BLC in the transmission of monetary policy, though this has recently been questioned by Ashcraft (2006). When using bank data, Ashcraft identifies a differential response of loan supply to changes in the federal funds rate across banks as well. However, when he aggregates the bank data up to the state level, the loan market share of affiliated banks tends to mitigate the negative response of state loan growth to changes in monetary policy, while the aggregate elasticity of output to bank lending is insignificant and negative.

Empirical studies from Europe are less conclusive. Favero *et al* (1999) investigated the presence of a BLC in Germany, France, Italy and Spain during the monetary restriction in 1992. They did not find any evidence for the BLC in these countries. The study presented by de Bondt (1999) analyses six European countries. The analysis shows that a bank lending channel is present in Germany, Belgium and the Netherlands when the short term interest rate is used as proxy for monetary policy stance. No supportive evidence is found for France, Italy and the United Kingdom. In the second part of his study, where the short-term interest rate is replaced by a monetary condition index, the BLC is present in France and Italy. Ehrmann *et al* (2003) investigate the BLC using micro and aggregate data for Germany, France, Italy and Spain. They find that less liquid banks react more strongly to shifts in monetary policy than more liquid banks, but bank size and capitalisation are generally not important. Kakes and Sturm (2002) find that lending in small German banks declines more than in large banks after a monetary contraction. Gambacorta (2005) finds similar evidence for Italian banks with regards to capitalisation and liquidity. Altunbas *et al* (2002) also assesses the existence of a BLC in European countries. They find that across the EMU system, undercapitalised banks tend to respond more to changes in monetary policy, irrespective of their size. We are unaware of any study that analyses monetary transmission mechanism through the BLC in Turkey.

3.2 Bank Efficiency

There has been extensive research on bank efficiency in Turkey. Recent studies include Isik and Hassan (2002) who estimated bank efficiency in Turkey over the period 1988-1996. They compare nonparametric and parametric approaches. Their results showed that the main source of inefficiency in the Turkish banking was due to technical inefficiency rather than allocative inefficiency caused by diseconomies of scale. They supported the view that foreign banks operating in Turkey are significantly more efficient than their domestic peers. Kasman (2002) used a three input—three output Fourier-flexible cost function specification to investigate cost efficiency, scale economies, and technological progress in the Turkish banking system over the period 1988-1998. Empirical results disclosed that the Turkish banking system had significant inefficiency problems in the analysed period. The average annual inefficiency levels decreased over the sample period. Kasman argued that commercial banks in the sector operated more inefficiently than their U.S. and European counterparts. They confirmed the existence of scale economies across the sample and no evidence of diseconomies of scale for larger banks was identified.

Denizer et al. (2007) examined bank efficiency before and after the liberalisation process in Turkey by applying Data Envelopment Analysis (DEA). They concluded that liberalisation programmes were followed by a decline in bank efficiency. The second part of their research indicated that the decline in efficiency was closely related with macroeconomic instability. A recent study by Ozkan-Gunay and Tektas (2008) computes the technical efficiency of non-public commercial banks between 1990 and 2001 by using the DEA model. They find a gradual decline in bank efficiency over the period.

In the following part, we provide a brief summary of papers that have been published on transition economies and could be of interest for comparision purposes. Bonin et al. (2005) and Fries and Taci (2005) analysed the effects of bank ownership on bank efficiency and concluded that foreign banks are more cost-efficient than domestic banks. Another study by

Kasman and Yildirim (2006) analysed the cost and profit efficiencies in commercial banking in the eight Central and Eastern European countries that became members of the EU. They found significant levels of cost and profit inefficiency. They argued that there have been no strong and consistent efficiency gains in the new member countries' banking sectors in recent years. This contrasts with some previous studies on transition countries which show that banking sectors became more efficient in the late 1990s. Their results also indicated that foreign banks perform, on average, better than domestic banks.

Recent studies on this topic include Staikouras et al. (2008) and Koutsomanoli-Filippaki et al. (2009). The former examined cost efficiency in the banking sector of six South Eastern European countries, while the latter used a directional technology distance function to estimate the efficiency and productivity change in CEECs. Both papers, i.e. Staikouras et al. (2008) and Filippaki et al. (2009), confirmed that foreign banks and banks with foreign participation exhibit higher efficiency scores.

In our model we control for the impact of efficiency and, treating it like a fourth bank characteristic, consider whether the BLC operates through differences in the degree of efficiency of banks. The inclusion of bank efficiency scores into a model is an innovation of our paper.

4. Data and Model Specification

In our analysis, we use annual data over the period 1991-2007. The sample includes 25 commercial banks operating in Turkey, which are listed in Table 3. The source of our database is the bank statistics published by the Banks Association of Turkey. Our sample reflects almost the entire population of commercial banks in Turkey and is superior to the BankScope database.

4.1 Bank Lending Channel

As shown by Bernanke and Blinder (1992), macroeconomic time series are not helpful in identifying a lending channel that is actually the sub-channel of a credit channel. Aggregate data do not allow us to distinguish between supply and demand factors that affect bank lending activities. Disaggregated data on banks, on the other hand, may effectively capture the distributional effects of monetary policy through a lending channel.

The presence of a lending channel is typically tested by assuming three bank characteristics. Kashyap and Stein (1995, 2000) and Kishan and Opiela (2000) consider the size of banks as one of these characteristics. It is assumed that small banks are more prone to the problem of information asymmetry than large banks and that large banks can issue market instruments such as certificate of deposits. This implies a higher sensitivity of small banks to monetary policy shocks. The second bank characteristic is liquidity. Evidence provided by Kashyap and Stein (2000) and Ehrmann *et al* (2003) shows that liquid banks can insulate their loan portfolios by reducing their liquid assets, while less liquid banks are unable to do so. Finally, bank capitalisation is another characteristic used in some BLC models. Peek and Rosengren (1995) and Kishan and Opiela (2000, 2006) argue that poorly capitalised banks reduce their loan supply more than well capitalised banks after a monetary contraction, due to their limited ability to tap into uninsured sources of funds. Hence, the size, liquidity and capitalisation of banks are all expected to be positively correlated with bank loans.

Two approaches are employed in the empirical literature for testing the bank lending channel. One is to divide banks by size, capitalisation and liquidity (e.g. Kashyap and Stein (1995, 2000); Kishan and Opiela (2000, 2006); Altunbas *et al* (2002)). This approach requires a large number of banks, which is not a problem for the USA, however, the number of banks in Turkey is relatively small so such an approach is not feasible. The alternative approach is to use a panel data model that allows the reaction of bank loans to monetary policy to become dependent on the bank characteristics, as in Ehrmann *et al* (2003). This approach avoids the above problem associated with the number of banks, and this is used in our paper. The authors develop a model of the loans market that draws upon Bernanke and Blinder (1988). The solution of their model yields an equation for bank loans that relates the response of bank loans to monetary policy both directly (via the money channel) and to bank characteristics (through the bank lending channel). Following Ehrmann *et al* (2003) the dynamic panel data model that relates bank loan growth to monetary policy both directly and indirectly is specified as follows:[5]

$$\Delta lnL_{it} =$$
$$\alpha_i + \beta_1 \Delta lnL_{it-1} + \sum_{j=0}^{1} \gamma_j \Delta R_{t-j} + \sum_{j=0}^{1} \delta_j GGDP_{t-j} + \sum_{j=0}^{1} \lambda_j INF_{t-j} + \sum_{k=1}^{3} \theta_k Z_{kit-1} +$$
$$\sum_{k=1}^{3} \sum_{j=0}^{1} \phi_{kj} Z_{kit-1} \Delta R_{t-j} + \sum_{k=1}^{2} \sum_{h=k+1}^{3} \sum_{j=0}^{1} \rho_{khj} Z_{kit-1} Z_{hit-1} \Delta R_{t-j} + u_{it} \quad (1)$$

where L represents bank loans, R, denotes the short-term interbank money market rate, $GGDP$ is the real (2005 base year) GDP growth rate and INF gives the rate of inflation – the latter two variables are proxies for the demand for loans while the former indicates the policy stance.[6] Z_k denote the $k = 1, 2, 3$ bank specific characteristic variables: size (S_{it}), liquidity (LIQ_{it}) and capital (CAP_{it}).[7] Further, ln represents the natural logarithm operator, Δ the first-difference operator, $i = 1, 2, \dots, N$ and $t = 1, 2, \dots, T$, where N is the number of banks, and T the number of time periods. Finally, we allow for fixed-effects across banks with α_i.

Following Ehrmann *et al* (2003) and Gambacorta (2005), amongst others, we define the bank characteristic variables as:

$$S_{it} = lnA_{it} - \frac{\sum_{i=1}^{N_i} lnA_{it}}{N_i} \quad (2)$$

$$LIQ_{it} = \frac{LA_{it}}{A_{it}} - \frac{\left[\frac{\sum_{i=1}^{N_i} \left(\frac{LA_{it}}{A_{it}}\right)}{N_i}\right]}{T} \quad (3)$$

[5] We found that one lag was sufficient to deal with autocorrelation and enabled us to avoid unduly over-parameterised specifications.
[6] The three macroeconomic variables are not bank specific (so only vary through time) and their data is taken from IMF International Financial Statistics downloaded via the ESDS data service. The interest rate (measured as a proportion) is taken from line 60B..ZF, nominal GDP from line 99B..ZF, the GDP price deflator from line 99BIPZF (these two series are used to construct real GDP) and the consumer price index, used to construct inflation, from line 64...ZF. Due to the relatively high levels of inflation in Turkey over our period of study we use the standard growth rate formula, $\frac{X_t - X_{t-1}}{X_{t-1}}$, rather than the log approximation to construct the inflation and GDP growth variables.
[7] We denote efficiency (discussed below) with Z_4.

$$CAP_{it} = \frac{C_{it}}{A_{it}} - \frac{\left[\frac{\sum_{i=1}^{N_i}\left(\frac{C_{it}}{A_{it}}\right)}{N_i}\right]}{T} \quad (4)$$

where, A denotes a bank's total assets, LA represents a bank's liquid assets (cash, interbank lending and securities), C gives bank capital and reserves (total equity) and N_i is the number of time-series observations that are available for the i^{th} bank. All three bank characteristics are normalised with respect to their averages across all banks in the sample to ensure that they sum to zero across the full sample so that the γ_j coefficients in (1) are directly interpretable as the monetary policy effects for the average bank – see Gambacorta (2005, p. 1744). In order to eliminate the trend in the size bank characteristic (S), the sample is normalised not only over the whole period but also over each single period – see Ehrmann et al. (2003).

As has already been discussed the interaction term of the bank specific characteristics with the short-term interest rate should capture the distributional effects of the monetary policy stance. It is assumed that small, less liquid and less capitalised banks should respond more strongly to monetary policy changes compared with large, more liquid and more capitalised banks. Following Matousek and Sarantis (2009), MS hereafter, we test the following three related hypotheses of the existence of a bank lending channel. First, if $\frac{\partial^2 \Delta lnL_{it}}{\partial \Delta R_{it-j} \partial S_{it-1}} > 0$ this implies that the lending of large banks is less sensitive to a change in the monetary policy stance than the lending of small banks. A second hypothesis is that more liquid banks can extend their lending by reducing their stock of liquid assets, which implies, $\frac{\partial^2 \Delta lnL_{it}}{\partial \Delta R_{it-j} \partial Liq_{it-1}} > 0$. In other words, less liquid banks have to contract their loan portfolio. Third, more capitalised banks are less sensitive to changes in monetary policy stance, such that, $\frac{\partial^2 \Delta lnL_{it}}{\partial \Delta R_{it-j} \partial Cap_{it-1}} > 0$. Hence the existence of a BLC suggests that the interaction terms will have positive coefficients in (1).

