The impact of financial sector on innovation activity: theoretical background and new evidence from russian banking sector

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The impact of financial sector on innovation activity: Theoretical background and new evidence from Russian banking sector[1]

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Abstract

This paper is to summarize the literature on finance-innovation link and produce evidence that the development of banking sector in Russia is to foster innovation process. Finance-innovation link is a new and scarcely covered issue. Nevertheless it is conventional wisdom that stock market institutions are preferable for financing innovation. But researchers claim that in the developing countries banking institution together with thorough government policy can foster innovations. Also they claim that stock market institutions are more suitable for financing breakthrough innovations, while banks are more suitable for incremental innovations. The main contribution of this paper is that is was empirically shown using panel data models that banks can facilitate innovation in Russia.

***JEL Classification**: C23, 031, G18, G21, E50*
***Keywords**: Finance, innovation, banking system, panel data, Russia, financial system.*

[1] This is merely a draft working paper, if you have any ideas to discuss or remarks to make please do not hesitate to contact me. My e-mail is snakers4@mail.ru. Initially this paper was based on the results of the state sponsored research on the topic in question. The dataset is available upon request.

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1. Introduction

It is widely discussed that relatively more developed financial systems are to foster economic development. The same might be applied to innovation activity. The aim of this paper is to establish a link (either theoretically or empirically) between the development of financial system (in this case banking sector) or alleviating financial constraints and innovative activity. It is common knowledge that sustainable development can be possibly achieved through massive investment in R&D and that it is to be based on the growth of innovative sector of economy. By definition, **innovative activity** is connected with transforming new ideas (usually the results of scientific research) into creating new products or services or improving the existing ones. It can also apply to technological processes used to produce such products or services.[5] As a rule, the following types of investment and expenses are related to the innovative sector: R&D spending, design and marketing spending, investment in new equipment or in human capital, R&D being the most important part of it.[6]

When considering the finance-innovation link, it is worth defining **process** and **product** innovations. Process innovations imply the development and adoption of technologically new or significantly improved production methods. Product innovations imply the development of technologically new or technologically improved products. Product innovations are thought to be of more long-term nature and they are more science intensive or high-tech. The experience acquired via implementing process innovations is unique for a particular enterprise and cannot be replicated easily[7]. Nowadays scientific potential is acquired usually within highly complex organizational structures of big firms. These types of innovations correspond with different types of financial systems in different ways, which is to be discussed later.

In market economy firms willing to be engaged in innovative activity usually face a number of constraints, which can be alleviated by means of developed financial sector to a certain extend. The following problems arise out of the very nature of innovative activity (the ways to solve these problems will be mentioned later)[8]:

- A country might lack adequate mechanisms of financing R&D projects;
- Information asymmetry (as only the innovative entrepreneur is adequately informed about the prospects of his project);
- High level of uncertainty, whether the project is going to be successful;
- No statistics available to estimate inherent risks of such projects;
- Moral hazard problem;
- Adverse selection in credit markets;
- Risk assessment might be quite biased and not based on true merits of innovative project (for example you may consider the so-called "This time is different syndrome[9]");
- The fact that intangible assets created in R&D process are hardly marketable and illiquid;

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[5] Indikatory innovatsionnoi deyatelnosti: 2009. Statistical digest. – HSE, 2009.

[6] Hall B. The Financing of Innovative Firms // European Investment Bank Papers. 2009. Vol. 14 (2). P. 8 – 29.

[7] Thorsten Block, Financial Systems Innovations and Economic Performance // MERIT-Infonomics Research Memorandum Series, 2002

[8] Christian Schröder, Financial System and Innovations-Determinants of Early Stage Venture Capital in Europe // SCHUMPETER DISCUSSION PAPERS 2009-004, September 2009; Hall B. The Financing of Innovative Firms // European Investment Bank Papers. 2009. Vol. 14 (2). P. 8 – 29.

[9] For details see Carmen M. Reinhart, Kenneth S. Rogoff, This time is different eight centuries of financial folly // Princeton University Press, 2009

- The significant role of human capital and intangible assets and poor prospects of replicating these assets.

The developed financial system can act as good intermediary in order to solve some of these problems and alleviate financial constraint inherent to R&D ventures. This paper is to provide statistical evidence from Russian banking sector that more bank credits foster innovation process. This finance-innovation link is scarcely covered in the literature. Nevertheless the other aim of this paper is to provide a thorough summary of empirical evidence and statistical methods.

This paper is divided into 6 sections. After the introduction Section 2 briefly summarizes the existing literature on the finance-innovation link mechanisms. Section 3 describes the dataset. Section 4 is dedicated mainly to statistical and econometric methods. Section 5 provides the results. Section 6 concludes.

