BANK LENDING CHANNEL IN UKRAINE: THE EFFECT OF CAPITAL

by

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Abstract

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The paper studies a specific channel of monetary transmission mechanism – bank lending channel. The emphasis is made onto bank capital as a source of heterogeneous lending behaviour among banks due to monetary policy actions. The underlying idea is the extent of bank risk aversion as a function of its capital. Capital is defined to be independent factor of bank credit portfolio at the same time affecting lending response to exogenous policy. The study investigates viability of bank lending channel under both directions of central bank policy: expansionary and contractionary. It looks on comparative levels of risk aversion among three groups of banks ranged by capitalization. The results suggest that risk aversion decreases with the bank capital and this causes the latter to affect bank lending channel. Larger banks do thus instantaneously suffer more from capital requirements enlargement, but have better chances to build capital up further on than smaller banks do. The channel itself has been found to work only when transmitting restraining impulses of monetary authority to the real economy. This could be attributed to the powerful economic growth driving lending activity.

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GLOSSARY

Capital Adequacy – a certain level of capital bank is obliged to maintain proportionately to its risk-weighted assets. The higher is the capital adequacy the higher share of risk is loaded on bank owners, and the lower is the ratio-the more risk is loaded on bank creditors.

Channel of Monetary Transmission Mechanism – specific link of causation between several variables that starts from central bank's certain policy action and ends up at some real sector variable (e.g. output). A specific monetary policy action may be transmitted simultaneously through different channels of MTM. Viability of a certain channel depends on general economic environment and structure of financial system.

Monetary Transmission Mechanism – a process of monetary policy actions transmission into the real economic activity aimed at achievement of the central bank goals.

NBU – National Bank of Ukraine

Chapter 1

INTRODUCTION

The necessary condition to efficient and stable economy is the proper government regulation. It is perceived, however, that government should not make excessive use of its authority so as to avoid market mechanism distortion. In the developing countries such as Ukraine economy development relies greatly on the government policy conduct, although its control has relaxed over the last decade.

In this course monetary policy has been one of the driving sources of economy growth since 2000. It allowed the banking system to become the leader of economic and technological reforms in Ukraine. Monetary policy is one of the means of economy regulation. Its final goals is targeting of growth of output, high employment, low inflation.

A superficial perception of the way monetary impulses pass to real economy lies in impact of interest rate on investment, consumption and production. Traditional policy tools employed by the Central bank are: interest rate (the cost of Central bank's funds provided to support commercial banks or the cost of inter-bank loans); open market trade; and bank reserve regulation.

The effect of monetary actions onto target indicators of real economy can be transmitted through several "channels" as they are conventionally referred to in the literature. They are in essence more profound explanation of monetary policy work highlighting that "black box".

The major means of transmission are the values of various assets influenced by interest rate, demand for and supply of funds within the banking system.

A certain channel or a group of channels usually prevails in specific country or during certain period due to general economic, financial and institutional environment. Therefore notification about the channel of monetary transmission should be of special interest to policy makers so that they could use appropriate tools in targeting a given environment.

The aim of this thesis is to verify the existence and determinants of one of the monetary channels, namely bank lending channel. The core of the mechanism is the response of bank lending supply to monetary regulation holding response of respective demand aside. Preliminary justification of why that particular channel is supposed to be significant in Ukraine is correspondence of actual developments of financial market to theoretical underpinnings.

The role of capital in bank behavior as reaction to exogenous impulses is of particular interest for the author. The reason lies in the real world evidence: during recent years lending growth rate has been constantly ahead of capital. This leads banks to face with the problem of capital adequacy which is intensified by marking up mandatory capital adequacy requirements from 8% to 10% since March 2004. As such, a serious cut in lending might occur, moreover a necessity of capital injection, most probably from abroad, would be the most likely "salvation" of constrained banks. Then question arises: which banks are more likely to suffer from, partly, their "short-sighted" behavior? Won't these be large perceived strong banks? A similar result, called "credit crunch" came up in Japan in late 1990's when negative capital shock has brought banks to reduce their lending (Watanabe, 2003).

The aim of this thesis is to find out the effect of the policy instruments, the level of capital excess (shortage) over (under) the required minimum, and their interactive effect on the level of lending.

Ukrainian financial market is not diversified enough neither to gratify banks with fluent access to long funding (unreserved debt) nor allow them to substitute traditional loans for securities or investments. This suggests that highly capitalized banks are less able to make effective use of this property, compared, for example, to US banks. On the other part, lower interest rate attracts depositors to reliable high-capital banks more; hence they would augment their lending, amplifying significance of capital in monetary policy transmission mechanism. Depending on the level of risk-aversion of banks, which crucially depends on the level of capitalization, different banks are expected to make different decisions about the extent of lending changes in respond to monetary policy regulation.

I would like to investigate how monetary policy in Ukraine affects the level of lending in the context of bank capital adequacy for the next reasons:

i) To be able to conclude whether the capital affects lending channel of monetary policy in Ukraine and whether it is independent source of lending adjustment;

ii) Research for the U.S. banks showed in general more extensive drop in lending due to tight policy at low capitalized banks, whereas studies for European banks came up with less conclusive result;

iii) Investigated literature has not distinguished between the effects of different policy types on bank activity.

These have led me to undertake alternative approach in evaluating lending channel and the role of capital. Contribution of this thesis lies in:

- Explicit accent on risk aversion when evaluating bank lending behavior, which will allow to identify whether the capital is the source of lending channel and direction of capital influence;
- Distinguishing impacts of opposite policy directions, which will allow being more concrete in inferences of lending channel existence and strength.

C h a p t e r 2

THEORETICAL BACKGROUND. MONETARY TRANSMISSION MECHANISM

There are three traditional tools of monetary policy:

Open market operations: the CB trades the government securities (bonds) with the commercial banks in order to regulate their reserves, namely it sells/purchases government securities when extraction/injection of bank reserves are needed.

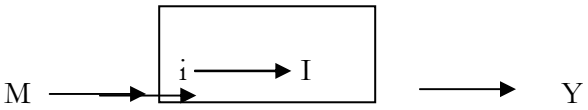
Discount policy: the CB sets the discount rate – the price of credit resources available to banks from the CB. As such the discount rate determines the market rates to the great extent, although sometimes it may have no real power.

Reserve requirements, applied to bank deposits. It is quite strong instrument, compared to the previous one, since it has compulsory and multiplied effect on the available. Higher requirements contracts resources that otherwise could be injected into economy and bring interest to the banks. Lower requirements to the contrary widen the monetary volume.

It follows that desired levels of targeted economic indicators are expected to be reached by regulation of monetary resources volume available to economic agents, and their price.

The process of transferring monetary signals to the real economy (production, employment) is referred to as monetary transmission mechanism (MTM). A theory about specific mechanism (channel) through which monetary tightening or

expansion affects aggregate output and consumption was initially presented by Keynesian structural model which explores interest-rate effect:



The model assumes that change in money supply influences interest rates, resulting in change of investments by firms (and durable consumption spending by households) and overall spending and output. Empirical evidence during the US Great Depression didn't confirm this channel to work, and this led Keynesians to doubt on the power of the monetary policy. Monetarists actively argued that the model support by evidence depends greatly on the appropriate definition of more narrowly specified channel via policy signals, transmitted in particular period and at the particular country.

Three major types of MTM

(According to Mishkin, 2001; Nualtaranee, 2004)

1. Traditional *interest rate channel* - as perceived by Keynesians. It says: money supply expansion brings agents to expect higher prices, i.e. inflation, hence lower real interest rates. This will induce them to invest more, thus driving total output and consumption up.

2. Group of channels that influence *other* than loan *assets prices*.

Exchange rate effect. Increase in money supply results in lower real interest rate due to expected inflation. Agents now demand deposits in foreign currency (or

deposits abroad), providing higher real interest, more attractive relative to domestic currency. This causes depreciation of the currency and higher demand for inside products from abroad. Thus, expansion of net export will expand overall output.

Tobin's q theory. q is a share of firm's market value to the cost of capital. Monetary transmission through the firm's value works as follows: monetary expansion increases aggregate demand, including that for stocks. Result is a higher market price of firm relative to the cost of capital. Hence, firms benefit from rise of their capital stock exceeds cost of investments. They will have stronger incentives to invest and expand production.

Wealth effect. This channel stems from lifetime consumption theory. Individuals smooth their consumption over time based on incorporating of lifetime resources, including financial (e.g. stocks). Expansionary monetary policy will have positive influence on private demand.

3. The third group includes two types of channels, that originate from the so called *"credit view".*

a) One, considered from the bank' aspect, is referred to as the "*bank lending channel*". It explains the transmission via bank balance sheets changes. Easy monetary regulation makes economic agents willing to put "extra' money at deposit in order to enjoy higher future gains. Also, open market operations and/or reserve regulation alter the available funds. Bank will then build-up their disposable resources and increase lending. Loans, in traditional view, are the source of investment and durable consumption, inducing growth of production and consumption.

Bank lending channel (BLC) on its own disregards the effect of monetary policy on loan demand. For it rests on the bank behaviour solely, it is also defined as the narrow credit channel or cost-of-capital channel.

b) The opposite and complementary side to the credit view, presented from a firm' aspect, comprises a few reasons of firms' response to monetary policy, particularly its demand for loans and its credibility. It is widely referred to as the *"Balance sheet channel*", while Mishkin (2001) marks out a few ways of firm balance sheet alteration:

Balance sheet channel, itself. Keeping track with the expansionary policy analysis, consider its impact on a representative firm's balance sheet. In line with Tobin's q theory, growth of investments induced by higher price of firms impairs adverse selection and moral hazard problems. Thus, demand for investment projects is met by reasonably stronger trust of banks, i.e. readiness to provide firms with funds. This expanded version of Tobin's q effect, therefore, explains increase in investment and output growth backed up by lending expansion.

Cash-flow channel. It develops traditional interest rate channel from such a point of view: lower interest rate naturally lowers borrower's cash expenses. Higher cash-flow makes firm more liquid, thus impairs adverse selection problem (lower interest rate attracts less risky projects, so banks will be more prone to lend, overcoming lower "profits" from loans).

Unanticipated price level channel. Relaxing monetary actions causes increase of prices. This brings real value of firms' deferred liabilities to fall, but real value of assets is assumed not to change. As a result, higher net worth, making adverse selection and moral hazard problems of less power, increases lending, investment, consumption and aggregate output.

Household liquidity effects. This channel represents, oppositely to the previous, response of individuals to the monetary policy, and is driven by the same factors: value of household's assets and cash flows.

Summing up the overview of "credit channel", some clarifications should be added. Analyzed above effects that rely on change (here-increase) of prices are doubted to work economy wide. Namely, unanticipated price level change is assumed to change (decrease) only deferred (contractual) liabilities' real value, not that of assets. However, such conditions will be favourable for firms with high share of liabilities to be paid at a fixed value preset in the contract a (number of) period(s) before. "Firms-lenders" to the contrary will suffer a lower net value due to lower real value of receivables. They will not be considered as credible borrowers by banks. Hence, gross effect will be negligible for the counteractive effects of firms characterized with deferred asset receivables or liabilities.

Considering household liquidity effect, it should be noted that monetary policy would have significant effect only on those households which own financial assets. Those, whose core income consists of traditional sources such as wage, would probably not feel stronger. They could even become more subject to distress in case that the price level increase exceeds increase of their income.

Since the CB has different instruments at its disposal to achieve its global targets, they can be arrived to through different channels. The route of transmission depends on specific characteristics of adjacent policies, stance of real economy and financial system at the time of policy application. Although above channels of MTM work in quite different way, they are often interrelated and operate side by side simply because of common driving force. For instance, change in interest rate (following that in discount rate) should affect net export as well as credibility

of borrowers (adverse selection problem), such that both exchange rate and balance sheet channel are in effect. Furthermore, initial working channel results usually affect other monetary indicators and further induce others channel operation. For example, if reduction of reserve requirements are followed by considerably higher volume of lending (bank lending channel), which may reduce interest rate and consequently impair adverse selection problem, further leading to increase in lending (cash-flow channel). However, there is often the case that some channel(s) is (are) not likely to operate in particular country or during particular period (e.g. fixed exchange rate policy).

In economies characterized by banking financial system, where other financial institutions play less noticeable role, such features influence the MTM:

- Importance of bank loan to a firm gives evidence for the BLC mechanism;

- Short-term loans and wide application of collateral;

- Close relationship between banks and their agents reduces the power of MTM;

- The powerful government regulation enhances MTM.

Bank lending channel

The fundamental underpinning of the BLC is the transmission of monetary impulse to real economy via the bank's responsive behaviour. This behaviour is assumed to be driven by change in reserves available to the bank. In order to separate the subjective bank's adjustment of loan volume a control for exogenous shifts in loan demand should be applied.