The model given by (1) includes cross-sectional fixed-effects and a lagged dependent variable which, in a panel with a relatively small time-series dimension (T is at most 17), requires the use of a Generalised Method of Moments (GMM) estimation procedure, such as that proposed by Arellano and Bond (1991), to secure consistency. The GMM estimator ensures consistent parameter estimates by choosing instruments for the lagged dependent variable so that the sample correlations between the instruments and the model's error term are as close to zero as possible (see Hamilton, 1994). Current and lagged values of the right-hand side variables are considered for use as instruments. To test the validity of the over-identifying restrictions (or orthogonality conditions) we employ both the Sargan test and Hansen's J-test. Additionally, we test the hypothesis that there is no second-order serial correlation in the disturbance of the first-difference equation using the Arellano and Bond test.[8] However, if the lagged dependent variable is excluded from (1) the model would not need to be instrumented and estimation by the standard fixed-effects method would be appropriate (unless there were other endogenous covariates).

We use unbalanced panel data where not all banks feature over the whole sample. Verbeek and Nijman (1992) argue that estimates using unbalanced panel data may give rise to a selectivity bias because of the selection of observed banks or the correlation between the selection process and the model's random effects. Our primary focus is the macroeconomic effects on all banks through time so the composition of banks is unlikely to have a substantial impact on our results (unless the composition changes significantly). Nevertheless, we consider whether such selectivity effects may have affected our inference by applying Verbeek and Nijman's (1992) variable addition test.[9] Three dummy variables are constructed to capture the selectivity effects of banks entry and exit during the sample period. The first dummy, D_1, is defined as the number of years that a bank features in the sample. The second, D_2, is unity if a bank is absent for at least one year in the sample and is zero otherwise. The third, D_3, is unity for a particular period if the bank was absent from the sample in the previous year and is zero

[8] Arellano and Bond (1991) show that the consistency of the GMM estimators depends crucially on the assumption that there is no second-order serial correlation in the first-difference residuals.

[9] Although two alternative tests (LM and quasi-Hausman) could be applied they are computationally demanding whereas the variable addition test is not and performs reasonably (exhibiting quite good power).

otherwise. If any dummy variable is found to be significant (either individually or jointly) there is evidence of selection bias, otherwise the null of no bias cannot be rejected.

4.2 Cost efficiency

Empirical studies apply two approaches to measure bank outputs and costs in banking (Sealey and Lindley (1977), Berger and Humphrey (1997)). The production approach considers that banks produce accounts of various sizes by processing deposits and loans. The intermediation approach considers banks as transforming deposits and purchased funds into loans and other assets. These two approaches have been applied in different ways depending on the availability of data and the purpose of the study. Inputs include the price of capital, price of labour and price of funds. In this study, we assume that in carrying out their production process Turkish banks use three input variables: price of labour, assets and deposits. Specifically, the price of labour (P_1) is calculated as personnel expenses over number of employees; the price of assets (P_2) is measured as non-interest expenses over total assets; and the price of deposits (P_3) is measured as interest expenses over deposits. On the output side, we assume that banks produce three outputs: (Y_1) loans, (Y_2) securities and (Y_3) off-balance sheet assets. Table 4 reports the descriptive statistics of the inputs and outputs used in the empirical analysis.

Ferrier and Lovell (1990) pointed out that the approach selected depends upon the aim of the research. They argue that the production approach is appropriate in the case of the cost efficiency of banks and that this approach focuses on the operating costs of banking. The second approach, the intermediation approach, deals with the overall costs of banking and is therefore suitable when one wants to consider issues about the economic viability of banks.

The estimation of a cost function, however, allows an examination of input inefficiencies only. Berger et al. (1993) argue in favour of a profit function for examining banking inefficiency. It is difficult to implement the profit function approach in Turkey because of the data quality. The data on profits are extremely unreliable being greatly affected by the sub-optimal level of loan provisions, resulting in only ‘paper’ profits. Moreover, since the profit function specifies both inputs and outputs, the number of parameters is significantly higher than that for a cost function. Thus, degrees of freedom become a more severe constraint. Therefore, estimating the cost function is the most feasible approach and this is the focus of our discussion in measuring efficiency, however, we also construct efficiency measures using the profit function. Thus, cost efficiency is measured using the Stochastic Frontier Analysis (SFA) that can be written as follows:

$$\ln TC_{i,t} = x_{i,t}\beta + (V_{i,t} + U_{i,t}) \tag{5}$$

where t denotes the time dimension, $\ln TC_i$ is the logarithm of the cost of production of the i-th bank, x_i is a $kx1$ vector of input prices and output quantities of the i-th bank, β is a vector of unknown parameters, V_i are random variables which are assumed to be i.i.d $N(0, \sigma^2_v)$ and independent of U_i, U_i are non-negative random variables which are assumed to account for cost inefficiency and to be i.i.d. as truncations at zero of the $N(0, \sigma_U^2)$.

Following an approach similar to Radić et al. 2012, we use the following translog functional form[10]:

$$\begin{aligned}\ln TC_{kt} &= \beta_0 + \sum_{i=1}^{3}\beta_i \ln Y_i + \sum_{j=1}^{3}\alpha_j \ln P_j + \lambda_1 T + \frac{1}{2}\left(\sum_{i=1}^{3}\sum_{j=1}^{3}\delta_{ij}\ln Y_i \ln Y_j + \sum_{i=1}^{3}\sum_{j=1}^{3}\gamma_{ij}\ln P_i \ln P_j + \lambda_{11}T^2\right)\\ &+ \sum_{i=1}^{3}\sum_{j=1}^{3}\rho_{ij}\ln Y_i \ln P_i + \sum_{i=1}^{3}\beta_{iT} T \ln Y_i + \sum_{j=1}^{3}\alpha_{jT} T \ln P_j\\ &+ \frac{1}{2}\tau_{EE}\ln E \ln E + \tau_E \ln E + \sum_{i=1}^{3}\beta_{iE}\ln Y_i \ln E + \sum_{j=1}^{3}\alpha_{jE}\ln P_j \ln E + \varepsilon_{kt} \quad \varepsilon_{kt} = v_{kt} + u_{kt}, \; for\ i \neq j \end{aligned} \tag{6}$$

where $\ln TC_{kt}$ (ln TP) is the natural logarithm of total cost (total profit) of bank k in period t, Y_i is the vector of output quantities, P_j are the input prices, E represents bank's shareholder equity capital and is included as a fixed input, specifying interaction terms with both output and input prices in line with recent studies (see e.g. Altunbas et al., 2000; Vander Vennet, 2002; and Radić

[10] The choice of using the translog functional form is motivated by two main reasons. First, Altunbas and Chakravarty (2001) identify some problems associated with more flexible functional forms like the Fourier (Mitchell and Onvural, 1996) when dealing with heterogeneous data sets. Secondly, Berger and Mester (1997) observe that the translog and the Fourier-flexible are substantially equivalent from an economic viewpoint and both rank individual bank efficiency in almost the same order.

et al., 2012). We use this functional form to estimate a model for a single frontier of commercial banks operating in Turkey. Unlike, Coelli et al. (1999) and Radić et al. (2012) we do not attempt to account for heterogeneity including environmental conditions, or firm-specific factors. We expect to account for bank-specific factors in our main econometric approach.

Lastly, we expect more efficient banks to be better able to maintain loans as interest rates rise than less efficient banks via the BLC, as specified in equation (1). This motivates our hypothesis of a positive correlation between the change in the interest rate interacted with efficiency and the growth of loans. We also expect a positive correlation between the non-interacted efficiency variable and loan growth.

Figure 1 and Figure 2 plot, respectively, the cost and profit measures of efficiency for each bank through time. Both measures clearly demonstrate that every bank has become more efficient over the period 1991 – 2007. This is consistent with the notion that the liberalisation and restructuring processes in the early 1990s and 2001 has had the expected effect on the Turkish banking system in terms of improved performance. This contrasts with the finding of Ozkan-Gunay and Tektas (2008) and Demir *et al* (2007), among others.

Table 5 gives the average of the efficiency measures by the type of bank. Surprisingly, foreign banks have a lower average efficiency than domestic banks according to both measures. This result is inconsistent with our hypothesis that foreign banks should be more efficient than domestic banks [Isik and Hassan (2002), Mercan and Yolalan, (2000), De Haas and Van Lelyveld (2006)]. When we divide domestic banks in to privately-owned and state-owned banks we find that the latter are, on average, the most (least) efficient type of bank using the cost (profit) measure of efficiency.

5. Estimation Results

Table 6 reports estimation results of (1), excluding efficiency variables, based on the Arellano and Bond two-step system estimator with Windmeijer (2005) corrected coefficient standard errors.[11] The two-step coefficient estimator is asymptotically efficient and robust to whatever heteroscedasticity, autocorrelation and cross-correlation is modelled by the new variance-covariance matrix. The Windmeijer (2005) corrected standard errors greatly reduces the problem of biased coefficient standard errors associated with the two-step estimator, especially when the number of instruments is large. The rule of thumb is to keep the number of instruments below the number of cross-sections to ensure valid inference. We therefore use the dependent variable lagged two periods and deeper as "collapsed" GMM-style instruments to keep their number down and avoid overfitting the endogenous variable (collapsing instruments in this way does come at the loss of some efficiency). We also restrict the IV-style instruments to be the same for each model, being the current value and first lag of each of ΔR_t, $GGDP_t$ and INF_t.[12] Consequently 22 instruments are used in all of our models estimated by GMM, which is less than the 24 cross-sections in our panel data.

There is no evidence of invalid instruments according to Hansen's J-test and the Sargan test with the exception of the model containing only the liquidity bank characteristic variable (in the column headed liq) – the probability values of these two tests are reported as p(Hansen) and p(Sargan), respectively.[13] This suggests that it is important to include either size and/or capital bank characteristics in the model to secure instrument validity. There is also no evidence of second order autocorrelation in the idiosyncratic residuals – the probability value of this test is reported as p[AR(2)]. Therefore, with the exception of the model reported in the column headed liq the models are presented as valid for inference.[14]

We report eight models in Table 6. The first seven all contain the current and first lagged value of ΔR_t, $GGDP_t$ and INF_t. The differences in these models lie in the bank characteristic variables that are included. The first three models include variables based on one bank

[11] In "… difference GMM regressions on simulated panels, Windmeijer finds that the two-step efficient GMM performs somewhat better than one-step in estimating coefficients, with lower bias and standard errors. And the reported two-step standard errors, with his correction, are quite accurate, so that two-step estimation with corrected standard errors seems modestly superior to robust one-step." Roodman (2006, p. 11).

[12] Lags of the bank characteristics were excluded from the IV-style instrument set to keep the number of instruments below the number of cross-sectional units.

[13] Hansen's J-test is robust to non-spherical disturbances while Sargan's test is not robust to non-spherical disturbances (it is inconsistent).

[14] We also note that all models have significant explanatory power according to the Wald test for the joint exclusion of all of the variables in the model – the probability value of this test is denoted as p(Wald).

characteristic (being size, liquidity or capital): the lag of that characteristic and the lag of that variables interaction with the current and lagged value of ΔR_t (respectively). The next three models include variables based on two bank characteristics (size and liquidity, size and capital or liquidity and capital) and include three way interaction terms with ΔR_t and its lagged value. The seventh (pseudo-general) model incorporates variables based on all three bank characteristics, however, the three-way interaction covariates are not included because such a model could not be estimated due to collinearity problems. The t-ratios, reported in parentheses below coefficients, indicate that virtually all of the variables in our models are not statistically significant at the 5% level. To assess whether this genuinely implies that these variables are not significant determinants of the growth in loans or if there are efficiency problems with the estimated models, we employ a general-to specific search for a parsimonious model.