2. The finance-innovation link mechanisms

2.1 Banking sector

Finance-innovation link is scarcely covered in the literature. Schumpeter was the first to discuss it in his "Theory of economic development". He emphasized the role of innovative entrepreneur unable to perform his function without effective financial intermediary. He claimed banking sector to be highly important for financing innovations.

Then the importance of banks was to some extend revised and now they are considered to have lost their absolute power, although still contributing to innovation process. According to "Eurobarometer" 71% of the interviewed SMEs agree with the fact that banks are unwilling to take on the risks of financing such companies[10]. Nowadays there are certain limitations when it comes to the ability of banks to finance innovation activity.

According to polls conducted in Russia the most popular factors hampering the development of innovative sector are lack of funds, high costs of innovation and lack of financial support from the government. All these factors are connected with financial constraints of Russian business[11]. Also the recent joint research conducted by PriceWaterhouseCoopers and New Economic School implies that financial constraints are the main factor hampering innovative development[12]. Generally speaking, the main factors preventing banks from serving as financial intermediaries for financing innovation are the following[13]:

1. Adverse selection in credit markets combined with information asymmetry leads to credit rationing;
2. Information asymmetry (between credit institution and innovative entrepreneurs) and no statistical record of innovations again lead to credit rationing;
3. Banking credits usually imply fixed rates. It means that banks consider only the probability of losing their investment. The fact that innovative ventures can be highly profitable is thus not considered by banking institutions.
4. The significant role of human capital and intangible assets imply that information asymmetry problems cannot be solved by proper collateral as patents usually are a significant part of innovator's assets.

It is nevertheless worth mentioning that if we consider three sources of financing (loan capital, owned capital and reinvested profits) the majority if empirical working papers claim that loan capital is the cheapest (this notion usually being true for the developed world), for example Hall (2009)[14].

These are the main reasons of decrease in the role of banks in financing innovation throughout the 20th century. It means that more suitable institutions were created to serve this purpose, viz. venture capital funds and IPO practice, which are to be discussed later. This raises the issue of fitness of particle types of financial systems for the purpose of financing

[10] EUROPEAN COMMISION, 2005a, p. 25

[11] Indiktory innovatsionnoi deyatelnosti: 2009. Statistical digest. – HSE, 2009, page 53

[12] Innovatsionnaya deyatelnost krypnogo biznesa v Rossii. Mechanizmi, barieri, perspektivi.: NES, 2010. page 22.

[13] Stiglitz J., Weiss A. Credit Rationing in Markets with Imperfect Information // American Economic Review. June 1981. Vol. 71.

[14] Hall B. The Financing of Innovative Firms // European Investment Bank Papers. 2009. Vol. 14 (2). P. 8 – 29, см. также Alan J. Auerbach, TAXES, FIRM FINANCIAL POLICY AND THE COST OF CAPITAL: AN EMPIRICAL ANALYSIS // NBER WORKING PAPER SERIES Working Paper No. 955

innovations. As anticipated, negative link is discovered between innovative activity of firms and their financial leverage. This link is robust for the USA and the EU countries. Moreover, Audretsch and Lehmann (2004) claim that raising funds by taking credits and by means of stock market are considered to be incompatible and not complementary, as anticipated. This was shown on the example of the empirical research basing on a dataset containing data for 341 German enterprises[15].

The empiric literature claims that the developed stock market is preferable for financing innovations. For example, Martinsson[16] (2009) claims that it is the financial system of the USA, which secures its advantage in developing new products and services in comparison with bank-based Europe. In this respect, Schröder (2009) points out that higher banking depth results in lower venture funds volumes in the EU, which was empirically shown for 15 EU countries using panel data[17].

On the other hand, Huang and Xu (1999) claim that it turns out that banks in highly competitive banking systems, represented by a big number of banks, are likely to end financing R&D projects prematurely due to competitive pressure. Banks in concentrated banking systems have more resources for collecting technical information, and therefore more readily finance innovative projects[18]. This indicates, that standard financial system dichotomy is to certain extent no longer is applicable.

In spite of the foregoing, the developed market economy can provide a set of mechanisms, enabling banks to participate more actively and efficiently in financing innovation activity.

1. Banks are more or less integrated in the process of creating and managing venture capital finds. Bottazzi (2009) claims that in the EU banks are investors of venture funds in 44% of cases and their share in capital is 40% on average[19]. Although not interfering with venture capitalists directly, banks are heavily engaged in funding them.
2. Higher liquidity of intellectual property markets may lead to friskier banks' investments in innovative activity. This requires some structural shifts on this market, which must result in the ability of patents to serve as collateral. Harhoff (2009) claims that less that 1% of firms in Germany acquired credit, with patents serving as collateral[20].
3. Bank's involvement in financing innovation can increase significantly by developing improved intangible asset assessment techniques.