The sources allowing BLC to operate are:

- Bank loans are specific important sources of funding for economic agents, so that they can not freely substitute loans for corporate papers and bank can not be "thrown out of the game";

- Imperfection of bank debt market, i.e. inability of banks to substitute perfectly reserved and unreserved funds (short-term deposits vs. long-term deposits, borrowings from other banks), otherwise bank could sustain its optimal level of lending despite monetary shocks affecting reservable borrowed funds;

- Loans and securities are imperfect substitutes both for banks and borrowers, otherwise bank could sustain its optimal level of lending by investing in the more expedient way.

Chapter 3

UKRAINE PREREQUISITES

Now that we have discussed theoretical underpinnings of monetary transmissions mechanisms let us turn to the analysis of Ukrainian financial environment. We will try to outline validity of lending channel and bank capital as one of its determinants in the light of monetary policy regime conducted in Ukraine. The target of monetary policy of the NBU is, besides the monetary unit stability, a more broadly task-to favour production growth and economic developments. So then, domestic monetary policy can be defined as dual mandate. Referring to Kryshko (2001), Zaderey (2003) and NBU information, we can make inferences about the ways central bank achieve its goals. Concerning the interest rate channel, it is indecisive whether it does take place in Ukraine in a view of contradictive findings. The group of asset price channels is not likely to be important mechanism of monetary targeting. First, despite announced in 2000 dirty float exchange rate regime, hryvnia (UAH) has been de-facto pegged to U.S. dollar (USD). Second, channels asset price channels coherent with stock market are less plausible due to the latter being underdeveloped. The most plausible candidate for the real monetary channel preliminary is credit channel. Empirical findings are, however, not strongly confirming. In particular, Zaderey (2003) has found balance sheet channel to be statistically significant, but of low quantitative importance. Kryshko (2001) has thoroughly investigated the other side of credit channel-bank lending channel-employing two approaches: VEC model to analyse aggregated macro data on banking system; and two-step procedure with the use of micro data. He concluded that nominal interbank interest rate do affect

production implying that lending channel does operate. His results at the bank micro level were not so conclusive, though.

I suggest that bank lending channel is operating. The following justification ground this statement.

- NBU has been actively using refinancing lending to commercial banks to regulate monetary and real aggregates. Reserve rate, set diversified respectively to bank debt structure (favoring long term debt) since 2001, has been one of the main instruments of regulation (average frequency of change is 3 times per year during the period of interest: 1999 to 2004). Both instruments caused response of bank lending through the bank lending channel for they influence bank resources and behavior.
- Banks are the main source of external funding for the firms and households, since stock market is still underdeveloped. This effect is deteriorated by the fact that external funding is not widely used yet, although the tendency of growing debt funding facilitates economic growth.
- Securities are viewed as perfect substitutes neither by firms nor by banks, since very few firms issue bonds nowadays.
- During the recent years deposit interest rate has been falling less quickly than loan interest rate (Fig.1), thus being one of the sources of deposit-driven supply of loans (growth of economy, money volume and relatively lower rate of decrease of deposit rates cause higher growth of deposit supply, which results in higher disposable bank reserves). Therefore, lending channel is supposed to be an important working part of monetary transmission.

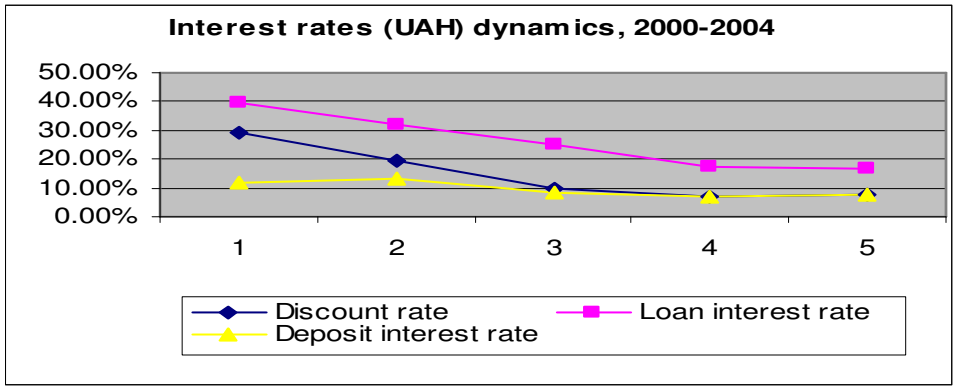


FIGURE 1. INTEREST RATES FOR LOANS AND DEPOSITS IN UKRAINIAN CURRENCY AND DISCOUNT RATE DYNAMICS, 2000-2004

Source: NBU

The general influence on economy consists naturally of aggregation of individual bank responses. These are in turn determined by bank-specific features, such as size, liquidity, capitalization. The latter statement can be justified as that different bank might face different opportunities regarding effect of monetary shocks.

In order to better understand the lending channel I rely on bank capital as one of possible determinants. Specifically, bank capital is assumed to affect lending behavior in a view of capital adequacy ratio maintenance and related risk aversion of the bank. Formally, why can capital be the factor of bank lending response to monetary regulation?

- it is not easy for banks to issue new equities due to low interest of potential investors in making investment in already competitive banking business, furthermore, the profitability is further expected to decrease, and tax disincentives for investing into banking business (especially small banks are faced with the problem to increase capital);
- another possible outcome: despite higher growth rate of long-term deposits versus growth of long-term loans in banks' portfolios, loans take a

higher share (49%) than deposits (35%) leaving a source of profit, thus leads to the capital increment due to maturity mismatching and fall of interest rates.

- The level of risk aversion or, alternatively, risk exposure under binding capital constraint might explain lower or greater extent of lending expansion. Risk aversion in its turn is incited to some extent by the scope of informational asymmetries between banks and their borrowers (adverse selection and moral hazard), and banks and their shareholders.

One of the most appealing problems of Ukrainian banking system is capital adequacy. The following figures as of June 2004 are quite demonstrative: bank capital-to-GDP ratio amounts to 5.5% compared 18% in France, 13.3% in Germany, 12% in Estonia. According to the NBU statistics 21 commercial banks, which compile half of the banking system assets, resulted by mid-2004 in undercapitalization.

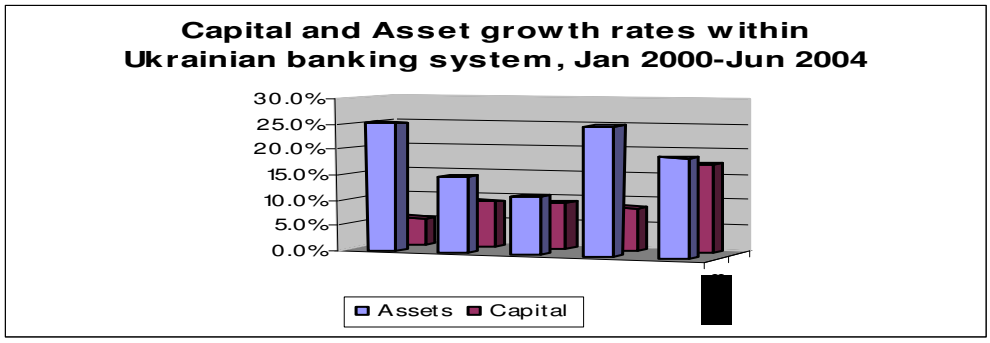


FIGURE 2. CAPITAL AND ASSET GROWTH RATES WITHIN UKRAINIAN BANKING SYSTEM, JAN 2000-JUN 2004
Source: NBU

In order to keep banking more secure and support its further growth NBU has leveled capital adequacy requirement from 8% t0 10% on March 1, 2004. Described developments have caused prompt slowing down of lending growth

rate. In particular, 2004 semi-annual growth of bank credit portfolio has declined to 20.6% from 25% during corresponding period of year 2003.

Across bank analysis provides evidence that larger banks tend to hold lower bunch of capital per unit of loan during the period under study. Figure 3 which depicts average relation reflects a general tendency over time.

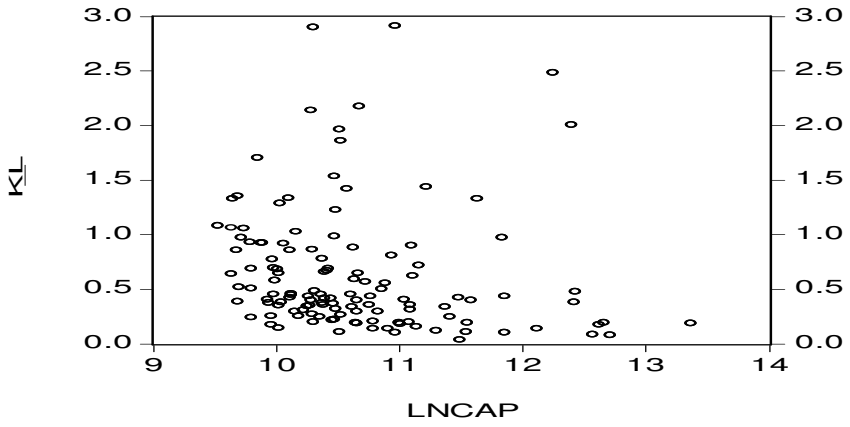


FIGURE 3. CAPITAL –TO-LOANS RATIO AGAINST BANK CAPITALIZATION.

Source: NBU, author's calculations.

The above information arouses interest in investigation of dispersion between banks as mediums of lending channel and how their lending response to policy actions depends on capital. While Fig.2 depicts aggregated tendency, Fig.3 seems to stay for larger banks being less cautious in maintenance of required capital stock, or, alternatively, in their lending activity.

Chapter 4

PREVIOUS RESEARCH

The cornerstone studies of bank lending channel

Operation of monetary policy and its effect on real economy in general terms cannot be denied. However, the assessment of the basics of the mechanism is more challenging and important for policy makers primarily. As already stated, central bank policy was traditionally perceived to work through interest rate channel. But in due course both theoretical and empirical investigations explored much deeper foundation for the ways monetary impulses are transmitted to the real economy. They depend extensively on the stance of various sectors (financial, involvement into international collaboration, business specifics, etc.). A willingness to explore the core engine of MTM (in particular country, during specific period) resulted in numerous studies. The "pioneers" of rather new approach to evaluation of monetary transmission are Bernanke and Blinder. Their model (Bernanke and Blinder, 1988) disentangles conventional IS/LM model by allowing loans to enter initial two-asset (money and bonds) basket available to economic agents, and relaxing assumption of perfect substitutability between loans and bonds. This modification changes the IS curve into the CC ("commodities and credit") curve. The implication is following: in the modified model monetary expansion (contraction) works not only through money market (change in bank reserves represent change in money - shift in LM curve), but also through credit market (the same reason causes credit to expand – CC curve shifts in the same direction). The CC curve, which represents the link between consumption/investment expenditures and financial market through the credit, is

shifted now by both monetary policy and credit shocks, contrary to the IS curve. Hence, credit channel enhances effect of monetary policy on real output, as compared to traditional 'money-view'.

Authors confirm their theoretical framework by empirical findings in the later work (Bernanke and Blinder, 1992). VAR model was used to identify timing and terminal results of changes in bank portfolio, deposits, as well as in target variables: CPI and unemployment rate. They found that monetary tightening dried security holdings of banks immediately, but the final long run effect was rebalanced portfolio in favor of securities, that is, with time banks reduced loans supplied while securities gradually turned to their initial level. The findings that the federal funds rate but not T-bill or bond rates, and terminal decrease in loans but not in securities (i.e. driving force is bank supply of funds, not demand) do have a strong impact on bank behavior, suggest that bank lending channel does work. These works have become cornerstones for further research of the credit channel. McMillin (1996) employs VAR model, similar to that used in Bernanke and Blinder (1992). The only modifications applied are: adding to the initial variables (monetary policy indicator, unemployment rate, log of CPI and logs of real bank deposits, security holdings and loans) the volume of commercial papers issued by firms and spread between loan and commercial paper rates; and adding to the FFR a no-borrowed (excess) reserves as alternative measure of policy. The results achieved are basically the same, and confirm that rebalancing of bank portfolio from loans to securities after monetary tightening testify to the credit channel operation.

