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An Empirical Analysis of the Risk Taking Channel of Monetary Policy in Turkey

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AN EMPIRICAL ANALYSIS OF THE RISK TAKING CHANNEL OF MONETARY POLICY IN TURKEY*

Abstract

The mechanism by which monetary policy affects financial institutions' risk perception and/or tolerance has been called the 'risk-taking channel' of monetary policy. It has been recently argued that periods of low interest rates due to expansionary monetary policy, might induce an increase in bank risk-appetite and risk-taking behavior. This paper investigates the bank specific characteristics of risk-taking behavior of the Turkish banking sector as well as the existence of risk taking channel of monetary policy in Turkey. Using bank level quarterly data over the period 2002-2012 a dynamic panel model is estimated. Our sample accounts for 53 banks that have been active in Turkey during the period. To deal with the potential endogeneity between risk and bank specific characteristics, which are explanatory variables in our model, the GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998) is used. Four alternative risk measures are used in the analysis; three accounting-based risk indicators and a market-based indicator- Expected Default Frequency. We find evidence that low levels of interest rates have a positive impact on banks' risk-taking behavior for all the risk measures. Specifically, low short term interest rates reduce the risk of outstanding loans; however short term interest rates below a theoretical benchmark increase risk-taking of banks. This result holds for macroeconomic controls as well. Furthermore, in terms of bank specific characteristics, our analysis suggests that large, liquid and well-capitalized banks are less prone to risk-taking.

JEL Codes: E44**,** E52, G21

Keywords: Monetary policy; Transmission mechanisms; Risk-taking channel; Turkey; Panel Data

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1. Introduction

The 2008 global financial crises has shown that even the world's most advanced financial systems are vulnerable to crisis and, failure or collapse of the international financial markets could have destructive effects on the real economies all around the world. The major credit expansion and the burst of a series of asset bubbles in the property markets fanned the flame for this turmoil, which resulted in disruptions in the global credit markets and endangered financial stability of the economy worldwide.

Policymakers and researchers have questioned the reasons behind the crisis, trying to provide some explanations on the forces behind the fragility of the global financial system. There seems to be a consensus on some possible causes of the crisis such as; the failure in the regulatory and supervisory frameworks, development of complex credit market instruments and poor governance practices. On the other hand, central banks are also blamed for putting on too accommodative monetary policies, which started a strong debate among economists. This argument posits that a prolonged period of extremely low interest rates and lax liquidity conditions encourage financial institutions to take on more risk. The supporters of this view argue that monetary policy is an important driving force in the emergence of the financial crisis. This claim becomes even more controversial, as many central banks lowered interest rates in response to the crisis in an attempt to overcome recession.

In the light of these developments, the debate over the relationship between monetary policy and financial stability has been intensified. During the pre-crisis period, central banks mostly disregard financial stability aspect, since the conventional wisdom for the practice of monetary policy was solely to maintain price stability. Ensuring price stability was thought to be the best contribution of central banks to enhance economic progress, whereas macroprudential tools are assumed by regulatory and supervisory authorities. Furthermore, developments in the credit transfer techniques that comes with financial innovation was often regarded as contributing to financial stability (Duffie, 2008; Altunbaş et al., 2010). However, as the global crisis displays that monetary policy actions may have consequences on financial stability, the role of the financial stability considerations in monetary policy decisions and ways to modify the existing monetary policy frameworks taking account of macro imbalances have come into question vigorously. Moreover, this turmoil suggest that monetary transmission mechanism might be more complex than it was previously thought to be, such that; its impacts are not limited on inflation and aggregate demand in the short-term, but indeed go beyond that and embrace the risk-taking tendency of economic agents with longer and unknown lags as well (Angeloni et al., 2010).

The question of how monetary policy affects banks' risk-taking incentives is key to the aforementioned policy debate. This discussion attracted considerable attention and formed the basis for the theory of risk-taking channel of monetary policy transmission that emerged recently. In short, risk-taking channel posits that an expansionary monetary policy for an extended period of time have an impact on risk perceptions or attitudes of banks. In other words, prolonged period of low interest rates induce banks to take more risk in their portfolio. In this case, the result is not only an increase in lending in line with the traditional transmission mechanisms, but the risk-taking channel also implies an increase in riskiness of lending, i.e.; a deterioration in the quality of portfolios. In this instance, monetary policy actions could contribute to the buildup of financial imbalances via its impact on risk attitudes, which could eventually result in a financial crisis.

Notably, banks play a prominent role both in the credit and risk-taking channel of monetary transmission mechanism, but in a different way. In the credit channel, a decrease in the interest rates lead to a rise in asset values, thereby increasing the collateral or net worth of the borrower and improving the debtors' repayment capability. In this case, banks are willing to increase the supply of loans to this borrower because it is less risky to lend money. In other words, there is no change in their risk tolerance and even, end up with a better risk position. On the other hand, the risk taking channel goes beyond to the effects of the interest rates on the riskiness of the borrower, but it is more about the behavior of banks, i.e. banks' incentives to undertake risk regarding the supply of credit. In that case, banks increase their lending as a result of the increase in their risk appetite. To put differently, banks are willing to take on higher risks or to increase their credit supply for the same level of risk (Gaggl and Valderrama, 2010). Apart from these, it could also be stated that in some way, the risk-taking channel builds on the bank lending channel. While the bank lending channel assumes that banks' conditions are not neutral for monetary policy transmission mechanism, the risk-taking channel takes one step further and assumes that the direction of causality may run from monetary policy to bank risk (Altunbaş et al., 2010).

As a relatively recent issue of monetary transmission mechanism, risk-taking channel does not have a specific definition, but indeed, it is a common term used for various mechanisms at work, which are all mutually inclusive. While this new monetary policy channel has its gray areas at the time being, it deserves close exploration for a fuller understanding the link between the monetary policy and financial stability and to draw clear-cut policy conclusions.

The findings regarding the risk-taking channel have potentially important implications for the conduct and design of monetary policy, as a better understanding of risk taking channel may provide an insight for monetary authorities to adjust their policies in order to mitigate the adverse consequences of their polices on bank risk-taking and in turn, avoid the buildup of risks in the financial system. If policymakers understand banks' risk-taking incentives and focus on the potential impact of their polices on bank risk, they may find answers to when and how to be more cautious and what factors they should take into account in their policy design. Furthermore, understanding the risk-taking channel would provide us comprehension regarding the macroeconomic implications of bank supervision and regulation as well.

The above-mentioned policy debate specifically identifies the period from early to mid 2000s as which policy interest rates had been too low for too long in the US and Europe and regards this period as the main driver for the increase in risk-taking. It has to be noted that this discussion is more loosely related to the Turkish case, because not only policy rates are not too low when compared to the United States or Europe, but also the monetary policy is not too accommodative for an extended period of time. Nevertheless, we believe that there is a strong case for studying risk-taking channel in Turkey for a number of reasons. First of all, while it is true that interest rates are not as low as that of some countries like, US, UK, France, etc., we can still claim that interest rates reached historically low levels; i.e. below their historical norms, in Turkey in the period following the 2000-2001 financial crisis if country-specific conditions and dynamics are taken into account. Furthermore, monetary authorities adopted implicit inflation targeting from 2002 to 2006, and moved on to explicit inflation targeting from 2006 onwards. Risk-taking channel is more likely to prevail under this policy framework with decreased levels of uncertainty, and hence, in that sense, Turkey provides an ideal setting to empirically analyze the link between low interest rates and bank risk-taking. Bank-based financial system of Turkey is another factor that may increase the potency of a risk-taking channel as well. In this sense, we place particular emphasis on how monetary policy actions impact risk perception and risk-taking of banks. Therefore, our analysis regarding the risk-taking channel focuses on investigating the relationship between the stance of monetary policy and banks' risk appetite.

Against this background, this paper aims to analyze the impact of monetary policy stance on Turkish banks' risk during the 2002-2012 period. This study is innovative in several respects. To the best of our knowledge, this study is the first one that addresses the relation between low interest rates and bank risk and hence, examines the risk-taking channel in Turkey, bringing additional insights to the monetary transmission mechanism in Turkey. In addition to that, this study sheds light on the bank specific characteristics which may have an impact on bank risk and also examine the differential responses of banks with different characteristics to monetary policy shocks in terms of their risk-taking. Furthermore, our computation of risk–taking behavior presents another novelty in the sense that instead of relying on one particular risk measure as done by most studies on the risk-taking channel, we employ alternative risk indicators in an attempt to cover different aspects of risk-taking behavior. Even more, we use accounting-based indicators together with a market-based indicator. Apart from these, the scant empirical literature on risk taking channel focuses mostly on the advanced countries and further, mainly examines the effectiveness of the channel at the international level. Therefore, our study is one of the handful studies in providing empirical evidence for an emerging market.

There are some important caveats that need to be asserted before going into details of our analysis. First, we do not make any inferences on the optimality of risk choices of banks, as from a theoretical viewpoint, it may be optimal for a bank to engage in riskier projects when interest rates are low and further, it may also be the socially optimal outcome of monetary policy during recession periods as well. To put it in another way, this higher risk-taking may be a result of optimal adjustment and hence, is not necessarily the sign of banks acting less responsible or taking risks in an excessive way. (De Nicolo et al., 2010; Apel and Claussen, 2012). Second, there is a part of literature positing that risk-taking channel principally refers to new risk, i.e. new loans. In other words, it refers to incentives of banks to engage in ex-ante risky projects. Along these lines, it is crucial to distinguish between the realized risk and new risk to draw an accurate inference concerning the relationship between monetary policy and bank risk-taking. This necessitates the use of comprehensive data on individual bank loans from credit registers, which provides information on lending standards, loan performance etc. Unfortunately, such detailed data is not available for Turkey. Actually data on individual loans borrower characteristics is confidential in most cases and available for very few countries that maintain a credit register (Altunbaş et al., 2010). Accordingly, it is not surprising that there are only a handful of studies in the literature (Jimenez et al., 2009; Ioannidou et al., 2009; Lopez et al., 2010; 2012), which make use of such detailed data to analyze the interest rate-bank risk nexus. In short, as we would have preferred to work on such comprehensive datasets that convey more information, it would not be wrong to say that this study is somewhat limited by the availability of the data.

In this study, we empirically test for the existence of the risk-taking channel by analyzing the panel of banks operating in Turkey for the period 2002-2012, using four different risk indicators. We control for a number of factors that may have an impact on banks' risk such as macroeconomic activity, stock market returns, and banking market structure. We further analyze the relationship between low interest rates and bank risk relatively to bank-specific characteristics, namely size, liquidity and capitalization. Finally, we examine whether there exists heterogeneous response of banks in terms of their risk-taking decisions in a low interest rate environment, stemming from their individual characteristics.

Our results, obtained by using GMM for dynamic panel data developed by Arellano-Bover (1995)/ Blundell-Bond (1998), provide some evidence for the existence of a risk-taking channel of monetary policy for Turkish banks, when assessed using four alternative risk measures.

The remainder of this chapter is organized as follows: The next section offers a survey of theoretical and empirical literature on the risk taking channel. Section 3 describes the data used in the analysis. Section 4 presents the econometric model and methodology. After that, in section 5 the estimation results and their interpretations are discussed. Finally, Section 6 concludes.

2. Literature Review

2.1. Theoretical Background of the Risk-Taking Channel

The elements of the theory of risk-taking channel can be traced in the theoretical propositions of some previous studies such as; Gibson (1997); Keeley (1990); Allen and Gale (2000;) Dell' Ariccia and Marquez (2006); Rajan (2006), and Matsuyama (2007).[1] Although some of the mechanisms have been discussed previously, the term 'risk-taking channel' of monetary policy is firstly appeared in a paper written by Borio and Zhu (2008) in which they point to the potential relationship between low interest rates and increased bank risk-taking. Specifically, Borio and Zhu (2008) describe the risk-taking channel of monetary transmission mechanism as "the impact of changes in policy rates on either risk perceptions or risk-tolerance and hence on the degree of risk in the portfolios, on the pricing of assets, and on the price and non-price terms of the extension of funding."

Risk-taking channel could operate in several different ways. First one is through the effect of low interest rates on valuations, income and cash flows. A reduction in interest rates boosts asset prices and collateral values as well as incomes, which in turn, lead to a reduction in risk perception and/or increase in risk tolerance. Evidence for the impact of higher wealth on risk tolerance lie in the downsized estimates of probabilities of default, loss given default, and volatilities. Therefore, reduced volatility tends to release risk budgets and encourages positions of higher risk in rising markets. A complementary argument is provided by Adrian and Shin (2010) who suggest that after a positive shock to asset prices as a result of lower interest rates, the value of bank's equity relative to its debt increase, thereby leading to a reduction in leverage. The drop in leverage lead to spare capacity on the balance sheet such that equity is now larger than it is necessary to meet the Value-at-Risk.[2] Accordingly, bank would respond to this fall in leverage by increasing its holdings of risky securities. Adrian and

[1] Disyatat (2010) proposes a reformulation of the bank lending channel, in which monetary policy affects, primarily banks' balance sheet strength and risk perception.

[2] This can be applied to the widespread use of Value-at-Risk models for economic and regulatory capital purposes (Danielssson et al., 2004).

Shin (2010) further posits that these adjustments in the bank balance sheets, which are determined by the changes in measured risk, in turn, amplify business cycle movements.[3]

Another mechanism the risk-taking channel may operate through is the ‘search for yield (Rajan, 2006). In a low interest rate environment, the incentives of asset managers to engage in more risky projects rise for a number of reasons. Primarily, this mechanism predominantly works through the relationship between the low levels of short-term interest rates and sticky target rate of returns. These sticky target rates of return may reflect psychological or behavioral aspects, such as money illusion. Alternatively, they may reflect the nature of contracts, together with the institutional and regulatory constraints. Some financial institutions, such as pension funds and insurance companies, which have long-term commitments, have to match the yield they promised on their liabilities to the yield they obtain from their assets in order to avoid default on their commitments. As they have nominal liabilities predefined at long-term fixed rates, when interest rates are low these institutions shift to riskier assets with higher yields, in order to meet their obligations. Because in that case, investing in safe assets (such as highly-rated government bonds) would not generate the necessary returns as it would if interest rates were high. Moreover, a similar mechanism could be in place whenever managerial compensation is linked to absolute yields. In a low interest rate environment, lower yields on safe assets imply a lower compensation for managers that choose to invest in safe assets, giving managers higher incentives to invest in more risky assets. In all cases, the effect of the channel becomes stronger as the resulting gap between the market and target rates becomes larger.

Similarly, very low interest rates usually bring about a reduction in the spread between lending and deposit rate of banks, which would squeeze profit margins of banks and increase their incentives for search for yield. Putting main emphasis on the existence the informational asymmetries among banks, Keeley (1990) and Dell’ Ariccia and Marquez (2006) suggest that lower interest rates drives adverse selection problems down, which in turn lead to a higher competition together with credit expansion. Accordingly, banks have more incentives to search for yield and hence, engage in riskier projects with higher expected returns to increase their profit margins. Consequently, banks relax their lending standards and increase their risk-taking.

[3] In this mechanism the risk-taking channel includes not just new assets or loans, but also the valuation of assets outstanding in portfolios of banks.