It is important, that the empirically proven concept of superiority of stock market based systems in terms of financing innovations holds only for the developed world, where banking sector and stock market already have proper financial depth.

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[15] Audretsch D., Lehmann E. Financing High – Tech Growth: The Role of Debt and Equity // Max Planck Institute for Research into Economic Systems Discussion Paper № 1904. May 2004.

[16] Martinsson G. Equity Financing and Innovation: Is Europe Different from the United States? // Swedish Royal Institute of Technology Working Paper № 192. August 2009.

[17] Christian Schröder, Financial System and Innovations-Determinants of Early Stage Venture Capital in Europe // SCHUMPETER DISCUSSION PAPERS 2009-004, September 2009.

[18] Haizhou Huang and Chenggang Xu, Financial Institutions, Financial Contagion, and Financial Crises // Center for International Development at Harvard University Working Paper No. 21 July 1999

[19] Bottazzi L. The Role of Venture Capital in Alleviating Financial Constraints of Innovative Firms // European Investment Bank Papers. 2009. Vol. 14 (2). P. 44.

[20] Harhoff D. The Role of Patents and Licenses in Securing External Finance for Innovation // European Investment Bank Papers. 2009. Vol. 14 (2). P. 87 – 90.

The developing world relies mainly on banking institutions and simultaneous development of these two financial sectors is more of an exception for such countries. The "depth" of stock markets and their effectiveness in developing countries leaves much to be desired and does not enable venture capitalists to choose them as their source of funds.

Dabla-Norris, Kersting and Verdier (2009) in a comprehensive research based on database consisting of more than 14000 firms from 63 countries study (the majority of them are developing countries)[21] claim the development of financial system is very important for innovative firms, especially from high-tech industries. They imply that innovation activity is a very important factor of productivity growth and is stimulated by the financial system. It is worth mentioning that the measure of being innovative is a dummy showing whether a firm was engaged in innovative activity. The measure of financial sophistication is the amount of credit divided by GDP. The positive sign of the interception of these variables proves that banking sector plays a significant role in financing innovation in developing world. So we may state a hypothesis that **in the developing world it is the banking sector, which plays the role of financial intermediary when it comes to financing innovative activities.**

Moreover, researchers from Brazil state that enterprises in the countries with underdeveloped financial markets are likely to focus on banking institutions as sources of funds to finance innovation[22]. They showed with the use of macroeconomic modeling that the banking system of Brazil is connected with innovative activity on regional level. Banking system supports the chain process of giving credits, investing and implementing innovations. Applying a special index showing the effectiveness of using scientific recourses they also showed that high credit disproportions among the constituent territories of Brazil correlate with scientific activity disproportions. It is worth mentioning that the index applied is Opportunity Taking Indicator, calculated as the share of country in world scientific publications divided by the share of country in the total number of patents[23].

It is widely discussed in the literature that financial liberalization has a positive impact on economic growth. But whether government policy affects innovation process is usually not covered. Ang and James[24] (2009) claim proper monetary policy can significantly contribute to innovation. Financial liberalization increases the availability of credit and develops the innovative sector of economy. Ang and James in their empiric research give new evidence of the fact that the process of knowledge creation depends on government monetary policy, the results being robust for several estimation methods. Particularly interest rate cuts correlate positively with innovation activity. Higher liquidity and reserve rates for banks result in less innovative activity. The researchers conclude that the emphasis is to be made upon funding small high-tech enterprises and cutting credit rates for innovative entrepreneurs.

The foregoing can also be applied to certain developed countries with typically bank-based financial system, viz. Italy. Benfratello, Schiantarelli and Sembenelli[25] (2006) showed using

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[21] Era Dabla-Norris, Erasmus Kersting and Geneviève Verdier, Firm Productivity, Innovation and Financial Development // IMF Working Paper, Strategy, Policy and Review and African Departments, February 2010

[22] João Prates Romero Frederico G. Jayme Jr., Financial system, innovation and regional development: a study on the relationship between liquidity preference and innovation in Brazil.- Belo Horizonte: UFMG/Cedeplar, 2009

[23] Eduardo da Motta e Albuquerque, Scientific Infrastructure and Catching-Up Process: Notes about a Relationship Illustrated by Science and Technology Statistics // Rev. Bras. Econ. vol.55 no.4 Rio de Janeiro Sept./Dec. 2001

[24] Ang, James, Do Financial Sector Policies Promote Innovative Activity in Developing Countries? Evidence from India // MPRA Paper No. 14495, posted 06. April 2009 / 10:53

[25] Benfratello B., Schiantarelli F., Sembenelli A. Banks and Innovation: Microeconometric Evidence on Italian Firms // IZA Discussion Paper № 2032. March 2006. P. 24 – 25.

microeconometric modeling that the development of banking sector has a positive impact on growth rates of small high-tech companies. It is also interesting that the researchers claim banking sector to be more preferable to finance process innovations. Also the researcher from LSE claim that stock market institutions are more suitable for financing breakthrough (or product) innovation, whereas banking sector can work satisfactory in case of incremental (process) innovations[26].

