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FINANCIAL INTERMEDIATION AND ECONOMIC GROWTH: BANK CREDIT MATURITY AND ITS DETERMINANTS

BY

NIKOLA TASIC

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree
of
Doctor of Philosophy
in the
Andrew Young School of Policy Studies
of
Georgia State University

GEORGIA STATE UNIVERSITY
2007

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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

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ABSTRACT

FINANCIAL INTERMEDIATION AND ECONOMIC GROWTH:
BANK CREDIT MATURITY AND
ITS DETERMINANTS

BY

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December, 2007

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Major Department: Economics

This dissertation is an investigation into one of the important functions of the banking system: to transform short-term liquid deposits into long-term illiquid financial assets that can fund long gestation activities and, thus, raise the rate of economic growth. To investigate this function empirically, the dissertation uses two new data sets on the maturity of bank credit to the private sector. First data set contains yearly observations covering 74 countries during the period from about 1990 to 2005, while the second data set contains quarterly observations covering 14 transition countries from about 1995 to 2006.

Using the data on a broad set of countries, the dissertation shows that economic growth is enhanced in countries where the financial system extends more long-term credit. This finding is the first empirical confirmation of the theoretical predictions

regarding the liquidity transformation function of banks. Furthermore, using the same data set, the dissertation shows that credit maturity depends on a number of institutional and economic factors. The determinants of credit maturity have an impact on economic growth via their influence on the availability of long-term external financing. Credit maturity is longer in countries with strong legal institutions, with low inflation, with deeper financial markets, and with schemes for sharing credit information between financial institutions. From a policy perspective, the institutions for sharing credit information probably present the most interest because their establishment is a policy choice.

Findings from the broad set of countries are confirmed in the second data set using several definitions of maturity. Additional results from the second data set suggest that credit maturity is longer in countries at the higher level of economic development, with less liquid stock markets, and with more privately owned domestic banks. Furthermore, the results suggest that credit information sharing mechanisms lengthen the maturity of credit if credit information sharing institutions are privately owned or have greater quality of information.

CHAPTER ONE

INTRODUCTION

The literature on financial development and economic growth has established that finance has a positive, statistically significant, and economically large causal effect on economic growth (Beck, Levine, and Loayza 2000; Levine 2005; Wachtel 2001). The theoretical literature describes five functions of the financial system that can contribute to this effect. The extent to which the financial system performs these functions well has clear implications on the rate of economic growth. However, Levine (2005) points to the main weakness of the empirical literature as having "insufficiently precise link between theory and measurement."

In the following chapter we elaborate on this imprecise link and look in more detail into how one important function of the banking system, liquidity transformation, relates to the rate of economic growth from a theoretical perspective. We briefly review Bencivenga and Smith (1991), a paper that derives an insightful model of the economic growth and provides clear theoretical predictions that more liquid banking system increases the rate of economic growth. Such banking system transforms short-term liquid deposits into long-term illiquid financial assets that can fund long gestation activities and, thus, raise the rate of economic growth. In chapter 3 we provide empirical evidence for this function using a unique data set that covers 74 countries during the period from about 1990 to 2005. We find that the banking system has a positive effect on economic growth,

as reported in the previous literature. In addition, we show that the effect is stronger when the banking system performs its liquidity transformation function well. This finding is the first empirical confirmation of the theoretical predictions regarding the liquidity transformation function of banks. This result is obtained using methodology found elsewhere in the literature, but slightly modified because of data limitations. In particular, the literature usually investigates the effect of finance on growth by averaging data over 5 years to reduce the impact of business cycles and to concentrate on long-term growth. However, relatively short time series in most countries required using overlapping averages and the adjustment of the moving average component in the residuals as introduced by Newey and West (1987).

Furthermore, in chapter 3 we show that the extent to which the banking system performs its liquidity provision function depends on a number of financial, economic, and institutional measures. The major determinants of the liquidity provision function of the banking sector are rule of law, inflation, the existence of institutions for credit information sharing, and the size of the financial system. These effects are robust across various estimation techniques, specifications of the models, alternative institutional indexes, and different definitions of the credit information sharing.