The final model (reported in the column headed specific of Table 6) was obtained by applying the general-to-specific model reduction method to the pseudo-general model by sequentially deleting insignificant variables (tested jointly against the pseudo-general model) until only significant variables remained in the model. We then conducted variable addition tests for each of the three-way interaction terms to see if they were statistically significant. Our parsimonious specific model includes only significant variables.[15] Further, the joint restrictions placed on the pseudo-general model to obtain the specific model could not be rejected at the 5% level – where p(restrict) is the probability value of the test for these restrictions.[16] The significant variables in this parsimonious model are the first lag of GDP growth, the first lag of size and the interaction between lagged liquidity and the current change in the interest rate. While GDP growth has the expected positive sign the other two variables have unexpected negative signs. We expect both interacted and non-interacted size, liquidity and capitalisation variables to have positive coefficients although MS (p. 328) do offer a “dynamic lending

[15] We do apply a prejudiced search in our general-to-specific modelling in the sense that we never exclude the lagged dependent variable (even if appears to be insignificant) or the intercept. This is because these variables are defining characteristics of the Arellano and Bond system estimator and their exclusion means that we are no longer using this estimator. We consider alternative estimation methods below.

[16] Only one of the other models nested within the pseudo-general model rejected the joint exclusion restrictions imposed (being the model that only includes the size bank characteristic variables). This suggests that size is an important determinant of loans growth using this estimation method.

activities" rationalisation for a negative coefficient on the non-interacted size variable. Bank loans are expected to be related to monetary policy (interest rates) directly through the money lending channel and indirectly (interaction terms with interest rates) via the bank lending channel. We find no support for a direct effect and whilst there is evidence of an indirect effect the negative coefficient on the liquidity interaction term is unexpected. Hence these results do not support the bank lending channel hypothesis.

Table 7 reports the probability values of t-tests for the addition of non-interacted and two- and three-way interacted efficiency variables (using both cost and profit measures) to the models displayed in Table 6. For only 5 out of the 144 tests (3%) conducted can the efficiency variables be added with statistical significance at the 5% level. In three of these cases, three-way interaction terms (the profit measure of $EFF_{it-1}\Delta R_t CAP_{it-1}$ and both cost and profit measures of $EFF_{it-1}\Delta R_{t-1}LIQ_{it-1}$) are significant when added to the model that only includes capital bank-specific characteristics. However, from Table 6 this model that only includes the bank-specific characteristic capital is not a valid simplification of the pseudo general model, suggesting that significant variables are excluded from this model. Hence, the significance of the three efficiency covariates when added to this model may be due to omitted variable bias. The other two cases where efficiency variables are significant is for two-way interacted terms (both cost and profit measures of $EFF_{it-1}\Delta R_{t-1}$) when they are added to the parsimonious specific model from Table 6. This latter result suggests that further investigation of the role of efficiency variables is warranted. Indeed, the general insignificance of efficiency variables may be due to inefficient estimation arising from overparameterisation of many of the models. Hence, we apply a new general-to-specific search with the non-interacted and two-way interacted efficiency variables included in the general model to further explore the role of this variable.[17]

In Table 8 we report general and specific models when the general specification of (1) includes non-interacted and two-way interacted bank-characteristic and efficiency variables.[18]

[17] We note that in all five cases where efficiency was found to be significant it had a theoretically unexpected sign which casts some doubt on our ability to uncover a theoretically plausible significant relationship between efficiency and the growth of bank loans.

[18] Three-way interacted terms could not be incorporated in the general models in addition to the variables already included because estimation would fail. Since the evidence from Table 7 (Table 6) suggests that two-way

These are estimated using the Arellano and Bond method. Two specific models are reported when the cost efficiency measure is used. The first (denoted as Specific 1) is the result of applying the general-to-specific method in the standard way. The second (Specific 2) simply adds the efficiency variable found to be significant in Table 7 ($EFF_{it-1}\Delta R_{t-1}$) to the specific model reported in Table 6. Regarding the profit measure of efficiency the standard application of the general-to-specific method yielded the specific model reported in Table 6 (with no efficiency variables included). Hence, for this measure of efficiency we only provide estimates for the specific model from Table 6 with $EFF_{it-1}\Delta R_{t-1}$ added. All models are free from evident misspecification, except for Specific 1, where the Sargan test indicates invalid instruments at the 5% level, if not the 1% level (the more appropriate Hansen test cannot reject the validity of instruments). In addition, the restrictions imposed to obtain the specific models from their corresponding general counterparts cannot be rejected. Further, all models have significant explanatory power according to the Wald test except for the general specification using the cost measure of efficiency – this apparent insignificance is likely related to too many variables featuring in the general model and highlights the need to use parsimonious specifications for inference.

All three specific models include $EFF_{it-1}\Delta R_{t-1}$ as a significant variable with a negatively signed coefficient. This negative coefficient is inconsistent with a theoretically plausible efficiency effect working through the BLC. Further, two of these specific models include an insignificant covariate, $GGDP_{t-1}$, suggesting the model can be improved by further model reduction while the other specific regression has some evidence of invalid instruments. Overall, we do not favour any of the specific models reported in Table 8 and suggest that the specific regression presented in Table 6 is the least unsatisfactory of those estimated using the Arellano and Bond method. This implies that there is no significant impact of efficiency on the growth of bank loans.

The motivation for using the Arellano and Bond estimation method is the dynamic specification in terms of including a lagged dependent variable. However, the results in Table 6 indicate that the lagged dependent variable is unambiguously insignificant (in all models). This

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interacted terms are the most likely efficiency (bank-characterstic) variables to be significant the exclusion of three-way interaction terms should not cause any omitted variable bias.

suggests that it can be excluded from the model.[19] In this case it is not necessary to employ the Arellano and Bond estimator and the standard fixed-effects (FE) estimator may be employed.

Table 9 reports the first seven models from Table 6 (excluding the lagged dependent variable) re-estimated using cross-sectional fixed effects.[20] Table 13 reports a general model (including all variables considered) and a parsimonious model (obtained using the general-to-specific method) estimated using cross-sectional fixed effects – these models are indicated with the column headings General and Specific(FE), respectively. The probability value of a t-test for the addition of a first-order autoregressive term to each model {denoted p[AR(1)]} indicates no significant autocorrelation, confirming that there is no need for a dynamic specification and suggests that all models are free from evident misspecification. However, the model that includes just liquidity based variables (see the column headed liq) and the model with size and liquidity variables (see the column headed size, liq) are not valid simplifications of the general model in the sense that the restrictions placed on the latter to obtain the former are rejected – see p(F, restrict). All other models are valid simplifications of the general model. Further, all models feature significant explanatory power [p(F,R^2=0) denotes the probability value of the F-test for the null R^2=0] and many of the variables' coefficients are individually significant according to t-tests (based on White's heteroscedasticity corrected standard errors).[21] It is particularly noteworthy that the current and lagged value of the interest rate variable, ΔR_t, are negative and significant in all regressions. This provides unambiguous support for the notion that bank loans are directly affected by monetary policy through the money lending channel and is in contrast with the results obtained using the GMM estimation method. Another unambiguous finding is that neither the cost nor the profit based efficiency measures have a significant impact on bank loans in any model, which is consistent with the results from Table 6.

[19] Using the difference of the log-level of loans as the dependent variable implies that the log-level of loans is related to its lagged value. Hence, while there are no evident dynamics in the growth of loans dynamics are implicit in the log-levels.

[20] We cannot add time period fixed-effects because macroeconomic variables (ΔR_t, $GGDP_t$ and INF_t) only exhibit variation through time and not across the banks and so would be perfectly collinear with any period effects.

[21] Since our tests indicate no evidence of autocorrelation we do not correct our coefficient standard errors for autocorrelation.

The parsimonious model based on the FE estimator is reported in the column headed Specific(FE) in Table 13.[22] In addition to clearly supporting a direct negative impact of interest rates on loans through the money lending channel this model also suggests an indirect effect through the three-way interaction term of ΔR_t with lagged liquidity and lagged capital. This three-way interaction is significant and has the expected positive sign. This parsimonious model also suggests that the lagged value of capital has the expected positive (and significant) influence on bank loans. All other variables except the intercept are not statistically significant.

In Table 10 and 14 we report the probability values of t-tests for the addition of non-interacted and two- and three-way interacted efficiency variables (using both cost and profit measures) to the models given in Table 9 and 13. For only 12 out of the 126 tests (10%) reported in Table 10 can the efficiency variables be added with statistical significance at the 5% level. However, the significance of these efficiency covariates may be due to omitted variable bias because each model excludes some bank-characteristic variables. Arguably the variable addition tests applied to the models based upon the general-to-specific model reduction method will be more informative because they should not be subject to any omitted variable bias. Such tests are reported in Table 14 and show that none of the efficiency variables can be added to the general or specific models that are estimated by fixed-effects. Hence, these results indicate that there are no evidently significant efficiency effects.

However, it is important to notice that the F-test for the exclusion of the fixed-effects [the probability value is denoted by p(F, FE)] suggests that the fixed-effects are redundant in all regressions reported in Table 9 and 13. Hence, these fixed-effects should be excluded because it is inefficient to include them when they are insignificant. This may seem surprising because one would expect heterogeneity between banks. However, it should be remembered that the dependent variable is the difference of the natural logarithm of bank loans and that differencing is a standard method for eliminating fixed-effects from a model (this is the method that the Arellano and Bond estimation technique employs).[23] Thus, the difference specification of our model suggests that we can apply the pooled OLS estimation method.[24]

[22] This parsimonious model has the lowest value of the Schwartz Information Criterion (SIC) out of those estimated by FE, which confirms its status as the favoured FE specification.
[23] One might wonder why we have not applied a specification in log-levels (without the differencing). The reason is

Table 11 reports the same seven specifications given in Table 9 re-estimated using pooled OLS. Table 13 reports a general model (including all variables considered) and a parsimonious model (obtained using the general-to-specific method) estimated using pooled OLS - these models are indicated with the column headings General and Specific(OLS), respectively. According to p[AR(1)] there is no significant autocorrelation in any model, which suggests all models are free from evident misspecification and confirms that there is no need for a dynamic specification. All models are valid simplifications of the general model except for the one including both size and liquidity variables (reported in the column headed size, liq) – see p(F, restrict). All models exhibit significant explanatory power according to p(F,R^2=0) and many of the variables' coefficients are individually significant according to t-tests (based on White's heteroscedasticity corrected standard errors). As for the models reported in Table 9, both the current and lagged value of the interest rate variable, ΔR_t, are negative and significant in all regressions reported in Table 11. This provides unambiguous support for the notion that bank loans are directly affected by monetary policy through the money lending channel and is consistent with the inference obtained from the FE estimation method but contrasts with the results found using GMM. Consistent with the results reported in both Table 6 and Table 9 we find that neither the cost nor the profit based efficiency measures have a significant impact on bank loans.

The parsimonious model based on the pooled OLS estimator is the model that we favour for inference and is reported in the column headed Specific(OLS) in Table 13.[25] In addition to clearly supporting a direct negative impact of interest rates on loans through the money lending channel this model also suggests an indirect effect through the three-way interaction

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to deal with nonstationarity. Variables such as GDP and prices (as well as bank loans) are intrinsically nonstationary in growing and inflationary economies such as Turkey. Hence, one needs differencing (or to use growth rates) to induce stationarity and so avoid the spurious regression phenomenon which can occur when the dependent variable is nonstationary and the regressors are either stationary or nonstationary – see, for examples, Stewart (2006) and Ventosa-Santaularia (2009).

[24] Whilst there may be cross-sectional heterogeneity in the log-levels of bank loans there does not appear to be significant heterogeneity across banks for the differenced log-levels of bank loans.