Monetary policy could also affect risk-taking through the communication policies and characteristics of the reaction function of the central bank. In this context, a higher transparency and predictability accompanying monetary policy to future policy decisions could reduce market uncertainty, which in turn, release risk budgets of banks and increase their risk-taking. This is the 'transparency effect'. Similarly, the expectation that the central bank reaction function is effective in cutting off large downside risk creates an 'insurance effect'. In other words, if market participants expect that the central bank will ease monetary policy in the face of a negative shock, which threatens stability of the system, then they would tend to take on more risk. (Borio and Zhu, 2008). Indeed, it is not the low rates themselves, but rather the implicit promise of low rates (in case if it is needed) that causes this typical moral hazard problem. Therefore, this effect, which is also known as the Greenspan or Bernanke put, works through the expected lower interest rates (De Nicolo et al., 2010).[4] Likewise, Diamond and Rajan (2009)[5] states that banks would take on more risk if they anticipate that monetary authority would lower the interest rates to bail them out. Moreover, the authors suggest keeping monetary policy tighter than the level suggested by underlying economic conditions in good times to reduce banks' incentives to undertake liquidity risk. In their formal model, Farhi and Tirole (2009) show that borrowers may choose to increase their interest rate sensitivity to macroeconomic conditions following bad news about future liquidity needs. This would in turn, lead to time inconsistent monetary policy, not for the standard inflation bias reason in the central banks' preferences, but rather to the higher macroeconomic exposure to interest rates.

The effects of monetary policy on risk-taking can also operate through habit formation. In their paper, Campell and Cochrane (1999) show that agents become less risk-averse during periods of expansion, since their consumption increases relative to normal

[4] However, De Nicolo et al. (2010) state that the level of the policy rate has implications for the magnitude of this effect. They posit that when rates are high, there is greater room for monetary stimulus than when rates are low; accordingly higher rates will correspond to greater risk-taking. Basically, an easy stance of monetary policy decreases this moral hazard problem by reducing room for further monetary expansion.

[5] In their paper, Diamond and Rajan (2009) present a model with no uncertainty from asset side of banks' balance sheets; however failure risk can come from substantial deposit withdrawals. Easing of monetary policy increases the attractiveness of bank playing on the mismatch between short-term deposits and long-term projects. Hence, low interest rates contribute to bank investment in illiquid assets and also to leverage, resulting in higher risk of failure.

levels. Hence, lower monetary policy rates, by increasing real economic activity, may lead to a reduction in the degree of investors' risk aversion. This mechanism is in along the lines of findings from literature on asset-pricing models, which predict higher credit spreads in the long run following low interest rate periods (Longstaff and Schwartz, 1995; Dufresne et al., 2001) (Altunbaş et al., 2010). Another similar mechanism is that when the economy has experienced a prolonged period of low risk and low interest rates, economic agents may became too complacent, in the sense that their anticipations about the future may be too optimistic by the prevailing situation. As Yellen (2011) states economic actors, which hold assets with greater credit risk exposure, may not fully appreciate, or demand appropriate compensation for, potential losses in such an environment (Apel and Clauessen, 2012).

In close spirit to habit formation, Berger and Udell (2003) introduced the institutional memory hypothesis to explain the procyclicality of bank lending and bank loan performance problems. They suggest that banks may undertake significantly more risk during expansions as a result of the deterioration in the capacity of bank loan officers to recognize potential loan problems as time passes since banks' last loan bust, and a subsequent loosening in the credit standards.

All of the above mentioned mechanisms are the candidate driving forces behind the risk-taking channel. Although being diverse, they may tend to work at the same time as well. Furthermore, it should be noted that none of these proposed explanations is more important than the other, as there is no conclusive evidence regarding the relative importance of them. In part, this is due to the lack of theoretical models, which reveal the details of either potential mechanism and allows the precise understanding of their characteristics. The risk-taking channel is a relatively recent area of monetary economics; hence the theoretical literature is still being developed and is rather limited for the time being. There are only a handful studies that present formal models where several mechanisms of the risk-taking channel act together. In what follows, we briefly summarize the studies that explicitly analyze the risk-taking channel in theoretical models.

Dubecq et al. (2009) provide a model with risk-shifting where the level of interest rates affects the risk perception of some investors and risk exposure by others. They argue that situation of uncertainty with respect to regulatory constraints may cause market participants to form wrong inferences on risks. In that case, the increase in the observed asset prices would be interpreted as a lower aggregate risk in the economy, while indeed asset prices were driven by higher risk-taking by financial intermediaries. In other words, in their theoretical model, regulatory arbitrage in conjunction with fuzzy capital requirements leads to uncertainty about financial intermediaries' risk exposure and this problem is more severe in the case of low interest rates, in the sense that lower interest rates increase the scale of underestimation of risk, which in turn amplifies the overpricing of risky assets.

Dell' Ariccia et al. (2010) use a static model to assess the impact of prolonged easy monetary policy on bank risk-taking. In their model, banks' risk appetite increase in prolonged periods of lax monetary conditions, however the net effect of monetary policy depends on the balance of the interest rate pass-through, risk shifting and capital structure. When banks are allowed to adjust their capital structures, monetary easing leads to an increase in leverage, which in turn lowers incentives to monitor, thereby increasing risk. On the other hand, if bank capital is fixed, then the balance would depend on the degree of bank capitalization: in well-capitalized banks monitoring will decrease, i.e. risk increase, with lower policy rates, whereas the opposite is true for the highly levered banks.

Agur and Demertzis (2010) develop a general-form dynamic model with endogenous risk profiles in an attempt to account for the role of monetary policy on financial markets' risk appetite. A monetary authority that concerns with financial stability objective adjusts its instrument in two ways. First, central bank has to be conservative and would set higher rates on average. Hence, it is willing to put a deflationary pressure on the economy to avoid the buildup of risks. Second, the monetary authority cut the policy rate sharply in reaction to negative shocks, but for a short period of time, since banks adjust their portfolio towards risky projects only when they foresee that interest rates remain low for a prolonged period of time. In other words, in the case of a negative shock, the central bank with financial stability objective would be more aggressive than the traditional policy oriented one, i.e. the one concerned only with inflation or output.

Valencia (2011) develops a dynamic model to understand what may lead banks to increase risk-taking when monetary policy rates are low. In the model, a decrease in risk-free rate increases profitability of lending by reducing funding costs and increasing the surplus the monopolistic bank can extract from borrowers. Because of limited liability, this increased profitability have an affect only on upside returns, hence banks increase leverage and take risk excessively. Furthermore, the author shows that capital requirements can reduce the impact of banks' risk-taking, but cannot eliminate entirely since the incentives to take excessive risk intensify when interest rates are low and accordingly, he proposes regulations that is contingent at the state of the economy, such as counter-cyclical regulatory policies, for financial stability.

Cociaba et al. (2011) present a dynamic general equilibrium model to examine the link between interest rate policy and risk-taking. In their model, they find optimal interest rate policy and evaluate the consequences of deviating from the optimal policy. The interest rate policy affects risk taking by changing the amount of safe bonds that intermediaries use as collateral in the repo market. They find that in a model with properly priced collateral, lower than optimal interest rates reduce risk-taking. After that, they also add to the model the possibility that intermediaries can augment their collateral by issuing assets whose risks are underestimated by credit rating agencies. In the presence of such mispriced collateral, lower than optimal interest rates increase risk-taking and amplify the severity of recessions.

Gonzalez-Aguado and Suarez (2011) develop a dynamic corporate financing model in an attempt to rationalize some of the empirical evidence regarding the risk-taking channel of monetary policy and they investigate the impact of risk-free interest rate on corporate leverage and default. In their model, firms' financing problem is influenced by moral hazard between the firms and outside financiers together with entrepreneurial wealth constraints; whereas interest rates determine the outside financiers' opportunity costs of funds. Firms start up with leverage ratios larger than their long-term targets and adjust it gradually via earnings retention. The authors find that interest rate cuts and rises have asymmetric effects on leverage and also the responses to interest rate changes are heterogeneous across firms. They further find that interest rate shifts have different implications for leverage and default in the short-run and in the long-run. While interest rate shifts increase the aggregate default rate in the short-term, higher rates cause to lower default rates in the long-run as they induce lower target leverage across all firms.

2.2. Empirical Evidence on the Risk-taking Channel

Although the risk-taking channel of monetary transmission is still not well-understood, an increasing number of empirical studies have been produced to analyze whether there is a relationship between low interest rates and bank risk-taking and attempt to clarify characteristics of the risk-taking channel. Nevertheless, the empirical studies regarding risk-taking channel are still few in number. In what follows, we briefly summarize these studies and their main findings.

There are two groups of studies; those using macro data and examine the relationship between monetary policy and different aggregated risk measures, and others using micro data to provide micro-level panel evidence for the impact of interest rate changes on individual bank' risk-taking behavior. The number of empirical studies that rely on micro data to analyze the risk-taking channel has been rapidly increased in recent years. Furthermore, some of the macro and micro studies utilize data from lending surveys to shed light on another interesting perspective of the risk-taking channel of monetary policy transmission.

Some studies use macro data to analyze the link between monetary policy and risk, but they are fewer in number when compared with the list of studies that employ micro data. Angeloni et al. (2010), by using vector autoregression (VAR), provide time series evidence on the risk-taking channel for the US and Europe. They employ three different measures of risk: the ratio of consumer and mortgage loans to total loans for bank funding risk; bank leverage (defined as the ratio of assets to deposits) for bank asset side risk; and the stock market volatility for general corporate sector risk. The authors provide evidence that the stance of monetary policy affects, with lags, bank risk-taking, however the strength, profile and significance of the impact of monetary policy on bank risk depends on the risk measure employed and is different between the US and Euro area. Specifically, they find that a decrease in monetary policy rates has a significant positive influence on bank balance sheet risk both in the US and the Euro area, and a significant positive influence on bank leverage only in the US. On the other hand, the effects on the stock market volatility are insignificant in both areas.

Eickmier and Hoffman (2010) use factor-augmented autoregressive model (FAVAR) estimated on quarterly US data covering the period 1987-2007 in order to investigate the role of monetary policy on the three imbalances that were observed prior to the global financial crisis; namely, high house price inflation, strong private debt growth and low credit risk spreads. As measure of bank risk, they employ several important credit risk spreads such as; spread of the 3-month Eurodollar deposit over the 3-month T-bill rate or spread of the C&I loan rate over the 2-year T-bill rate. Their empirical analysis shows a negative response of various credit risk spreads to a decline in monetary policy rates, providing supportive evidence in favor of risk-taking channel.

While not exactly testing the propositions of the risk-taking channel, Bekaert et al. (2010) provide a characterization of the dynamic links between risk, economic uncertainty and monetary policy for the US. They decompose VIX[6] into two components; risk aversion and uncertainty, and, show that interactions between each of the components and monetary policy are rather different by using a simple VAR system for the period from 1990 to 2007. Loose monetary policy decreases risk aversion in the medium term, whereas high uncertainty is found to lead to looser monetary policy stance in the near-term future.

Another group of studies utilize both macro and micro level data in their analysis. Among these studies, De Graeve et al. (2008) rest on an integrated micro-macro model that captures the feedback between bank-level distress and the macro economy. By using German bank and macro data during the period 1995-2004, they measure banks' probability of default, estimated from a logit model including CAMEL ratings, and then combine this microeconomic model with a structural VAR. Consequently, they find a reduction in German banks' probability of distress following a monetary loosening. Furthermore, the responses differ across banking groups, for instance distress responses are larger in absolute terms for small cooperative banks, and these heterogeneous dynamics may reflect banks' alternative business models.

De Nicolo et al. (2010) attempt to illustrate the effect of monetary policy stance on bank risk- taking in the US through two different approaches. First, the authors employ the quarterly survey on the terms of business lending and construct two ex-ante measures of risk-taking from this survey: the average internal risk rating and the average relative spread between loan rates and the effective federal funds rate. Their results reveal that policy rate has a negative impact both on risk rating and spread, and further this negative effect is less pronounced, if the banking sector is characterized by low capitalization. In the second exercise, they investigate the impact of changes in policy rates on the overall riskiness of banks' asset portfolios by using bank-level data from Call Reports. Using the ratio of risk-weighted assets to total assets as the measure bank risk, they find strong negative relationship

[6] The Chicago Board Options Exchange Volatility Index (VIX) essentially measures the 'risk-neutral' expected stock market variance for the US S&P500 index.

between real interest rates and the riskiness of banks' assets. The increase in the risk-weighted assets in response to the decline in policy rate is smaller in absolute terms if the bank is poorly capitalized. Therefore, the authors suggest that low policy rates are associated with greater risk-taking, but this relationship depends on the health of the banking system. Moreover, this effect is likely to be more important in good times, whereas to be less pronounced in times of financial stress.

Based on a FAVAR, Buch et. al (2010) use both time series and bank-level data for the US from the Call Reports over the period 1985-2008 to explore the net effect of macroeconomic shocks, mainly monetary policy, on bank risk. Using the share of non-performing loans in total loans as an indicator of bank risk, they find a decline in bank risk following an expansionary monetary policy shock, similar to the findings of De Graeve et al. (2008), but not to the findings of other empirical studies that provide evidence in favor of the risk-taking channel. Regarding sources of heterogeneity across banks, results show that the negative response of bank risk to a monetary policy shock is smaller for banks with high capital ratios, while it is higher for banks that are highly engaged in real estate lending. On the other hand, size has found to have no significant effect on the risk response to monetary policy shocks.

In their later study, Buch et al. (2011) employ FAVAR to provide evidence on the link between monetary policy, commercial property prices and bank risk for the US during the period 1997-2008. They use the Federal Reserve's survey of terms of business lending, which enables them to model the reactions of banks' new lending volumes and prices together with the riskiness of new loans. While they do not find evidence for increased risk-taking for the entire banking system following a monetary expansion or an unexpected increase in property prices, they show that the impact of monetary policy loosening on risk-taking is not uniform across different banking groups i.e., different bank groups respond differently to expansionary monetary shocks. Small domestic banks undertake more new risk, whereas foreign banks lower it and large domestic banks do not significantly change their exposure to new risk.

Karapetyan (2011) employs aggregate quarterly data for the over the period 1979-2010 to explore the impact of expansionary monetary policy, in the form of low key interest rates, on risk-taking of banks in Norway. The author employs the share of troubled loans and alternatively a bank risk index calculated from a logit model based on balance sheet data, as measures of banks' risk-taking. His results do not show statistical evidence for the risk-taking channels, since low key policy rates do not cause a higher share of troubled loans or an increase in other measure of bank risk.

The empirical studies on the risk-taking channel mostly use micro data; i.e. data based from individual banks, both at the individual country level or for groups of countries. Among these studies, Jimenez et al. (2009) employ confidential data from the Spanish credit register on individual loans at the bank-borrower level covering the period 1984-2006. Approximating risk by ex-ante loan characteristics together with the ex-post loan performance, they investigate the relationship between changes in monetary policy stance and the risk level of individual bank loans. They find that low interest rates affect the credit risk of Spanish banks in two different ways. In the short run, lower interest rates reduce the risk of default of outstanding loans, implying that lower rates reduce the interest burden of the previous borrowers. However, lower interest rates prior to loan origination lead banks to grant more risky new loans. In the medium term, banks soften their lending standards in the sense that they lend more to borrowers with a bad credit history or with high uncertainty as a result of higher collateral values and search for yield. Hence, they find that lower interest rates improve the quality of the loan portfolio in the short term, whereas increase the loan default risk in the medium term. The authors also show that small banks, savings banks and cooperative banks, banks that are net debtors on the interbank market undertake more risk than others. Therefore, they posit balance sheet strength, moral hazard and bank ownership as factors shaping the effect of monetary policy on bank risk. In addition, they find that banks with lower levels of capital expand credit to riskier firms more when compared with the highly capitalized banks.