Since the interest rate plays a substantial role in the MTM, the credit channel is considered as an extension amplifying conventional interest rate channel, rather than an independent mechanism. Bernanke dwells on this view together with

Gertler in their paper (Bernanke and Gertler, 1995). They start by pointing out an interesting mismatch between the traditional prediction of economy response to monetary shock and response observed in reality (U.S.). Namely, they emphasize that contrary to assumption of transitory effect of interest rate increase economy suffered sustained decline in GDP, demand and, most interestingly, residential investments. Authors explain such a 'puzzle' by "external finance premium"- a gap between cost of raising external funds (debt) and opportunity cost of internal sources used by firms. The major source of this gap is imperfections of credit market induced by principal-agent problem (moral hazard issues). Therefore, interest rate as the cost-of-borrowing effect is amplified by "external premium". Bernanke and Gertler define two reasons of this effect- BSC and BLC- in the framework of broad credit channel. The underlying explanation is as follows: open market sale by Fed reduces bank's core deposits (reservable, short-term essentially) and leads to higher relative cost of borrowed funds. Banks therefore reduce supply of loans, leading to higher external finance premium. A loss of core deposits (bank's reserves) cannot be freely counteracted by issuing large CD (nonreservable, long-term, large value) in order to maintain persistent level of lending. The study has shown 'prime' (loan) rate-fed funds rate spread and CD-spread widening as a result of discount rate increment by the central bank. This signifies an imperfect substitutability between both types of bank's assets (loans and bonds) and liabilities (core deposits and CD's), which are the necessary conditions of BLC. However, authors more readily stand for the credit channel in general, being cautious to distinguish between its two components.

The three discussed research studies became impetus for further empirical investigation of BLC.

Since the driving force of the BLC is the absence of perfect substitution neither between types of liabilities nor between types of assets for banks (as well as for firms-borrowers), studies reasonably presume diverse impact of monetary policy on bank micro level given heterogeneity of banks in the degree of substitutability. Specifically, banks differ in size, capitalization, liquidity, debt structure. To the extent that BLC works, monetary transmission might and, as was shown, indeed does have differential impact on different banks, and therefore on targeted economic variables.

Formal approaches to lending channel verification

Initial research papers were naturally aimed at the investigation of existence of bank lending channel according to theoretical background. Therefore, they concentrated on testing the expected rebalancing of bank portfolios as adjustment to monetary shock. The underlying assumption is absolute and relative restructuring of loan and securities shares within portfolio. The reason is: monetary policy affects loan interest rate which is followed by wedging between loan and bond rates (Smant, 2002, among others). Usual method used to explore the BLC is VAR "inherited" from Bernanke and Blinder (1992). This is not however widely used; rather comprehensive studies try to dwell on spacious sides of BLC (e.g., Kryshko, 2001).

The more substantial number of researchers focuses on the model which explores the extent of lending response to monetary policy shocks given bank-specific features, such as size, capitalization, liquidity. That is, they go deeper in specifying a sort of bank loan supply as a function of monetary indicator subject to its peculiarities. They test explicitly absolute change of loans supplied without comparing it with securities. The underlying assumptions of this model group are:

effect of size and capital on ability to manage borrowed funds (deposits), and effect of liquidity on ability to manage assets. The estimation method is represented by structural model with change in loans being explained by change in policy tool and its conditioning on bank specifics. Although such models correct for endogenous contemporaneous response of loan demand by incorporating "instruments" (GDP, inflation), they probably do not distinct precisely between lending demand and supply.

The main integrated conclusion of reviewed studies on BLC based on such approach is following: smaller, less liquid and less capitalized banks are affected by monetary policy more severely.

Review of results

Getting closer to the role of capital in bank lending policy in general, and in lending channel of monetary transmission researchers rely on information asymmetries (moral hazard and adverse selection problems), deposit insurance and reserve requirements issues. These allow identifying how level of capital or capitalization (capital adequacy) is related to (i) ability of restructuring the liability portfolio and to (ii) risk-taking incentives. According to the theoretical background, the former predicts that capital should be one of the determinants of BLC, while the latter stays for direct effect of capital on loan-supply, being the source of so called "bank capital channel" (Van den Heuvel, 2003). Specifically, the basics of some representative pieces of research are drawn below. These studies were conducted for the U.S. banking system.

Kishan and Opiela (2000) study two MTM of the "credit view": firm balance sheet channel and BLC. They employ federal funds rate and Bernanke-Mihov (1995) Indicator as monetary tools for different in leverage bank groups, although distinguish between absolute size of capital and leverage (capital-to-asset ratio).

The study confirms that stringent monetary policy affects only undercapitalized banks, while those with strong capital can afford to maintain loans relatively stable. Important finding of the authors is that, contrary to customary perception, quantity of bank capital does not always imply quality of borrowers. This follows from the estimate that large undercapitalized banks do not respond to tightening monetary policy as expected.

A core intuition of wide range of papers is based on banks' ability to shield their lending from contraction. They explain this ability as substitution of reduced sources of financing by the ones less subject to asymmetric information problem. That is, some banks might be perceived by the public as more reliable; additionally the deposit insurance coverage also mitigates such a problem.

Jayaratne and Morgan (2000), explicitly including deposits as driving factor of lending, found that lower capitalized banks attract more insured deposits and they respond more to the central bank's tightening policy (through deposit insurance) then their high-capitalized counterparts. Banks with higher leverage also were found to be more oriented on the unreserved funds. This study, as well as most of related ones (e.g. Stein, 1995), explains differences in lending response across banks by ability to vary liability structure. The reason is: low capitalized banks when facing relaxing monetary regulation will demand more insured (short-term) deposits than highly capitalized banks. The latter are able to acquire more uninsured (long-term) deposits, probably because these banks are perceived as more stable by depositors. Therefore, these banks are able to sustain lending volume during contraction. Additional evidence found is that higher share of assets invested into small business leads to tighter relation between insured deposits and loans. This is peculiar to low capitalized banks.

Takeda, Rocha, Nakane (2002) in their study for Brazil concluded that BLC worked mainly via deposit reserve requirement and contrary to the most of

research papers, large (with respect to assets, not capital) banks were more affected due to progressive reserve requirements.

The role of capital

Further studies view capital-risk relation as source of bank lending behavior. It should be noticed that the results are quite contradictive. In particular, Zarruk and Madura (1992) found that "increase in deposit insurance or in capital requirements lead the bank to shift funds from the federal funds to the loan market", i.e. to the more risky assets. The same circumstances brought margins to decline under non-increasing risk aversion. This may suggest that banks in general turn to pay higher interest on borrowings requiring investment in more profitable, thus riskier assets, but this doesn't cover loss of potential gain due to excess reserves. Hence, binding capital is the reason for risk-taking incentives and resulting possibility of further decline in capital (via lower profit and bad loans).

A similar conclusion is arrived to by Mitchener (2004) in his research of bank regulation during Great Depression. Initially he points onto ambiguous effect of reserve requirements on the asset quality. On the one hand, absence or low reserve requirements make deposits more valuable (in marginal terms) to the banks driving them to compete for depositors. Higher price of deposits will induce banks to acquire higher return on assets, so probably lead to more risky investments. On the other hand – (higher) reserve requirement may reduce external monitoring also leaving incentives to hold risky assets. Finally he comes up with confirmation of the latter: direct relation between reserve reguirements and bank risk taking preferences. However, this can be explained by higher cost of deposits, hence attraction of loans with high expected return and risk.What is even more important, a straightforward negative relation between minimum

capital requirements and bank failure via risky assets. Hence, both constraints, reserve and capital, have opposite effects on the riskiness of assets.

Hovakimian et al. (2000,2002) in the context of optimal deposit-insurance contract design also evidence that risk exposure is stronger at the low-capitalized banks, while high risk aversion of those with higher leverage can counteract risk-shifting(onto state insurer and depositors themselves) incentives caused by inadequate (underestimated) risk premium. Hence, the higher the capital-the higher is risk aversion of the bank (ers).

Such non-traditional outcomes about possibility of evasion to "obey" monetary rules are attributed to the fact that theory used to rely only on reserve requirements, avoiding capital requirements effect. All discussed studies implicitly incorporate risk aversion of the banks into their analysis when considering capital effect within the bank lending channel.

Gambacorta and Mistrulli (2003) sum-up two opposite approaches to capital-risk relation.

One group of models explains that higher capital increases risk-taking incentives of banks. The reason is that high cost of capital funding lowers the bank value and managers tend to be involved into more risky investments with higher expected return.

The other group of models gives different result. Based on studies on relation between deposit insurance and risk-taking incentives they conclude: if risk premium paid by the bank for deposit insurance is undervalued, banks receive implicit "subsidy", which decreases with capital. Hence, highly capitalized banks have less incentive to provide risky loans. That is, higher capital requirements mitigate the risky activity. Such approach is capable, contrary to the first models,

to explain why banks may hold capital in excess of required level. Authors also apply an excess capital as a measure of capitalization, which they defend to be better indicator of level of capitalization than gross capital and allows better explanation of risk-aversion. After analysis of two opposite capital--risk aversion interrelation they show that well capitalized Italian banks are more risk averse, and they are more capable to resist downturns.

Gambacorta and Mistrulli explicitly distinguish in their study bank capital channel from BLC. They suggest the following sources of the capital channel:

Imperfect market for bank equity, i.e. banks face agency costs and tax disadvantages when issuing new equities.

Maturity mismatch between assets and liabilities: loans have typically longer time to maturity than deposits. Decline of interest rate is shortly adjusted to deposits, while loan interest change takes more time. Therefore, liquidity risk is mitigated by higher interest margin and profit. This leads to higher capital

Direct effect of capital requirements with regard to risk-weighted assets.

The authors' view proceeds as follows. Increase of market interest rates adjusts promptly to deposits, margin decreases and leads via lower profit to lower capital. "If equity is sufficiently low and it is too costly to issue new shares, banks reduce lending; otherwise they fail to meet regulatory capital requirements". Decrease of interest by contrast enriches bank capital and allows expansion of lending.

Takhor (1996) proves similar result based on the theoretical model: he defines two contrary effects of money supply expansion: aggregate lending increases if short-run interest falls by more than the long-run (banks can acquire relatively cheaper funds, but earn relatively more on long term loans) and decrease otherwise. One important statement contradicts that of Zarruk and Madura

(1992) but is in line with traditional perception. It consists in that higher capital requirements lead to higher cost of bank funding. Since competitive banking sector does not allow shifting this cost onto borrowers via higher loan rates, loans as risky assets become less attractive for they have to be backed by capital, banks will demand less risky government securities. Such rebalancing of asset portfolio is consistent with prediction of BLC, which implies that capital channel may enhance the lending channel.

The capital however, has not been studied explicitly as a specific "channel" but rather as one of the factors of heterogeneous response of banks to monetary policy. Bank lending channel (BLC) to the contrary has been verified (empirically) to be important way of monetary policy targets achievement. Research for European countries (e.g. Germany) showed weaker evidence on BLC compared to the US evidence. The reason is close relationship between banks and their clientele, in particular affection of a borrower toward one bank. Hence, monetary policy is not likely to affect lending by banks significantly.

Regional Aspect

The geographical coverage of relevant literature includes the BLC country-specific studies for US and European countries mostly. The common feature of those developed countries is developed financial market, including non-bank financial institutions and instruments. This lowers importance of bank role in monetary transmission and makes BLC less likely to operate. Such a system is especially inherent to US, UK, Canada; while traditional banking system is fundamental in Germany, Austria, Japan, among others. As such, banks are important intermediaries not only in financial flows, but in monetary transmission whenever banking system prevails and financial market is underdeveloped.

Among European countries Italy, Germany, Spain, Netherlands has been under thorough investigation. There are also several comprehensive studies comprising a few countries into comparative analysis. For example, Chatelain et. al. (2002) study monetary transmission in several European countries: Germany, Italy, France and Spain. Considering behaviour of both sides-banks and firms-they conclude that interest rate affects investment strongly; moreover, liquidity constraints affect external finance premium suggesting about balance sheet channel. On the banks side, lending supply response to policy shocks is the most significant in France, the least-in Germany. The reason for the latter lies in close bank-borrower relationship structure of German banking system: banks do not deviate much from their collaboration with related borrowers even in case of shocks. The magnitude of response was found to be sensitive to bank liquidity mainly: more liquid banks cut on loans less, for they are capable to reduce more liquid (less interest-bearing) assets. Neither size, nor capital showed-up as influential factors. Country-specific studies have found size to be significant in Greece and Netherlands (due to unsecured lending effect) (Chatelain et. al., 2002).

Contrary to other inconclusive results about capitalization effect in bank lending transmission, studies for some countries arrived at strong suggestion about its high profile.

Specifically, an alternative structural model which develops loan-supply function directly allowed Farinha and Marques (2001) to overcome the supply identification problem and conclude that low capitalization enhances effect of monetary policy via Portuguese bank balance sheets effect. Van den Heuvel (2003) goes even further-he designs the bank value function determined by its capital in order to optimize lending. The result of such approach is already familiar fact, now stated more firmly: banks with low capital adequacy (according

to asset quality, i.e. riskiness) reaction to monetary shocks is delayed but then enhanced.

The comprehensive research was conducted also for EU accessing CEE countries by Schmitz (2003). She didn't find liquidity or capitalization to be the point in differential response of bank lending to domestic monetary policy. BLC seems to operate via size only. Significance of size to the magnitude of BLC is consistent with results found for the US banking system.