[25] This parsimonious model has the lowest value of the Akaike Information Criterion (AIC) out of the models estimated by both pooled OLS and FE. Although it does not exhibit the smallest SIC the lagged GDP variable is statistically significant and its inclusion is expected theoretically. On balance, we choose it as the favoured specification, although the model estimated by pooled OLS and excluding $GGDP_{t-1}$, reported as Specific(FE) in Table 13, yields qualitatively the same inference in terms of the lending channel (which is our primary interest).

term of ΔR_t with lagged liquidity and lagged capital. This three-way interaction is significant and has the expected positive sign. This parsimonious model suggests that the lagged value of capital has the expected positive influence on bank loans (and is significant). The lagged value of GDP is also significant and its coefficient has a plausible positive sign. All other variables except the intercept are not statistically significant. The inclusion of lagged GDP in the model estimated by pooled OLS is the only substantive difference from the parsimonious model chosen based on FE estimation. We suggest that this is due to the increased efficiency secured by excluding the redundant (in our application) fixed-effects.[26]

In Table 12 and 14 we report the probability values of t-tests for the addition of non-interacted and two- and three-way interacted efficiency variables (using both cost and profit measures) to the models given in Table 11 and 13. For only 12 out of the 126 tests (10%) reported in Table 12 can the efficiency variables be added with statistical significance at the 5% level. However, the significance of these efficiency covariates may be due to omitted variable bias because each model excludes some bank-characteristic variables. Arguably the variable addition tests applied to the models based upon the general-to-specific model reduction method will be more informative because they should not be subject to any omitted variable bias. Such tests are reported in Table 14 and show that none of the efficiency variables can be added to the general or specific models that are estimated by pooled-OLS. Hence, these results indicate that there are no evidently significant efficiency effects.

The static long-run solutions implied by the parsimonious dynamic models obtained by the three estimation methods that we consider are reported in Table 15.[27] In the long-run model based on GMM estimation bank loans are not directly influenced by monetary policy through the monetary lending channel because the ΔR_t variable is excluded. This contrasts with the models estimated by FE and OLS where the coefficient on ΔR_t is significant and has a negative coefficient that is consistent with the existence of a monetary lending channel. From

[26] In Table 13 we report the parsimonious model estimated by FE with lagged GDP added in the column headed Specific(OLS). This variable is insignificant at the 5% level which contrasts with its significance in the parsimonious model estimated by pooled OLS. This change in significance between different estimation methods is consistent with efficiency effects.

[27] Approximate coefficient standard errors of the long-run coefficients that are used to construct t-ratios are calculated using the method discussed in De Boef and Keele (2008).

the favoured model estimated by OLS we find that an increase in the change in interest rate by one percentage point causes the growth of loans to fall by around 1.3 percentage points (which seems to be of a reasonable order of magnitude). This suggests that loans are quite responsive to direct monetary policy in Turkey. Regarding indirect monetary policy effects in the long-run we find that the liquidity multiplied by ΔR_t interaction term is significant but features an implausible negative sign in the model estimated by GMM. In contrast, both the models estimated by FE and OLS indicate that the product of capital, liquidity and ΔR_t is significant and has an expected positive coefficient. Given that we base our inference on the model estimated by OLS we conclude that monetary policy has an indirect effect on bank loans through the bank lending channel.

Although bank size features in the GMM specification it exhibits an unexpected sign and is statistically insignificant. Given that this variable does not feature in the models estimated by FE and OLS we conclude that size is not a significant long-run determinant of bank loan growth. Indeed, capital is the only bank-specific variable that determines bank loans in the long-run given that it is significant in the models estimated by OLS and FE (if not GMM). This variable's coefficient has the anticipated positive sign. GDP growth is significant and features the expected positive sign in the models estimated by OLS and GMM, if not the one estimated by FE. We argue that the insignificance of this variable in the FE model is due to its inefficiency and conclude that GDP growth is a significant determinant of the growth of bank loans in the long-run.

To the extent that we can test for selection bias (following the procedure adopted in MS p. 327) we find that the dummy variables D_1, D_2 and D_3 are not significant, which indicates no selection bias arising from the unbalanced panel – see Table 16.

6. Conclusion

In contrast to much of the previous literature we find that it is not necessary to use the Arellano and Bond procedure to estimate a model of Turkish bank loan growth because the lagged dependent variable is never found to be significant. We note that in some applications of GMM to such models, for example Gambacorta (2005) and Olivero *et al* (2011), the lagged dependent variable is not reported, hence, it is not obvious that this variable is required as a regressor in their application. Similarly, the lagged dependent variable is not significant in 19 out of the 42 (45%) regressions (for 6 countries) reported by Matousek and Sarantis (2009). Hence, the use of GMM may not be warranted in many instances in the literature.[28] Indeed, we find no need to account for bank-specific fixed-effects and favour inference from the basic pooled OLS estimator. We argue that neither a dynamic specification nor fixed-effects are required because our model involves differenced variables (in line with the existing literature) that are used to help induce stationarity and avoid spurious inference – differencing embodies dynamics and removes fixed-effects in the log-level of bank loans. Our results suggest that determining which estimation method is most appropriate is crucially important because it has a substantial impact upon inference. For example, including unnecessary dynamics by using the Arellano and Bond GMM method would indicate that monetary policy has no direct impact upon bank loans through interest rates while applying the inefficient fixed-effects estimator would indicate that GDP growth is not significantly related to loans. Hence, we suggest that it is important that authors report and check whether the lagged dependent variable is significant when applying the Arellano and Bond estimation procedure and test whether fixed-effects are required when using the fixed-effects method.

Our favoured model, estimated by pooled OLS, suggests that, in the long-run, the growth in bank loans is related to monetary policy directly through the money lending channel

[28] Indeed, Goddard and Wilson (2009), within the context of the Rosse-Panzar test for the degree of competitiveness, note the while FE coefficient estimates are severely biased when the lagged dependent variable's coefficient in the data generation process (DGP) is non-zero, they are unbiased when the lagged dependent variable does not appear in the DGP. Bikker et al (2012) in their investigation of bank competitiveness in international countries also find little evidence of a significant lagged dependent variable when using the Arellano and Bond method in their empirical analysis and consequently prefer inference from the fixed-effects estimator.

(via interest rates) and indirectly (when liquidity and capital are interacted with interest rates) via the bank lending channel. Further, both capital and GDP growth have plausible positive and significant long-run effects on bank loan growth, whereas inflation, size and, in particular, efficiency do not have a significant equilibrium relationship with loan growth.

Despite our finding that efficiency does not affect the growth of loans we do find unambiguous evidence that both the cost and profit measures of efficiency for all banks in our sample increased over the period 1991 – 2007. This is consistent with the notion that the liberalisation and restructuring processes in the early 1990s and 2001 has had the expected effect on the Turkish banking system in terms of improved performance. Our results contrast with finding of a decline in Turkish banking efficiency after the liberalisation and restructuring process reported by Ozkan-Gunay and Tektas (2008) and Demir *et al* (2007), among others. However, we also obtain the unexpected finding that domestic banks are, on average, more efficient than foreign banks, which is inconsistent with the work of Isik and Hassan (2002), Mercan and Yolalan, (2000) and De Haas and Van Lelyveld (2006)].

Table 1: Turkish Banking Sector- Basic Market Structure Indicators

	1980	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007
Number of Banks	43	66	68	81	79	61	54	50	48	47	46	46
Deposit Banks	40	56	55	62	61	46	40	36	35	34	33	33
State-owned	12	8	5	4	4	3	3	3	3	3	3	3
Private	24	25	32	31	28	22	20	18	18	17	14	11
Foreign	4	23	18	19	18	15	15	13	13	13	15	18
SDIF Banks (1)	-	-	-	8	11	6	2	2	1	1	1	1
Dev. & Inv. Banks	3	10	13	19	18	15	14	14	13	13	13	13
Num. of Branches (2)	5,954	6,560	6,240	7,691	7,837	6,908	6,106	5,966	6,106	6,247	6,849	7,618
Employment (1,000 pers.)	125.3	154.1	144.8	174.0	170.4	137.5	123.3	123.2	127.2	132.3	143.1	158.5
Asset Concentr'n (CR, %)												
CR-5	63	54	48	46	48	56	58	60	60	63	63	62
CR-10	82	75	71	68	69	80	81	82	84	85	86	85
Asset Shares (%)												
Deposit Banks	91	91	93	95	96	95	96	96	96	97	97	97
State-owned	44	45	38	35	34	32	32	33	35	31	30	29
Private	44	43	52	49	47	56	56	57	57	60	55	52
Foreign	3	3	3	5	5	3	3	3	3	5	12	15
SDIF Banks (1)	-	-	-	6	8	4	4	3	1	0	0	0
Dev. & Inv. Banks	9	9	7	5	4	5	4	4	4	3	3	3

Table 1 notes:

1) Banks taken-over by the Savings Deposit Insurance Fund.

2) Including foreign branches.

Source: BAT, Banks in Turkey (various yearly issues).

Table 2: Turkish Banking Sector- Selected Financial Indicators/Ratios

	1980	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007
Volumes (USD, Billion)												
Assets	18.6	58.2	68.9	133.5	154.9	115	129.7	179.2	229.3	295.8	344.9	484.0
Loans	10.0	27.3	29.3	40.2	50.9	28.3	34.4	50.2	77.3	114.1	155.1	241.9
Deposits	9.1	32.6	44.8	89.4	101.9	81.0	86.8	115.4	147.7	189.0	222.6	307.9
Net Profits	0.3	1.3	1.8	-0.6	-4.7	-3.6	1.4	4.0	4.8	4.3	7.8	12.4
Own Funds	0.8	4.5	4.2	3.6	7.5	6.7	15.7	25.5	34.4	40.0	41.2	63.4
Fx Position (1)	-	-1.8	-3.1	-13.2	-14.5	-1.6	-0.6	-0.3	-1.9	-1.8	-5.5	-10.0
Ratios to GDP (%)												
Assets	32	43	53	69	63	69	61	55	55	61	64	69
Loans	17	20	23	21	21	17	16	15	19	24	29	34
Deposits	16	24	34	46	41	49	41	35	35	39	41	42
Selected Ratios (%)												
Loans/Assets	54	47	43	30	33	25	27	28	34	39	45	50
Non-Deposit Funds/Assets	6	20	14	17	19	16	15	16	15	17	18	16
Loans/Deposits	110	84	65	45	50	35	40	44	52	60	70	79
Own Funds/Assets	4	8	6	3	5	6	11	12	13	12	10	11
Sec. Portfolio/Assets	6	10	11	17	12	10	41	43	40	36	35	31
NPL/Gross Loans	-	1	1	11	11	25	18	12	6	5	4	4
Net Profits/Assets	1.3	2.3	2.6	-0.4	-3.0	-3.1	1.1	2.2	2.1	1.4	2.3	2.6
Net Profits/Own Funds	32	29	42	-16	-62	-53	9	16	14	11	19	20
Fx Deposits/T. Deposits	-	24	55	50	46	60	58	49	45	37	38	35
CAR (2)	-	-	-	8	9	21	25	31	28	24	22	19

Table 2 notes:

1) On-balance sheet position including fx indexed assets and liabilities.

2) Capital Adequacy Ratio as regulated by the BRSA (8 percent at minimum).

Source: BAT, Banks in Turkey (various yearly issues), and the authors' own calculations. Figures are rounded.