So, to sum this up two hypotheses can be stated. One of them will be to some extend supported by the results of empirical modeling.

1. **In the developing world banking sector institutions are likely to have a positive impact on innovative activity;**
2. **Stock markets and venture funds are more suitable for financing breakthrough innovations, whereas banking sector is for financing incremental innovations (although banks might act indirectly as venture fund investors).**

Having mentioned the limitations of standard stock market and banking sector dichotomy, I believe it is also worth mentioning that a new comprehensive approach to the classification of financial systems has been developed. Block (2002) emphasizes that both banks and stock markets contribute to stimulating growth and innovation. Such an approach embraces the impact of the following factors: banking sector influence, stock market influence, their joint influence, transparency of accountancy, banks' assets concentration. It was empirically shown for 17 OECD countries and 20 branches of industry that banking sector promotes process (incremental) innovation.

All things considered, banking sector can promote innovation activity under certain conditions. The positive effect of banking sector on innovation activity is more pronounced for developing countries (mainly BRIC countries are considered) and process innovations. Also one must keep in mind such a dichotomy has certain limitations. The results of empiric research are going to support this point of view.

2.1 Venture funds and stock markets

The role of stock markets is substantial in fostering the economic activity of innovational enterprises, which major problems of financing usually are: asymmetrical information, large intangible assets, risks connected to possibility of low return on investments compared to this in key industries.

Deleveraging is becoming a tendency in innovation projects financing, as more appropriate mechanisms of raising capital have appeared, first of all: venture financing and IPOs. Abilities to raise capital on stock market are more attractive to innovation companies, as they moderate asymmetry of information providing objective valuation of wide range of investors in contrast to subjective opinion of a credit organization[27].

Stock markets mechanisms create financial tools triggering corporate restructuring, mergers and acquisitions, contribute to faster company's adaptation to new technologies and market

[26] Tong J., Xu C. Financial Institutions and the Wealth of Nations: Tales of Development. – London School of Economics Discussion Paper № TE/04/469, March 2004. P. 3.

[27] Thorsten Block, Financial Systems Innovations and Economic Performance // MERIT-Infonomics Research Memorandum Series, 2002.

conditions. Stock markets provide considerable incentives for investors. For instance, amid the USA boom of the 1990's many employees of internet start-ups agreed to low salaries in return of share options due to potentially high income in the case of successful IPOs. High potential income from issuing shares is also a great motivation to invest funds. Large amounts of investors with different aims and strategies provide funding for many innovational start-ups, thus contributing to development of the most successful ones.

Stock market mechanisms contract risks and help to reasonably distribute control. In almost 100% venture capital funds finance starts up by issuing equities convertible in bonds. More than 50% of the issued capital remains under the control of the owners and venture capitalists, thus investors are directly involved in control exercising that softens asymmetrical information problem and "principal- agent" problem. If the enterprises demonstrate lower financial results than expected, investors have an opportunity to transfer their investments into loans, by using their options to convert stocks into debt instruments

Many economists consider on the basis of empirical researches that structures of financial system differ in their influence on an exact type of innovations. Stock market oriented financial systems foster product innovation, and those systems in which banking sector dominates foster process innovations. Besides, the priority of raising capital on stock markets for innovation projects is more applicable to developed countries, as their stock market and banking sector are characterized by enough depth.

3. The dataset and statistical peculiarities

Regrettably, but certain peculiarities and limitations of Russian statistics[28] limit the abilities of researchers, the FSSS (Federal State Statistics Service of Russia) being the most notorious case. This shapes the methods that are applied. All the data are obtained from the Bank of Russian and the FSSS.

The main difficulty is that time series characterizing innovation activity and the development of banking sector are relatively short. The necessary data is available since sometime around 2000. It is implicitly clear that the number of observations around 10-15 is insufficient, the number of regressors being around 10. That is why the only way to provide proper statistical inference and reliable results is to resort to panel data models (discussed in the next section). The use of panel data models enables us to cope with this problem and provide statistically significant estimates.