As one of very few studies providing evidence outside the US or Europe, Iannidou et al. (2009), use individual bank data from public credit registry of Bolivia together with bank balance sheet and income statements over the period 1999-2003 in order to examine whether there exist a risk-taking channel. Since the economy is fully dollarized in the period under consideration, they employ US federal funds rate as an exogenous monetary policy indicator. Notably, they investigate the impact of changes in interest rates not only on the quantity of new loans, but also on their interest rates, since they access to loan pricing. The authors find similar evidence to that of Jimenez et al. (2009), suggesting that a reduction in interest rates prior to loan origination increases the probability of loan default. Moreover, they find that banks also reduce the loan rates they charge to risky loans compared with what they charge to less risky ones, when interest rates are low.[7] Their results on bank characteristics show that banks with lower liquid assets and a lower level of funds from foreign institutions take more risk.

Altunbaş et al. (2010) analyze the risk-taking channel by using quarterly balance sheet data of 643 stock-listed banks in the EU-15 and the US over the period 1998-2008. They use expected default frequency (EDF), a forward looking indicator of risk, as a proxy for risk taking. Furthermore, the authors considered the deviation of interest rate from a benchmark level to evaluate the relative stance of monetary policy.[8] The study provides evidence in favor of risk-taking channel, since a negative deviation of the short-term interest rate from the benchmark level, i.e. expansionary monetary policy, leads to an increase in the probability of default. This result still holds when authors use alternative proxies for bank risk such as EDF with longer time horizon, idiosyncratic component of bank risk etc. Regarding bank characteristics, small, liquid and well-capitalized banks are found to be less risky.

Applying a similar methodology and the same database with Altunbaş et al. (2010), Gambacorta (2009) considers the time-span of the expansionary monetary policy by using the number of consecutive quarters in which interest rates have been below the benchmark. He shows that the increase in EDF is higher for banks in the US, where the federal funds rate were below the benchmark for 17 consecutive quarters between 2002 and 2006, than for banks in Europe where the policy rate was below the benchmark for 10 quarters. In sum, the author finds evidence of a significant link between an extended period of low interest rates prior to crisis and banks' risk-taking, consistent with the risk-taking channel hypothesis.

Tabak et al. (2009) uses individual bank- level data for commercial banks operating in Brazil over the period from 2003 to 2009 in order to analyze the risk-taking channel of monetary policy transmission. Their results indicate that lower interest rates lead to an increase in banks' credit risk exposure, supporting the existence of the risk-taking channel. Furthermore, liquidity and bank size are found to have a positive relation with risk. When the authors control for ownership in the analysis, they also find that state owned and foreign banks have different risk-taking profile.

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[7] This finding is contradicting with the 'search for yield' hypothesis, since it implies that banks do not price additional risk taken (Gaggl and Valderrama, 2010).

[8] They use the natural interest rate and interest rates implied by Taylor rules (with interest rate smoothing and with no interest rate smoothing) rate as benchmark levels.

Brissimis and Delis (2010) analyze the impact of monetary policy on bank lending, risk-taking and profitability for the US and Euro area. In the part of their study regarding risk-taking channel, the authors are rather more concerned with whether interest rates have a differential effect on bank risk due to certain characteristics of bank balance sheets. They analyze the heterogeneous response of banks in the US and 12 Euro area countries covering the period in 1994-2007 in terms of their risk-taking decisions following a change in monetary policy. Further, they choose liquidity, size and market power as bank specific characteristics and find that the impact of a monetary policy change on credit risk is lower for well-capitalized and liquid banks.

Michalak (2010) investigates the nexus between low-levels of interest rates, monetary policy decisions, the banking market structure, and bank risk-taking by using a dataset of stock-listed bank holding companies for EU-9 plus Switzerland during the period 1997-2008. The author utilizes EDF as the risk indicator. In line with Altunbaş et al. (2010), his results indicate that low short-term interest rates reduce default rates of outstanding loans and that an extended period of short-term interest rates below a theoretical benchmark level cause a reduction in risk perception and/or increase in risk tolerance in Western European banks. Moreover, he finds that an increase in competition in the loan market, which is proxied by the Boone-indicator[9], leads to higher fragility.

Following very closely the research by Jimenez et al. (2009), Lopez et al. (2010) employs a dataset from the Credit Register from Colombia, which contains detailed information on individual commercial bank loans over the period 2000-2008 to examine the effect of monetary policy stance on bank risk-taking. By using duration models, they find a significant link between low interest rates and risk-taking in Colombia. Their empirical results reveal that lower interest rates raise the probability of default on new loans but reduce that on outstanding loans, consistent with the findings of Jimenez et al. (2009). Furthermore, the authors posit that the risk-taking channel of monetary policy depends on some bank, loan and borrower characteristics. Regarding bank characteristics, they find that small and highly leveraged banks are more willing to take risks.

[9] Boone indicator is a new competition indicator, which enables to measure competition of bank market segments, such as the loan market. It is based on the notion that more efficient firms gain higher market shares as well as higher profits and this effect is stronger the higher the competition in the respective market is (Van Leuvensteijn et al. 2007).

Lopez et al. (2012) is in line with the Lopez et al. (2010), but this time authors use detailed information on consumer loans in addition to commercial loans, in order to examine whether there is a risk-taking behavior of banks when they grant loans to households and further, compare the incidence of risk-taking channel in both loan categories. Being the first paper that investigates the risk-taking channel in case of consumer loans, the paper presents empirical evidence which shows that Colombian banks undertake more risk when the level of interest rates are low and the response of commercial loans to interest rates is higher than in the case of consumer loans. The authors also find that small banks undertake more extra risk and grant more loans to risky borrowers when interest rates are low.

Delis and Kouretas (2011) examine low interest rates on bank risk using a large dataset of quarterly balance sheet data from banks in the 16 Euro area countries for the period 2001-2008. They are more concerned with the level of interest rates instead of monetary policy changes in their study. The ratio of risky assets to total assets and the ratio of non-performing loans to total loans being their risk indicators, they estimate risk equations by using various interest rates. The authors find that low interest rates increase bank-risk taking substantially, while this result is robust to different specifications and to the use of annual data. Furthermore, their empirical analysis reveals that the impact of low interest rates on risk assets is lower for well-capitalized banks, but it is amplified for banks with high off-balance sheet items.

Delis et al. (2011) examine the impact of US monetary policy on bank risk-taking by using two alternative micro datasets: quarterly balance sheet data from Call Reports and data on new loans from the syndicated loan market. They present empirical evidence that low interest rates tend to decrease loan portfolio risk of a bank in the short-run, but increase it in the long-run. Furthermore, their finding remains robust to different specifications and to different sub-periods and samples, suggesting positive evidence for the risk-taking channel of monetary policy transmission in the US since the 1990s.

A number of studies examine risk-taking with respect to lending standards. These studies use answers from surveys of lending behavior among banks (e.g. the Bank Lending Survey for the Euro area, the Senior Loan Officer Survey for the US) to explore whether monetary policy affects the lending practices of banks. In general, these surveys provide information about the strictness of the lending criteria, but not about the absolute level of strictness. Instead, questions in the surveys imply qualitative questions and accordingly, allow to examine whether lending standards have changed relative to the recent past. Net loosening of credit standards is considered to indicate enhanced access to credit by low quality borrowers. It should be noted that while these studies examine the impact of lower policy rates on banks' lending standards, they do not say anything about the banks' riskiness after they had loosened their standards and at the same time, the softening standards do not necessarily imply an increase in risk.

Lown and Morgan (2006) conduct VAR analysis using a measure of bank lending standards collected by the Federal Reserve and find no changes in standards in response to shocks to the federal funds rate. Instead, the authors show that lenders change loan rates broadly with the federal funds rate. Furthermore, they find a negative relationship between banks' capital to asset ratio and their lending standards.

Using the information from bank lending survey in Euro area, Maddaloni et al. (2008) examine the impact of monetary policy on bank risk-appetite during the period 2002-2008. They find weaker lending standards both for the average and riskier loans when interest rates are lowered. Banks loosen their credit standards mainly by decreasing spreads on average loans, and also by reducing collateral requirements and covenants as well as by increasing loan amount and maturity. The impact of relaxing credit standards is found to be stronger for loans to nonfinancial firms. Furthermore, the authors find that holding rates low for prolonged periods of time soften credit standards even further. While they find a stronger impact of overnight rates on credit standards in case of securitization, their analysis also reveals that larger banks tend to react less to overnight rates, particularly in their lending to small and medium-sized enterprises.

Maddaloni and Pedyro (2011) use data from lending surveys in both the Euro area and US and analyze the impact of low interest rates on lending standards that apply to firms and households over the period 2003-2008.[10] Their analysis reveals that low short-term interest rates soften standards, however this result does not hold for the long-term interest rates. Moreover, they find that securitization activity, weak supervision for bank capital and prolonged periods of low interest rates strengthen the impact of softening.

[10] The authors also run some regressions using only data for the US to exploit the longer time series dimension and hence, they start the analysis from 1991 in that case.

In general, we could state that there is much international empirical evidence in favor of the risk-taking channel, i.e. low interest rates lead to greater risk-taking. Notably, most of the existing empirical literature on the risk-taking channel provide evidence for the US and Euro area, whereas very few studies provide evidence for emerging markets. Specifically, these are Ioannidou et al. (2009) for Bolivia, Tabak et al. (2010) for Brazil and Lopez et al. (2010, 2012) for Colombia and all of them present empirical evidence on the existence of such a channel. None of the empirical studies have been published so far have specifically examined the risk-taking channel in Turkey. In this context, our study is the first empirical study for Turkey and also expected to contribute to the scant literature on the risk-taking channel in emerging markets. In what follows, we lay out our empirical assessment based on alternative risk indicators.

3. Data Description

The empirical analysis to assess the risk-taking channel of monetary policy relies on an unbalanced panel dataset, which consist of deposit banks and development and investment banks operating in Turkey over the period 2002q1-2012q1. We employ quarterly data which are considered to be more appropriate for capturing the short-term effect of monetary policy changes on bank risk (Altunbaş et al., 2010).

The sample period is chosen to start from 2002, since the 2000-2001 financial crisis constitute a structural break in the Turkish economy and hereafter there have been significant improvements in macroeconomic fundamentals with the implementation of a comprehensive economic program, coupled with changes in the conducts of macroeconomic policymaking. Furthermore, in the period following the 2000-2001 financial crisis, Turkish banking system has undergone a tremendous restructuring process and has been highly regulated with the amendments in the financial regulations as BRSA became fully operational. During that period, distortions in the financial sector have been eliminated, supervision quality has been increased, regulations have been brought to international standards, private banks were strengthened, operation of the state banks were restructured and new products have been introduced. Accordingly, our analysis aims to cover this new era in which banks have started to operate in a completely different macroeconomic scene and financial architecture following the 2000-2001 crisis. Furthermore, there is a shift towards an environment of low inflation rates and interest rates in the post crisis era as explained in more detail in the Introduction. While interest rates reached drastically high levels in the pre-crisis period, they started fall hereafter and remained at historically low levels in recent years. Thus, this is an additional reason for why we limit the sample period to these dates, since the pre-crisis era is not convenient to explain the theoretical discussion regarding the relationship between the short-term interest rates and bank risk-taking.

Quarterly bank-level data are collected from the balance sheet and income statement information extracted from Bank Association of Turkey. EDF data is obtained from Moody's KMV. While the three month interbank rate, seasonally adjusted real GDP and industrial production index are extracted from OECD Economic Outlook database, stock market returns are gathered from the electronic data delivery system of CBRT.

Our sample covers 53 banks that have been active in Turkey during the period under consideration. Unfortunately, EDF data is only available for 14 Turkish banks and we have been able to access these banks' EDF data for the period 2007q1-2012q1. Accordingly, we study this sample separately. Table A.1 in the Appendix shows the list of these banks in the whole sample and further, provides some information on acquisitions, mergers and failures occurred over the full time period. All the banks that have been operated at least one year during the period under consideration are involved. Furthermore, those observations for which data on our main bank-level variables are either not available or contain extreme values are discarded by applying an outlier rule.

Table A.2 in the Appendix briefly describes all variables employed in the empirical analysis. Table 1 and Table 2 report summary statistics of the whole sample (sample 1) and EDF sample (sample 2), respectively.[11] Summary statistics present that both samples consist enough heterogeneous observations. Table A.3 and Table A.4 provide the correlation matrix between these variables for the whole sample and EDF sample, correspondingly and they indicate that correlations are not higher than acceptable levels. The top left side of Table A.3 shows the correlation between the alternative accounting-based risk measures employed in this study. The correlation is always significant and while it is positive between non-

[11] Table 1 and Table 2 summarize the data before corrupt observations are controlled for.

performing loans ratio and standard deviation of returns on assets, it is negative between non-performing loans ratio and z-index. Furthermore, the correlation between z-index and standard deviation of return on assets is high as expected.

Table 1. Summary Statistics for Sample 1

Variable	Number of Observations	Mean	Std. Dev.	Min	Max
NPL	1748	18,790	66,661	0,000	851,300
Z-INDEX	1877	3,036	1,374	-1,948	9,226
STDROA	1890	2,544	3,798	0,001	22,977
ΔMP	1837	-1,337	2,379	-15,400	13,860
NRGAP	1890	0,031	3,781	-6,861	6,586
TGAP	1890	0,897	1,406	-1,005	4,545
ΔGDP	1890	1,441	2,229	-6,100	5,200
ΔSM	1784	0,002	0,163	-0,322	0,333
HHI	1890	944,618	30,625	866,702	993,264
SIZE	1889	7,222	2,361	1,007	12,044
LIQ	1889	42,847	25,159	1,500	99,800
CAP	1889	27,525	24,833	-112,105	100,000

Table 2. Summary Statistics for Sample 2

Variable	Number of Observations	Mean	Std. Dev.	Min	Max
EDF	290	1,390	1,890	0,010	13,210
ΔEDF	276	0,070	1,400	-8,470	10,170
ΔMP	280	-0,630	1,730	-4,750	3,500
NRGAP	294	-2,100	2,120	-3,660	3,610
TGAP	294	-0,062	0,582	-1,005	0,792
ΔIP	294	0,870	4,250	-10,200	6,400
ΔSM	266	-0,002	0,166	-0,322	0,333
SIZE	294	9,910	1,450	6,690	11,990
LIQ	294	28,770	9,520	6,000	51,600
CAP	294	14,120	8,380	6,200	61,100

In what follows, we comment on the choice of our bank risk-taking and explanatory variables.

The choice of measures accounting for banks' risk is of particular importance for our empirical analysis. Measuring risk is a complicated issue and there is no specific proxy for bank risk-taking, First of all, risk taking refers to the amount of uncertainty a lender is willing to hold in his/her portfolio. For a bank, this corresponds to the division between risky and risk-free assets in its balance sheet, but we cannot always observe this portfolio composition. Therefore, some alternative measures have been used to measure the extent of banks' risk tolerance (Gaggl and Valderrama, 2010). The previous literature suggests using either accounting-based measures or market-based measures. In the light of these, we proxy risk-taking behavior of banks by using three alternative accounting-based indicators, namely the ratio of non-performing loans to total loans, z-index and standard deviation of return on assets, in addition to one market-based indicator, which is the EDF. These indicators are considered to reveal different type of risk related information and reflect diverse aspects of risk-taking, hence each has its own advantages and disadvantages as measures of bank-risk taking. In other words, neither of them is more accurate or superior to another, but rather complementary to each other in capturing the main dimension of bank risk. Accordingly, in an effort to confirm and complement our results, we choose to experiment with various risk measures for examining the relationship between changes in interest rates and bank risk – taking in our analysis.

The first measure of bank-risk taking utilized in this study is the ratio of non-performing loans to total loans, which is an extensively used accounting based indicator of bank fragility. This ratio gives an indication of the asset quality in terms of the potential adverse exposure to earnings and market values of equity due to worsening loan quality. Accordingly, non-performing loans ratio is generally viewed to reflect credit or loan portfolio risk of a bank and higher levels of this ratio indicate a riskier loan portfolio since a part of non-performing loans would probably result in losses for the bank (Delis and Kouretas, 2011). Unlike the other measures for bank risk such as z-index or standard deviation of bank's return on assets, which reflect the insolvency risk, this measure directly refers to credit risk and hence, more strongly related to the theoretical discussion provided in section 3.2. However, it should be noted that this measure is a backward looking indicator and might be subject to managerial judgment (Fiordelisi et al., 2010).