Table 3: List of Currently Operating Banks in Turkey

Rank	Bank	Ownership as of end-2007	Established
1	Ziraat (ZIR)	State-owned	1863
2	Isbank (ISB)	Privately-owned	1924
3	Akbank (AKB)	Privately-owned	1948
4	Garanti (GAR)	Privately-owned	1946
5	Yapi Kredi (YAP)	Privately-owned	1944
6	Vakifbank (VAK)	State-owned	1954
7	Halkbank (HAL)	State-owned	1938
8	Finansbank (FIN)	Foreign	1987
9	Denizbank (DEN)	Foreign	1997
10	HSBC (HSB)	Foreign	1990
11	ING (OYA) [previously OYAK]	Foreign	1984
12	T Ekonomi Bankasi (TKO)	Privately-owned	1927
13	Fortis (DIS) [previously Disbank]	Foreign	1964
14	Sekerbank (SEK)	Privately-owned	1953
15	Citibank (CIT)	Foreign	1980
16	Anadolubank (ANA)	Privately-owned	1996
17	Tekstilbank (TKS)	Privately-owned	1986
18	Tekfenbank (BEK) [previously Bankekspres]	Foreign	1992
19	Alternatifbank (ALT)	Privately-owned	1992
20	ABN Amro (ABN)	Foreign	1921
21	West LB (WES)	Foreign	1985
22	Turkishbank (TUR)	Privately-owned	1982
23	Turkland (MNG) [previously MNG]	Foreign	1991
24	Arab-Turk (ARA)	Foreign	1977
25	Adabank (ADA)	Privately-owned	1985

Table 4.Variables Used to Estimate Cost Efficiency (Mil $US)

Variables	Loans	Securities	Off Balance	PL	PC	PF	TC
	Y_1	Y_2	Y_3	P_1	P_2	P_3	
Mean	2100.96	1695.00	8578.98	0.03	0.03	11.93	836.81
Max	32103.76	40177.23	209118.87	0.18	0.12	719.93	8822.90
Min	0.01	0.01	0.37	0.00	0.00	1.05	0.14
Std	4365.04	4553.63	23036.41	0.02	0.02	44.08	1504.76

Table 5: Average efficiency by bank type

		Cost measure of efficiency			Profit measure of efficiency		
Bank type		Average efficiency	No. banks	Obs.	Average efficiency	No. banks	Obs.
Foreign		0.920	11	178	0.856	11	178
Domestic		0.945	14	225	0.861	14	221
	Private	0.940	11	174	0.873	11	170
	State-owned	0.960	3	51	0.824	3	51

Table 5 notes: This table displays the average efficiency by type of bank using both cost and profit measures of efficiency in the columns headed “Average efficiency”. The number of banks (column headed “No. banks”) and total number of observations (Obs.) used in the calculation of average efficiency are also given. There are two main types of bank being foreign-owned (Foreign) and domestically-owned (Domestic) banks. The latter is further broken down in to two sub-categories: privately-owned banks (Private) and state-owned (State-owned) banks.

Table 6: Arellano and Bond estimates of (1), excluding efficiency variables

Model → Variable ↓	size	liq	cap	size, liq	size, cap	liq, cap	size, liq, cap Pseudo general	specific
ΔlnL_{it-1}	-0.152	-0.099	-0.057	-0.226	-0.313	-0.239	-0.382	0.009
	(-0.835)	(-1.082)	(-0.564)	(-0.534)	(-0.625)	(-1.377)	(-1.565)	(0.034)
	{0.182}	{0.092}	{0.102}	{0.424}	{0.501}	{0.174}	{0.244}	{0.256}
ΔR_t	-0.348	-0.793	-1.157	0.681	0.989	-0.961	0.641	
	(-0.296)	(-0.791)	(-1.228)	(0.466)	(0.614)	(-0.272)	(0.398)	
ΔR_{t-1}	-0.135	0.124	-0.537	0.395	0.633	0.774	0.231	
	(-0.143)	(0.243)	(-1.155)	(0.467)	(0.912)	(0.667)	(0.238)	
$GGDP_t$	2.071	1.050	-2.255	6.003	6.453	4.738	6.666	
	(0.774)	(0.416)	(-0.936)	(1.224)	(1.871)	(0.623)	(1.992)	
$GGDP_{t-1}$	1.455	3.180	0.542	5.342	1.512	1.354	3.709	4.322
	(1.361)	(1.295)	(0.461)	(1.243)	(0.358)	(0.179)	(0.936)	(2.440)
INF_t	0.492	0.032	1.035	-1.397	-0.394	-0.071	-1.019	
	(0.333)	(0.035)	(1.067)	(-0.579)	(-0.299)	(-0.017)	(-0.578)	
INF_{t-1}	-0.267	-0.573	-1.114	1.678	0.811	-0.596	1.155	
	(-0.183)	(-0.612)	(-1.168)	(0.818)	(0.670)	(-0.155)	(0.856)	
S_{it-1}	-0.649			-0.672	-0.841		-0.715	-0.905
	(-1.673)			(-1.866)	(-3.470)		(-1.074)	(-2.190)
$S_{it-1}\Delta R_t$	-0.328			-0.049	-0.550		-1.444	
	(-0.110)			(-0.034)	(-0.665)		(-0.763)	
$S_{it-1}\Delta R_{t-1}$	-0.170			0.350	0.729		-0.025	
	(-0.292)			(0.335)	(0.697)		(-0.030)	
LIQ_{it-1}		1.024		0.765		1.908	-0.221	
		(1.119)		(0.361)		(0.619)	(-0.123)	
$LIQ_{it-1}\Delta R_t$		-5.837		-4.302		4.675	-5.930	-12.674
		(-0.896)		(-0.418)		(0.212)	(-0.673)	(-3.301)
$LIQ_{it-1}\Delta R_{t-1}$		-5.327		-0.242		-10.656	-1.538	
		(-2.064)		(-0.028)		(-1.020)	(-0.121)	
CAP_{it-1}			5.205		5.674	4.718	-2.221	
			(0.806)		(0.639)	(0.269)	(-0.394)	
$CAP_{it-1}\Delta R_t$			20.333		0.244	-15.367	-30.809	
			(1.343)		(0.006)	(-0.269)	(-1.672)	
$CAP_{it-1}\Delta R_{t-1}$			2.721		19.393	10.117	3.717	
			(0.247)		(2.430)	(0.371)	(0.366)	
$S_{it-1}LIQ_{it-1}\Delta R_t$				-1.672				
				(-0.237)				
$S_{it-1}LIQ_{it-1}\Delta R_{t-1}$				-2.846				
				(-0.571)				
$S_{it-1}CAP_{it-1}\Delta R_t$					11.179			
					(0.658)			
$S_{it-1}CAP_{it-1}\Delta R_{t-1}$					14.068			
					(1.341)			
$LIQ_{it-1}CAP_{it-1}\Delta R_t$						6.264		
						(0.075)		
$LIQ_{it-1}CAP_{it-1}\Delta R_{t-1}$						-63.690		
						(-0.160)		
Intercept	0.268	0.363	0.486	-0.098	0.028	0.448	-0.086	0.205
	(0.621)	(1.534)	(2.915)	(-0.127)	(0.052)	(0.518)	(-0.152)	(0.481)
p[AR(2)]	0.917	0.147	0.600	0.913	0.870	0.790	0.619	0.245
p(Hansen)	0.682	0.312	0.234	0.838	0.962	0.697	0.853	0.173
p(Sargan)	0.993	**0.000**	0.095	0.985	0.989	0.682	0.951	0.228
p(Wald)	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p(restrict)	0.060	**0.000**	**0.005**	NA	NA	NA	NA	0.084
Number of observations	257	257	257	257	257	257	257	257
Number of instruments	22	22	22	22	22	22	22	22

Table 6 notes: The dependent variable is the difference of the natural logarithm of loans, ΔlnL_{it}. Coefficients for the regressors are reported with t-ratios based upon Windmeijer corrected standard errors given in parentheses and figures in braces, {}, are coefficient standard errors (these are only reported for the lagged dependent variable). All models are estimated using the same 22 instruments being the collapsed GMM-style instruments of the dependent variable lagged two periods and higher and the following IV-style instruments: ΔR_t, ΔR_{t-1}, $GGDP_t$, $GGDP_{t-1}$, INF_t and INF_{t-1}. Probability values for the following tests are also reported. Second-order autocorrelation, p[AR(2)], the Hansen test for over-identification restrictions, p(Hansen), the Sargan test for over-identification restrictions, p(Sargan), a Wald test testing the joint significance of the slope coefficients, p(Wald) and a joint test of the exclusion restrictions required to obtain the specific model from the pseudo-general specification, p(restrict). All estimation results were produced using STATA 11.

Table 7: Tests of the addition of efficiency variables to the models reported in Table 6

Model → Variables added ↓	size	liq	cap	size, liq	size, cap	liq, cap	size, liq, cap Pseudo general	specific
Cost measure of efficiency								
p[EFF_{it-1}]	0.493	0.495	0.147	0.902	0.394	0.287	0.348	0.971
p[$EFF_{it-1}\Delta R_t$]	0.982	0.878	0.196	0.897	0.572	0.812	0.871	0.277
p[$EFF_{it-1}\Delta R_{t-1}$]	0.998	0.988	0.828	0.632	0.722	0.799	0.711	**0.027**
p[$EFF_{it-1}\Delta R_t S_{it-1}$]	0.637	0.097	0.315	0.894	0.798	0.303	0.358	0.347
p[$EFF_{it-1}\Delta R_{t-1} S_{it-1}$]	0.708	0.845	0.796	0.702	0.929	0.633	0.516	0.422
p[$EFF_{it-1}\Delta R_t LIQ_{it-1}$]	0.917	0.555	0.459	0.832	0.768	0.740	0.565	0.987
p[$EFF_{it-1}\Delta R_{t-1} LIQ_{it-1}$]	0.753	0.440	**0.009**	0.782	0.919	0.610	0.510	0.247
p[$EFF_{it-1}\Delta R_t CAP_{it-1}$]	0.256	0.137	0.585	0.429	0.985	0.587	0.541	0.295
p[$EFF_{it-1}\Delta R_{t-1} CAP_{it-1}$]	0.282	0.935	0.892	0.358	0.906	0.826	0.543	0.745
Profit measure of efficiency								
p[EFF_{it-1}]	0.708	0.100	0.164	0.828	0.693	0.464	0.743	0.855
p[$EFF_{it-1}\Delta R_t$]	0.890	0.419	0.189	0.929	0.636	0.805	0.702	0.336
p[$EFF_{it-1}\Delta R_{t-1}$]	0.294	0.493	0.812	0.363	0.659	0.919	0.675	**0.031**
p[$EFF_{it-1}\Delta R_t S_{it-1}$]	0.911	0.124	0.273	0.886	0.926	0.235	0.775	0.288
p[$EFF_{it-1}\Delta R_{t-1} S_{it-1}$]	0.518	0.864	0.844	0.969	0.939	0.629	0.999	0.360
p[$EFF_{it-1}\Delta R_t LIQ_{it-1}$]	0.866	0.374	0.608	0.808	0.713	0.519	0.987	0.493
p[$EFF_{it-1}\Delta R_{t-1} LIQ_{it-1}$]	0.877	0.956	**0.013**	0.354	0.971	0.947	0.972	0.307
p[$EFF_{it-1}\Delta R_t CAP_{it-1}$]	0.230	0.218	**0.009**	0.362	0.686	0.486	0.823	0.375
p[$EFF_{it-1}\Delta R_{t-1} CAP_{it-1}$]	0.330	0.836	0.874	0.532	0.672	0.410	0.655	0.404

Table 7 notes: This table reports the probability values for individual t-tests for the addition of lagged efficiency variables, EFF_{it-1}, based on cost and profit measures both non-interacted and interacted with various combinations of the change in interest rates and bank-specific characteristics to the models estimated in Table 6. The results are obtained using the Arellano and Bond two-step system estimator with Windmeijer corrected coefficient standard errors implemented in STATA 11.