The data used in chapter 3, despite the coverage of a broad set of countries, have a limitation that prevents a full investigation of the extent to which the banking system performs its liquidity transformation function. The main limitation is the definition of long-term credit as credit with contractual maturity longer than one year. Using a more detailed data set that covers 14 countries, we partially overcome this limitation in chapter 4. We do that by isolating the portion of credit with contractual maturity of one year or

less, the portion of credit with contractual maturity longer than one year, and the portion of credit with contractual maturity longer than five years. Thus, we can investigate short-term, long-term, and very long-term credit.

We find that most results on the determinants of the portion of credit with maturity longer than one year obtained in the two chapters are similar. For example, the rule of law remains a significant determinant of credit maturity and the magnitude of the estimated coefficients is similar. Similarly, financial deepening is accompanied by lengthening of the maturity of credit in both samples. Inflation is a much more significant determinant in a broader set of countries, while per capita GDP growth and stock market activity are more significant in a smaller set of countries. In addition to the determinants investigated in a broad set of countries, in a smaller set we also investigate whether state and foreign ownership of banks influences credit maturity and find that credit maturity is longer in countries with more privately owned domestic banks. In a smaller set of countries we also look in more detail at credit information sharing institutions and find that the quality of information and the ownership structure of such institutions (public vs. private) have an important impact on maturity.

Overall, this dissertation provides a detailed investigation into one of the important functions of the banking system: to transform short-term liquid deposits into long-term illiquid financial assets that can fund long gestation activities and, thus, raise the rate of economic growth. The dissertation confirms the theoretical predictions and shows that the availability of long-term credit is particularly important, as economic growth is faster in countries where the banking system extends more long-term credits. This is an important missing link between the theoretical and empirical literature on

financial development and economic growth. Furthermore, the dissertation shows that credit maturity depends on a number of institutional and economic factors. These factors also influence economic growth through their impact on credit maturity.

CHAPTER TWO

CREDIT MATURITY AND ECONOMIC GROWTH: A CONCISE LITERATURE REVIEW

A large theoretical and empirical literature on financial development and economic growth has established that finance has a positive, statistically significant, and economically large causal effect on economic growth and its sources (Levine 2005). Theoretically, this effect arises through several channels which are summarized by Levine (2005) in five categories. The financial system increases the rate of economic growth as it: (1) produces information ex ante about possible investments and allocates capital, (2) monitors investments and exerts corporate governance after providing finance, (3) facilitates the trading, diversification, and management of risk, (4) mobilizes and pools savings, and (5) eases the exchange of goods and services. In essence, financial development can be defined as the extent to which the financial system performs these functions well.

King and Levine (1993) note that in the view of economist like Goldsmith (1969), McKinnon (1973), and Shaw (1973) "differences in the quantity and quality of services provided by financial institutions could partly explain why countries grow at different rates." However, the empirical literature that investigates the growth effects of bank lending has focused only on the quantity of services rather than on quality of the services provided by the banking sector. The literature has relied on the assumption made by

Goldsmith (1969) that the size of the financial system is a good measure of the quantity *and* quality of functions the financial system provides. Levine (2005) recognizes that even

> The organization of the empirical evidence advertises an important weakness in the finance and growth literature: there is frequently an insufficiently precise link between theory and measurement. Theory focuses on particular functions provided by the financial sector, [while the empirical literature] pertains to the proxies for financial development. (Levine 2005)

Furthermore, Beck and Levine (2004) note that ideally, researchers would construct a cross-country measure of how well banks perform their activities. The authors also note that "economists, however, have not been able to accurately measure these financial services … [and] consequently, researchers traditionally use measures of the overall size of the banking sector." Levine (1999) notes that

> Ideally one would like to construct measures of the particular functions provided by the financial system. That is, one would like to have a comparative measure of the ability of the financial system to reach firms and identify profitable ventures, exert corporate control, manage risk, mobilize savings, and ease transactions. Accurately measuring the provision of these services in any single country would be extraordinarily difficult; doing it for a broad cross-section of countries would be virtually impossible. (Levine 1999)