A similar research for Ukraine is quite rare. An example of initiative integrated analysis of BLC of domestic monetary transmission for the 1996-2000 period is presented by Kryshko (2001). Author employed both types of methodological approach. VEC model shows gradual adjustment of bank variables and economy indicators to the funds rate. Three facts:

sharper and faster drop of deposits relatively to that of loans; terminal deeper decline in securities relatively to that of loans; and timing correspondence between loan and production decline, being in line with theoretical background, can testify to the existence of BLC in Ukraine.

Structural specification – a two-step regression procedure- which tested liquidity (strength) and size effects on individual bank's lending response to funds rate showed less evident result. Namely, strength effect holds for small banks only: less liquid banks cut on their loans more than stronger banks; however larger banks were not found to be constrained by liquidity. Kryshko found little evidence of size being a source of heterogeneous bank response to changes in funds rate. The capital was not considered in the research as possible factor of lending channel. In an attempt to justify some inconclusiveness of results he refers to possible ineffectiveness of the data and institutional inconstancy of Ukrainian banking system during period under study.

Chapter 5

FORMAL SPECIFICATION

Loan supply-capital risk aversion analysis

In this section I develop the model of bank lending behavior with incorporation of its risk aversion. Optimal behavior of bank naturally implies that the loan would not be issued unless its marginal benefit covers its marginal cost.

We can define the *marginal benefit* (MB) of loan based on its expected return. Here we can use the most general sorting of loans:

1) Well-performing, i.e. timely repaid

2) Not performing, i.e. not repaid. This leads to the equivalent capital curtailment.

Obviously, a certain outcome is observed only at the target date. While deciding on issue of loan the bank can assess the riskiness of particular loan as

ρ - probability of loan not to perform well (borrower to default), then (1- ρ) - probability of loan to perform well.

Hence, the expected MB of a loan is:

$$MB = (1-\rho)\cdot \ell + \rho \cdot (-1) = \ell \cdot (1-\rho) - \rho \,, \quad \text{where} \quad (1)$$

$\rightarrow \ell$ -loan interest rate;

$\rightarrow \rho \in (0;1)$ such that E (ρ) = μ and var (ρ) = σ_ρ^2.

ρ is evaluated by bank at the stage of screening and is 'desired' by bank to be constant close to zero. However, exogenous shocks or any factors not observed/predicted by bank might affect performance of loan within lending period. Bank therefore regulates its reserves so as to meet changes in risk. To simplify, I neglect collateral issue with justification that not always collateral provides full loan coverage and difficulties (costs) with its sale. Hence, I assume the full loss of loan in case of borrower's default: MB=- ℓ when ρ turns out to be 1. Variability of borrower's solvency is incorporated into model as a var (ρ).

The *marginal cost* (MC) of a loan comprises cost of funds, that is: deposits, borrowing from banks and the central bank, capital. What is the most important for given research, MC of marginal loan involves the cost of additional capital to be acquired and held against additional loan. I assume that capital requirements are not subject to differentiation between loans with respect to their riskiness. This assumption is consistent with the methodology of capital adequacy ratio estimation for Ukrainian banks.

A bank faces capital adequacy ratio ($\dot{\kappa}$) requirement imposed exogenously by the central bank.

$$\dot{\kappa} = \frac{K}{A^R} \quad , \quad \text{where} \tag{2}$$

→K-bank capital,

→A^R –risk-weighted assets, less reserves held against risk-weighted loans.

Suppose ΔL is the loan to be made at time t given capital constraint is binding at time t-1. Let us now consider relation between this marginal loan provided and adjustment of capital required:

$$\overset{\bullet}{\kappa} = \frac{K_{t-1}}{A^R_{t-1}} = \frac{K_t}{A^R_t} = \frac{K_{t-1} + \Delta K}{A_{t-1} + \Delta L} \qquad \Rightarrow \Delta K = \overset{\bullet}{\kappa} * \Delta L \tag{3}$$

OR

$$\Rightarrow \Delta L = \frac{K_{t-1}}{\overset{\bullet}{\kappa}} + \frac{\Delta K}{\overset{\bullet}{\kappa}} - A^R_{t-1} \quad . \tag{4}$$

The latter equation reduces to $\Delta L = \frac{K_{t-1}}{\overset{\bullet}{\kappa}} - A^R_{t-1}$ in case when capital constraint is not binding and follows from $\overset{\bullet}{\kappa} = \frac{K_{t-1}}{A^R_{t-1} + \Delta L}$. Here ΔL means the maximum amount of additional loans supplied without necessity to back them with additional capital.

The marginal cost of loan thus is specified as follows:

$$MC = r_f * + s + r_k * (\overset{\bullet}{\kappa} * \Delta L), \tag{5}$$

with $r_f = d * \frac{D}{B} + r_k * \frac{K}{B} = d * w_d + r_k * w_k$, where

→D and K are borrowed funds (deposits, inter-bank borrowings, central bank refinancing) and capital respectively;

→B – total value of funds (and assets), the bank book value, such that $D + K = B$;

$\rightarrow d$ and r_k are returns on borrowed funds and on capital respectively.

I assume $r_k \geq d$, which can be explained by relatively less perfect market for capital. As such, it is also admissible that $\frac{\partial r_k}{\partial K} \prec 0$, reflecting the intuition that larger (more capitalized) banks have better opportunities to access cheaper capital due to their recognition by investors as being more reliable than small ones.

Similar reasoning can support assumption of $\frac{\partial d}{\partial D} \leq 0$. The latter is based on $\frac{\partial D}{\partial K} \geq 0$ meaning that larger (more capitalized) bank is more likely to be approached by depositors (mainly private) as they perceive it less risky. Hence, such a bank can offer lower d having in mind relative safety provided to depositors. However, the absolute value of $\frac{\partial d}{\partial D}$ is not likely to be significant due to market competition.

$\rightarrow s$ presents the cost of screening potential borrower, i.e. assessing riskiness of loan. s can approximate the thoroughness of loan potential performance examination. The more risk averse the bank is, the higher s would be, such that $\frac{\partial s}{\partial R} \succ 0$.

If bank was risk neutral, decision about providing loan would be made based upon comparing expected MB and MC. But, risk aversion acquires compensation for necessity to regulate risk-based reserves and/or to suffer profit (hence, capital) reduction.

Such a risk premium is found to be[1]:

$$\pi = \frac{1}{2} R(1+\ell)^2 \sigma_\rho^2, \quad \text{where} \tag{6}$$

$\rightarrow R$ - measure of the bank absolute risk aversion.

With this in mind, the marginal loan (ΔL) provided should satisfy MB-MC equality:

$$\ell \cdot (1-\rho) - \rho \overset{set}{=} r_f + s + r_k * \dot{\kappa} * \Delta L + \frac{1}{2} R(1+\ell)^2 \sigma_\rho^2 \tag{7}$$

This gives us (a positive) volume of loan that can be issued given certain parameters.

$$\Delta L = \frac{\ell(1-\rho) - \rho - r_f - s - \frac{1}{2} R(1+\ell)^2 \sigma_\rho^2}{r_k * \dot{\kappa}} \geq 0 \tag{8}$$

The above equation indicates implicitly 'qualitative' decision of bank: either to provide loan in an amount of ΔL or restrain (if indicator ΔL turns out to be not positive). A very high risk (σ_ρ^2) or risk-aversion (R), capital constraint ($\dot{\kappa}$), as well as other factors may withhold a bank from loan issue (ΔL =0).

Let us now see whether the loan will be supplied as initial riskiness increases:

[1] Derivation of risk premium is presented in Appendix 1

$$\frac{\partial \Delta L}{\partial \rho} = \frac{1}{r_k * \dot{\kappa}} * \left[\frac{\partial \ell}{\partial \rho} \left[(1-\rho) - R\sigma_\rho^2 (1+\ell) - \ell \right] - 1 \right], \qquad \text{where } \frac{\partial \ell}{\partial \rho} \succ 0 \text{ reflects}$$

higher price for risk, charged by bank.

No unambiguous conclusion can be made at the moment. It is more likely that no loan would be made given high initial assessment of risk. However, provided either low risk aversion (R) or/and low variability in borrower (i.e. loan) performance, loan still could be made ($\frac{\partial \Delta L}{\partial \rho} \succ 0$). This could be explained that bank would run 'certain' (not extreme ρ) risk backed by sufficient expected return ($\frac{\partial \ell}{\partial \rho} \succ 1$). It is obvious that risk-aversion and expected variability in performance reduce bank' willingness to provide loan: $\frac{\partial \Delta L}{\partial R} \prec 0$ and $\frac{\partial \Delta L}{\partial \sigma_\rho^2} \prec 0$.

From (8) follows that strict capital constraint also limits at least temporary bank's lending

$$\frac{\partial \Delta L}{\partial \dot{\kappa}} = \frac{\frac{1}{2} R(1+\ell)^2 \sigma_\rho^2 - \ell(1-\rho) + \rho + r_f + s}{r_k * \dot{\kappa}^2} = -\frac{\Delta L}{\dot{\kappa}} \prec 0. \qquad (9)$$

As such, an instantaneous increase in required capital adequacy ratio induces bank to refrain from making new loans. It should be noted, that bank would most likely cease to make large loans and those with higher expected risk ρ.

A very important point stems from above equation:

$$\frac{\partial \left[\partial \Delta L / \partial \dot{\kappa} \right]}{\partial R} = \frac{(1+\ell)^2 \sigma_\rho^2}{2 r_k * \dot{\kappa}} \succ 0 \qquad (10)$$

This means that restrictive effect of capital requirements is less severe for more risk-averse banks. This is attributed to the fact that they tend to maintain necessary level of capital or higher and can meet stricter requirements without cutting on lending or increasing capital instantaneously.

Continuing with the main question of the research, let us define direct effect of capital on loan-making decision. So far external factors such as monetary policy are left for consideration in more general demand-supply model.

$$\frac{\partial \Delta L}{\partial K} = \frac{\left[-(\frac{\partial r_k}{\partial K} * \frac{K}{B} + \frac{r_k}{B}) - \frac{\partial s}{\partial R} * \frac{\partial R}{\partial K} - \frac{1}{2}(1+\ell)^2 \sigma_\rho^2 \frac{\partial R}{\partial K} \right] * r_k}{\dot{\kappa}^* r_k^2} - \frac{\left[\ell(1-\rho) - \rho - r_f - s - \frac{1}{2} R(1+\ell)^2 \sigma_\rho^2 \right] * \frac{\partial r_k}{\partial K}}{\dot{\kappa}^* r_k^2} \tag{11}$$

Second term in (11) is negative. The positive lending response to change in capital therefore might be deteriorated only by higher risk-aversion, that is if $\frac{\partial R}{\partial K} \succ 0$.

Note,

$$\frac{\partial \Delta L}{\partial R} = \frac{\partial \left[\partial \Delta L / \partial K \right]}{\partial \left[\partial R / \partial K \right]} = -\frac{(1+\ell)^2 \sigma_\rho^2 + \frac{\partial s}{\partial R} * r_k}{2 \dot{\kappa}^* r_k} \prec 0 \text{, recalling} \qquad \frac{\partial s}{\partial R} \succ 0 \tag{12}$$

Hence, if higher capital makes the bank more risk averse, it will be willing to expand its lending to the lesser extent as compared to the case when risk-aversion declines with capital.

Bank Lending Channel and Bank Capital

We have considered so far the link between marginal loan to be supplied and capital constraints given the risk-aversion of bank at a specific level of capital. In this section let us incorporate the range of loan supply determinants. By estimating loan supply function we can find the following:

The extent of lending response to change in capital constraint.

Using the above analysis, we can suggest that binding capital restrains potential loan expansion. This constraint has especially strong instantaneous power, allowing bank to build-up capital and catch up with lending later on. Moreover, the higher risk-aversion is inherent to bank, the more severe this effect will be.

The extent of lending response to exogenous policy measures at the different capital levels.

We should distinguish two implicit sources of heterogeneous loan adjustment across banks according to their capitalization (risk-based capital sufficiency):

a) The *first* one is in line with dependence of risk aversion on capital. As such, R (K) will determine relative absolute results of MP on bank' lending.

b) The *second* one follows from banks' ability to smooth negative policy impact for different level of capital according to fundamentals of lending channel discussed in 'Theoretical Framework' above. Most justifications favor large capital banks (e.g., higher ability to restructure funds in order to maintain certain level of loans; probably relationship lending-but could be inherent to small banks as well).

Let us see possible effects of capital itself and monetary policy shock on loans with control over capital.