The second indicator constructed from balance sheet information accounting for bank risk is the z-index, which is a universal measure of individual bank fragility.[12] It is a proxy for the probability of bank's insolvency and inverse measure of its overall risk. Z-index combines in a single measure the profitability, leverage and return volatility. It is given by the ratio:

$$Z_i = \frac{ROA_i + E/TA_i}{\sigma(ROA_i)} \qquad (1)$$

where ROA_i is the return on assets for bank i, E/TA_i represents the equity to total assets ratio for bank *i* and $\sigma(ROA_i)$ stands for the standard deviation of return on assets of bank *i* over the period under study. It shows the number of standard deviations a return realization has to fall so as to deplete equity capital. In other words, it represents the probability of a negative shock to profits that forces bank to default (Yeyati and Micco, 2003). While z-index increases with higher profitability and capitalization levels, it decreases with unstable earnings captured by the standard deviation of return on assets. Therefore, larger values of z-index imply higher bank stability and lower overall risk i.e.; lower risk-taking.

We calculate bank specific z-indexes by using net profits to total assets and equity to total assets ratios respectively. Following Cihak et al. (2009), we use a three-year rolling time window for calculating standard deviation of returns on assets $\sigma(ROA_i)$ in order to depict the changing pattern of return volatility of banks.[13] Furthermore, given that z-index is highly skewed, we use natural logarithm of z-index, which is normally distributed, following Leaven and Levine (2009).

An important point to note is that, z-score comprises the return or loss on all activities of the bank, whereas non-performing loans ratio is directly related to traditional banking activities (Angkinand and Wihlborg, 2008). Furthermore, a higher probability of default may stem from the general macroeconomic conditions, which may have an impact on the components of z-index exogenously. In that case, this variable may not necessarily show the risk taking incentive of banks (Delis et al., 2011). In other words, while non-performing loans

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[12] For studies using z-index as a measure of financial soundness or risk-taking, see ,among others; De Nicolo et al. (2003), Demirgüç-Kunt et al. (2006), Angkinand and Wihlborg (2008), Berger et al. (2009), Tabak et al. (2010), Delis et al. (2011).

[13] We also experiment to calculate $\sigma(ROA_i)$ by using different number of quarters, but results are found to be very similar.

ratio corresponds to loan risk, this measure is better viewed as insolvency risk. When these drawbacks of z-index are taken into account, we favor non-performing loans ratio more from the standpoint of our analysis.

Finally, standard deviation of bank's asset returns is employed as the third proxy for banks' risk exposure derived from accounting information. Besides using z-index, which is a compound measure of bank risk, we choose to examine volatility of asset returns separately as a more simple measure. Again, we use a three-year rolling time window to calculate standard deviation of returns on assets $\sigma(ROA_i)$.

In addition to the classic measures derived from the accounting data, we use, as an additional measure of bank risk, EDF, which relies on market information and is computed by Moody's KMV. Build on Merton (1974) model of corporate bond pricing, EDF is a forward looking measure that refers to the probability that a company will fail to make a scheduled debt payment within a given time horizon. It is calculated using data on banks' financial statements, stock market information and stock market, and Moody's proprietary bankruptcy database. Financial institutions, central banks, supervisors and investors use EDF figures to observe the health of both individual banks and whole financial system[14] (Fiordelisi et al., 2010). Besides, this indicator has been widely employed as a measure of risk-taking in the recent related empirical literature as in Gambacorta, 2009; Altunbaş et al., 2009a, 2010; Fiordelisi et al., 2010; Huang et al., 2010. Accordingly, we include one-year EDF as an ex-ante measure of credit risk into our analysis. A limitation of using Moody's EDF is that it restricts sample to 14 banks, as EDF data is not available for all banks in our sample. Nonetheless, we have chosen to analyze that sample separately for which we had the necessary information covering the 2007q1-2012q1 period.

In addition to bank risk-taking measures, interest rate variable is another key measure to our analysis since the main focus of our study is to examine the impact of interest rate changes on risk-taking by banks. Many empirical studies (Jımenez et al. (2009); Ioannidou et al.(2009); Brissimis and Delis (2010); Tabak et al. (2010); Delis and Kouretas (2011)) have employed the change in overnight rates, quarterly interbank rates or the German interbank rates as a of measure monetary policy stance with the assumption that interest rates has reached to historical low levels. However; it is difficult to separate the impact of monetary

[14] See for instance; ECB (2011), IMF (2012).

policy changes on bank risk-taking on two different areas: first, the risk of outstanding loans and second, banks' appetite to take on new risk. As pointed out in section 2 in more detail, a drop in the interest rates has a positive direct impact on lending portfolios whereas a fall in the interest rates below the benchmark has a negative effect since 'search for yield' causes an overall increase in new risk-taking (Altunbaş et al., 2010). In the light of these, we include both the quarterly change in the interbank interest rate to control for the direct effect of interest rates on bank risk-taking and the deviation of interest rate from a benchmark level to assess the monetary policy stance following Altunbaş et al. (2010). Since a drop in interest may not necessarily imply excessive low rates, a benchmark would provide a measure for how low is actually low and as we are concerned with the impact of relatively low rates, this approach is closer to our empirical propositions.

More specifically, the crucial point is to what extent the interest rate that is significant for the banks' risk-taking is determined by monetary policy, since the fact that interest rates are low does not necessarily imply that central bank is conducting an expansionary monetary policy. It could also be the case that the general level of interest rates, or the natural interest rate, is low for reasons which have nothing to do with the monetary policy and indeed the central bank may have just adjusted its policy to these low interest rates. In that case, banks would take on more risk due to low general level of interest rates, but unrelated with the monetary policy. Accordingly, examining the relationship between short-term interest rates and risk-taking may be interesting in itself, but it does not necessarily imply that there is a risk-taking channel acting through monetary policy. Because; not the low interest rates themselves, but the impact of the difference between short real interest rate and the natural rate should be ascribed to the monetary policy. Therefore, one needs to distinguish the general level of interest rates and monetary policy in order to capture the impact of monetary policy on risk-taking, i.e. the link between the risk-taking and how expansionary monetary policy is (Apel and Claussen, 2012).

Another point to note is that interbank interest rates may be endogenous to general macroeconomic conditions. Moreover, causality may run in both directions between interest rates and bank-risk taking, if monetary authority takes interest rate decisions by considering credit market conditions. However, this is does not seem to hold exactly for Turkey, since the CBRT did not systematically take into account banking sector conditions on its policy rate decisions. Furthermore, as stated by Aydın and Igan (2010) endogeneity of the policy is less of a problem as policies have been designed to act anchors following the 2000-2001 crisis. Nevertheless, employing a specific benchmark level would still provide us an exogenous measure of monetary policy stance and is more favorable for the purposes of our analysis.

Considering all these and in line with Gambacorta (2009) and Altunbaş et al. (2010), we adopt a benchmark measure, which is the difference between the real short-term interest rate and the 'natural interest rate', calculated by means of the Hodrick-Prescott filter. Alternatively, we employ another interest rate gap measure, which is dictated by Taylor rule [15], as in Altunbaş et al. (2010). In order to ensure robustness, we experiment with this measure as well; however we use natural interest rate gap as our main measure of relative monetary policy in the analysis, since estimating Taylor rule type of interest rate gap presents some well-known limitations and may result in different findings with respect to other indicators.[16]

As the primary concern of this study is the relationship between bank risk and monetary policy, we control for a number of factors including bank specific characteristics and macroeconomic conditions that may have an effect on bank risk-taking attitude in an attempt to isolate the impact of monetary policy. By doing so, we expect to shed light on which of these factors do have an impact on risk of the banks as well.

Turning to macroeconomic variables, we control for the state of the macroeconomic conditions by GDP growth in our specification. Following Altunbaş et al. (2010), we include the quarterly changes in stock market returns to capture improvements in borrowers' net worth and collateral.[17] We further include HHI, which is a widely used measure of

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[15] First presented in Taylor (1993),Taylor rule suggests a simple way to formulate monetary policy. It stipulates how the central bank should change its policy rate as output and inflation deviated from certain levels. Algebraically, it could be expressed as: $i_t = r^* + \beta_\pi(\pi_t - \pi^*) + \beta_y\,(y_t - y_t^*)$, where i_t is the policy interest rate, r^* is equilibrium real interest rate, π_t is the inflation rate, π^* is the target inflation rate and $(y_t - y_t^*)$ is the output gap (the deviation of the actual GDP from its long-term potential level). Taylor (1993,2001) proposed setting $\beta_\pi = \beta_y = 0.5$.

[16] For instance, Apel and Claussen (2012) state that using Taylor rate as a measure of the degree of expansionary monetary policy is problematic, because Taylor rate is typically based on a constant, long-term neutral real interest rate. More specifically, when inflation is on target and at the same time, production is equal to its potential, the policy rate must be at the long-term normal (natural) level. Furthermore, another drawback of Taylor rule is that it may lead to serious different findings depending on the methods employed in calculating the output gap and/or real interest rates, since they are unobservable.

[17] To capture the evolution of asset prices, Altunbaş et al. (2010) employ quarterly changes in the housing price index as well. However, we could not use this measure in our model, since it is not available for Turkey.

concentration and a proxy for competition in the literature, to account for the impact of market concentration on bank-risk taking. HHI is calculated as the sum of squared market shares in terms of total assets of all banks.

We expect individual bank characteristics to affect the impact of monetary policy on banks' risk exposure as bank incentives are at the centre of the functioning of the risk-taking channel (Altunbaş et al., 2012). At the bank-level, we control for liquidity, capitalization and size as appealing measures of bank financial soundness that show the banks' ability and willingness to supply additional loans, since these factors may affect the risk-taking behavior of banks. We use the ratio of liquid assets to total assets for liquidity; the ratio of shareholders' equity to total assets for capitalization; and natural logarithm of total assets for size.

4. The Econometric Model and Methodology

Our empirical approach to test whether changes in monetary policy stance affect bank-risk-taking relies on a series of panel regressions. First, we present the models that use accounting-based risk indicators and then, introduce the specifications with EDF as our dependent variable.[18]

The following baseline model is used to assess the impact of low short-term interest rates on accounting-based bank risk measures:

$$r_{i,t} = \alpha + \beta r_{i,t-1} + \sum_{j=0}^{1} \gamma_j \, \Delta MP_{t-j} + \sum_{j=0}^{1} \delta_j \, NRGAP_{t-j} + \sum_{j=0}^{1} \theta_j \, \Delta GDP_{t-j} + \epsilon_{i,t} \qquad (2)$$

with *i=1,……,N* and *t=1,….., T* where *N* is the number of banks and *T* is the final quarter. $r_{i,t}$ represents one of our accounting based indicator namely, change in non-performing loans ratio, z-index or standard deviation of banks' asset returns. In the above equation (2), each risk indicator is regressed on changes in monetary policy indicator (ΔMP), which is three-month interbank rate; the natural interest rate gap ($NRGAP$); and nominal GDP growth rate

[18] The period analyzed and the number of banks is different for models employing EDF and other risk measures.

(ΔGDP). In all estimations, we include time effects to control for unobservable time-varying shocks that might influence monetary policy stance and banks' risk-taking appetite.

The estimated value of the coefficient of the natural interest rate gap variable is the primary focus of our analysis, since it is associated with the risk-taking channel and shows whether banks take more risk when interest rates are below benchmark level. Accordingly, we expect the coefficient of the natural interest rate gap to be negative. On the contrary, the coefficient of the interest rate is expected to be positive as lower interest rates are supposed to decrease bank risk on the outstanding loans, i.e. at the short run. Regarding the nexus between the output growth and bank risk-taking, the relationship is not clear. On the one hand, number of profitable projects could rise with better economic conditions, thus reducing the overall credit risk of the banks (Kashyap et al., 1993; Altunbaş et al., 2010). On the other hand, banks might increase their lending and undertake more risk in search for yield despite of the favorable economic conditions.

We extend the baseline model by introducing quarterly changes in the stock market returns (ΔSM):

$$r_{i,t} = \alpha + \beta r_{i,t-1} + \sum_{j=0}^{1} \gamma_j \, \Delta MP_{t-j} + \sum_{j=0}^{1} \delta_j \, NRGAP_{t-j} + \sum_{j=0}^{1} \theta_j \, \Delta GDP_{t-j} + \sum_{j=0}^{1} \varphi_j \, \Delta SM_{t-j} + \epsilon_{i,t} \qquad (3)$$

We expect to find a negative coefficient for this variable, since a rise in asset prices would increase the collateral value and reduces the bank risk.

Then, we account for the banking industry concentration using Herfindahl- Hirschman Index *(HHI)*, leading to equation (4) below:

$$r_{i,t} = \alpha + \beta r_{i,t-1} + \sum_{j=0}^{1} \gamma_j \, \Delta MP_{t-j} + \sum_{j=0}^{1} \delta_j \, NRGAP_{t-j} + \sum_{j=0}^{1} \theta_j \, \Delta GDP_{t-j} + \omega HHI_t + \epsilon_{i,t} \qquad (4)$$

Previous literature on the banking market concentration and bank fragility provide mixed results; while some studies (e.g. De Nicolo et al., 2004; Boyd et al., 2006; De Nicolo and Loukoianova, 2007; Uhde and Heimeshoff, 2009) find a positive relationship between risk of bank failure and concentration, the others (e.g.Beck et al., 2006; Schaeck et al., 2006; Schaeck and Cihak, 2007; Yeyati and Micco, 2007) suggest that an increase in banking market concentration is associated with lower level of risk taking and hence, lower probability of failure. Non-performing loans and banking market concentration are found to be uncorrelated in some studies as well (e.g. Jimenez et al., 2007). Against this background, we don't have a particular expectation regarding the impact of our concentration measure on bank risk-taking.

We also consider bank-specific variables including size ($SIZE$), liquidity (LIQ), and capitalization (CAP), which may affect the relationship between bank risk and monetary policy. The choice of the bank specific characteristics are in line with the previous empirical literature on the bank lending channel (Kashyap and Stein, 2000; Kishan and Opiela, 2000; Van Den Heuvel, 2002; Ehrmann et al.,2003) To this end, we estimate equation (5) that relates changes in the riskiness of banks to their individual characteristics, together with the macroeconomic conditions:

$$r_{i,t} = \alpha + \beta r_{i,t-1} + \sum_{j=0}^{1} \gamma_j \, \Delta MP_{t-j} + \sum_{j=0}^{1} \delta_j \, NRGAP_{t-j} + \sum_{j=0}^{1} \theta_j \, \Delta GDP_{t-j} + \tau SIZE_{i,t-1} + \phi LIQ_{i,t-1} + \psi CAP_{i,t-1} + \epsilon_{i,t} \quad (5)$$

where all bank specific characteristics refer to *t-1* primarily to avoid endogeneity bias. Furthermore, all of them are normalized with respect to their average across all banks in their respective samples.[19]

Regarding the impact of capital, liquidity, and size on bank risk-taking, the theoretical and empirical literature provides contradictory results. Hence, the signs of the coefficients of these bank-specific characteristics are ambiguous. Concerning the impact of bank capital on risk, we expect to find a negative coefficient as higher equity capital provides a buffer to withstand negative shocks and implies more prudent bank behavior. This expectation is in line with empirical literature that predominantly supports the view that higher levels of capital help banks to raise their probability of survival and their profitability during times of crisis (Berger and Bouwman, 2010). On the contrary, higher capital ratios might be associated higher overall risk if there are agency problems between managers and shareholders that lead to excessive risk-taking via managerial rent-seeking or if regulators force riskier banks to

[19] In what follows, we will modify the baseline model with the interaction effects. As stated in Delis and Kouretas (2011) "A problem with the inclusion of interaction effects is the severe multicollinearity between the multiplicative term and its constituents." Hence, we deal with this problem by normalizing the bank-specific variables.

increase their capital (Altunbaş et al., 2012). Focusing on the impact of liquidity on bank risk, while liquid banks are considered to be more risk averse, it could be the contrary since they may take on more risk as a result of the higher cost of holding liquid assets with low returns. If we turn to the impact of size; on the one hand, large banks may undertake higher levels of risky assets since they are more capable in managing risk and have an easier access to external funds when needed. On the other hand, larger banks may be more risk-averse, which can be attributed to tighter supervision and better access to capital markets (Delis et al., 2011).