This dissertation contributes in that direction by exploring one of the channels through which financial development enhances economic growth–liquidity provision and liquidity risk amelioration. In particular, the dissertation provides empirical evidence for the liquidity transformation function performed by banks, which is a part of the third function in Levine's categorization described above. The dissertation shows that the

effect of banking sector activity on economic growth depends on the liquidity transformation function performed by banks. In addition, the dissertation explains what factors determine the extent to which the banking system performs liquidity transformation, and looks into how these factors in turn influence the rate of economic growth. Before turning to the empirical evidence and to the literature on the determinants of liquidity transformation, in the remainder of this chapter we review the theoretical literature relating the liquidity transformation function of banks to the rate of economic growth. This review will help in formulating the empirical hypothesis about this relationship.

Levine (1997) defines liquidity as "the ease and speed with which agents can convert assets into purchasing power at agreed prices" and liquidity risk as the risk that "arises due to the uncertainties associated with converting assets into a medium of exchange." Liquidity may be inhibited by various informational asymmetries as well as transaction costs and financial intermediaries and markets arise to ameliorate these problems. Levine explains that a system which properly provides liquidity will leave little uncertainty about the timing and settlement of contracts, and contracts will be inexpensive to trade.

Furthermore, Levine (1997; 2005) explains that economic growth is closely linked to the liquidity provision function of the financial system. The link arises "because some high-return projects require a long commitment of capital, but savers do not like to relinquish control of their savings for long periods." Therefore, the financial system plays a key role as it makes individual savers' funds more liquid, while it invests a portion of the funds into illiquid long-term investments.

Levine (1997) draws on the historical evidence summed by Hicks (1969) to support this claim. According to Hicks, the improvements of capital markets that mitigated liquidity risks were the primary causes of the industrial revolution in England. Individual investors could hold liquid assets but at the same time the financial system transformed these "liquid financial instruments into long-term capital investments in illiquid production process." As England's industrial revolution required large commitments to capital for long periods of time, Levine (1997) goes as far as suggesting that "the industrial revolution may not have occurred without this liquidity transformation."

Bencivenga and Smith (1991) formalize these ideas in an insightful model of economic growth. In their model financial institutions emerge to meet the liquidity needs of individual economic agents while allocating a higher proportion of the economy's savings toward long-term investments compared to the case of financial autarky. The model adopts the Diamond and Dybvig (1983) framework of an economy populated by agents who are uncertain about their future liquidity needs at the time they make capital allocation decisions. This framework is incorporated into a growth model featuring capital investment externalities where production depends on firms' individual capital levels as well as the societal capital level, as in Romer (1986). Economic growth is enhanced by the presence of financial institutions since they allocate a greater proportion of the economy's savings to long-term, high productivity projects.

In particular, there are two savings assets: one is a *liquid* asset that matures earlier but returns less of the consumption good than an *illiquid* asset. The higher return on the illiquid asset captures the idea of the slow production cycle of high productivity

investments, as well as the long gestation periods in capital production, as discussed by Böhm-Bawerk (1891), Cameron (1967), and Kydland and Prescott (1982). However, if the illiquid asset is liquidated before it matures, the liquidation value is lower than the return on the liquid asset.

Individuals' preferences over consumption are modeled as in Diamond and Dybvig (1983) so that agents may experience a liquidity need in any period with some probability. If agents have invested a portion of their savings in the long-term assets and are faced with such liquidity need, agents liquidate their holdings of the long-term asset. They consume the amount available after liquidation, plus the proceeds from their short-term investments. Consumption is lower compared to the case when the entire savings are allocated to the low-return but liquid asset (i.e.,, short-term investments).

In this environment, agents invest a large proportion of their savings in the liquid asset reducing the funds available for the high productivity illiquid capital. Financial institutions emerge as a group of individual investors who pool their savings. The financial institution can meet the liquidity needs of its individual members by keeping reserves invested in the liquid asset. However, the financial institutions can keep a smaller fraction of the total savings in liquid assets compared to the case of financial autarky when individual agents allocate their savings between liquid and illiquid assets. By the law of large numbers, the need for liquidity is predictable on the aggregate level so the financial institution can keep reserves only in the amount necessary to meet that aggregate liquidity need. Therefore, with financial institutions, a greater portion of the savings is allocated to the long-term illiquid assets raising economic growth.