The other difficulty is incompatibility of the data inside the time series when the data is divided by types of economic activity, which is caused by methodology shifts. The other specific difficulty is the fact that it is impossible to ascertain which amount of credit is directed at financing innovations. The amount of credits was substituted by its proxy (debt outstanding) due to shortness and incompatibility of time series. Anyway, bearing all that in mind a comprehensive database was created. The use of this dataset enables us to provide statistically significant and reliable estimates.

Let us proceed to the description of the dataset. Initially the dataset comprised the data for 81 constituent territories of Russia. But after data processing it turned out that there is sufficient amount of data for 75 constituent territories from 2001 to 2008. The following variables were included:

1. The amount of innovative production in money terms (value for 2008 was obtained using individual regressions for each constituent territory), annually;
2. Debt outstanding of corporate bodies and entrepreneurs[29] to credit facilities on 01.01.20__. These variables are collected on national level and for sectors of the national economy. The debt outstanding is a proxy for credit activity during the previous year;
3. The number of people engaged in R&D per thousand, annually;
4. The amount of patents listed by domestic patentees, annually;
5. The number and the percentage of companies performing innovative activities;
6. RTS capitalization in nominal terms in rubles, averaged;
7. The amount innovative production as a percentage of gross product of the constituent territory (gross product being a scale variable);

[28] This is quite a controversial issue, but it is promising that there are positive changes.
[29] In terms of Russian legislation these are big and small companies

Table 1

The description of the variables

Variable	Comment
innov	The amount of innovative production in money terms, annually (dependant variable)
debttot	Debt outstanding of corporate bodies and entrepreneurs on 01.01.20__, **total**
debta	Debt outstanding of corporate bodies and entrepreneurs on 01.01.20__, **agriculture**[30]
debtcde	Debt outstanding of corporate bodies and entrepreneurs on 01.01.20__, **industry** (mining industry, manufacturing industry, utilities industry)
debtf	Debt outstanding of corporate bodies and entrepreneurs on 01.01.20__, **construction industry**
debtg	Debt outstanding of corporate bodies and entrepreneurs on 01.01.20__, **transport and telecommunications**
debti	Debt outstanding of corporate bodies and entrepreneurs on 01.01.20__, **trade**
people	The number of people engaged in R&D per thousand, annually
patent	The amount of patents listed by domestic patentees, annually (only on federal level)
act	The number of companies performing innovative activities
actper	The percentage of companies performing innovative activities
volrtsrur	RTS trade turnover, annually, in nominal terms
caprtsrur	RTS capitalization, in nominal terms
index	The amount innovative production as a percentage of gross product of the constituent territory (gross product being a scale variable)

[30] These variables correspond with the national classification of sectors of national economy, which is omitted for the sake of simplicity

4. Statistical and econometric methods

This section is to describe briefly the merits of panel data approach and the usual statistical methods applied when measuring the impact of financial system.

As previously mentioned panel data models help to resolve certain problems. The common panel data approaches are the following[31] [32]:

1. Pooled OLS estimator (not using longitudinal data structure);
2. LSDV estimator (Least Squares Dummy Variables);
3. Within estimator or Fixed Effect (FE) estimator;
4. Random effect estimator.

Pooled OLS simply ignores panel data structure and considers all countries to be homogeneous, which is a weak assumption. But from computational standpoint this one is the easiest. LSDV estimator and FE-estimator assume all countries to be unique, and it is recommended to use such and approach when dealing with big regions, countries or big firms. In case unobservable country effects are correlated with other explanatory variables RE-estimator is introduced. It also worth mentioning that LSDV estimator and FE-estimator provide exactly the same coefficients and standard deviations, but in case of LSDV computation of R^2 might be quite misleading (as inclusion of 102 dummies can increase R^2 significantly telling us nothing about goodness of fit). That is why I will report the so called R^2 within, which is a measure of correlation between fitted value and actual value.

In fact in panel data empiric papers there are usually two ways of producing results, either to produce all estimations or to choose the most appropriate method. It might be sensible to perform a robustness check using all the estimators, but it might be quite bulky. The FE-estimator was chosen for the regressions computed according to the following criteria:

1. F-test that all the country specific dummies are zero;
2. Common sense;
3. Hausman test[33] (testing the null of correlation among the unobserved individual effects and the explanatory variables).

When studying economic phenomena, which cannot be measured easily, various indexes and proxies are being constructed. These may be used in various analytical methods ranging from regressive analysis to PCA. Also business polls are introduced on micro level.