In the final specification, we aim to analyze whether monetary policy fluctuations have a differential effect on bank-risk taking attitude owing to certain individual balance sheet characteristics following the similar approach extensively used in the empirical studies of the bank lending channel. For this reason, we re-formulate equation (2) and include the interactions of the NRGAP variable with our bank specific characteristics; liquidity, capitalization, and size, respectively.

$$r_{i,t} = \alpha + \beta r_{i,t-1} + \sum_{j=0}^{1} \gamma_j \, \Delta MP_{t-j} + \sum_{j=0}^{1} \delta_j \, NRGAP_{t-j} + \sum_{j=0}^{1} \theta_j \, \Delta GDP_{t-j} + \zeta SIZE_{i,t-1} * \Delta NRGAP_t + \lambda LIQ_{i,t-1} * \Delta NRGAP_t + \kappa CAP_{i,t-1} * \Delta NRGAP_t + \epsilon_{i,t} \quad (6)$$

By estimating the above equation (6), we expect to shed light on whether there exists heterogeneity in the impact of monetary policy (actually in a too low direction) on bank-risk taking. More specifically, the significance of the coefficients associated with the interaction terms between monetary policy and bank characteristics shows the distributional effects of monetary policy due to these characteristics, allowing the identification of changes in risk-taking following a change in the monetary policy. In this framework, we expect that the impact of a monetary policy change on bank risk taking will be lower for big, liquid and well-capitalized banks.

Next, we present the specifications based on EDF to examine the link between low interest rates and bank-risk taking. For our EDF sample, which comprises a panel of 14 banks with the data covering the period 2007q1-2012q1, we first consider the following generic equation:

$$\Delta EDF_t = \alpha \Delta EDF_{t-1} + \beta \Delta MP_{t-1} + \gamma NRGAP_{t-1} + \delta \Delta IP_{t-1} + \varepsilon \qquad (7)$$

with $t=1, \ldots, T$ where T is the final quarter. Quarterly changes in expected default frequency (ΔEDF) is regressed on its one year lag; the change in monetary policy indicator (ΔMP); the natural interest rate gap ($NRGAP$); the change in industrial production index (ΔIP);[20] in the equation (7), which is the best fitted model in terms of coefficient significance.

In general, we follow with the same strategy which we adopted in the analysis using accounting-based measures for the bank risk. To this end, we estimate the following equations:

$$\Delta EDF_t = \alpha \Delta EDF_{t-1} + \beta \Delta MP_{t-1} + \gamma NRGAP_{t-1} + \delta \Delta IP_{t-1} + \varphi \Delta SM_{t-1} + \varepsilon \quad (8)$$

$$\Delta EDF_t = \alpha \Delta EDF_{t-1} + \beta \Delta MP_{t-1} + \gamma NRGAP_{t-1} + \delta \Delta IP_{t-1} + \theta HHI + \varepsilon \quad (9)$$

$$\Delta EDF_t = \alpha \Delta EDF_{t-1} + \beta \Delta MP_{t-1} + \gamma NRGAP_{t-1} + \delta \Delta IP_{t-1} + \tau SIZE_{t-1} + \phi LIQ_{t-1} + \psi CAP_{t-1} + \varepsilon \quad (10)$$

$$\Delta EDF_t = \alpha \Delta EDF_{t-1} + \beta \Delta MP_{t-1} + \gamma NRGAP_{t-1} + \delta \Delta IP_{t-1} + \zeta SIZE_{i,t-1} + \lambda LIQ_{i,t-1} * \Delta NRGAP_t + \kappa CAP_{i,t-1} * \Delta NRGAP_t + \varepsilon \quad (11)$$

The models have been estimated using the generalized methods of moments (GMM) estimator for dynamic panel data models developed by Arellano and Bover (1995) and Blundell and Bond (1998)[21]. This approach allows us to cope with a number of identification challenges and hence, it is the appropriate estimation method for several reasons.

We choose to estimate a dynamic empirical model, in which we introduce the lagged dependent variable among regressors that accounts for the persistence and dynamic nature of risk, as many empirical and theoretical studies indicate that bank-risk taking behavior is

[20] In the models that we use EDF as our dependent variable, we have employed change in the industrial production index instead of the growth rate of GDP; because the GDP data for 2012q1 is not available at the time of this study.

[21] All empirical analyses in this study are done with STATA version 10.

highly persistent. Delis and Kouretas (2011: 846) present four theoretical reasons to explain the dynamic nature of bank risk:

> First, persistence may reflect the existence of intense competition, which tends to alleviate the risk-taking of banks (e.g. Keeley, 1990; Cordella and Yeyati, 2002). Second, relationship-banking with risky borrowers will have a lasting effect on the levels of bank risk-taking, despite the fact that dealing repeatedly with the same customer will improve efficiency. A similar mechanism would prevail given bank networks or if the banking industry is opaque. Third, to the extent that bank risk is associated with the phase of the business cycle, banks may require time to smooth the effects of macroeconomic shocks. Fourth, risks may persist due to regulation. In particular, deposit guarantees or capital requirements may exacerbate moral hazard issues, leading to inefficient and risky investments over a considerable period of time.

Another point other than these theoretical considerations is the fact that a dynamic formulation approximates the potential impact of stock variables on flow variables better. When these are all taken into account, the application of a dynamic panel data model is more appropriate, since a static model would be biased under these conditions.

Furthermore, interest rates are considered to be endogenous in bank risk equations. In other words, the direction of causality between monetary policy and bank risk is not obvious and hence, it is needed to control the reverse causality as a special form of endogeneity. Other than the monetary policy variable, some of the control variables are not strictly exogenous as well. The potential endogeneity between risk and bank specific characteristics, which are explanatory variables in our model, presents another identification problem. In this context, the GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998) is the convenient strategy as it accommodates both for the persistence of risk and possible endogeneity of bank specific characteristics by using appropriate instruments, which are their lagged levels.[22]

This estimator ensures efficiency and consistency, provided that the dynamic regression model is not subject to second-order serial correlation and that the instruments used are valid. Accordingly, we employ AR(1) and AR(2) tests for first and second-order autocorrelation. While first-order autocorrelation could be expected in the first differenced residuals, the p-value of AR(2) should be large accepting the null hypothesis of no serial

[22] Another benefit of the Blundell- Bond estimator is that it does not breakdown in the presence of unit roots as well. For proof; see Binder et al.(2003) (Delis and Kouretas, 2011).

correlation of order two in first differences of the errors. Because higher order autocorrelation would imply that lags of the dependent variable is not actually endogenous and, hence bad instruments. Furthermore, the validity of the instruments is checked by using Sargan test for over-identifying restrictions.

In the next section, we will proceed with the presentation and interpretation of the results of our empirical analysis.

5. Estimation Results

Estimation results for non-performing loans ratio, z-index, standard deviation of the return on assets and EDF with the natural interest rate gap variable are respectively reported in Tables 3, 4, 5 and 6. We first consider the results of the models that use the three accounting-based risk measures namely; non-performing loans ratio, z-index and standard deviation of the return on assets, as the dependent variable and then proceed with the models with EDF as the risk-taking measure.

In tables 3, 4, 5 regression specification (I) reports our baseline regression results obtained from the estimation of equation (2) with the Blundell-Bond estimator. Regression specifications (II) and (III) presents the estimation results of equations (3) and (4) augmented with the stock market return and concentration measures to account for the impact of asset prices and banking market concentration on banks' risk-taking, respectively. Regression specification (IV) reports the outcomes of the estimation of equation (5), which comprises bank-specific characteristics namely; size, liquidity and capitalization to control for the effect of these individual bank characteristics on the relationship between monetary policy and bank-risk. Finally, regression specification (V) presents the results obtained from the estimation of equation (6) and shows the distributional effects of interest rates on bank risk-taking due to individual bank characteristics.

Table 3. Regression Results: NPL

Dependent variable:NPL	(I) Baseline Model		(II) Accounting for stock market effect		(III) Accounting for market concentration		(IV) Bank Specific Characteristics		(V) Distributional effects due to bank charactérisitcs	
	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error
ΔNPL_{t-1}	0.581***	0.001	0.580***	0.001	0.576***	0.001	0.576***	0.001	0.583***	0.001
ΔMP_t	0.119***	0.004	0.091***	0.009	0.086***	0.006	0.106**	0.016	0.065***	0.009
ΔMP_{t-1}	0.158***	0.004	0.163***	0.008	0.162***	0.009	0.184***	0.100	0.134***	0.014
$NRGAP_t$	-0.046***	0.004	-0.041***	0.004	-0.036***	0.005	-0.060***	0.005	-0.046**	0.022
$NRGAP_{t-1}$	-0.043***	0.003	-0.060***	0.006	-0.062***	0.008	-0.030***	0.010	-0.013*	0.011
ΔGDP_t	-0.423***	0.004	-0.371***	0.004	-0.363***	0.005	-0.401***	0.119	-0.347***	0.014
ΔGDP_{t-1}	-0.139***	0.005	-0.098***	0.005	-0.092***	0.006	-0.140***	0.008	-0.043***	0.008
ΔSM_t			-0.001***	1.870						
ΔSM_{t-1}			-0.004***	1.250						
HHI					-0.020***	0.001				
$SIZE_{t-1}$							-0.256***	0.026		
LIQ_{t-1}							-0.054***	0.001		
CAP_{t-1}							-0.006***	0.001		
$SIZE_{t-1} * NRGAP_t$									0.300***	0.008
$LIQ_{t-1} * NRGAP_t$									0.031***	0.001
$CAP_{t-1} * NRGAP_t$									0.026***	0.001
Sample period	2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4	
Number of observations	1388		1388		1388		1388		1388	
Sargan test (p-value)	0.289		0.311		0.692		0.415		0.309	
AR(1), AR(2) (p-value)	0.011, 0.226		0.000, 0.415		0.000, 0.325		0.008, 0.297		0.000, 0.223	

Note: * Significance level of 10%
** Significance level of 5%
*** Significance level of 1%

We start with the results of the models using non-performing loans ratio as dependent variable. As shown in Table 3, the monetary policy stance measured by the change in the short term interest rate enters the regression specification (I) as being significantly positive at the one percent level, suggesting that a decrease in short term interest rates has a positive impact on the loan portfolio quality and thereby, financial soundness of banks. In other words, bank risk-taking (i.e. banks' non-performing loans ratio) decreases if interest rates are lowered. This is consistent with the findings of the previous empirical literature (Jimenez et al., 2009; Altunbaş et al., 2010) that lower short term interest rates reduce the credit risk of outstanding loans. Lower rates make loan repayment easier by decreasing the interest burden of the borrowers, which in turn, lead to lower loan default rates. As stated in Altunbaş et al. (2010) the drop in the quality of the loan portfolio is probably further strengthened by the reduction of banks' funding liquidity costs following the decrease in the short term interest rates (Diamond and Rajan, 2009; Adrian and Shin, 2009). Another point to note is that this positive impact of low interest rates on credit risk of bank portfolios might also stem from the fact that the volume of outstanding loans outweighs the new loans in the short term, and hence this effect primarily corresponds to a shorter-term phenomenon as it has also been established as a short-term effect of low interest rates by Jimenez et al. (2009).

The natural rate gap, which is the difference between the real short-term interest rate and the natural interest rate, has a negative and significant coefficient. This result implies that when short-term interest rates are below a benchmark level, banks increase their risk-taking. In other words, relatively low levels of interest rates cause either a decrease in risk perception or an increase in risk tolerance. This result gives evidence of a change in risk perception or risk tolerance and accordingly, it confirms the impact of the risk-taking channel of monetary policy transmission. This finding is consistent with Altunbaş et al. (2010) as well.

If we look at the estimation results from specification (I) in Table 3, we see that if the interest rate is 100 basis points below the natural interest rate value, the average probability of loan default increases by 0.09 percent after a quarter and by 0.2 in the long run. Therefore; the strength of the risk-taking channel, i.e. the negative effect of low interest rates on banks' risk profile, increases in the long-run.

Concerning the impact of macroeconomic variables, GDP growth enters the regression significantly negative at the one-percent as shown in first column of Table 3, implying that the probability of loan default is negatively related with the growth rate of GDP. Favorable economic conditions is associated with an increase in the number of projects becoming profitable in terms of expected net present value, and which in turn lead to a reduction in overall credit risk of a bank (Kashyap and Stein, 1993; Altunbaş et al., 2010). Moreover, borrowers would earn more and accordingly, their capability to pay back their loans would be higher in times of good economic outlook. This result is consistent with the findings of Gambacorta (2009), Altunbaş et al. (2010) and Lopez et al. (2012), whereas it is in stark contrast to Delis and Kouretas (2011) who provide evidence of a positive relationship between GDP growth and risk in the European banking sector. One possible interpretation for this positive relationship is that in times of good macroeconomic stance banks tend to grant more credit in search for high yield, and also soften their screening standards. However, as our results indicate this is not the case for Turkish banking system.

The results displayed in regression specification (II) of Table 3 show that the coefficient for the change in stock market return is significant and negative, which is consistent with our prior expectations. This result indicates that an increase in stock market prices cause a reduction in banks' risk. A possible interpretation is that a boost in assets prices leads to an increase in collateral value and hence, borrowers' net worth, which in turn result in a lower overall credit risk. In addition to that, increase in asset prices may also have an impact on the bank risk via a higher value for banks' securities portfolio. This finding is in line with Borio and Zhu (2008) and Altunbaş et al. (2010). However, it should be noted that with regard to the risk-taking channel of monetary policy, it is posited that the boosts in asset and collateral values lead to a change in risk perception or risk tolerance, making both borrowers and banks to accept higher risk-taking in the long run.

As regression specification (III) in Table 3 reports, the concentration measure HHI appears to be negative and statistically significant at the one per-cent level. As higher values of HHI imply more concentration and possibly less competition, the negative coefficient of this variable suggests that as concentration in the Turkish banking sector increases or conversely competition decreases, non-performing loans ratio and hence; the loan risk of banks declines. With regard to the risk-taking channel of monetary policy, this result supports the search for yield hypothesis put forward by Rajan, (2006) and the transmission mechanism implied in Dell' Ariccia and Marquez (2006), as it suggests that intensified competition lead to higher pressure on profits, which in turn creates incentives for banks to search for higher yield and engage in more risky projects, resulting in excessive risk-taking. Other than this, in more competitive markets banks are expected to earn less informational rents from their relationship with borrowers, which might reduce their incentives to tightly screen borrowers and, eventually cause an increase in bank fragility (Boot and Greenbaum, 1993; Allen and Gale, 2000, 2004; Beck, 2008; Michalak, 2010).