This is only a simplified and concise explanation of the results in Bencivenga and Smith (1991), as the paper pursues a number of additional avenues and provides additional interesting results. When savings are allowed to vary with or without banks, we see that the theoretical results are ambiguous. As the income and substitution effects are working in the opposite direction, increased liquidity risk amelioration may decrease savings. Jappelli and Pagano (1994) show that increasing liquidity can cause saving rates to fall enough to decrease equilibrium growth. Even when savings fall with the presence of financial intermediaries, the overall effect on growth can be positive if the intermediaries devote a higher portion of (smaller) savings to long-term credit, i.e., if long-term credit is greater under intermediaries than under autarky, despite overall credit being higher under autarky. In addition, empirical results that look at the impact of financial intermediation on savings have shown that financial intermediation has little or no impact on savings rates. Therefore, the assumption of financial intermediaries having no impact on savings is in line with the empirical work that shows no economically strong and statistically significant impact.

Building on Bencivenga and Smith (1991), Greenwood and Smith (1997) show that the financial intermediation provided by banks is necessarily growth enhancing, while in the original model it was growth enhancing under some weak assumptions. Furthermore, Greenwood and Smith (1997) draw on Hicks (1969) and North (1981) to note that "new technologies could be employed only by 'tying up' large-scale investments in illiquid capital for long period." By providing liquidity in an effective way the financial sector can promote investment in innovation, capital accumulation, and growth.

Noting that production processes can take a long time, be uncertain, and subject to shocks, Holmstrom and Triole (1998) argue that access to credit during production reduces the risk of premature liquidation and increases the incentives for investing in longer gestation, higher-return projects. Their model, however, does not provide a formal link between liquidity provision and economic growth as in Bencivenga and Smith (1991). In contrast, Aghion et al. (2005) show that innovation and long-run growth will be enhanced in an economy that experiences macroeconomic shocks but firms have access to credit during the entire production process. Their predictions are confirmed empirically by showing that financial development reduces the adverse growth effects of macroeconomic volatility. However, they do not investigate data on the maturity of credits.

Despite the convincing arguments discussed above, the notion that long-term credit is good for growth is not universally accepted. Sissoko (2006) combines the monetary and the financial role of intermediaries into a growth model with the division of labor. The model allows agents to buy and sell a cash-in-advance constraint which gives rise to growth enhancing short-term credit. The model predicts that short-term credit increases growth, but the author does not tests this prediction for "lack of data on credit maturity."

Other theoretical work where short-term lending is growth-enhancing is the signaling framework of Flannery (1986): firms that are not concerned with reevaluation by the credit markets (good firms) will borrow short-term, while firms that fear reevaluation (bad firms) will want to borrow long-term. Therefore, short-term credit could have a positive effect on growth as more short-term credit implies more efficient

investments. However, this holds if there is no direct communication between borrower and lender, and signaling is the only form of communication.

Still in the signaling framework, Titman (1992) introduces a more realistic setting (uncertain interest rate and financial distress cost) which leads good firms to a pooling long-term equilibrium, despite their wish to borrow short-term. Furthermore, Diamond (1991) shows that the good firms borrow short-term and long-term as this allows them to extract the benefits of good news while lowering liquidity risk.

There are other theories that argue that long-term credit can increase economic growth by decreasing the likelihood of financial crises. Ennis and Keister (2003) present a model where long-term credit is beneficial for both growth and "crisis prevention." The authors construct an endogenous growth model where bank runs affect capital stock and output permanently. Their model is similar to Bencivenga and Smith as the consumers have similar utility and banks can choose between similar investment opportunities. If banks keep their portfolio more illiquid, this raises the expected payoff to investors and induces them to wait until the long-term projects are completed. This lowers the probability of a run. As a result, the authors note that in their model there is "no tradeoff between growth and stability… [as] less liquid portfolios bring higher growth with fewer bank runs."