Table 8: Arellano and Bond estimates of (1), including efficiency variables

	Cost efficiency measure			Profit efficiency measure	
Model → Variable ↓	General	Specific 1	Specific 2	General	Specific
ΔlnL_{it-1}	-0.482 (-0.228) {2.111}	-0.035 (-0.176) {0.197}	-0.023 (-0.091) {0.253}	-0.501 (-0.513) {0.977}	-0.030 (-0.113) {0.270}
ΔR_t	-5.372 (-0.015)			0.558 (0.025)	
ΔR_{t-1}	-31.348 (-0.087)			4.302 (0.138)	
$GGDP_t$	7.103 (0.220)	3.200 (1.971)		7.654 (0.797)	
$GGDP_{t-1}$	2.118 (0.055)		2.841 (1.434)	1.745 (0.099)	2.811 (1.430)
INF_t	-0.219 (-0.017)			-0.380 (-0.078)	
INF_{t-1}	0.708 (0.082)			0.779 (0.273)	
S_{it-1}	-0.664 (-0.121)	-0.965 (-2.734)	-0.937 (-2.491)	-0.495 (-0.269)	-0.926 (-2.547)
$S_{it-1}\Delta R_t$	-3.029 (-0.619)			-2.479 (-0.355)	
$S_{it-1}\Delta R_{t-1}$	-1.455 (-0.159)			-0.705 (-0.096)	
LIQ_{it-1}	-0.019 (-0.001)			-0.33 (-0.123)	
$LIQ_{it-1}\Delta R_t$	-7.864 (-0.086)	-7.268 (-2.408)	-14.422 (-2.677)	-0.848 (-0.054)	-14.564 (-2.895)
$LIQ_{it-1}\Delta R_{t-1}$	1.308 (0.006)			-11.426 (-0.152)	
CAP_{it-1}	3.099 (0.034)			1.130 (0.134)	
$CAP_{it-1}\Delta R_t$	-45.999 (-0.234)			-28.943 (-0.287)	
$CAP_{it-1}\Delta R_{t-1}$	15.907 (0.096)			11.262 (0.778)	
EFF_{it-1}	10.854 (0.065)			1.450 (0.423)	
$EFF_{it-1}\Delta R_t$	6.393 (0.016)			-0.204 (-0.007)	
$EFF_{it-1}\Delta R_{t-1}$	33.492 (0.092)	-0.435 (-2.161)	-0.572 (-2.213)	-4.535 (-0.141)	-0.699 (-2.152)
Intercept	-10.502 (-0.066)	0.475 (1.027)	0.324 (0.755)	-1.430 (-0.453)	0.317 (0.740)
p[AR(2)]	0.949	0.541	0.157	0.973	0.204
p(Hansen)	0.942	0.440	0.193	0.469	0.197
p(Sargan)	0.992	**0.048**	0.466	0.533	0.474
p(Wald)	0.110	0.000	0.000	0.000	0.000
p(restrict)	NA	0.985	0.999	NA	0.186
Number of observations	257	257	257	257	257
Number of instruments	22	22	22	22	22

Table 8 notes: see notes to Table 6.

Table 9: Fixed-effects estimates of (1), excluding efficiency variables

Model → Variable ↓	size	liq	cap	size, liq	size, cap	liq, cap	size, liq, cap
ΔR_t	-1.923 (-4.721)	-1.872 (-5.778)	-1.691 (-4.644)	-1.938 (-4.956)	-1.790 (-4.937)	-1.813 (-4.467)	-1.885 (-4.565)
ΔR_{t-1}	-0.670 (-3.505)	-0.592 (-4.138)	-0.610 (-3.543)	-0.627 (-3.948)	-0.623 (-3.253)	-0.568 (-3.367)	-0.587 (-3.414)
$GGDP_t$	-1.355 (-1.062)	-1.431 (-1.372)	-1.163 (-1.002)	-1.527 (-1.214)	-1.462 (-1.211)	-1.759 (-1.427)	-1.609 (-1.204)
$GGDP_{t-1}$	1.074 (2.199)	1.519 (3.695)	0.905 (1.691)	1.368 (2.731)	0.896 (1.746)	1.488 (2.928)	1.304 (2.738)
INF_t	1.205 (2.336)	1.121 (2.520)	1.069 (2.192)	1.204 (2.474)	1.173 (2.430)	1.226 (2.303)	1.193 (2.259)
INF_{t-1}	-1.412 (-2.671)	-1.350 (-3.055)	-1.174 (-2.492)	-1.469 (-2.860)	-1.321 (-2.738)	-1.439 (-2.728)	-1.420 (-2.662)
S_{it-1}	-0.145 (-2.327)			-0.134 (-1.986)	-0.083 (-1.227)		-0.072 (-1.125)
$S_{it-1}\Delta R_t$	0.018 (0.272)			0.022 (0.234)	0.077 (1.185)		0.081 (1.041)
$S_{it-1}\Delta R_{t-1}$	0.006 (0.147)			-0.034 (-0.842)	0.019 (0.307)		-0.020 (-0.278)
LIQ_{it-1}		0.096 (0.353)		0.112 (0.400)		0.424 (1.546)	0.326 (1.156)
$LIQ_{it-1}\Delta R_t$		-0.890 (-2.215)		-0.979 (-1.980)		0.148 (0.275)	0.112 (0.217)
$LIQ_{it-1}\Delta R_{t-1}$		-0.871 (-1.642)		-0.754 (-1.380)		-0.443 (-0.722)	-0.628 (-1.010)
CAP_{it-1}			1.649 (2.401)		1.360 (2.118)	1.931 (2.848)	1.549 (2.320)
$CAP_{it-1}\Delta R_t$			2.913 (1.752)		3.499 (2.736)	3.201 (2.459)	3.832 (2.905)
$CAP_{it-1}\Delta R_{t-1}$			0.611 (0.472)		1.294 (1.042)	1.555 (1.796)	0.571 (0.303)
$S_{it-1}LIQ_{it-1}\Delta R_t$				-0.455 (-0.664)			
$S_{it-1}LIQ_{it-1}\Delta R_{t-1}$				0.125 (0.492)			
$S_{it-1}CAP_{it-1}\Delta R_t$					0.196 (0.218)		
$S_{it-1}CAP_{it-1}\Delta R_{t-1}$					0.403 (0.532)		
$LIQ_{it-1}CAP_{it-1}\Delta R_t$						29.072 (3.438)	
$LIQ_{it-1}CAP_{it-1}\Delta R_{t-1}$						11.627 (1.179)	
Intercept	0.343 (3.013)	0.341 (3.373)	0.298 (2.678)	0.376 (3.110)	0.341 (2.806)	0.376 (3.285)	0.379 (3.003)
$\bar{R}^2$	0.281	0.265	0.286	0.276	0.285	0.303	0.290
s	0.432	0.437	0.431	0.434	0.431	0.425	0.429
AIC	1.264	1.286	1.257	1.284	1.272	1.247	1.268
SIC	1.676	1.697	1.669	1.757	1.744	1.719	1.753
p[AR(1)]	0.536	0.227	0.278	0.419	0.386	0.233	0.268
p(F,R^2=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p(F,FE)	0.196	0.513	0.414	0.211	0.286	0.275	0.259
p(F,restrict)	0.087	**0.015**	0.141	**0.028**	0.085	0.570	0.137
Number of observations	308	308	308	308	308	308	308

Table 9 notes: The dependent variable is the difference of the natural logarithm of loans, dlloans. Coefficients for the regressors are reported with t-ratios based upon White's heteroscedasticity corrected standard errors given in parentheses. $\bar{R}^2$ denotes the adjusted coefficient of determination, s is the regression standard error, AIC gives Akaike's information criterion and SIC denotes Schwart's information criterion. Probability values for the following tests are also reported. A t-test for the coefficient on a first-order autoregressive term when added to the model, p[AR(1)], an F-test testing the joint significance of the slope coefficients, p(F,R^2=0), an F-test for the joint significance of the cross-sectional fixed-effects, p(F,FE). Probability values are also reported for a joint test of the exclusion restrictions required to obtain the specific model from the general specification reported in Table 13, p(restrict). All results were produced using EViews 6.0.

Table 10: Tests of the addition of efficiency variables to the models reported in Table 9

Model → Variables added ↓	Size	Liq	Cap	Size, Liq	Size, Cap	Liq, Cap	Size, Liq, Cap
Cost measure of efficiency							
p[EFF_{it-1}]	0.389	0.576	0.622	0.293	0.345	0.387	0.266
p[$EFF_{it-1}\Delta R_t$]	0.243	0.411	0.584	0.169	0.297	0.777	0.397
p[$EFF_{it-1}\Delta R_{t-1}$]	0.603	0.983	0.773	0.853	0.891	0.913	0.978
p[$EFF_{it-1}\Delta R_t S_{it-1}$]	0.026	0.507	0.073	**0.042**	0.142	**0.033**	0.174
p[$EFF_{it-1}\Delta R_{t-1} S_{it-1}$]	0.964	0.282	0.681	0.862	0.598	0.410	0.563
p[$EFF_{it-1}\Delta R_t LIQ_{it-1}$]	0.144	0.946	0.625	0.665	0.822	0.832	0.671
p[$EFF_{it-1}\Delta R_{t-1} LIQ_{it-1}$]	0.379	0.803	0.260	0.698	0.232	0.708	0.705
p[$EFF_{it-1}\Delta R_t CAP_{it-1}$]	0.193	0.071	**0.009**	0.259	**0.016**	0.111	**0.023**
p[$EFF_{it-1}\Delta R_{t-1} CAP_{it-1}$]	0.714	0.617	**0.012**	0.570	**0.001**	**0.013**	**0.011**
Profit measure of efficiency							
p[EFF_{it-1}]	0.410	0.529	0.562	0.407	0.429	0.439	0.433
p[$EFF_{it-1}\Delta R_t$]	0.532	0.459	0.538	0.693	0.865	0.586	0.983
p[$EFF_{it-1}\Delta R_{t-1}$]	0.239	0.316	0.124	0.307	0.115	0.459	0.131
p[$EFF_{it-1}\Delta R_t S_{it-1}$]	0.094	0.937	0.389	0.064	0.149	0.320	0.158
p[$EFF_{it-1}\Delta R_{t-1} S_{it-1}$]	0.806	0.284	0.714	0.807	0.893	0.435	0.931
p[$EFF_{it-1}\Delta R_t LIQ_{it-1}$]	0.797	**0.000**	0.703	**0.000**	0.420	0.053	**0.004**
p[$EFF_{it-1}\Delta R_{t-1} LIQ_{it-1}$]	0.183	0.506	0.164	0.632	0.144	0.373	0.785
p[$EFF_{it-1}\Delta R_t CAP_{it-1}$]	0.213	0.111	0.738	0.251	0.964	0.340	0.943
p[$EFF_{it-1}\Delta R_{t-1} CAP_{it-1}$]	0.518	0.394	0.085	0.430	0.118	0.288	0.140

Table 10 notes: This table reports the probability values for individual t-tests for the addition of lagged efficiency variables, based on cost and profit measures both non-interacted and interacted with various combinations of the change in interest rates and bank-specific characteristics to the models estimated in Table 9. The results are obtained using the fixed-effects estimator with White heteroscedasticty corrected coefficient standard errors implemented in EViews 6. Bold emphasis indicates statistical significance at the 5% level.