Aiming to measure the size of innovation sector of economy the following indicators are usually used:

- Data collected in the course of various polls;
- The number or percentage of people working in R&D;
- The amount of innovative products scaled by GDP;
- R&D expenditure to GDP;
- The amount of patent listing and patents outstanding;

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[31] Magnus, Katishev, Peresetsky Introductory Econometrics — 373-375

[32] Jeffrey Wooldridge Introductory Econometrics: A Modern Approach - Michigan State University ISBN-10: 0324581629 ISBN-13: 9780324581621, chapter 14

[33] Econometric Analysis of Cross Section and Panel Data Jeffrey M. Wooldridge The MIT Press Cambridge, Massachusetts London, England, page 251

- Opportunity Taking Indicator[34];
- Various citation indexes and rankings of educational institutions;
- The size of venture capital funds;

The following indicators characterize the development of the financial system, traditional financial dichotomy being disclaimed:

- Banking depth, assets of banking institutions divided by GDP;
- Credit depth;
- Insurance depth;
- Ownership concentration in banking sector (CR3, CR4, HHI);
- Stock market variables;
- Bond market variables;
- Transparency indicators (CPI[35], for example) and measures of quality of accounting standards;
- Indicators of financial openness (KAOPEN[36], for example);
- Ownership concentration for biggest listed companies;

A vast amount of such indexes might be constructed on macro level. Taking into consideration the regional character of this research, we decided to use debts outstanding as proxies of credit activity.

Such a system of indicators can be imagined as a point in N-dimensional space and can be depicted as a wind rose[37].

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[34] Eduardo da Motta e Albuquerque, Scientific Infrastructure and Catching-Up Process: Notes about a Relationship Illustrated by Science and Technology Statistics // Rev. Bras. Econ. vol.55 no.4 Rio de Janeiro Sept./Dec. 2001

[35] For a more detailed explanation of the CPI method please visit www.transparency.org/cpi

[36] Chinn: Robert M. La Follette School of Public Affairs; and Department of Economics, University of Wisconsin, 1180 Observatory Drive, Madison, WI 53706.

[37] Thorsten Block, Financial Systems Innovations and Economic Performance // MERIT-Infonomics Research Memorandum Series, 2002

5. The Results

The following model was estimated:

$$\ln(innov_{it}) = \beta_0 + \beta_1 \ln(debtcde_{it}) + \beta_2 \ln(debtf_{it}) + \beta_3 \ln(debtg_{it}) + \beta_4 \ln(debti_{it}) + \beta_5 \ln(debta_{it}) + \beta_6 \ln(caprtsrur_t) + \beta_7 \ln(patent_t) + \beta_8 actper_{it} + \beta_9 \ln(index_{it}) + \beta_{10} \ln(people_{it}) + \xi_{it},$$

where variable names correspond to those described in table 1. It is important that the share of innovative production in GDP was chosen to indicate how inherently innovative a constituent territory is. To estimate the partial effect of banking institutions (taking into consideration the fact that we have only total amounts of debt outstanding) we must eliminate the effect of institutional environment. It may turn out that economically more developed territories are more likely to be more innovative. That is why we considered introducing a variable responsible for inherent propensity to innovation to be beneficial[38].

It is worth mentioning that this equation was estimated using FE-estimator because common sense and special statistical tests indicated that FE-estimator is preferable, namely F-test of null that all fixed effects are zero and Hausman test that there are no random effects (for more detailed description you may refer to the Appendix).

In the process of analyzing the regression outcome it turned out that the dataset may be divided into 2 parts. Figure 2 implicitly shows that there are different elasticities and intercepts for these parts of the dataset. It is also important that the left part of the figure refers to data for 2001, 2002, 2007 and 2008. The right part of the figure 2 is for 2003-2006. No sensible reason for such a difference was discovered. This difference holds also for all other credit indicators. You may also want to consider Chow test output given in the Appendix.