However, this result should be evaluated cautiously since the related literature regarding the impact of the banking market structure on bank fragility posits that structural measures of competition like concentration ratios and non-structural measures of competition of measures, calculated from firm level data are different proxies and accordingly, measures different aspects of competition in the market.[23] Therefore, results of the analysis might be sensitive to the market structure variable employed. However, as our primary concern is not on the bank market concentration-financial fragility nexus, this point is not critical from the standpoint of our analysis.

As regression specification (IV) in Table 3 reports, the three bank-specific characteristics enter the regression significantly negative at one-percent level. The negative coefficient of the size variable implies that larger banks take on lower levels of non-performing loans and hence, have a better loan portfolio quality. In other words, loan risk tend to be lower in larger banks, which gives support to the hypothesis that larger banks are more risk averse than smaller banks. Larger banks may be able to diversify loan portfolio risks more efficiently stemming from their comparative advantages in providing credit monitoring services (Carletti and Hartmann, 2003; Demsetz and Strahan, 1997) and higher economies of scale and scope (Berger *et al.*, 2007; Allen and Liu, 2007). Furthermore, larger banks may ration credit more heavily, as they lend fewer borrowers with higher credit quality, the loan portfolio quality and hence, financial soundness of the bank would increase (Michalak, 2001).

Notably, our result regarding bank size is contrary to the 'too big to fail' paradigm. Large banks may have greater incentives to take risk than smaller banks as a result of the moral hazard problems created by 'too big to fail' paradigm. Additionally, it could be high competition that could provoke larger banks to engage in more risky projects. However, this does not seem to be the case for Turkey, since Turkish banks operate in a monopolistic competitive structure, instead of a competitive environment, as stated in Abbasoğlu et al. (2007) and Yaldız and Bazzana (2010). When these are taken into account, our result on the size variable is reasonable and also consistent with our prior expectations. Notably, the coefficient associated with the size variable is significantly larger than that of liquidity and capital, suggesting size as a more effective indicator in risk-taking behaviour of banks when compared to the other two characteristics.

[23] Furthermore, there are some studies in the empirical literature saying that concentration might not be a good measure of the degree of competitiveness in banking system (e.g. Beck et. al, 2006); high concentration banking markets may indeed be competitive.

With regard to bank-specific variables, the coefficient of liquid assets to total assets is negative and significant in the regression specification (IV) in Table 3, suggesting that banks with higher liquidity levels tend to have lower non-performing loans and hence, face lower loan risk. Banks that are more liquid are perceived as being safer by the market, as they could be able to meet unexpected withdrawals by liquidating their assets promptly. Accordingly, banks carry higher level of securities to serve as buffer stocks to cushion the adverse effects of shocks and hence, to protect themselves against risk. On the other hand, it could be the case that liquid banks undertake more risk, since holding liquid assets with low yields cause higher costs, which in turn prompts banks to shift their investments towards more risky projects. However, this does not seem to hold for the Turkish banking system. Furthermore, the negative impact of liquidity on bank risk is contrary to the regulatory hypothesis, which states that regulators encourage banks to hold more liquidity to cover the risks being taken (Altunbaş et al., 2007). Therefore, our results suggest that banks in Turkey choose to keep certain amounts of risk-free securities in their balance sheet mainly because of the risk mitigating character of the liquid assets. In other words, the level of liquid assets in banks' balance sheets is primarily driven by their risk aversion motives. Finally, our result regarding liquidity differs from Jimenez et al. (2009) and Iannidou et al. (2009), who find positive relationship between bank liquidity and risk, whereas it is in line with Gambacorta (2009) and Altunbaş et al. (2010).

Among the bank-specific characteristics, capital enters the regression specification (IV) significant and negative, showing that well-capitalized banks carry less non-performing loans and have a lower risk-taking. The negative impact of capital on bank risk suggest that banks with higher equity to assets ratios have less moral hazard incentives to take on more risk and tend to behave more prudently. Accordingly, they hold capital as buffers against assets side risk to withstand losses, together with the effect of strict capital requirements. This result confirms the expectation that well-capitalized banks are more risk averse than their not so well-capitalized peers. Furthermore, it could also be inferred that well-capitalized banks in Turkey do not tend to engage in risky projects in an attempt to maximize revenues. Another interpretation is that regulators or markets do not force riskier banks to accumulate capital (Altunbaş et al. 2012), that is to say they do not have to offset risk by higher levels of capitalization. Moreover, our result is in line with the moral hazard hypothesis, which suggests that when the level of bank capital is low, bank managers have more incentives to take on excessive risk stemming from the existence of agency problems between bank managers and shareholders (e.g. managers undertake risk which are entirely borne by the owners) (Fiordelisi et al., 2010). In sum, we could state that in the Turkish banking system, banks with higher capital levels tended to have a better loan portfolio quality and enjoy lower levels of credit risk.

Finally, regression specification (V) in Table 3 presents estimation results for size, liquidity, and capitalization interaction with the natural rate gap, showing the distributional effects of changes in monetary policy stance on bank risk due to individual bank characteristics. In other words, these results shows whether certain bank characteristics lead to heterogeneous response in bank risk-taking related to monetary policy. The coefficients of the interactions between the natural rate gap and bank characteristics; size, liquidity, and capital, enter the regression positive significantly at the one-percent level, suggesting that banks with different characteristics maintained different risk strategies when interest rates are relatively low during the period under consideration.

Regarding the distributional effects of low interest rates on bank risk, our result implies that larger banks are able to absorb the impact of low interest rates on non-performing loans and thus, on their credit risk. In other words, the impact of a monetary policy change in a too low direction would have a higher effect on the level of risk of smaller banks. While banks on average undertake higher loan risk in the relatively low interest rate periods, larger banks do not have to engage in more risky projects in search for yield, as they have more power in the market for interbank resources and could also rely on different businesses for income generation and diversify their earnings. As this is not the case for smaller banks, their risk-appetite increases more than their larger counterparts when interest rates are low.

Concerning with the distributional effect of capital on the interest rates-bank risk nexus a positive and significant coefficient is found on the interaction term of the capitalization with natural rate gap. This result suggests that the insulation effects on risk in response to low interest rates are lower for banks with higher equity to total assets ratio. As higher levels of equity capital serve banks as buffer against excess loan losses and hence, to withstand to adverse shocks, more capitalized banks tend to increase risk-taking to a smaller extent than less-capitalized ones.

The positive and significant coefficient of the interaction term of liquidity with the natural rate gap shows that the impact of low interest rates on non-performing loans is diminished for banks with higher liquidity ratios. As banks could avert from higher risk exposure by holding more liquid assets in their portfolio, liquid banks are less vulnerable to risk-taking. In other words, banks with higher levels of liquid assets, which are more risk averse, would have lower incentives to engage in risky projects in a low interest rate environment. On the contrary, the impact of low interest rates on risk-taking would be stronger for banks with less liquid balance sheets.

Table 4 reports the estimations results when z-index is used as the dependent variable, in an attempt to see whether our results hold when this measure is considered as a proxy for bank risk. Since z-index is an inverse measure of overall bank risk, i.e. higher the value of z-index lower the risk, we expect the opposite signs on the estimated coefficients when the z-index replaces the other risk measures used in our analysis as the dependent variable and hence, one should interpret the results accordingly.

Table 4. Regression Results: Z-index

Dependent variable: Z-index	(I) Baseline Model		(II) Accounting for stock market effect		(III) Accounting for market concentration		(IV) Bank Specific Characteristics		(V) Distributional effects due to bank characterisitcs	
	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error
Z_index_{t-1}	0.773***	0.004	0.760***	0.005	0.746***	0.007	0.756***	0.001	0.750***	0.006
ΔMP_t	-0.090***	0.004	-0.114***	0.009	-0.118***	0.009	-0.108**	0.001	-0.115***	0.009
ΔMP_{t-1}	-0.044***	0.004	-0.043***	0.007	-0.046***	0.008	-0.039***	0.001	-0.471***	0.006
$NRGAP_t$	0.064***	0.003	0.062***	0.005	0.058***	0.006	0.060***	0.001	0.061**	0.006
$NRGAP_{t-1}$	0.014***	0.001	0.021***	0.003	0.027***	0.003	0.018***	0.001	0.021*	0.004
ΔGDP_t	0.047***	0.003	0.098***	0.010	0.077***	0.008	0.098***	0.002	0.099***	0.010
ΔGDP_{t-1}	0.061***	0.005	0.093***	0.010	0.081***	0.008	0.091***	0.002	0.093***	0.001
ΔSM_t			0.002***	2.340						
ΔSM_{t-1}			0.002***	2.980						
HHI					-0.001***	0.001				
$SIZE_{t-1}$							-0.093***	0.004		
LIQ_{t-1}							0.001***	0.002		
CAP_{t-1}										
$SIZE_{t-1} * NRGAP_t$									-0.006***	0.004
$LIQ_{t-1} * NRGAP_t$									0.0006	0.003
$CAP_{t-1} * NRGAP_t$										
Sample period	2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4	
Number of observations	1783		1783		1783		1783		1783	
Sargan test (p-value)	0.197		0.217		0.183		0.129		0.113	
AR(1), AR(2) (p-value)	0.001, 0.896		0.000, 0.513		0.000, 0.881		0.000, 0.557		0.001, 0.336	

Note: * Significance level of 10%
** Significance level of 5%
*** Significance level of 1%

Regression specification (I) in Table 4 presents the estimation results for the baseline model. While we find a positive and significant coefficient for the natural rate gap variable, the coefficient for the change in the short term interest rate is negative and significant, confirming our previous finding on the risk-taking channel. The negative coefficient of the monetary stance measured by the change in short term interest rate implies that softer monetary conditions decrease banks' overall risk, similar to the result that we find for the non-performing loans, which is a measure for loan portfolio risk. Accordingly, we could interpret this result as lower interest rates make loan repayment easier for borrowers which would result in lower loan default rates and hence, lower overall riskiness of banks. The positive coefficient of the natural rate gap variable suggests that interest rates below the natural interest rate benchmark lead to an increase in banks' appetite for risk, giving evidence to risk-taking channel. Regarding the macroeconomic variables, GDP growth enters the regression significantly positive at one per-cent level. Moreover, the stock market returns variable is significantly positive at the one-percent level as regression specification (II) in Table 4 shows. The signs of the GDP growth and stock market returns variables reconfirm the results of our baseline model with NPL as our dependent variable.

On the other hand, introducing the HHI to account for the market concentration, this variable enters the regression significantly negative at the one-percent level as shown in the regression specification (III) in Table 4. This outcome is in contrast to our result regarding market concentration when non-performing loans ratio is employed as banks' risk measure, since it implies that riskiness of banks rises when concentration in the market increases or inversely competition decreases. In other words, it indicates that increasing the banking market concentration has a negative impact on the Turkish banks' financial soundness. That is to say, the direction of the impact of concentration on bank risk differs for these two measures of bank risk. This could stem from the fact that these indicators measure diverse aspects of bank risk; while z-index measures the overall risk by taking into account the return on assets, capitalization level and the return volatility, non-performing loans ratio accounts only for the risk arising from loan portfolio of banks. When these are taken into consideration, our results regarding the impact of market concentration on non-performing loans and z-index can be interpreted as, while lower levels of concentration in the Turkish banking sector lead to riskier loan portfolios, it depresses the overall riskiness of banks stemming from all of the operations alongside the supply of credit. Therefore, it could be the case that banks may hold higher capital or use other risk management methods to mitigate higher loan risk and hence, have safer portfolios overall (Berger et. al., 2009).

Concerning the impact of bank specific variables on z-index[24], while size enters the regression significantly negative at one-percent level, liquidity has a positive and significant coefficient in regression specification (IV) in Table 4. The negative coefficient of size variable implies that large banks tend to engage in more risky projects and exposed to more overall bank risk. We do not interpret this result as a contradiction to our previous finding on the impact of size on bank risk, suggesting that larger banks take on lower levels of credit risk. Indeed, we interpret those opposing results as, while larger banks hold considerably less non-performing loans and have less risky loan portfolios than their smaller counterparts; smaller banks enjoy greater overall stability as a result of their higher capitalization levels. That is to say, since a higher value for z-index either comes from higher capital and/or earnings level or lower variability in earnings, it would be the case that the lower overall risk of smaller banks may result from their high levels of capitalization, as smaller banks tend to be better capitalized in Turkish banking system. The positive and significant coefficient of liquidity supports our previous finding that liquid banks are more risk averse. In other words, banks holding higher levels of liquid assets in their portfolio are associated with lower overall risk.

Regarding the distributional effects of low interest rates on overall bank risk owing to individual bank characteristics, we find only bank size to have a distributional effect in regression specification (V) in Table 4. This result suggests that the impact of low interest rates on riskiness is less severe for larger banks. This result may seem inconsistent with our previous result regarding bank size in specification (IV), which implies that larger banks have less overall risk. However, this result could be interpreted as larger banks have superior hedging techniques to reduce portfolio volatility, which enables them to buffer the impact of low interest rates on the overall risk. Furthermore, liquidity does not seem to have a distributional effect when z-index is used as proxy for risk-taking as its coefficient is found to be insignificant in regression specification (IV) in Table 4. However, z-index is rather a measure of insolvency risk and more loosely related to our considerations on risk-taking, we favor non-performing loans ratio as a measure of bank-risk taking more. Therefore, it could be suggested that the distributional effect of liquidity on the low interest rates –bank risk nexus is better captured in non-performing loans equations.

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[24] Among bank-specific characteristics, capitalization is not included as an explanatory variable in the regression where z-index is employed as dependent variable; since the ratio of equity to total assets is used to compute z-index as well.

Table 5. Regression Results: STDROA

Dependent variable: STDROA	(I) Baseline Model		(II) Accounting for stock market effect		(III) Accounting for market concentration		(IV) Bank Specific Characteristics		(V) Distributional effects due to bank characterisitcs	
	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error
$STDROA_{t-1}$	0.559***	0.007	0.538***	0.008	0.449***	0.008	0.409***	0.013	0.543***	0.012
ΔMP_t	0.014***	0.002	0.032***	0.002	0.039***	0.002	0.030**	0.002	0.031***	0.002
ΔMP_{t-1}	0.054***	0.002	0.053***	0.002	0.056***	0.002	0.057***	0.002	0.052***	0.003
$NRGAP_t$	-0.010***	0.001	-0.008***	0.001	-0.012*	0.001	-0.006***	0.001	-0.008***	0.001
$NRGAP_{t-1}$	-0.027***	0.001	-0.022***	0.001	-0.020***	0.001	-0.026***	0.001	-0.021**	0.002
ΔGDP_t	-0.020***	0.002	-0.045***	0.002	-0.027***	0.002	-0.046***	0.002	-0.046***	0.002
ΔGDP_{t-1}	-0.034***	0.001	-0.049***	0.001	-0.036***	0.001	-0.049***	0.001	-0.048***	0.002
ΔSM_t			0.0001	7.300						
ΔSM_{t-1}			0.0001	4.650						
HHI					-0.007*	0.0001				
$SIZE_{t-1}$							-0.169***	0.007		
LIQ_{t-1}							-0.0011*	0.001		
CAP_{t-1}							-0.010*	0.040		
$SIZE_{t-1} * NRGAP_t$									0.011**	0.007
$LIQ_{t-1} * NRGAP_t$									0.001***	0.002
$CAP_{t-1} * NRGAP_t$									0.005***	0.001
Sample period	2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4	
Number of observations	1730		1730		1730		1730		1730	
Sargan test (p-value)	0.143		0.158		0.155		0.168		0.189	
AR(1), AR(2) (p-value)	0.000, 0.598		0.000, 0.691		0.000, 0.838		0.000, 0.733		0.000, 0.784	

Note: * Significance level of 10%
** Significance level of 5%
*** Significance level of 1%

Table 5 reports the estimation results when standard deviation of return on assets, our third accounting-based risk measure, is used as the dependent variable. Our main findings are reiterated. While coefficient of the change in short-term interest rate is positive and significant, the coefficient of the natural rate gap variable remains negative and highly significant, which are consistent with our results obtained by using the non-performing loans ratio and z-index. Besides, the sign of the GDP variable and HHI index remain robust as well. On the other hand, in contrast to our previous results, the coefficient of the stock market returns variable has incorrect sign and is found to be insignificant in regression specification (III) in Table 5. The coefficients of our bank-specific characteristics are negative and significant, suggesting that large, liquid and well-capitalized banks are more risk averse. Therefore, regarding the individual bank characteristics' impact on risk, our volatility of assets returns regression (IV) in Table 5 confirms the findings to those of non-performing loans ratio equations. Furthermore, previous findings regarding the distributional effects of size, capital and liquidity in the regression specification (V) in Table 3 continue to hold when return volatility is used as the dependent variable.