Table 11: Pooled OLS estimates of (1), excluding efficiency variables

Model → Variable ↓	size	liq	cap	size, liq	size, cap	liq, cap	size, liq, cap
ΔR_t	-1.876 (-5.176)	-1.924 (-5.885)	-1.762 (-5.037)	-1.909 (-6.005)	-1.782 (-5.485)	-1.885 (-5.361)	-1.893 (-5.579)
ΔR_{t-1}	-0.627 (-3.863)	-0.596 (-4.485)	-0.615 (-3.845)	-0.591 (-5.091)	-0.598 (-3.561)	-0.602 (-4.217)	-0.579 (-4.251)
$GGDP_t$	-1.420 (-1.213)	-1.665 (-1.521)	-1.473 (-1.254)	-1.641 (-1.540)	-1.639 (-1.474)	-1.997 (-1.742)	-1.803 (-1.564)
$GGDP_{t-1}$	1.272 (2.688)	1.576 (3.419)	1.039 (1.931)	1.473 (3.159)	1.046 (1.962)	1.411 (2.797)	1.346 (2.750)
INF_t	1.093 (2.317)	1.117 (2.563)	1.060 (2.236)	1.121 (2.782)	1.091 (2.435)	1.238 (2.625)	1.144 (2.519)
INF_{t-1}	-1.312 (-2.747)	-1.379 (-3.092)	-1.235 (-2.608)	-1.380 (-3.267)	-1.273 (-2.835)	-1.475 (-3.076)	-1.376 (-2.970)
S_{it-1}	-0.020 (-1.138)			-0.017 (-0.964)	0.001 (0.032)		0.008 (0.422)
$S_{it-1}\Delta R_t$	0.003 (0.044)			0.010 (0.111)	0.074 (0.980)		0.083 (1.016)
$S_{it-1}\Delta R_{t-1}$	-0.025 (-0.486)			-0.064 (-1.261)	0.000 (0.001)		-0.033 (-0.432)
LIQ_{it-1}		0.094 (0.626)		0.023 (0.182)		0.233 (1.524)	0.199 (1.358)
$LIQ_{it-1}\Delta R_t$		-0.619 (-1.618)		-0.949 (-1.695)		0.189 (0.446)	0.192 (0.385)
$LIQ_{it-1}\Delta R_{t-1}$		-0.777 (-1.592)		-0.877 (-1.633)		-0.374 (-0.735)	-0.697 (-1.204)
CAP_{it-1}			1.207 (2.367)		1.270 (2.320)	1.335 (2.802)	1.356 (2.498)
$CAP_{it-1}\Delta R_t$			2.755 (1.822)		3.766 (3.068)	2.854 (2.431)	4.141 (2.895)
$CAP_{it-1}\Delta R_{t-1}$			0.862 (0.745)		1.510 (1.672)	1.822 (2.471)	0.838 (0.510)
$S_{it-1}LIQ_{it-1}\Delta R_t$				-0.438 (-0.740)			
$S_{it-1}LIQ_{it-1}\Delta R_{t-1}$				0.188 (0.786)			
$S_{it-1}CAP_{it-1}\Delta R_t$					0.141 (0.170)		
$S_{it-1}CAP_{it-1}\Delta R_{t-1}$					0.396 (0.463)		
$LIQ_{it-1}CAP_{it-1}\Delta R_t$						25.727 (5.154)	
$LIQ_{it-1}CAP_{it-1}\Delta R_{t-1}$						7.061 (0.881)	
Intercept	0.338 (3.438)	0.366 (3.776)	0.341 (3.226)	0.368 (3.767)	0.357 (3.333)	0.396 (3.790)	0.384 (3.654)
$\bar{R}^2$	0.266	0.267	0.283	0.262	0.276	0.293	0.279
s	0.437	0.436	0.431	0.438	0.434	0.428	0.433
AIC	1.212	1.211	1.188	1.233	1.214	1.189	1.213
SIC	1.333	1.332	1.309	1.415	1.396	1.371	1.407
p[AR(1)]	0.822	0.714	0.744	0.771	0.755	0.777	0.659
p(F,R^2=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p(F,restrict)	0.093	0.102	0.456	**0.033**	0.196	0.908	0.270
N	308	308	308	308	308	308	308

Table 11 notes: The dependent variable is the difference of the natural logarithm of loans, dlloans. Coefficients for the regressors are reported with t-ratios based upon White's corrected standard errors given in parentheses. $\bar{R}^2$ denotes the adjusted coefficient of determination, s is the regression standard error, AIC gives Akaike's information criterion and SIC denotes Schwart's information criterion. Probability values for the following tests are also reported. A t-test for the coefficient on a first-order autoregressive term when added to the model, p[AR(1)], an F-test testing the joint significance of the slope coefficients, p(F,R^2=0) and a joint test of the exclusion restrictions required to obtain the specific model from the general specification reported in Table 13, p(restrict). All results were produced using EViews 6.0.

Table 12: Tests of the addition of efficiency variables to the models reported in Table 11

Model → Variables added ↓	Size	Liq	Cap	Size, Liq	Size, Cap	Liq, Cap	Size, Liq, Cap
Cost measure of efficiency							
p[EFF_{it-1}]	0.119	0.388	0.271	0.141	0.174	0.316	0.168
p[$EFF_{it-1}\Delta R_t$]	0.394	0.380	0.448	0.271	0.250	0.660	0.387
p[$EFF_{it-1}\Delta R_{t-1}$]	0.854	0.806	0.957	0.947	0.845	0.603	0.686
p[$EFF_{it-1}\Delta R_t S_{it-1}$]	**0.018**	0.475	0.115	0.068	**0.047**	0.156	0.093
p[$EFF_{it-1}\Delta R_{t-1} S_{it-1}$]	0.939	0.246	0.568	0.821	0.467	0.346	0.459
p[$EFF_{it-1}\Delta R_t LIQ_{it-1}$]	0.217	0.804	0.902	0.828	0.465	0.728	0.801
p[$EFF_{it-1}\Delta R_{t-1} LIQ_{it-1}$]	0.177	0.998	0.161	0.996	0.093	0.959	0.965
p[$EFF_{it-1}\Delta R_t CAP_{it-1}$]	0.135	0.152	**0.000**	0.186	**0.003**	0.073	**0.011**
p[$EFF_{it-1}\Delta R_{t-1} CAP_{it-1}$]	0.526	0.833	**0.001**	0.375	**0.000**	0.003	**0.007**
Profit measure of efficiency							
p[EFF_{it-1}]	0.600	0.716	0.986	0.657	0.975	0.967	0.999
p[$EFF_{it-1}\Delta R_t$]	0.337	0.382	0.527	0.487	0.842	0.563	0.977
p[$EFF_{it-1}\Delta R_{t-1}$]	0.118	0.233	0.126	0.199	0.117	0.395	0.143
p[$EFF_{it-1}\Delta R_t S_{it-1}$]	0.039	0.941	0.488	**0.017**	0.093	0.534	0.090
p[$EFF_{it-1}\Delta R_{t-1} S_{it-1}$]	0.884	0.241	0.586	0.854	0.695	0.365	0.633
p[$EFF_{it-1}\Delta R_t LIQ_{it-1}$]	0.828	**0.001**	0.548	**0.003**	0.277	0.052	**0.015**
p[$EFF_{it-1}\Delta R_{t-1} LIQ_{it-1}$]	0.089	0.256	0.100	0.377	0.075	0.203	0.589
p[$EFF_{it-1}\Delta R_t CAP_{it-1}$]	0.105	0.079	0.517	0.135	0.614	0.149	0.549
p[$EFF_{it-1}\Delta R_{t-1} CAP_{it-1}$]	0.317	0.444	0.058	0.240	0.053	0.261	0.131

Table 12 notes: This table reports the probability values for individual t-tests for the addition of lagged efficiency variables, based on cost and profit measures both non-interacted and interacted with various combinations of the change in interest rates and bank-specific characteristics to the models estimated in Table 11. The results are obtained using the pooled OLS estimators with White heteroscedasticty corrected coefficient standard errors implemented in EViews 6. Bold emphasis indicates statistical significance at the 5% level.

Table 13: Pooled OLS and Fixed-effects estimates for general-to-specific modelling, excluding efficiency

Estimation method →	Fixed-effects			Pooled OLS		
Model → Variable ↓	General	Specific(FE)	Specific(OLS)	General	Specific(FE)	Specific(OLS)
ΔR_t	-1.921 (-4.337)	-0.863 (-9.597)	-0.972 (-10.495)	-1.923 (-5.292)	-0.896 (-9.555)	-1.025 (-11.010)
ΔR_{t-1}	-0.540 (-2.834)	-0.401 (-7.025)	-0.315 (-3.938)	-0.550 (-3.379)	-0.420 (-7.260)	-0.312 (-4.200)
$GGDP_t$	-1.975 (-1.417)			-2.106 (-1.716)		
$GGDP_{t-1}$	1.436 (2.596)		1.370 (1.792)	1.424 (2.562)		1.673 (2.092)
INF_t	1.332 (2.324)			1.264 (2.542)		
INF_{t-1}	-1.575 (-2.683)			-1.503 (-2.901)		
S_{it-1}	-0.081 (-1.219)			0.006 (0.311)		
$S_{it-1}\Delta R_t$	0.098 (1.421)			0.093 (1.172)		
$S_{it-1}\Delta R_{t-1}$	-0.001 (-0.010)			-0.015 (-0.286)		
LIQ_{it-1}	0.452 (1.688)			0.274 (1.631)		
$LIQ_{it-1}\Delta R_t$	0.794 (1.071)			0.711 (0.961)		
$LIQ_{it-1}\Delta R_{t-1}$	-0.101 (-0.145)			-0.256 (-0.379)		
CAP_{it-1}	1.676 (2.585)	1.862 (3.249)	1.678 (2.863)	1.471 (2.703)	1.437 (3.503)	1.285 (2.933)
$CAP_{it-1}\Delta R_t$	4.461 (1.728)			4.415 (1.898)		
$CAP_{it-1}\Delta R_{t-1}$	2.083 (1.115)			2.279 (1.323)		
$S_{it-1}LIQ_{it-1}\Delta R_t$	0.113 (0.176)			0.086 (0.132)		
$S_{it-1}LIQ_{it-1}\Delta R_{t-1}$	0.440 (1.536)			0.343 (1.168)		
$S_{it-1}CAP_{it-1}\Delta R_t$	0.082 (0.054)			-0.029 (-0.021)		
$S_{it-1}CAP_{it-1}\Delta R_{t-1}$	0.493 (0.489)			0.324 (0.296)		
$LIQ_{it-1}CAP_{it-1}\Delta R_t$	30.475 (3.995)	23.671 (4.639)	23.105 (4.504)	26.195 (4.074)	21.857 (6.062)	21.080 (5.840)
$LIQ_{it-1}CAP_{it-1}\Delta R_{t-1}$	22.120 (2.417)			14.106 (1.721)		
Intercept	0.404 (2.991)	0.221 (6.642)	0.154 (3.651)	0.403 (3.393)	0.217 (6.471)	0.135 (2.967)
$\bar{R}^2$	0.299	0.291	0.294	0.283	0.282	0.288
s	0.426	0.429	0.428	0.431	0.432	0.430
AIC	1.270	1.235	1.233	1.225	1.174	1.169
SIC	1.827	1.586	1.597	1.492	1.234	1.241
p[AR(1)]	0.065	0.392	0.374	0.622	0.890	0.859
p(F,R^2=0)	0.000	0.000	0.000	0.000	0.000	0.000
p(F,FE)	0.176	0.288	0.337	NA	NA	NA
p(F,restrict)	NA	0.260	0.194	NA	0.440	0.615
N	308	308	308	308	308	308

Table 13 notes: see notes to Table 9.