Figure 2

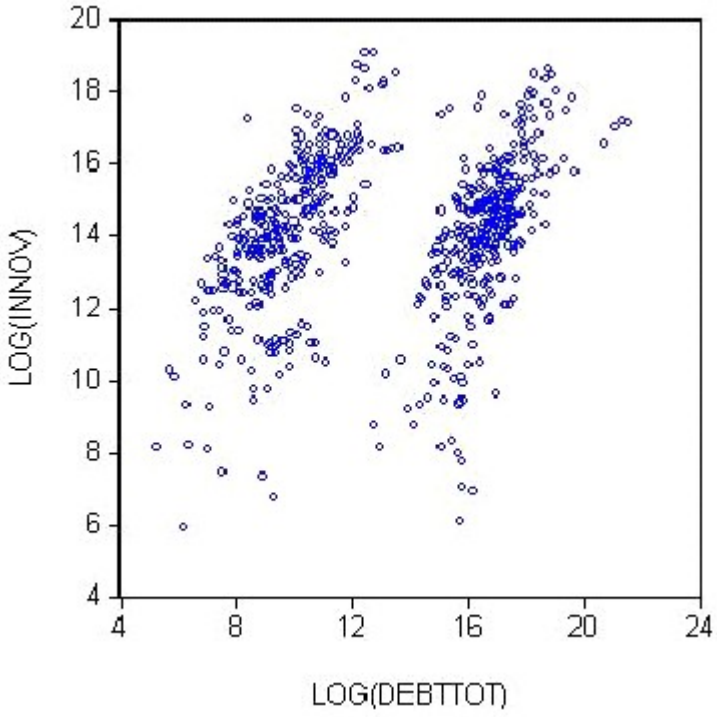

Table 2

[38] Please note that omission of this variable does not change the signs or confidence levels of coefficients of debt variables. If this variable is omitted, in our opinion, ceteris paribus condition does not hold

	The main results (coefficients not significant at any conventional confidence levels are in bold)	
	2003-2006	**2001,2002,2007,2008**
Number of obs.	295	298
R squared within	0.991	0.972
Prob > F	0.000	0.000

	Coefficient	Prob.	Coefficient	Prob.
LN(DEBTCDE)	0.101	0.000	0.185	0.000
LN(DEBTF)	0.062	0.001	0.021	0.085
LN(DEBTG)	0.048	0.016	0.172	0.000
LN(DEBTI)	0.003	**0.791**	-0.002	**0.808**
LN(DEBTA)	0.083	0.000	-0.029	0.002
LN(CAPRTSRUR)	-0.141	0.000	0.156	0.000
LN(PATENT)	1.308	0.000	3.771	0.000
ACTPER	-0.003	**0.471**	-0.007	**0.202**
LN(INDEX)	1.001	0.000	0.943	0.000
PEOPLE	-0.003	0.004	0.000	**0.206**

Table 2 represents the main results of the research. To begin with, statistically most coefficients are significant at all conventional confidence levels. Also the effect PEOPLE (people engaged in R&D per thousand) is either insignificant of negative mainly because of the poor state of post-soviet research facilities, which result in continuous reduction of research staff. Therefore there is little variance in this variable, it is steadily decreasing for most of territories. Therefore this coefficient does not tell is much.

As anticipated INDEX (the amount of innovational products divided by regional GDP) is supposed to represent the innovational potential of territories and absorb major cross regional fluctuations in order to satisfy ceteris paribus condition. ACTPER (share of innovative companies) is insignificant at all conventional confidence levels, which indicates that the cluster of innovational enterprises in Russia is to small to have an impact via the amount of innovational companies. As anticipated, the number of patents has proper sign and value, but nevertheless this variable cannot be relied upon as it is available on federal level. CAPTSRUR (capitalization of RTS) cannot also be relied upon for the same reason. While estimate for combined subset for 2001, 2002, 2007, 2008 may be quite biased due to the obvious reasons, negative sign for 2003-2006 may indicate that the stock market of Russia is not developed enough to finance innovation. Again, this result cannot be relied upon as there is no separate data for each territory.

The most important result of this paper is the significance of almost all debt outstanding variables. The exception is debt outstanding of trade companies, which is sensible as they are not likely to be very innovative. The debt outstanding coefficient of industrial sector, building industry, transport, telecommunications and agriculture is significantly different from zero. We will disregard the results for agriculture as they are controversial. Anyway, the most important results are:

1. Elasticities of debt outstanding for industrial sector, transport, telecommunications and building industry are from 0.021 to 0.185, the average being around 0.1. It means that 1% increase in debt outstanding results into 0.1% increase in the amount of innovative production;
2. Total multiplier is around 0.211 (for **2003-2006**) and 0.378[39] (for the rest);

[39] Please note, that it would be more correct to divide the dataset into 3 parts (for 2001-2002, 2003-2006, 2007-2008) but it does not change the signs or significance of the regressors. Estimates for 2001,2002, 2006, 2007 may be quite biased, but in this case we can always consider estimated for 2003-2006.

6 Conclusion

The main conclusions are the following. Finance-innovation link is a new and scarcely covered issue. Nevertheless it is conventional wisdom that stock market institutions are preferable for financing innovation. But researchers claim that in the developing countries banking institution together with thorough government policy can foster innovations. Also they claim that stock market institutions are more suitable for financing breakthrough innovations, while banks are more suitable for incremental innovations.

The main contribution of this paper is that is was empirically shown using panel data models that banks can facilitate innovation in Russia.