Restrictive measures:

An increase in capital will have more pronounced positive effect on less risk-averse bank:

$$+K \Rightarrow \left\{ \begin{array}{l} \dfrac{\partial R}{\partial K} \geq 0 \\ \dfrac{\partial R}{\partial K} \prec 0 \end{array} \right\} \Rightarrow \left\{ \begin{array}{l} +L^l \\ +L^h \end{array} \right\}, L^l \prec L^h \qquad (13)$$

2A. Restrictive monetary action effect depends on two implicit sources:

a) R (K):

$$-MP \Rightarrow \left\{ \begin{array}{l} \{K^l\} \\ \{K^h\} \end{array} \middle| \frac{\partial R}{\partial K} \geq 0 \right| \Rightarrow \left\{ \begin{array}{l} -L^l \\ -L^h \end{array} \right\} \qquad \text{<or>}$$

$$-MP \Rightarrow \left\{ \begin{array}{l} \{K^l\} \\ \{K^h\} \end{array} \middle| \frac{\partial R}{\partial K} \prec 0 \right| \Rightarrow \left\{ \begin{array}{l} -L^h \\ -L^l \end{array} \right\} \qquad (14)$$

b) Bank' ability to smooth consequences of negative monetary shock:

$$-MP \Rightarrow \left| \frac{K^l}{K^h} \right| \Rightarrow \left\{ \begin{array}{l} -L^h \\ -L^l \end{array} \right. , \qquad \text{where } L^l \prec L^h \text{ and}$$

$$K^l \prec K^h . \qquad (14a)$$

Hence, negative monetary shock effect on strongly capitalized bank's loan portfolio deterioration (source *a*) will be enforced (especially at small banks) if risk aversion decreases with capital (i.e. $\frac{\partial R}{\partial K} \prec 0$). In particular, small banks will

"suffer" most. On the other hand, no significant difference over the groups will be observed if risk aversion increases with capital (i.e. $\frac{\partial R}{\partial K} \geq 0$).

Expansionary measures:

At the same time, favoring policy presented, for instance, by option of extensive financing of banks, will favor smaller banks more extensively relatively to large banks. Former might take greater advantage of opened opportunities. This situation can be described in a similar fashion:

2B. Expansionary monetary action effect depends on two implicit sources:

a) R(K): (15)

$$+MP \Rightarrow \left\{ \left\{ \frac{K^l}{K^h} \right\} \middle| \frac{\partial R}{\partial K} \geq 0 \right| \Rightarrow \left\{ \frac{+L^h}{+L^l} \right\} \qquad +MP \Rightarrow \left\{ \left\{ \frac{K^l}{K^h} \right\} \middle| \frac{\partial R}{\partial K} \prec 0 \right| \Rightarrow \left\{ \frac{+L^l}{+L^h} \right\}$$

<*or*>

b) Bank' ability to take "marginal" advantage of positive monetary shock, in relative terms:

$$+MP \Rightarrow \left| \frac{K^l}{K^h} \right| \Rightarrow \left\{ \frac{+L^h}{+L^l} \right. \qquad (15a)$$

Expansion of bank lending in relative terms, as a result of central bank's actions, will be the most pronounced at small banks provided increasing risk aversion ($\frac{\partial R}{\partial K} \geq 0$). Otherwise (i.e. if $\frac{\partial R}{\partial K} \prec 0$), there will be little difference in lending adjustment between groups of banks.

The above reasoning could serve as explanation for why empirical studies quite rarely supported idea that capital was a source of heterogeneous response of lending to restrictive exogenous policy. Namely, this suggests that bank owners do monitor bank managers closely enough and have little risk-taking incentives in order not to lose their capital.

Oppositely, if bank was more prone to risky actions given higher capital, supposedly for willingness to cover high cost of capital, it could shield from policy actions. In this case, ceteris paribus, the central bank will be less likely to achieve its targets given relatively high level of capital concentration in banking industry.

Loan Supply Function

In order to be able to verify empirically influence of capital alone and of monetary shocks on lending behavior of banks at a certain level of capital we should specify the loan supply function.

In this respect I refer to Farinha and Marques (2001). They have applied alternative to customary way of loan supply estimation. Most of relative studies used aggregate income as a proxy for deposits so as to avoid endogeneity problem. Farinha and Marques have used *simultaneous equation* method to estimate loan supply directly as a function of deposits.

I have modified supply-demand functions for loans and deposits in such a way:

1) I incorporated capital and monetary shocks into loan supply and deposit demand so as to capture their influence on lending in light of lending channel given level of capitalization;

2) I interpret deposits as funds demanded by banks / supplied by individuals, rather then reserves available at banks as the authors do. The reason is to point out bank 'independent' role in the process of credit generation.

Loan demand and supply functions:

$$L^d = \alpha_0 + \alpha_1 Y + \alpha_2 \ell + \alpha_3 i$$

(16)

with relations presumed to be determined by such signs: $\alpha_1 \succ 0$; $\alpha_2 \prec 0$ (own price effect); $\alpha_3 \succ 0$ (substitute price effect), noting that

Y - Aggregate national income (GDP),

ℓ - Loan interest rate,

i - Securities interest rate.

$$L^s = \beta_0 + \beta_1 D + \beta_2 K + \beta_3 K * \Delta MP + \beta_4 \ell + \beta_5 i + \beta_6 \Delta MP \quad (17)$$

with relations presumed to be determined by such signs: $\beta_1 \succ 0$ (funds at disposal); $\beta_2 \overset{expected}{\succ} 0$; $\beta_3 \overset{expected}{\prec} 0$; $\beta_4 \succ 0$ (own price effect); $\beta_5 \prec 0$ (substitute price effect), $\beta_6 \succ 0$ (expansive policy is expected to increase supply of credit by banks), noting that coefficients D, K and MP are the same as in previous section.

β_2 and β_3 are parameters of very special interest.

In context of the above analysis (equation (11)) β_2 is likely to be positive, but is expected to vary across different capital level being dependent on risk-aversion. Thus, β_2 is going to take smaller value if $\frac{\partial R}{\partial K} \geq 0$, then otherwise (if $\frac{\partial R}{\partial K} \prec 0$).

β_3 is closely related to intuition in (13). β_3 is expected to be negative conditioned on source *b)*, but its absolute value will be determined by dependence of risk-aversion on capital level: if risk-aversion increases with capital: $\frac{\partial R}{\partial K} \geq 0$ (which is most likely in reality), $|\beta_3|$ should be smaller than otherwise (if $\frac{\partial R}{\partial K} \prec 0$).

Deposit demand and supply functions:

$$D^d = \gamma_0 + \gamma_1 \ell + \gamma_2 i + \gamma_3 K * \Delta MP + \gamma_4 \Delta MP$$

(18)

with relations presumed to be determined by such signs: $\gamma_1 \succ 0$ (higher demand for funds to be invested under higher return); $\gamma_2 \succ 0$ (higher demand for funds to be invested under higher return); $\gamma_3 \overset{\exp ected}{\prec} 0$ (higher capital enables bank to mitigate impact of MP); the sign of γ_4 depends on particular measure reflected in ΔMP, for instance refinancing lending to commercial banks adds to disposable funds thus might reduce demand for deposits in which case γ_4 is negative.

$$D^s = \delta_0 + \delta_1 Y + \delta_2 i + \delta_3 K$$

(19)

with relations presumed to be determined by such signs: $\delta_1 \succ 0$; $\delta_2 \prec 0$ (substitute' price effect); $\delta_3 \succ 0$ (individuals are aware of large known banks and attracted of their perceived relative reliability).

where:

Y - aggregate income (GDP)

ℓ -loan interest rate;

i - interest rate on government securities (alternative source of investment)

D - deposits held by individuals and commercial units

ΔMP - monetary policy regulations (changes).

The reduced form of loan supply function, derived from loan and demand function, is[2]:

$$L^* = \theta_0 + \theta_1 Y + \theta_2 D + \theta_3 K + \theta_4 K * \Delta MP + \theta_5 \Delta MP$$

(20)

With relations specified as: $\theta_1 \succ 0; \theta_2 \succ 0; \theta_3^{\exp ected} \succ 0; \theta_4^{\exp ected} \leq 0, \theta_5^{\exp ected} \succ 0$

where:

$$\theta_1 = \left[\alpha_3 + \frac{\alpha_2(\beta_5 - \alpha_3)}{\alpha_2 - \beta_4}\right] * \left[\frac{-\delta_1 - \alpha_1\gamma_1}{(\delta_2 - \gamma_2)(\alpha_2 - \beta_4) - \gamma_1(\beta_5 - \alpha_3)}\right] - \frac{\alpha_1(\alpha_1 + \alpha_2)}{\alpha_2 - \beta_4} \succ 0$$

$$\theta_2 = \frac{\alpha_2\beta_1}{\alpha_2 - \beta_4} + \left(\alpha_3 + \alpha_2\frac{\beta_5 - \alpha_3}{\alpha_2 - \beta_4}\right) * \frac{\gamma_1\beta_1}{(\delta_2 - \gamma_2)(\alpha_2 - \beta_4) - \gamma_1(\beta_5 - \alpha_3)} \succ 0$$

$$\theta_3 = \frac{\alpha_2\beta_2}{\alpha_2 - \beta_4} + \left[\alpha_3 + \alpha_2 * \frac{\beta_5 - \alpha_3}{\alpha_2 - \beta_4}\right] * \left[\frac{\gamma_1\beta_2 - \delta_3(\alpha_2 - \beta_4)}{(\delta_2 - \gamma_2)(\alpha_2 - \beta_4) - \gamma_1(\beta_5 - \alpha_3)}\right]$$

$$\theta_4 = \frac{\alpha_2\beta_3}{\alpha_2 - \beta_4} + \left[\alpha_3 + \alpha_2 * \frac{\beta_5 - \alpha_3}{\alpha_2 - \beta_4}\right] * \left[\frac{\gamma_1\beta_3 + \gamma_3(\alpha_2 - \beta_4)}{(\delta_2 - \gamma_2)(\alpha_2 - \beta_4) - \gamma_1\delta_2(\beta_5 - \alpha_3)}\right]$$

$$\theta_5 = \frac{\alpha_2\beta_6}{\alpha_2 - \beta_4} + \left[\alpha_3 + \alpha_2 * \frac{\beta_5 - \alpha_3}{\alpha_2 - \beta_4}\right] * \left[\frac{\gamma_1\beta_6 + \gamma_4(\alpha_2 - \beta_4)}{(\delta_2 - \gamma_2)(\alpha_2 - \beta_4) - \gamma_1\delta_2(\beta_5 - \alpha_3)}\right]$$

Chapter 6

EMPIRICAL APPLICATION

Econometric model specification

The use of (20) in empirical testing will require some modification:

$$\Delta \ln L_{it}^{*} = \tilde{\theta}_0 + \tilde{\theta}_1 \Delta \ln Y_t + \tilde{\theta}_2 \Delta \ln D_{it} + \tilde{\theta}_3 \Delta MP_t + \tilde{\theta}_4 \ \ln \hat{K}_{it-1} + \tilde{\theta}_5 \ln \hat{K}_{it-1} * \Delta MP_t \quad (20^*)$$

Difference approach fits better the estimation of building-up loan portfolio due to changes in either capital or/and exogenous shocks. Another important feature of this approach is elimination of possible nonstationarity.

I include the net effect of monetary shock itself despite the fact that it was not specified in the original setting. In essence, it captures the issue of possibility of different banks to mitigate negative shock and take marginal advantage of positive shock.

Logarithmic specification allows us to obtain easily interpretable parameters of correspondent elasticity.

There is however a caution about possible correlation between policy measures, deposits and level of aggregate income (Y) which reflects the overall economy stance. The primary task of monetary policy is to regulate economy performance, hence affect Y, while deposits and aggregate income Y are virtually moving together. As such, ΔY and ΔMP , as well as ΔY and D, must be checked for correlation.

Analysis

Monetary policy impact

The extent of bank response to policy actions can be evaluated in light of risk-aversion behavior.

Results of (20*) will enable us to infer about aggregate impact of policy onto bank lending. Our attention will be drawn onto $\tilde{\theta}_3$ and $\tilde{\theta}_5$. The sign of the latter depends solely on β_3, which allows direct inference of capital-controlled policy effect. Since parameters are expected to vary across level of capitalization, it is appropriate to estimate loan supply function (20*) for 3 groups of banks: those of small, medium and large capital.

$\tilde{\theta}_3$ reflects here the second source of different loan adjustment due to change in capital over the groups of banks. According to (14a) and (15a) $\tilde{\theta}_3$ is expected to be positive and decreasing with capital (over three groups of banks).

Justifications of a so called capital channel (pointed out in notational form in source b)) must be supported by negative sign of $\tilde{\theta}_5$. At the same time behavior of $\tilde{\theta}_5$ bears different meaning being dependent on policy direction.

As such, for expansionary policy regime the following treatment should take place (following 15): increasing in absolute value $\tilde{\theta}_5$ would suggest decreasing risk-aversion.

For another type of policy regime results can be treated the other way around (following 14): higher magnitude of $\tilde{\theta}_5$ (reflecting mitigation of consequences) at a higher capital level will stand for increasing risk-aversion.