Table 14: Tests of the addition of efficiency variables to the models reported in Table 13

Model → Variables added ↓	General [FE]	Specific(FE) [FE]	Specific(OLS) [FE]	General [OLS]	Specific(FE) [OLS]	Specific(OLS) [OLS]
Cost measure of efficiency						
p[EFF_{it-1}]	0.207	0.915	0.749	0.233	0.164	0.237
p[$EFF_{it-1}\Delta R_t$]	0.500	0.533	0.503	0.607	0.455	0.410
p[$EFF_{it-1}\Delta R_{t-1}$]	0.853	0.953	0.958	0.518	0.592	0.618
p[$EFF_{it-1}\Delta R_t S_{it-1}$]	0.890	0.534	0.545	0.780	0.536	0.552
p[$EFF_{it-1}\Delta R_{t-1} S_{it-1}$]	0.306	0.643	0.631	0.181	0.388	0.399
p[$EFF_{it-1}\Delta R_t LIQ_{it-1}$]	0.501	0.624	0.495	0.808	0.882	0.699
p[$EFF_{it-1}\Delta R_{t-1} LIQ_{it-1}$]	0.818	0.543	0.447	0.685	0.535	0.379
p[$EFF_{it-1}\Delta R_t CAP_{it-1}$]	0.670	0.116	0.115	0.503	0.082	0.077
p[$EFF_{it-1}\Delta R_{t-1} CAP_{it-1}$]	0.115	0.771	0.678	0.028	0.611	0.510
Profit measure of efficiency						
p[EFF_{it-1}]	0.439	0.891	0.873	0.962	0.423	0.609
p[$EFF_{it-1}\Delta R_t$]	0.993	0.359	0.516	0.992	0.386	0.611
p[$EFF_{it-1}\Delta R_{t-1}$]	0.298	0.391	0.310	0.267	0.399	0.295
p[$EFF_{it-1}\Delta R_t S_{it-1}$]	0.136	0.963	0.960	0.069	0.945	0.934
p[$EFF_{it-1}\Delta R_{t-1} S_{it-1}$]	0.412	0.637	0.610	0.749	0.359	0.367
p[$EFF_{it-1}\Delta R_t LIQ_{it-1}$]	0.231	0.986	0.795	0.244	0.832	0.920
p[$EFF_{it-1}\Delta R_{t-1} LIQ_{it-1}$]	0.380	0.422	0.336	0.395	0.421	0.281
p[$EFF_{it-1}\Delta R_t CAP_{it-1}$]	0.506	0.123	0.129	0.201	0.069	0.074
p[$EFF_{it-1}\Delta R_{t-1} CAP_{it-1}$]	0.509	0.978	0.897	0.420	0.868	0.782

Table 14 notes: This table reports the probability values for individual t-tests for the addition of lagged efficiency variables, based on cost and profit measures both non-interacted and interacted with various combinations of the change in interest rates and bank-specific characteristics to the models estimated in Table 13. The results are obtained using the OLS and fixed-effects estimators (the estimation method is indicated in squared brackets in the model headings) with White heteroscedasticty corrected coefficient standard errors implemented in EViews 6. Bold emphasis indicates statistical significance at the 5% level.

Table 15: Long-run estimates of specific models obtained using GMM, Fixed-effects and pooled OLS

Estimation method → Variable ↓	GMM	FE	OLS
ΔR		-1.265 (-9.161)	-1.337 (-11.282)
$GGDP$	4.360 (2.388)		1.673 (2.092)
S	-0.913 (-1.498)		
CAP		1.862 (3.249)	1.285 (2.933)
$\text{Liq} \times \Delta R$	-12.785 (-2.279)		
$\text{Liq} \times \text{CAP} \times \Delta R$		23.671 (4.639)	21.080 (5.840)
Intercept	0.207 (0.482)	0.221 (6.642)	0.135 (2.967)

Table 15 notes: The static equilibrium coefficients derived from the favoured specific models estimated by GMM, fixed-effects (specific FE) and pooled OLS (specific OLS) reported in Table 6 and Table 13 are given in the columns headed GMM, FE and OLS, respectively. Equilibrium t-ratios are reported in parentheses where the coefficient standard error for the GMM model is calculated using the approximation based upon a Taylor series expansion (see De Boef and Keele, 2008).

Table 16: Tests for selectivity bias

	GMM	Fixed-effects	Pooled OLS
D_1	0.746	Collinearity	0.174
D_2	0.609	Collinearity	0.087
D_3	Collinearity	Collinearity	Collinearity
Joint	0.851	Collinearity	0.075

Table 16 notes: probability values for the null of no selection bias in the dynamic parsimonious specifications whose long-run solutions are reported in Table 15. For D_1, D_2 and D_3 these are based on t-tests whereas Joint denotes a test for the joint exclusion of all *included* dummy variables. An entry of Collinearity indicates that this variable was dropped from the regression due to multicollineaity.

Figure 1: Evolution through time of the cost measure of Turkish bank efficiency

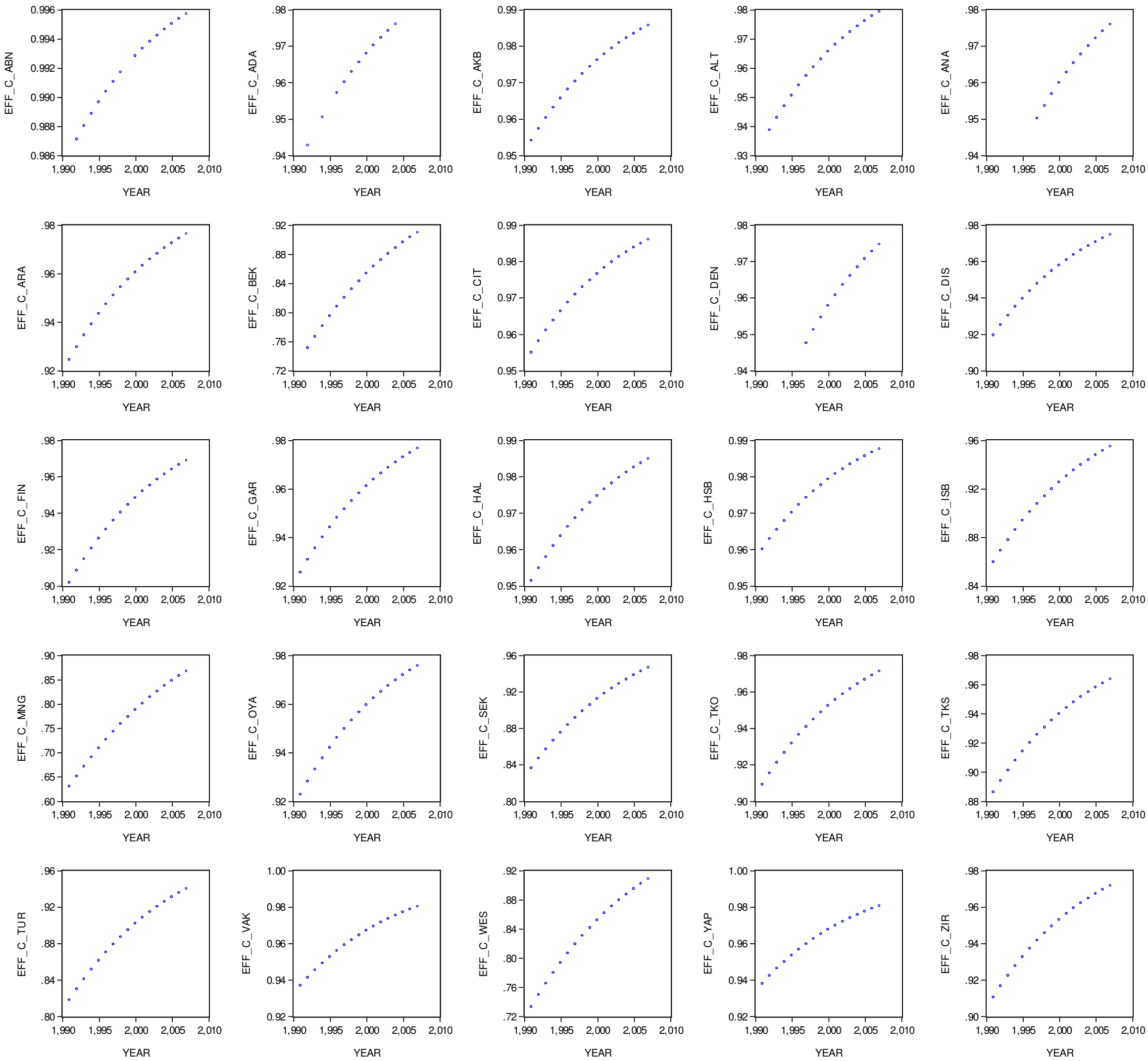

Figure 1 notes: The vertical axis denotes the cost measure of bank efficiency for each bank (EFF_C_*) where * is the bank identifier (the key is specified in Table 3 in parentheses after the name of each bank) and the year is given on the horizontal axis (1991 – 2007).

Figure 2: Evolution through time of the profit measure of Turkish bank efficiency

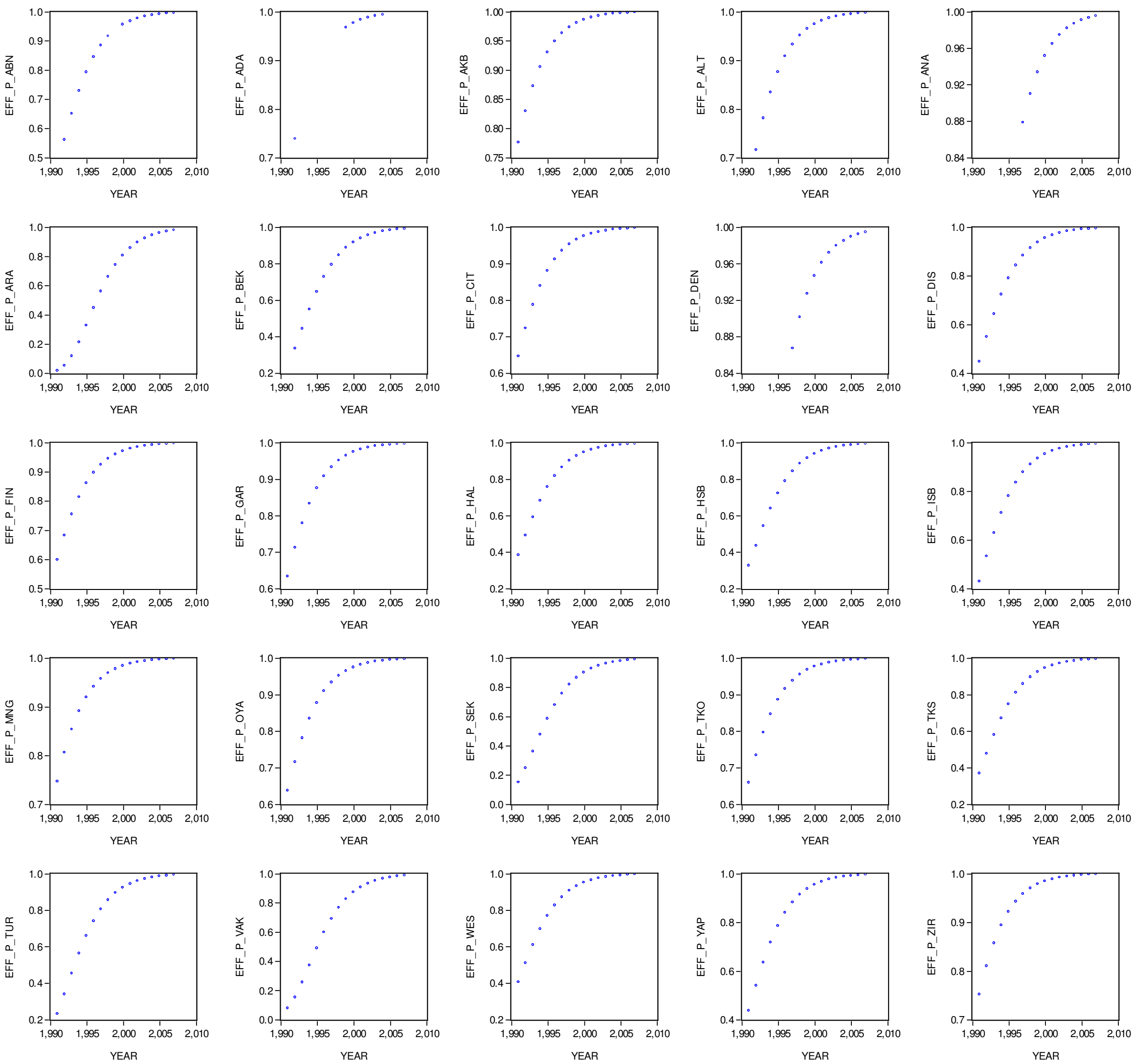

Figure 2 notes: The vertical axis denotes the profit measure of bank efficiency for each bank (EFF_P_*) where * is the bank identifier (the key is specified in Table 3 in parentheses after the name of each bank) and the year is given on the horizontal axis (1991 – 2007).

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