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Appendix

Table A1

Chow Test			
RSS	369,400	**n**	593
RSS1	58,380	**n1**	298
RSS2	38,662	**n2**	295
	m	11	
	F	145,689	
	F critical	1,805	

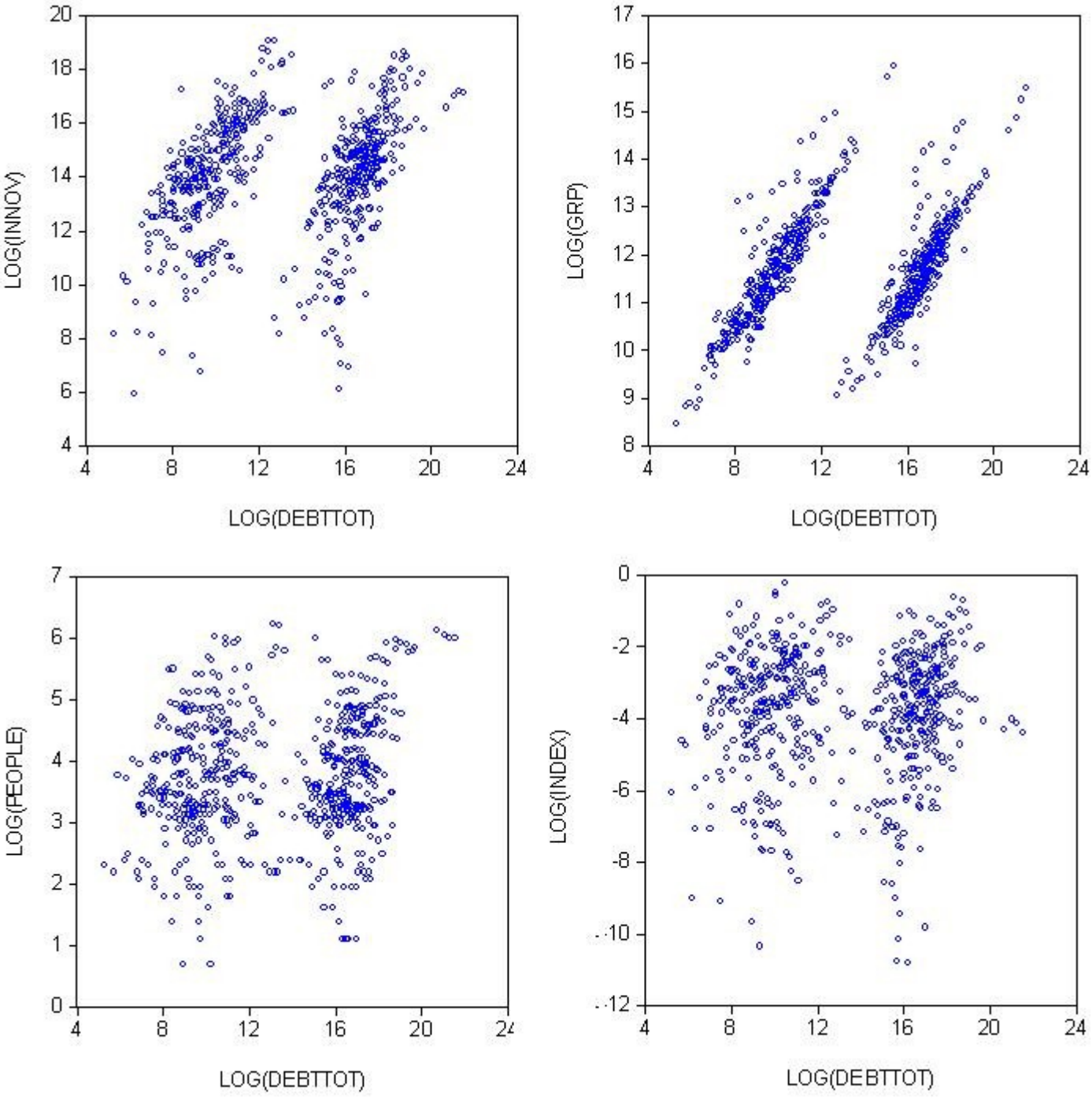
Table A2

F-test of the null that all the fixed effects are zero				
Part 1	F test that all α_i=0:	F(74, 213) =	14.93	Prob > F = 0.0000
Part 2	F test that all α_i=0:	F(74, 210) =	44.50	Prob > F = 0.0000

Table A3

Hausman test of the null that there are random effects			
	Chi-Sq. Statistic	**Chi-Sq. d.f.**	**Prob.**
Part 1	82.181636	10	0.0000
Part 2	170.857768	10	0.0000

Figure A1


LOG(INNOV)
LOG(DEBTTOT)
LOG(GRP)
LOG(DEBTTOT)
LOG(PEOPLE)
LOG(DEBTTOT)
LOG(INDEX)
LOG(DEBTTOT)