Table 6. Regression Results: EDF

Dependent variable: ΔEDF	(I) Baseline Model		(II) Accounting for stock market effect		(III) Accounting for market concentration		(IV) Bank Specific Characteristics		(V) Distributional effects due to bank characteristics	
	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error
ΔEDF_{t-1}	0.149***	0.022	0.129***	0.033	0.121***	0.019	0.128***	0.049	0.109***	0.100
ΔMP_{t-1}	0.446***	0.104	0.265***	0.040	0.211***	0.025	0.409***	0.078	0.417***	0.089
$NRGAP_{t-1}$	-0.208***	0.048	-0.144*	0.050	-0.118***	0.042	-0.154***	0.068	-0.109***	0.058
ΔIP_{t-1}	-0.045*	0.027	-0.024*	0.019	-0.088***	0.006	-0.014*	0.033	-0.054*	0.024
ΔSM_{t-1}			-0.002*	0.001						
HHI					-0.053***	0.002	-0.956*	1.642		
$SIZE_{t-1}$							-0.058*	0.098		
LIQ_{t-1}							-0.336***	0.168		
CAP_{t-1}									-0.928***	0.025
$SIZE_{t-1} * NRGAP_t$									0.006**	0.004
$LIQ_{t-1} * NRGAP_t$									-0.005*	0.003
$CAP_{t-1} * NRGAP_t$										
Sample period	2007q1-2012q2		2007q1-2012q2		2007q1-2012q2		2007q1-2012q2		2007q1-2012q2	
Number of observations	262		262		262		262		262	
Sargan test (p-value)	0.585		0.423		0.412		0.383		0.214	
AR(1), AR(2) (p-value)	0.150,0.198		0.140,0.138		0.380,0.178		0.007, 0.379		0.017, 0.256	

Note: * Significance level of 10%
** Significance level of 5%
*** Significance level of 1%

Table 6 reports the coefficient estimates obtained from the estimation of equations (7)-(11), using EDF as the dependent variable and a different sample than previous estimations. The estimation results in Table 6 verify that the risk-taking channel is still in place when a market-based risk indicator, EDF, is used as the risk measure. The results from the EDF variable corroborate our results established so far. First of all, the coefficients associated with the monetary policy indicator and natural rate gap measures have the correct signs and are significant. Therefore, a fall in monetary policy still reduces bank risk measured with EDF by lowering the credit risk on outstanding loans and risk-taking channel is still in place; as banks take on more risks when interest rates are below the benchmark rate. The coefficient of the industrial production index, which we include to control for macroeconomic activity, is negative and significant at ten-percent level in all regression specifications in Table 6, showing a negative relation between good economic conditions and bank risk. Furthermore, the stock market index variable enters the regression specification (II), supporting our previous finding that a boost in asset prices lead to a reduction in overall credit risk by increasing collateral values. In regression specification (III), the coefficient of the HHI is found to be negative and significant, which is consistent with our previous finding in the non-performing loans ratio regression. As regression specification (IV) reports, the effects of size, liquidity and capital on bank risk are negative, implying that large, liquid and well-capitalized tend to take on less risk. Note that the results are similar to the one obtained in the non-performing loans ratio regression. However, in this case bank size and liquidity lose on statistical significance, but remain significant at ten percent. Turning to distributive effects, the positive and significant coefficients of the interaction term between bank characteristics and natural rate gap confirms our previous finding that the impact of low interest rates on bank risk is less severe for large, liquid and well capitalized banks. Consequently, our results are very similar to those observed when accounting-based risk measures are employed as the dependent variable.

The robustness of these results has been checked by considering an alternative benchmark dictated by Taylor rule instead of natural rate gap variable as a measure of accommodative monetary policy. In an attempt to confirm our previous results and to see if we could detect the risk-taking channel yet again, using Taylor rule gap, we rerun equations (2)-(6) for non-performing loans ratio, z-index and standard deviation of return on assets and equations (7)-(11) for EDF as dependent variables. The construction of the Taylor rule gap measure is discussed in detail [25] and further, the results of the estimations are provided in the Tables A.5- A.8 in the Appendix.

In general, the results are very similar and consistent with those for the models that use the natural rate gap as a measure of monetary policy stance. Notably, the sign and the significance of the coefficients attached to the monetary policy indicator and the benchmark measures do not change drastically. However, the magnitude of these coefficients has changed in most cases. Specifically, the magnitude of the coefficient for Taylor rule gap is higher compared with that of the coefficients attached to natural rate gap (except the models where EDF is employed as the risk measure), suggesting a stronger risk-taking channel.[26] In other words, the results are even more in favor of the existence of a risk-taking channel when a Taylor rule dictated benchmark is employed. The coefficients associated with the stock market returns and HHI have correct signs and are found to be significant in most specifications. Regarding impact of the bank-specific characteristics on bank risk and the distributive effects owing to these certain characteristics, there are some slight changes in terms of significance and magnitude of the coefficients. Remarkably, some coefficients change sign, but no longer are significant.

To conclude, the effects of change in the short term interest rate on banks' risk is positive, whereas the impact of short term monetary policy rate below the benchmark rate on risk-taking is negative, irrespective of the variable used to proxy bank risk-taking. Thus, the results of our analysis provide evidence in favor of existence of a risk-taking channel in Turkey during the period considered.

6. Conclusion

The recent global financial crisis that unfolded into recession in 2008 has raised many questions about the conduct of monetary policy. Particularly, it has drawn attention of researchers and policy makers to the relationship between monetary policy and financial stability and has brought this issue to the forefront of the economic policy debate. Moreover,

[25] The derivation of a Taylor rule for Turkey could be subject to many criticisms, however our main point is not to analyze monetary policy rule or examine the efficiency of Turkish monetary policy regime, but just to provide a simple benchmark in order to assess the relative stance of the monetary policy. Therefore, the concerns regarding whether it is reasonable to approximate the behavior of the CBRT by the proposed Taylor rule is beyond the scope of this study.

[26] This is especially true for the specifications which use the non-performing loans ratio as the dependent variable, since the magnitude of coefficient of the Taylor rule gap variable is significantly high.

it has motivated some recent developments in the theory of monetary policy transmission mechanism. As one of these developments, the risk-taking channel of monetary policy (Borio and Zhu, 2008) is a recent theory that examines the potential link between monetary policy and risk perceptions in the financial markets. Particular emphasis has been put on how monetary policy stance impacts risk perceptions and risk appetite of financial intermediaries. According to the propositions of the risk-taking channel, very low levels of interest rates following monetary expansions may induce an increase in the risk-taking of banks and financial institutions, leading a shift in the supply of credit.

The mechanisms through which monetary policy may impact banks' and other financial institutions' risk-taking are complex, including several different aspects. Risk-taking channel could operate through 'search for yield' in the presence of rigid nominal target returns, which may reflect either nature of contracts or behavioral aspects such as money illusion. Other set of effects operate through the procylical valuation of assets, incomes and cash flows, whereas another way the risk-taking channel may operate is through the communication policies and reaction function of the monetary authority, such as the insurance effect produced by the perception that the central bank reaction function is effective in cutting off large downside risk. Apart from these, there exist many other theoretical explanations about the operation of the risk-taking channel as well.

Although the empirical literature on risk-taking channel is growing, it is rather limited for the time being. In addition to the fact that risk-taking channel is a relatively recent issue, the difficulty to separate its effects from the other transmission channels and complexity to measure risk has been other some other factors that give rise to this admittedly scant literature as well. However, an increasing number of recent studies explore the potential interaction between monetary policy stance and banks' risk-taking in an attempt to assess if a risk-taking channel of monetary policy is actually take place. Most of them provide evidence of the existence of this channel, establishing that monetary policy is not neutral from a financial stability perspective.

This study contributes to the growing empirical literature on the risk-taking channel of monetary policy by investigating the bank specific characteristics of risk-taking behavior of the Turkish banking sector as well as the existence of risk taking channel of monetary policy in Turkey. In particular, it is the first study that investigates the evidence of this channel in Turkey. Moreover, it adds to the literature on risk-taking channel by providing evidence from a emerging market as most studies of the existing studies are related to developed countries.

Using bank- level quarterly data over the period 2002-2012, a dynamic panel model is estimated to examine risk of Turkish banks in response to changes in monetary policy stance. Our sample accounts for 53 banks that have been active in Turkey during the period. To deal with the potential endogeneity between risk and bank specific characteristics, which are explanatory variables in our model, the GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998) is used. Four alternative risk measures are used in the analysis; three accounting-based risk indicators and a market-based indicator- EDF.

We find evidence that low levels of interest rates have a positive impact on banks' risk-taking behavior for all the risk measures. Specifically, we find that the effects of change in the short term interest rate on banks' risk is positive, whereas the impact of short term monetary policy rate below the benchmark rate on risk-taking is negative, irrespective of the variable used to proxy bank risk-taking. Regarding the bank-specific characteristics, we find that size, liquidity and capitalization affect risk-taking behavior. While we find that liquid and well-capitalized banks to take on higher credit risk, an interesting result is found about the relationship between size and banks' risk-taking. Larger banks hold considerably less non-performing loans and have less risky loan portfolios than their smaller counterparts; smaller banks enjoy greater overall stability as a result of their higher capitalization levels. Moreover, our empirical analysis reveals that large, liquid and well-capitalized banks are less prone to take risks in response to a change in monetary policy stance. In sum, although it is not possible to draw firm conclusions, our study provides evidence in favor of the existence of a risk-taking channel in Turkey over the period 2002-2012.

In the light of these facts, our findings point to several policy considerations. First of all, when setting monetary policy, central bank should take into account the banking sector conditions since our empirical results suggest that monetary policy and financial stability are interrelated. In other words, monetary policy is not neutral from a financial stability perspective and, hence monetary policy is able to mitigate or at least, offset some negative consequences of financial instabilities on the real economic activity. Accordingly, examining the risk-taking of banks can guide policy makers in providing advice on the possible actions that could help in maintaining financial stability. Furthermore, the fact that bank specific characteristics; such as capitalization and liquidity, seem to play a central role in Turkish banks' lending and risk-taking behavior shows the power of the effective regulation and supervision over these characteristics. Therefore, efficient regulation and supervision is an important factor in providing prudent bank behavior. Moreover, the global financial crisis and debates regarding the role of the risk-taking channel in that crisis bring about policy discussions on macroprudential regulations and supervision. As stated in Apel and Claussen (2012), if the risk-taking channel is at the heart of the emergence of the global crisis, there could be two possible explanations about why the supervision and regulatory activities at the micro level did not detect the excessive risk-taking before the financial crisis. First one is that methods which microprudential supervision and regulation used before the financial crisis were not developed enough to notice the risks in the individual bank- level, suggesting strengthening the traditional microprudential supervision and making it more effective as a solution. The second explanation is that these methods of microprudential regulations were well-developed; however risk could build up at the macro level, and in that case, the problems in individual institutions did not seem serious enough for microprudential regulation to be on the alert. This view underlines the importance and need for macroprudential regulation and supervision. Notably, the interaction between macroprudential regulation and monetary policy is an important issue for Turkey as well.

APPENDIX

Table A.1. Banks in the Dataset

Name of the Bank	Type	Ownership category	
Adabank A.Ş.	Deposit	Domestic private	
Ak Uluslararası Bankası A.Ş.	Deposit	Foreign subsidiary	Acquired by Akbank T.A.Ş in 2005
Akbank T.A.Ş.	Deposit	Domestic private	
Aktif Yatırım Bankası A.Ş.	Development and Investment	Domestic private	
Alternatif BankA.Ş	Deposit	Domestic private	
Anadolubank A.Ş	Deposit	Domestic private	
Arap Türk Bankası A.Ş.	Deposit	Foreign subsidiary	
Bank Mellat	Deposit	Foreign branch	
Bank Pozitif Kredi ve Kalkınma Bankası	Development and Investment	Foreign subsidiary	
Birleşik Fon Bankası A.Ş.	Deposit	Domestic public	
Citibank A.Ş.	Deposit	Foreign subsidiary	
Credit Agricole Yatırım Bankası Türk A.Ş.	Development and Investment	Foreign subsidiary	
Credit Lyonnais S.A.	Deposit	Foreign branch	Acquired by Credit Agricole Indosuez Türk Bank A.Ş. (Credit Agricole Yatırım Bankası Türk A.Ş.) in 2004
Denizbank A.Ş.	Deposit	Foreign subsidiary	
Deutsche Bank A.Ş.	Deposit	Foreign subsidiary	
Diler Yatırım Bankası	Development and Investment	Domestic private	
Eurobank Tekfen A.Ş.	Deposit	Foreign subsidiary	
Fiba Bank A.Ş.	Deposit	Domestic private	Acquired by Finans Bank A.Ş. in 2003
Fibabanka A.Ş.	Deposit	Foreign subsidiary	
Finans Bank A.Ş.	Deposit	Foreign subsidiary	
Fortis Bank A.Ş.	Deposit	Foreign subsidiary	Acquired by Türk Ekonomi Bankası A.Ş. in 2011.
GSD Yatırım Bankası A.Ş.	Development and Investment	Domestic private	
Habib Bank Limited	Deposit	Foreign branch	
HSBC Bank A.Ş.	Deposit	Foreign subsidiary	
İller Bankası	Development and Investment	Domestic public	
İMKB Takas ve Saklama Bankası A.Ş.	Development and	Domestic private	

Table A.1. continued

Name of the Bank	Type	Ownership category	
	Investment		
ING Bank A.Ş.	Deposit	Foreign subsidiary	
ING Bank N.V.	Deposit	Foreign branch	Dissolved in 2003
JPMorgan Chase Bank N.A.	Deposit	Foreign branch	
Koçbank A.Ş.	Deposit	Domestic private	Acquired by Yapı ve Kredi Bankası A.Ş. in 2006
Merrill Lynch Yatırım Bank A.Ş.	Development and Investment	Foreign subsidiary	
Nurol Yatırım Bankası A.Ş.	Development and Investment	Domestic private	
Pamukbank T.A.Ş.	Deposit	Domestic public	Acquired by Türkiye Halk Bankası A.Ş. in 2004
Societe Generale (SA)	Deposit	Foreign branch	
Şekerbank T.A.Ş	Deposit	Domestic private	
Taib Yatırım Bank A.Ş.	Development and Investment	Foreign subsidiary	
Tekstil Bankası A.Ş	Deposit	Domestic private	
The Royal Bank of Scotland N.V.	Deposit	Foreign branch	
Turkish Bank A.Ş	Deposit	Domestic private	
Turkland Bank A.Ş.	Deposit	Foreign subsidiary	
Türk Ekonomi Bankası A.Ş.	Deposit	Domestic private	
Türk Eximbank	Development and Investment	Domestic public	
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	Deposit	Domestic public	
Türkiye Garanti Bankası A.Ş.	Deposit	Domestic private	
Türkiye Halk Bankası A.Ş.	Deposit	Domestic public	
Türkiye İmar Bankası T.A.Ş.	Deposit	Domestic private	Dissolved in 2003
Türkiye İş Bankası A.Ş.	Deposit	Domestic private	
Türkiye Kalkınma Bankası A.Ş.	Development and Investment	Domestic public	
Türkiye Sınai Kalkınma Bankası A.Ş.	Development and Investment	Domestic private	
Türkiye Vakıflar Bankası T.A.O.	Deposit	Domestic public	
Unicredit Banca di Roma S.p.A.	Deposit	Foreign branch	Dissolved in 2008
Yapı ve Kredi Bankası A.Ş.	Deposit	Domestic private	
WestLB AG	Deposit	Foreign branch	

Note: The table is based on author's gathering of information on the records provided as of 01 April 2011 by the Banks Association of Turkey. The statute of many banks has been subject to some changes during the period analyzed and these are not reported in the table for the sake of brevity. Accordingly, the ownership category reports the current status for the banks operating as end of 2011, while it is based on the status at time of the exit for the closed banks.