Finally, to evaluate aggregate impact of central bank actions on three groups of banks, we are required to compare the sum of coefficients $\tilde{\theta}_3$ and $\tilde{\theta}_5$. Its meaning depends on particular type of policy as well.

Consider the case of positive shock: the sum decreasing with capital allows concluding about increasing risk-aversion, and vice-versa. If it does not differ significantly over groups, this will support decreasing risk-aversion of banks with their capital.

Alternative, negative, shock: the sum decreasing with capital allows concluding about decreasing risk-aversion, and vice-versa. If it reveals not to differ significantly over groups, this would pretend to support increasing risk-aversion of banks with their capital.

More generally, we can say about overall strength of policy and its channels in the sense of individual banks. If the environment promotes risky behavior as capital of bank is higher, the central bank will reach its constraining goals via small banks mainly as their less favorable market position is enhanced by relatively higher risk-aversion. However, should the central bank apply tools to expand banking activities, there will be no considerable difference in extent of response over group. Nominal power will depend on initial stance of banking industry and other exogenous economic factors.

The effect of capital

Capital as the source of differing lending response can be distinguished by estimating coefficient $\tilde{\theta}_4$ for two policy types. A following version of (20*) allows that:

$$\Delta \ln L_{it}^{*} = \tilde{\theta}_0 + \tilde{\theta}_1 \Delta \ln Y_t + \tilde{\theta}_2 \Delta \ln D_{it} + \tilde{\theta}_3 \Delta MP_t + \tilde{\theta}_4 \ \ln \hat{K}_{it-1} + \tilde{\theta}_5 \ln \hat{K}_{it-1} * \Delta MP_t \quad (20^*)$$

$\tilde{\theta}_4$ increasing with capital under expansionary policy would suggest decreasing risk-aversion, while decreasing $\tilde{\theta}_4$ would stand for increasing risk-aversion (as follows from combined effects of 13 and 14). Under restrictive measures increasing $\tilde{\theta}_4$ is expected to witness about increasing risk-aversion and vice versa.

Expectations

To sum up, $\tilde{\theta}_3$, $\tilde{\theta}_5$ and $\tilde{\theta}_4$ are partially determined by risk aversion of banks.

In either case $\tilde{\theta}_3$ must be positive and decreasing with capital, as is predicted by ability of smoothing negative effects by large banks and taking maximum advantage by small banks in case of favoring policy.

It is most probable that capital owners do supervise bank managers closely and become more reluctant to take risks as capital invested in bank increases ($\frac{\partial R}{\partial K} \geq 0$). Then under the restrictive measures $\tilde{\theta}_4$ is likely to acquire the largest value for the group of large banks.

$\tilde{\theta}_5$ is expected to be of the highest magnitude for the group of small banks.

Yet, the opposite behavior of banks, that is, decreasing risk aversion ($\frac{\partial R}{\partial K} \prec 0$) should not be rejected. This could be attributed to low supervision of capital owners or not strict punishment for defaulting on risky activities. In such a case $\tilde{\theta}_4$ is expected to be the highest for small banks, while $\tilde{\theta}_5$ might be of low importance at a higher level of capital.

Under the expansionary policy $\frac{\partial R}{\partial K} \geq 0$ should be supported by declining $\tilde{\theta}_4$ and increasing in absolute value $\tilde{\theta}_5$ with capital of the bank. The opposite behavior should take place if $\frac{\partial R}{\partial K} \prec 0$.

Chapter 7

DATA

The source of data to be used in empirical estimation of hypothesis is the National bank of Ukraine (www.bank.gov.ua) and Association of Ukrainian banks (www.aub.com.ua).

Sample used for the (20*) estimation covers the period 1999:01 to 2004:03 with quarterly frequency.

The data includes following variables:

a) Individual observations on each bank:

i) $\Delta \ln L_{it}$ - Difference in (logarithm of) commercial loan portfolio (business and private loans) during the quarter.

ii) $\Delta \ln D_{it}$ - Difference in (logarithm of) absolute amount of deposits.

iii) $\ln \hat{K}_{it}$: $\hat{K}_{it} = K_{it} - \left(\overset{\bullet}{\kappa}^{*} A_{it}^{R} \right)$ deviations of current capital from the minimum required to hold.

This term will enter empirical model. But it should be noted, that ranging of banks into three groups is based on the absolute amount of capital. The groups' borders of small and medium capital banks were determined at a 75 and 95 lower percentile respectively so as to reflect breaking points.

b) Aggregate macro data

iv) $\Delta \ln Y$ - Change in (logarithm of) GDP.

v) ΔMP reflects the NBU tools in conducting its policy. During the period under study the NBU has been applying the following means to affect banks' behavior:

Refinancing of commercial banks – the total volume of loans or securities lent by NBU to the banking system (effectively, increase disposable funds);

Certificates of deposits – CD issued (effectively, deposits of banks within the NBU-withdrawal of disposable funds);

Reserve requirements (λ_i) imposed on deposits, which constricts the room for profitable investment of acquired deposits.

I have used refinancing lending in my estimations. It comprises both types of policy: restrictive, that is reducing lending volume provided to commercial banks by the central bank, until 2001:1Q, and expansive further on.

Reserve requirements has served fairly the same task as refinancing of banks, that is allowance to widen banks activity via supplying them with additional resources. The Central bank had been lowering reserve norms with their differentiation over types of deposits according to their timing for about 3 times since 2001. These actions favored long deposits mostly: as of 2004 corresponding norm is set at 0%.

An alternative approach of testing risk aversion is conducted with the use of monthly data for 2000-2004 (i.e., 60 time observations). Sample of 152 banks

with at least 10 time observations employed reflects closely the whole population (presented by 154 working banks as of 200:01 and 160 working banks by the end of 2004). The data used includes variables:

K - balance value of gross capital

L - volume of commercial loans portfolio

RoC - return on shareholders capital

GDP - Gross domestic product, in real terms

Chapter 8

RESULTS AND INTERPRETATION

Testing the model

I have used tested the model two types of data:

the population of 193 banks, including those operating during either beginning of my period range (at most till 2000:1Q) and those during latter periods only (since 2002) covering at least 3 quarters, at most 23 quarters;

sample covering only 128 banks operating during whole period under study (that is 23 quarters), presenting balanced panel of observations.

Let me introduce here the results for the sample, while population results I postpone until appendix, since they are fairly the same and lead to unique inference, supporting consistency of estimates.

As noted above, $\Delta \ln Y$ was indeed dropped due to correlation within independent variables. Direct inclusion of deposits makes us to disregard GDP as explanatory variable.

Estimation of (20*) is as follows[2]:

[2] * significant at 95% confidence level

Table 1. Results of testing influence of monetary policy on bank lending

dif_Loan		**Large**	**Medium**	**Small**
θ_2	**dif_Dep**	0.73396*	0.45168*	0.401545*
Contractionary MP				
θ_3	**dif_Ref**	0.34493	1.42106*	3.324242*
θ_5	**K*dif_Ref**	-0.0079	-0.0572*	-0.10035*
$\theta_3+\theta_5$	***Ref+K*Ref***	0.33701	1.363878*	3.2238887*
Expansionary MP				
θ_3	**Ref**	0.160917	0.039646	0.138618
θ_5	**K_Ref**	0.004594	0.003908	-0.0061485
$\theta_3+\theta_5$	***Ref+K_Ref***	0.165511	0.043554	0.1324695

Cross-sectional time-series method applied as the panel data consists of 128 observations over 23 time periods. Hausman test allowed not rejecting random effect hypothesis in neither whole population (193 banks) nor in sample of 128 banks. Applicability of random effects is consistent with widely perceived idea about random effect specification better fit for the sample close to the one exhausting population.

According to clarifications of the model, given restrictive policy measures $\tilde{\theta}_3$ is indeed decreasing with capital standing for ability of large banks to smooth negative impact of exogenous shock on their lending activity.

Given the same environment, $\tilde{\theta}_5$ implying the strongest amplification of negative shock for the smallest banks, testifies about decreasing with capital risk-aversion.

Now, constraining monetary policy is seen an affecting the smallest banks most severely due to overlapped restrictions to overcome partially shocks and relatively

high risk-aversion. The largest banks due to the same reason have not experienced considerable influence of the central bank measures.

Somewhat unexpected are insignificant results of positive monetary policy impact on lending. This can be attributed to the fact, that the major driving force of expanding banking activity starting FY2001 was growing economy with high demand for loans, especially that of business.

It is worth to note that lending is the most sensitive to deposits at the largest banks. This witness about those banks being the "engine" of banking system in the sense that they are leaders at financial market. The strongest dependence of loans on deposits for the group of highly capitalized banks supports idea of low susceptibility to monetary policy. This fact can be explained by positive correlation between capital and deposits outsourced from market perception of large banks as more trustworthy, they being well-known to public, widely represented regionally.

This reasoning implies that the central bank can achieve its targets mainly via less capitalized banks. And as banks build up their capital, this leads to instantaneous cut in lending and reduces power of monetary authority.

Let us now turn to more explicit evidence of capital as a source of heterogeneous lending response. Estimation results of (20*) provide us with such evidence:

Table 2. Capital effect on bank lending

Contractionary MP		***Large***	***Medium***	***Small***
$\hat{\theta}_4$	**Lag (K)**	0.00392	0.00669*	0.0089023*
Expansionary MP				
$\hat{\theta}_4$	**Lag (K)**	-0.00401	-0.00244	-0.0032618

According to justification for relative magnitude of θ_4 over bank groups, these results also confirm idea of decreasing risk aversion. That is, small banks cut on lending to the higher extent than larger banks do when unfavorable policy is implemented. In opposite case the effect of capital is not significant at the largest banks. The absence of differences in coefficients over groups also supports idea of decreasing risk-aversion. These results are explained by risk aversion due to controlling for different types of policy. The intuition behind little evidence of capital effect on lending during favorable exogenous conditions points on exogenous driving forces, not only central bank's actions but developing business environment (growth of demand for and supply of funds), of bank activities.

Summarizing, we can make inferences on two issues stemming from the empirical results. The first inference is regarded to the risk taking behavior of banks according to their capitalization level. Outcomes of tested model confirm the idea of decreasing risk aversion with capital within the capital adequacy maintenance process. The effect of this feature of individual bank is close to the effect of financing (debt and capital acquisition and adjustment) opportunities available to particular banks. But the model allowed distinguishing the risk-aversion degree. As such, large banks are not as cautious as might be perceived publicly. And some might be quite likely to get into trouble when they face necessity to build-up their capital and fail to implement this rapidly enough. A temptation to earn high profits might lead them to undertake risky projects more readily than others which will lock them into closed circle. Few bank candidates are expected to behave in such a way, but analysis show they are likely to come from the group of the largest banks.

Risk aversion is reveled to be (one of) the source(s) of diverse lending response to monetary measures over the three groups of banks. Lending response, as the second issue we can infer of, has steamed mostly from small and medium capital

banks and was quite considerable. This effect was perceptible however only when the central bank targeted via constraints in banking activity. That is, lending channel does work when monetary authority tries to restrain negative economic developments. This channel works via less capitalized banks as the medium.

Expansive tools were not effective enough for all groups of banks. This might be referred to the fact that the major driving force of growing lending was outside economic engines which have bid-up demand for funds (hence, loans) of economic agents, as well as supply of funds to financial institutions. This basically means that monetary policy was working via another transmission channel during the period when expansion of central bank refinancing lending was considered. Finally, combining both conclusions, we can expect that higher concentration of bank capital will reduce power of the central bank in its attempt to restrain inflation (or other targets) via regulation of bank activity.

An alternative approach to risk aversion evaluation

Intuitively straightforward way to estimate alignment of risk-taking disposition over three groups of banks is to estimate the rate of build-up of capital due to increase of loans (i.e. risky assets) and capital profitability.

The volume of current bank capital less retained earnings from the previous period is used in the following estimation as a measure of capital being presented by $External\_capital_{it}$. This variable will thus approximate external equity issue. It will allow me to draw inference on profit as an implicit determinant of capital growth. However, there is a drawback in appeal to the form of external capital defined above since control for other internal sources of capital, such as reserve funds, asset (including investments) revaluation, is absent.

Taking into account this fact estimates should be treated cautiously.

The following regression was estimated. In addition to OLS regression instrumental variable method was used in a view of positive interdependence between capital and loans. I have used GDP as an instrument for bank lending since the latter is important source of finance for business, hence is positively related to national output (GDP). The relative magnitudes of estimated coefficients are fairly similar, while p-values show estimates of coefficients to be more reliable (specifically for two extreme bank groups) when GDP was used as instrument for loans.

$$Ln(External\_capital_{it}) = b_0 + b_1 \ln(L_{it-1}) + b_2 \ln(RoC_{it-1}) + b_3 (\ln L_{it-1} * \ln PR_{it-1})$$

Table 3. Capital adjustment to lending activity

External Capital		***Large***	***Medium***	***Small***
Lag(L)	($\hat{b}_1$)	1.148997*	.6775166*	.4924026*
Lag(RoC)	($\hat{b}_2$)	.2336988*	-.0605368*	.0525979*
Lag(L*PR)	($\hat{b}_3$)	-.0495946*	-.0092807*	-.0450652*

There are few points resulted from estimation. First, positive influence of lending on future acquisition of new capital (coefficient $\hat{b}_1$) testifies that banks do tend to follow capital adequacy requirements. Second, $\hat{b}_2$ gives an evidence of bank attractiveness for investors. We can treat return on capital as an indicator of investment return. As such, investors consider large banks as most profitable projects, allowing bank owners to issue new capital, or sell their stakes at a quite high price. This coincides with the meaning of diverse influence of lending on capital over bank groups ($\hat{b}_1$). Growing return on capital at the smallest banks also attracts additional investments into bank equity, although much smaller then that of the largest banks does: 0.05% versus 0.23% growth of capital due to 1% profitability increase. Despite small banks are less attractive for investors, they afford to build up their capital probably at expense of holding companies, as such relationship is quite widespread within that group of banks. The other possible

reason related to the risk taking issue is "double benefit" from additional investment into capital by existing shareholders (besides related parties-not controlling shareholders): profitability and maintenance of capital adequacy in order to avoid trap.

To the contrast, inverse relation evaluated for the medium capital banks witnesses partially about undesirable dilution of the rights by existing owners, partially about inability of such banks to attract new capital inflow.

Finally, there is behavioral aspect of capital adjustment which we may consider as the extent of "saturation" with the previous period profit and decision to intensify capitalization. That particular result reflects the opposite effect to lending response outcome and is referred to the other source of risk-taking behavior. Specifically, estimate $\hat{\beta}_3$ testifies the extent to which the bank will ease its (willingness to) response in capital increment given certain level of profitability. Coefficients $\hat{\beta}_3$ vary across three groups being of the highest magnitude for highly capitalized banks and the smallest for medium ones. Although the hierarchy diverges from that obtained in above models, we can conclude in a similar fashion that large banks are the most willing to evade from external capital build-up. This fact may be treated to some extent as a lower risk aversion of those banks, while medium-capital banks are the most risk-averse.

Altogether as gross and net influence of loans on capital witness, the higher is the capital of the bank the stronger adjustment of capital to lending growth it will incur: a 1% increase in loan volume makes bank to pile-up its capital by 0.44%, 0.67% and 1% respectively in capital-increasing sequence. One explanation of this range is that large banks are more attractive for "investors" and have better opportunities to acquire new capital.Chapter 12

Chapter 9

CONCLUSIONS

This research appears as a contribution to investigation of monetary transmission mechanism in Ukraine. It represents a specific narrow aspect of the bank lending channel: an insight through the bank capital. In this course the research dwells on the issue of bank risk taking behaviour concerning the binding capital adequacy requirement.

The underlying reasoning of the research compiles two related ideas drawn from observed market information. The first one is an existence and extent of the bank lending channel. The second one – bank capital as an influential factor of this channel on the one hand, and its direct impact on bank lending behavior on the other hand; both reflecting the extent of bank risk aversion.

First, evidence from the recent banking developments that confirm viability of lending channel is provided. It is followed by the facts of capital lagging behind lending growth which has been taking place during the last years. Theoretical part of the paper incorporates: basic derivation of bank lending decision given its risk taking incentives constraint; response of lending to monetary policy structured by risk aversion and differential bank abilities to smooth or intensify the effect of exogenous policy onto their credit portfolios – all across three groups of banks (constructed according to capitalization) and being divisible between two directions of policy: expansionary and contractionary. Derivation of loan supply function and its application to the relevant data enabled us to investigate questions of interest and come up with conclusions.

The first inference about bank lending channel confirms expectations with some limitations. It did work when the central bank applied restrictive measures. In particular, mainly medium and small banks were mediums of monetary signals transmission to the real economy. It did not work, however, during expansive measures of the central bank. The most plausible explanation for such outcome is strong driving force of economic growth.

The second inference is regarded to the risk taking behavior of banks according to their capitalization level. Risk aversion was also reveled to be (one of) the source(s) of diverse lending response to monetary measures over the three groups of banks. Although the effect of this feature of individual bank is close to the effect of bank specific financing opportunities, the model allowed distinguishing the risk-aversion degree. Outcomes of tested model confirm the idea of decreasing risk aversion with capital in light of the capital adequacy maintenance process. However, comparative difference is significant, while qualitative strength is rather small. As such, large banks are not as cautious as might be perceived publicly. Theoretical justification together with empirical findings suggests that enlarged capital adequacy requirements has harmed larger banks initially more than their smaller counterparts since they maintained capital stock close to the margin.

Combining both conclusions, we can expect that too high concentration of bank capital will reduce power of the central bank in its attempt to restrain inflation (or other targets) via regulation of bank activity. It might also undermine the stability of financial system in a view of high weight in the whole system of a single bank which is relatively risk prone.

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Appendix 1 Risk premium derivation[3]

$$MB = l \cdot (1-\rho) - \rho$$

$$\text{var}(MB) = \text{var}[l \cdot (1-\rho) - \rho] = \text{var}[l - (1+l)\rho] = (1+l)^2 \text{ var}(\rho) = (1+l)^2 \cdot \sigma_\rho{}^2$$

Since bank would ideally prefer certainty, that is absence of chance of no loan repayment, it will require compensation for bearing the risk. This compensation can be referred to as risk premium, which will result in equal "utilities" from facing risk and sure outcome with risk premium paid.

Let $\breve{W}$ be the MB in risky situation and W_0-certain known in advance marginal benefit, such that $E(\breve{W}) = W_0$.

Then in indifferent situation it should be:

$$E[U(\breve{W})] = E[U(W_0 - \pi)] = U[W^*] \qquad \text{(a)}$$

A first order Taylor approximation gives

$$U[W^*] \approx U[W_0] + U'[W_0] * (W^* - W_0) = U[W_0] - U'[W_0]\pi \qquad \text{(b)}$$

A second order Taylor approximation gives

$$U[\breve{W}] \approx U[W_0] + U'[W_0\} * (\breve{W} - W_0) + \frac{1}{2} U''[W_0] * (\breve{W} - W_0)^2$$

Take expectations we have

$$E(U[\breve{W}]) \approx U[W_0] + U'[W_0] * E(\breve{W} - W_0) + \frac{1}{2} U''[W_0] * E((\breve{W} - W_0)^2) \ ,$$

noting that $E(\breve{W} - W_0) = 0$ and $E((\breve{W} - W_0)^2) = (1+l)^2 \sigma_\rho^2$ reduce (2) to

$$E(U[\breve{W}]) \approx U[W_0] + \frac{1}{2} U''[W_0](1+l)^2 \sigma_\rho^2 \qquad \text{(c)}$$

Combining (a), (b), and (c) we arrive at

$$E(U[\breve{W}]) = U[W^*] = U[W_0] - U'[W_0]\pi \approx U[W_0] + \frac{1}{2} U''[W_0](1+l)^2 \sigma_\rho^2$$

$$\pi \approx -\frac{1}{2} \frac{U''[W_0]}{U'[W_0]} l^2 \sigma_\rho^2 = \frac{1}{2} R \cdot (1+l)^2 \sigma_\rho^2$$

where $R = -\dfrac{U''[W_0]}{U'[W_0]}$ is the degree of absolute risk aversion.

[3] Based on lecture notes in Labor economics by Prof. Coupe (2005)

Appendix 2 Evaluation of the aggregate monetary policy impact and risk aversion. Sample of 128 banks.

a) Large capital banks

hausman FE RE

```
                 ---- Coefficients ----
             |      (b)           (B)             (b-B)     sqrt(diag(V_b-
V_B))
             |       FE            RE         Difference          S.E.
-------------+----------------------------------------------------------------
------
   dif_lnDep |    .7308728     .7339606       -.0030878        .0153936
   dif_lnRef |    .3420433     .3449284       -.0028851        .0527211
     Cap_lag |    .0039868     .0039177        .0000691        .0020464
 Cap_lev_Ref |   -.0071399    -.0079183        .0007784        .0077636
   d_Ref_pos |   -.1824875    -.1840116        .0015241        .0662402
lagK_dRef_~s |    .0114542     .0125122       -.0010581        .0074056
   lag_K_Pos |   -.0079697    -.0079273       -.0000423        .0019754
------------------------------------------------------------------------------
------
                           b = consistent under Ho and Ha; obtained from
xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from
xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.10
                Prob>chi2 =      1.0000
```

xtreg dif_lnLoan dif_lnDep dif_lnRef Cap_lag Cap_lev_Ref d_Ref_pos lagK_dRef_Pos lag_K_Pos if Dbig==1, re

```
Random-effects GLS regression                   Number of obs      =       207
Group variable (i): id                          Number of groups   =         9

R-sq:  within  = 0.4832                         Obs per group: min =        23
       between = 0.9248                                        avg =      23.0
       overall = 0.4914                                        max =        23

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    192.28
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

dif_lnLoan	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
dif_lnDep	.7339606	.0625105	11.74	0.000	.6114423	.8564788
dif_lnRef	.3449284	.2498636	1.38	0.167	-.1447953	.8346521
Cap_lag	.0039177	.0044718	0.88	0.381	-.0048469	.0126823
Cap_lev_Ref	-.0079183	.0270354	-0.29	0.770	-.0609067	.0450702
d_Ref_pos	-.1840116	.3039282	-0.61	0.545	-.7796999	.4116766
lagK_dRef_~s	.0125122	.0295911	0.42	0.672	-.0454852	.0705096
lag_K_Pos	-.0079273	.0059358	-1.34	0.182	-.0195614	.0037067
_cons	.0038863	.0360281	0.11	0.914	-.0667274	.0745001
sigma_u	0					
sigma_e	.40811693					
rho	0	(fraction of variance due to u_i)				

b) Medium capital banks

hausman FE RE

	---- Coefficients ----			
	(b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
dif_lnDep	.4462622	.4516826	-.0054204	.0065706
dif_lnRef	1.414395	1.421055	-.0066602	.0290406
Cap_lag	.0074309	.0066937	.0007372	.001048
Cap_lev_Ref	-.0557635	-.0571766	.0014131	.004174
d_Ref_pos	-1.376087	-1.381409	.0053219	.0324927
lagK_dRef_~s	.0593439	.0610842	-.0017403	.0041594
lag_K_Pos	-.0092779	-.0091375	-.0001404	.0008928

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 1.51
Prob>chi2 = 0.9820

*xtreg dif_lnLoan dif_lnDep dif_lnRef Cap_lag Cap_lev_Ref d_Ref_pos lagK_dRef_Pos lag_K_Pos if Dmed**==1**, re*

```
Random-effects GLS regression                   Number of obs      =       572
Group variable (i): id                          Number of groups   =        25

R-sq:  within  = 0.5365                         Obs per group: min =        21
       between = 0.7407                                        avg =      22.9
       overall = 0.5406                                        max =        23

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    663.60
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
  dif_lnLoan |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   dif_lnDep |   .4516826   .0304014    14.86   0.000     .3920969    .5112683
   dif_lnRef |   1.421055   .1604535     8.86   0.000     1.106572    1.735538
     Cap_lag |   .0066937   .0031075     2.15   0.031      .000603    .0127843
 Cap_lev_Ref |  -.0571766    .016561    -3.45   0.001    -.0896356   -.0247175
   d_Ref_pos |  -1.381409   .1832927    -7.54   0.000    -1.740656   -1.022162
lagK_dRef_~s |   .0610842   .0181596     3.36   0.001     .0254921    .0966763
   lag_K_Pos |  -.0091375   .0035071    -2.61   0.009    -.0160114   -.0022637
       _cons |   .0490533   .0218917     2.24   0.025     .0061463    .0919602
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .37581156
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

c) Small capital banks

hausman FE RE

```
                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           RE         Difference          S.E.
-------------+----------------------------------------------------------------
   dif_lnDep |    .3977631     .4015452       -.0037821        .0039516
   dif_lnRef |    3.348187     3.324242        .0239451        .0344253
     Cap_lag |    .0088438     .0089023       -.0000586        .0011286
 Cap_lev_Ref |   -.1029922    -.1003533       -.0026389        .0037932
   d_Ref_pos |   -3.208701    -3.185624       -.0230764        .0389439
lagK_dRef_~s |    .0968913     .0942048        .0026865        .0043446
   lag_K_Pos |   -.0123807    -.0121641       -.0002166        .0007361
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg
```

```
    Test:  Ho:  difference in coefficients not systematic

                  chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        1.28
                Prob>chi2 =      0.9891
```

xtreg dif_lnLoan dif_lnDep dif_lnRef Cap_lag Cap_lev_Ref d_Ref_pos lagK_dRef_Pos lag_K_Pos if Dsml==1, re

```
Random-effects GLS regression                   Number of obs      =      2150
Group variable (i): id                          Number of groups   =        94

R-sq:  within  = 0.6478                         Obs per group: min =        20
       between = 0.7656                                        avg =      22.9
       overall = 0.6485                                        max =        23

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   3952.22
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

dif_lnLoan	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
dif_lnDep	.4015452	.0167924	23.91	0.000	.3686327	.4344577
dif_lnRef	3.324242	.1461036	22.75	0.000	3.037884	3.610599
Cap_lag	.0089023	.0031974	2.78	0.005	.0026356	.0151691
Cap_lev_Ref	-.1003533	.0124461	-8.06	0.000	-.1247472	-.0759593
d_Ref_pos	-3.185624	.1723962	-18.48	0.000	-3.523514	-2.847734
lagK_dRef_~s	.0942048	.0153755	6.13	0.000	.0640695	.1243401
lag_K_Pos	-.0121641	.0028397	-4.28	0.000	-.0177298	-.0065984
_cons	.0586593	.0235258	2.49	0.013	.0125495	.1047691
sigma_u	0					
sigma_e	.57578854					
rho	0	(fraction of variance due to u_i)				

Appendix 3 Evaluation of the aggregate monetary policy impact and risk aversion. Population, 193 banks

a) Large capital banks