Table A.2. Description of the Variables

Variable	Symbol	Description
Expected Deafult Frequency	EDF	Expected Default Frequency (1 year ahead)
Non-performing loans	NPL	Non-performing loans (gross)-to-total loans*100
Z-index	Z_index	Computed as the sum of the ratio of return on assets (ROA) and the ratio of equity to total assets divided by the standard deviation of ROA. Calculated at the three-year rolling time window.
Standard deviation of ROA	STDROA	The standard deviation of return on assets; calculated three-year rolling time window.
Interest rate	MP	Short-term interbank rate
Natural rate gap	NRGAP	Difference between short-term interbank rate and the natural interest rate
Taylor Rule Gap	TGAP	Difference between short-term interbank rate and that generated by a standard 'Taylor Rule'
GDP growth	GDP	Quarterly changes in real GDP at constant 1998 prices, seasonally adjusted
Industrial production index	IP	Quarterly changes in industrial production index
Stock markets returns index	SM	Continuously compounded percentage rate of return based on daily ISE-100 index
Herfindahl-Hirschman index	HHI	Herfindahl-Hirschman index computed as the sum of squared assets market share of banks
Size	SIZE	Log of total assets (million TRY)
Liquidity	LIQ	Liquid assets-to-total assets*100
Capital	CAP	Shareholders 'equity-to-total assets*100

Table A.3. Correlation Matrix for Sample 1

	NPL	Z-INDEX	STDROA	MP	NRGAP	TGAP	ΔGDP	ΔSM	HHI	SIZE	LIQ	CAP
NPL	1.000											
Z-INDEX	-0.105	1.000										
	(0.000)											
STDROA	0.121	-0.832	1.000									
	(0.000)	(0.000)										
MP	-0.061	0.366	-0.371	1.000								
	(0.011)	(0.000)	(0.000)									
NRGAP	-0.032	0.002	-0.004	0.313	1.000							
	(0.183)	(0.091)	(0.085)	(0.000)								
TGAP	-0.031	0.094	-0.123	0.405	0.589	1.000						
	(0.225)	(0.000)	(0.000)	(0.000)	(0.000)							
ΔGDP	0.079	-0.123	0.120	-0.009	-0.368	-0.096	1.000					
	(0.001)	(0.000)	(0.000)	(0.700)	(0.000)	(0.000)						
ΔSM	0.051	0.120	-0.076	-0.184	-0.304	-0.104	0.292	1.000				
	(0.034)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)					
HHI	0.008	0.319	-0.255	-0.301	-0.319	-0.339	0.187	0.263	1.000			
	(0.716)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				
SIZE	-0.021	0.256	-0.324	-0.256	-0.006	-0.213	-0.045	0.014	0.147	1.000		
	(0.373)	(0.000)	(0.000)	(0.000)	(0.778)	(0.000)	(0.063)	(0.550)	(0.000)			
LIQ	-0.034	-0.172	0.112	0.046	0.015	0.008	-0.029	0.010	-0.017	-0.226	1.000	
	(0.163)	(0.000)	(0.000)	(0.055)	(0.513)	(0.732)	(0.226)	(0.678)	(0.463)	(0.000)		
CAP	0.009	0.114	0.268	-0.010	-0.018	-0.052	0.017	0.069	0.069	-0.520	0.038	1.000
	(0.691)	(0.000)	(0.000)	(0.680)	(0.446)	(0.022)	(0.483)	(0.004)	(0.004)	(0.000)	(0.113)	

Note: p -values in paranthesis.

Table A.4. Correlation Matrix for Sample 2

	EDF	MP	NRGAP	TGAP	ΔIP	ΔSM	HHI	SIZE	LIQ	CAP
EDF	1.000									
MP	0.151	1.000								
	(0.011)									
NRGAP	0.208	0.486	1.000							
	(0.000)	(0.000)								
TGAP	0.130	0.537	0.656	1.000						
	(0.026)	(0.000)	(0.000)							
ΔIP	-0.137	-0.381	-0.396	-0.412	1.000					
	(0.022)	(0.000)	(0.000)	(0.000)						
ΔSM	-0.337	0.040	-0.354	-0.483	0.395	1.000				
	(0.000)	(0.498)	(0.000)	(0.000)	(0.000)					
HHI	-0.132	-0.310	-0.462	-0.260	0.254	0.169	1.000			
	(0.028)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)				
SIZE	-0.046	-0.213	-0.002	-0.229	0.045	-0.060	0.029	1.000		
	(0.443)	(0.000)	(0.966)	(0.000)	(0.453)	(0.320)	(0.628)			
LIQ	-0.132	0.145	0.019	0.121	-0.010	0.029	-0.065	0.308	1.000	
	(0.027)	(0.015)	(0.758)	(0.037)	(0.866)	(0.621)	(0.312)	(0.000)		
CAP	-0.130	-0.062	-0.225	-0.042	0.115	0.243	0.071	-0.093	0.379	1.000
	(0.030)	(0.301)	(0.000)	(0.472)	(0.055)	(0.000)	(0.230)	(0.121)	(0.000)	

Note: p -values in paranthesis.

Definition of Taylor Rule Gap

We compute the Taylor rule gap (TGAP) as the difference between the three months interbank rate and the rate implied by the simple Taylor rule according to the formula:

$$i_t = r^* + \beta_\pi(\pi_t - \pi^*) + \beta_y(y_t - y_t^*).$$

Following Kannan (2008) and Khakimov et.al. (2010), we set 10 per cent real interest rate as the long-run real interest rate for Turkey. We use quarterly changes in the Consumer Price Index (CPI) extracted from OECD Economic Outlook Database. As the CBRT announces only annual end-of-year inflation target, we convert end-of-year inflation targets to quarterly series. Real GDP data is taken from the electronic data delivery system of the CBRT. The base year of national accounts is 1998=100. The seasonally adjusted series is then used to obtain the potential GDP by employing the classical Hodrick-Prescott filter. We set $\beta_\pi = 0.75$ and $\beta_y = 0.25$ given the heavy weight the CBRT put reducing inflation. Following the standard set-up for the Taylor rule, we put equal weights on inflation and output by setting $\beta_\pi = \beta_y = 0.5$ and hence, construct an alternative Taylor rule gap as well. Very similar results are obtained when this measure is used, however we report the results with the Taylor rule gap calculated by setting $\beta_\pi = 0.75$ and $\beta_y = 0.25$, which provide better fit.

Table A.5. Regression Results: NPL (Taylor Gap)

Dependent Variable:NPL	(I) Baseline Model		(II) Accounting for stock market effect		(III) Accounting for market concentration		(IV) Bank Specific Characteristics		(V) Distributional effects due to bank characteristics	
	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error
ΔNPL_{t-1}	0.583***	0.003	0.582***	0.005	0.580***	0.004	0.578***	0.008	0.586***	0.001
ΔMP_t	0.217***	0.050	0,236***	0.070	0.119***	0.070	0.235***	0.135	0.223***	0.159
ΔMP_{t-1}	0.124***	0.001	0.148***	0.080	0.098***	0.050	0.120***	0.114	0.153***	0.132
$TGAP_t$	-2.858***	0.209	-2,688***	0.530	-2.686***	0.047	-2.862***	0.434	-2.653***	0.106
$TGAP_{t-1}$	-2.558***	0.176	-2.421***	0.355	-2.100***	0.030	-2.434***	0.261	-2.820***	0.050
ΔGDP_t	-0.630***	0.005	-0.621***	0.007	-0.575***	0.004	-0.634***	0.008	-0.621***	0.007
ΔGDP_{t-1}	-0.073***	0.002	-0.086***	0.007	-0.096***	0.005	-0.113***	0.006	-0.017***	0.100
ΔSM_t			-0.023***	0.980						
ΔSM_{t-1}			-0.027***	0.680						
HHI					-0.015***	0.009				
$SIZE_{t-1}$							-0.310***	0.224		
LIQ_{t-1}							-0.001***	0.011		
CAP_{t-1}							-0.011***	0.008		
$SIZE_{t-1} * TGAP_t$									0.502***	0.330
$LIQ_{t-1} * TGAP_t$									0.062***	0.002
$CAP_{t-1} * TGAP_t$									0.072***	0.002
Sample period	2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4	
Number of observations	1388		1388		1388		1388		1388	
Sargan test (p-value)	0.490		0.413		0.547		0.318		0.386	
AR(1), AR(2) (p-value)	0.930, 0.310		0.810, 0.224		0.000, 0.305		0.160, 0.283		0.310, 0.274	

Note: * Significance level of 10%
** Significance level of 5%
*** Significance level of 1%

Table A.6. Regression Results: Z-index (Taylor Gap)

Dependent variable: Z-index	(I) Baseline Model		(II) Accounting for stock market effect		(III) Accounting for market concentration		(IV) Bank Specific Characteristics		(V) Distributional effects due to bank characteristics	
	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error
Z_index_{t-1}	0.767***	0.005	0.770***	0.008	0.768***	0.001	0.766***	0.010	0.720***	0.010
ΔMP_t	-0.014***	0.004	-0.013***	0.004	-0.021***	0.007	-0.010***	0.006	-0.017***	0.004
ΔMP_{t-1}	-0.003***	0.003	-0.002***	0.003	-0.005***	0.001	-0.002***	0.005	-0.003***	0.005
$TGAP_t$	0.163***	0.210	0.130***	0.400	0.177***	0.501	0.129***	0.620	0.186***	0.507
$TGAP_{t-1}$	0.126***	0.301	0.159***	0.309	0.092***	0.450	0.147***	0.400	0.154***	0.401
ΔGDP_t	0.144***	0.004	0.014***	0.006	0.017***	0.008	0.011***	0.007	0.015***	0.007
ΔGDP_{t-1}	0.032***	0.004	0.028***	0.004	0.032***	0.003	0.031***	0.006	0.037***	0.006
ΔSM_t			0.015***	1.050						
ΔSM_{t-1}			0.018***	0.940						
HHI					-0.001***	0.001				
CAP_{t-1}							-0.059***	0.030		
$SIZE_{t-1}$							0.002***	0.002		
$SIZE_{t-1} * TGAP_t$										
LIQ_{t-1}									-0.038***	0.030
$LIQ_{t-1} * TGAP_t$									0.003***	0.002
$CAP_{t-1} * TGAP_t$										
Sample period	2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4	
Number of observations	1783		1783		1783		1783		1783	
Sargan test (p-value)	0.216		0.282		0.381		0.289		0.391	
AR(1), AR(2) (p-value)	0.001, 0.667		0.001, 0.463		0.001, 0.607		0.001, 0.657		0.001, 0.576	

Note: * Significance level of 10%
** Significance level of 5%
*** Significance level of 1%

Table A.7. Regression Results: STDROA (Taylor Gap)

Dependent variable: STDROA	(I) Baseline Model		(II) Accounting for stock market effect		(III) Accounting for market concentration		(IV) Bank Specific Characteristics		(V) Distributional effects due to bank characteristics	
	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error
$STDROA_{t-1}$	0.649***	0.007	0.652***	0.007	0.650***	0.007	0.602***	0.110	0.647***	0.007
ΔMP_t	-0.002	0.001	-0.001	0.001	0005**	0.002	-0.003**	0.010	-0.002	0.010
ΔMP_{t-1}	0.007***	0.001	0.006***	0.002	0,009***	0.001	0.008***	0.001	0.007***	0.001
$TGAP_t$	-0.087***	0.120	-0.053***	0.140	-0.095***	0.170	-0.065***	0.130	-0.083***	0.130
$TGAP_{t-1}$	-0.112***	0.120	-0.146***	0.130	-0.078***	0.180	-0.125***	0.120	-0.103***	0.110
ΔGDP_t	-0.012***	0.001	-0.012***	0.002	-0.014***	0.001	-0.009***	0.015	-0.010***	0.001
ΔGDP_{t-1}	-0.022***	0.001	-0.017***	0.001	-0.022***	0.001	-0.020***	0.012	-0.019***	0.001
ΔSM_t			0.019***	1.190						
ΔSM_{t-1}			0.037***	2.240						
HHI					0.001***	0.0001				
$SIZE_{t-1}$							-0.082***	0.060		
LIQ_{t-1}							-0.001***	0.004		
CAP_{t-1}							0.004	0.005		
$SIZE_{t-1} * TGAP_t$									0.016***	0.020
$LIQ_{t-1} * TGAP_t$									-0.0001	0.003
$CAP_{t-1} * TGAP_t$									0.0004**	0.002
Sample period	2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4		2002q1-2011q4	
Number of observations	1730		1730		1730		1730		1730	
Sargan test (p-value)	0.195		0.262		0.265		0.283		0.385	
AR(1), AR(2) (p-value)	0.000, 0.244		0.000, 0.137		0.000, 0.198		0.000, 0.219		0.000, 0.262	

Note: * Significance level of 10%
** Significance level of 5%
*** Significance level of 1%

Table A.8. Regression Results: EDF (Taylor Gap)

Dependent variable: ΔEDF	(I) Baseline Model		(II) Accounting for stock market effect		(III) Accounting for market concentration		(IV) Bank Specific Characteristics		(V) Distributional effects due to bank characteristics	
	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error	Coeff.	S. Error
ΔEDF_{t-1}	0.170***	0.070	0.111***	0.022	0.120***	0.009	0.156***	0.017	0.165**	0.065
ΔMP_{t-1}	0.196***	0.023	0.145***	0.018	0.108***	0.017	0.150***	0.033	0.167***	0.032
$TGAP_{t-1}$	-0.115**	0.041	-0.116***	0.033	-0.159***	0.045	-0.090*	0.089	-0.149**	0.060
ΔIP_{t-1}	-0.008*	0.004	-0.017*	0.007	-0.008	0.005	-0.008*	0.005	0.0009	0.011
ΔSM_{t-1}			-0.013**	0.036						
HHI					-0.014***	0.003				
$SIZE_{t-1}$							-0.133*	0.398		
LIQ_{t-1}							-0.010*	0.019		
CAP_{t-1}							-0.013*	0.042		
$SIZE_{t-1} * TGAP_t$									0.085*	0.067
$LIQ_{t-1} * TGAP_t$									0.014*	0.014
$CAP_{t-1} * TGAP_t$									0.017	0.006
Sample period	2007q1-2012q2		2007q1-2012q2		2007q1-2012q2		2007q1-2012q2		2007q1-2012q2	
Number of observations	262		262		262		262		262	
Sargan test (p-value)	0.297		0.299		0.565		0.791		0.688	
AR(1), AR(2) (p-value)	0.013, 0.106		0.018, 0.114		0.015, 0.105		0.020, 0.189		0.025, 0.100	

Note: * Significance level of 10%
** Significance level of 5%
*** Significance level of 1%

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