```
hausman FE RE

                 ---- Coefficients ----
             |       (b)           (B)             (b-B)     sqrt(diag(V_b-
V_B))
             |       FE            RE         Difference          S.E.
-------------+----------------------------------------------------------------
---
   dif_lnDep |    .6953678     .6979623       -.0025945         .019777
   dif_lnRef |     .217613     .2163045        .0013085        .0574726
     Cap_lag |    .0019862     .0016133        .0003729        .0019294
 Cap_lev_Ref |    -.010142    -.0115813        .0014393        .0083922
     Ref_pos |   -.1357404    -.1300722       -.0056682        .0682995
lagK_difRe~s |    .0156056     .0175723       -.0019667        .0080373
   lag_K_Pos |   -.0053454    -.0050063       -.0003391        .0018987
------------------------------------------------------------------------------
---
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.16
                Prob>chi2 =      1.0000

xtreg   dif_lnLoan   dif_lnDep   dif_lnRef   Cap_lag   Cap_lev_Ref
Ref_pos  lagK_difRef_pos lag_K_Pos if  Dbig==1, re

Random-effects GLS regression                   Number of obs      =       270
Group variable (i): id                          Number of groups   =        13

R-sq:  within  = 0.3626                         Obs per group: min =         7
       between = 0.7265                                        avg =      20.8
       overall = 0.3726                                        max =        23

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    155.58
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
```

```
  dif_lnLoan |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   dif_lnDep |   .6979623   .0625537    11.16   0.000     .5753592    .8205653
   dif_lnRef |   .2163045   .2385174     0.91   0.364     -.251181    .6837901
     Cap_lag |   .0016133   .0044604     0.36   0.718    -.0071289    .0103555
 Cap_lev_Ref |  -.0115813   .0256821    -0.45   0.652    -.0619173    .0387546
     Ref_pos |  -.1300722   .2977413    -0.44   0.662    -.7136344      .45349
lagK_difRe~s |   .0175723   .0285206     0.62   0.538    -.0383271    .0734718
   lag_K_Pos |  -.0050063   .0059693    -0.84   0.402    -.0167059    .0066934
       _cons |   .0143908   .0360313     0.40   0.690    -.0562293    .0850108
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .46108825
         rho |          0   (fraction of variance due to u_i)
```

b) Medium capital banks

```
hausman FE RE
```

```
                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           RE         Difference          S.E.
-------------+----------------------------------------------------------------
   dif_lnDep |     .407745     .4139669       -.0062219        .0066705
   dif_lnRef |    1.651478     1.656704        -.005226        .0325781
     Cap_lag |    .0075385     .0066855         .000853        .0011108
 Cap_lev_Ref |   -.0800176     -.081294        .0012764        .0042746
     Ref_pos |   -1.607893    -1.615344        .0074514        .0353674
lagK_difRe~s |    .0836996     .0852022       -.0015027        .0042944
   lag_K_Pos |   -.0092194    -.0085745       -.0006449        .0010734
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        1.59
                Prob>chi2 =      0.9790
```

```
xtreg   dif_lnLoan   dif_lnDep   dif_lnRef   Cap_lag   Cap_lev_Ref
Ref_pos  lagK_difRef_pos lag_K_Pos if  Dmed==1, re
```

```
Random-effects GLS regression                   Number of obs      =       638
Group variable (i): id                          Number of groups   =        31

R-sq:  within  = 0.5407                         Obs per group: min =         8
       between = 0.7215                                        avg =      20.6
       overall = 0.5457                                        max =        23

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    756.69
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
  dif_lnLoan |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   dif_lnDep |   .4139669   .0286115    14.47   0.000     .3578893    .4700445
   dif_lnRef |   1.656704   .1585048    10.45   0.000      1.34604    1.967367
     Cap_lag |   .0066855   .0028617     2.34   0.019     .0010767    .0122942
 Cap_lev_Ref |   -.081294   .0163292    -4.98   0.000    -.1132986   -.0492894
     Ref_pos |  -1.615344   .1770173    -9.13   0.000    -1.962292   -1.268397
lagK_difRe~s |   .0852022   .0176617     4.82   0.000     .0505859    .1198186
   lag_K_Pos |  -.0085745   .0031409    -2.73   0.006    -.0147305   -.0024185
       _cons |   .0550568   .0199754     2.76   0.006     .0159058    .0942079
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .35762426
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

c) Small capital banks

```
hausman FE RE
```

```
                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           RE         Difference          S.E.
-------------+----------------------------------------------------------------
   dif_lnDep |    .3200285     .3150381        .0049904        .0033815
```

```
   dif_lnRef |    3.510837      3.53264       -.0218029         .024902
     Cap_lag |    .0148325     .0156439       -.0008114        .0008907
 Cap_lev_Ref |   -.0985138    -.0976824       -.0008314        .0023872
     Ref_pos |   -3.408178    -3.432985        .0248069        .0270783
lagK_difRe~s |    .0985444     .0976399        .0009044        .0026965
   lag_K_Pos |   -.0163732    -.0164585        .0000853        .0006338
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                        =        4.01
              Prob>chi2 =      0.7788
```

xtreg dif_lnLoan dif_lnDep dif_lnRef Cap_lag Cap_lev_Ref Ref_pos lagK_difRef_pos lag_K_Pos if Dsml==1, re

```
Random-effects GLS regression                   Number of obs      =      2597
Group variable (i): id                          Number of groups   =       147

R-sq:  within  = 0.6245                         Obs per group: min =         2
       between = 0.1149                                        avg =      17.7
       overall = 0.6122                                        max =        23

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   4169.20
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
  dif_lnLoan |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   dif_lnDep |   .3150381   .0150035    21.00   0.000     .2856319    .3444444
   dif_lnRef |    3.53264   .1262202    27.99   0.000     3.285253    3.780027
     Cap_lag |   .0156439   .0027075     5.78   0.000     .0103373    .0209505
 Cap_lev_Ref |  -.0976824   .0110133    -8.87   0.000     -.119268   -.0760968
     Ref_pos |  -3.432985   .1482132   -23.16   0.000    -3.723478   -3.142492
lagK_difRe~s |   .0976399   .0134682     7.25   0.000     .0712428    .1240371
   lag_K_Pos |  -.0164585   .0024168    -6.81   0.000    -.0211953   -.0117216
       _cons |   .0223359   .0283057     0.79   0.430    -.0331423     .077814
-------------+----------------------------------------------------------------
     sigma_u |  .23741947
     sigma_e |  .52271311
         rho |  .17102099   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Appendix 4 Capital adjustment to bank lending.

a) Large capital banks

```
hausman FE RE

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           RE         Difference          S.E.
-------------+----------------------------------------------------------------
      l_ln_L |    1.159108     1.148997        .0101115               .
    l_ln_RoC |    .2146927     .2336988       -.0190061        .0018455
      l_L_PR |   -.0491541    -.0495946        .0004405               .
------------------------------------------------------------------------------
                        b = consistent under Ho and Ha; obtained from xtivreg
         B = inconsistent under Ha, efficient under Ho; obtained from xtivreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        5.42
                Prob>chi2 =      0.1435

xtivreg    ln_Xtrn_K    l_ln_RoC    l_L_PR  ( l_ln_L = l_lnGDP ) if
Dbig==1, re

G2SLS random-effects IV regression              Number of obs      =       466
Group variable: id                              Number of groups   =        10

R-sq:  within  = 0.4640                         Obs per group: min =        17
       between = 0.5483                                        avg =      46.6
       overall = 0.4855                                        max =        54

                                                Wald chi2(3)       =    188.40
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
   ln_Xtrn_K |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      l_ln_L |   1.148997   .0970814    11.84   0.000     .9587208    1.339273
    l_ln_RoC |   .2336988   .0510962     4.57   0.000     .1335522    .3338454
      l_L_PR |  -.0495946   .0078574    -6.31   0.000    -.0649949   -.0341943
       _cons |  -2.414441   .6895742    -3.50   0.000    -3.765982    -1.0629
-------------+----------------------------------------------------------------
     sigma_u |  .33561824
     sigma_e |  .62496164
         rho |  .22383919   (fraction of variance due to u_i)
```

```
------------------------------------------------------------------------------
Instrumented:   l_ln_L
Instruments:    l_ln_RoC l_L_PR l_lnGDP
```

b) Medium capital banks

```
hausman FE RE

                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           RE         Difference          S.E.
-------------+----------------------------------------------------------------
      l_ln_L |    .6774863     .6775166       -.0000303        .0063138
    l_ln_RoC |   -.0605384    -.0605368       -1.65e-06        .0027376
      l_L_PR |   -.0092831    -.0092807       -2.42e-06        .0006838
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtivreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtivreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.00
                Prob>chi2 =      1.0000


xtivreg    ln_Xtrn_K    l_ln_RoC    l_L_PR  ( l_ln_L = l_lnGDP ) if
Dmed==1, re

G2SLS random-effects IV regression              Number of obs      =      1473
Group variable: id                              Number of groups   =        32

R-sq:  within  = 0.4697                         Obs per group: min =        14
       between = 0.3427                                        avg =      46.0
       overall = 0.4031                                        max =        59

                                                Wald chi2(3)       =    522.37
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
   ln_Xtrn_K |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      l_ln_L |   .6775166   .0443831    15.27   0.000     .5905272    .7645059
    l_ln_RoC |  -.0605368   .0187394    -3.23   0.001    -.0972653   -.0238083
      l_L_PR |  -.0092807   .0047911    -1.94   0.053     -.018671    .0001096
       _cons |   .7737965   .4270699     1.81   0.070    -.0632451    1.610838
-------------+----------------------------------------------------------------
```

```
     sigma_u |  2.0309507
     sigma_e |  .45866163
         rho |   .9514731   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Instrumented:   l_ln_L
Instruments:    l_ln_RoC l_L_PR l_lnGDP
```

c) Small capital banks

```
hausman FE RE

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           RE         Difference          S.E.
-------------+----------------------------------------------------------------
      l_ln_L |    .4924026     .4937914       -.0013888        .0013974
    l_ln_RoC |    .0525979     .0506526        .0019454        .0012252
      l_L_PR |   -.0450652     -.044116       -.0009492        .0002528
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtivreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtivreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       14.11
                Prob>chi2 =      0.0028

xtivreg    ln_Xtrn_K    l_ln_RoC    l_L_PR  ( l_ln_L = l_lnGDP ) if
Dsml==1, fe

Fixed-effects (within) IV regression         Number of obs      =         4258
Group variable: id                           Number of groups   =          110

R-sq:  within  = 0.1132                      Obs per group: min =            1
       between = 0.4222                                     avg =         38.7
       overall = 0.2862                                     max =           60

                                             Wald chi2(3)       = 208083.31
corr(u_i, Xb)  = -0.3159                     Prob > chi2        =    0.0000

------------------------------------------------------------------------------
   ln_Xtrn_K |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
      l_ln_L |   .4924026   .0191312    25.74   0.000      .454906    .5298991
    l_ln_RoC |   .0525979   .0074705     7.04   0.000      .037956    .0672399
      l_L_PR |  -.0450652   .0025428   -17.72   0.000    -.0500489   -.0400815
       _cons |   1.351886    .076923    17.57   0.000      1.20112    1.502653
-------------+----------------------------------------------------------------
     sigma_u |  .32068382
     sigma_e |  .48308826
         rho |  .30587248   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F  test that all u_i=0:     F(109,4145) =    12.50        Prob > F    = 0.0000
------------------------------------------------------------------------------
Instrumented:   l_ln_L
Instruments:                                l_ln_RoC        l_L_PR        l_lnGDP
```