In summing the empirical evidence linking liquidity provision and economic growth, Levine (2005) notes that "isolating this liquidity function from the other financial functions performed by banks, however, has proven prohibitively difficult." Because of this difficulty, research has focused on the effects of liquidity of one security on its price. Levine notes that, "security-level studies of the relationship between the liquidity of

individual securities and their prices, however, do not link liquidity with national long run growth rates."

Therefore, the empirical evidence is more limited and it focuses only on the liquidity provision by the stock market, while the literature linking the liquidity transformation function of banks and credit maturity to economic growth remains theoretical. This is not surprising as data on credit maturity are not readily available. Following the arguments in Bencivenga and Smith (1991), we collect cross country data on maturity of bank credit to the private sector. Bencivenga and Smith (1991) argue that long-term credit enhances growth. Drawing on this theoretical prediction, the remainder of this dissertation tests whether this theoretical prediction holds. In addition, we draw on the previous literature and investigate what factors influence the portion of credit given out as long-term.

CHAPTER THREE

THE MATURITY STRUCTURE OF BANK CREDIT: DETERMINANTS AND EFFECTS ON ECONOMIC GROWTH

The literature on financial development and economic growth has established that finance has a positive, statistically significant, and economically large causal effect on economic growth (2005). There is, however, much less empirical evidence on the channels through which this positive effect is obtained. Levine (2005) points out that even the organization of the empirical evidence advertises an important weakness in the finance and growth literature: there is frequently an insufficiently precise link between theory and measurement: ”theory focuses on particular functions provided by the financial sector, [while the empirical literature] pertains to the proxies for financial development.”

As discussed in the previous chapter, transforming liquid savings into illiquid assets that can fund long-term investment projects is one of the important functions of the financial system. Levine (1997) explains that economic growth is closely linked to the maturity transformation function of the financial system, as high-return projects require a long commitment of capital but savers do not like to relinquish control of their savings for long periods. The financial system plays a key role in preserving the liquidity of savings of individual savers while investing a portion of the funds into illiquid long-term projects. Historical evidence supports this claim. According to Hicks (1969), the capital

market improvements that mitigated liquidity risks were the primary cause of England's industrial revolution as individual investors could hold liquid assets but at the same time the financial system transformed these liquid financial instruments into long-term capital investments. As England's industrial revolution required large commitments of capital for long periods, Levine (1997) goes as far as noting that the industrial revolution may not have occurred without this liquidity transformation.

Our objective is to provide empirical evidence for that function of the financial system. For that purpose we collect and analyze a unique data set on the maturity of domestic credit to the private sector in 74 countries during the period from about 1990 to 2005. We ask two broad questions. First, what factors determine the differences in credit maturity across countries? For example, only 24 percent of domestic private credit in Mali has maturity longer than 1 year, whereas in Hungary 75 percent of credit has maturity longer than 1 year. What explains that difference? Second, we investigate whether the effect of private credit on economic growth depends on the maturity of credit. Theory suggests that credit will be more effective in terms of raising economic growth when the financial system performs better its maturity transformation function.

Bencivenga and Smith (1991) develop an insightful model that formalizes the relationship between the maturity transformation role of banks and economic growth. There are two savings assets in the model: a *liquid* asset that matures early but returns less of the consumption good and an *illiquid* asset that has a higher (but later) payoff.[1] If liquidated before it matures, the illiquid asset returns less than the liquid asset. Following Diamond and Dybvig (1983), individuals are uncertain about their future liquidity needs

[1] The higher return on the illiquid asset captures the idea of the slow production cycle of high productivity investments, as well as the long gestation periods in capital production, as discussed by Böhm-Bawerk (1891), Cameron (1967), and Kydland and Prescott (1982).

at the time they make capital allocation decisions and therefore they invest most of their savings into the liquid low-return asset. Financial institutions emerge as groups of individuals who pool their savings, keep a portion of the pooled savings in liquid assets to meet the liquidity needs of its members, and invest the remaining amounts in illiquid high-return project. Thus, the proportion of society's savings that are invested in projects with high productivity increases and this enhances economic growth.[2]

In Bencivenga and Smith, economic growth increases in the proportion of savings invested in long-term assets. We provide empirical evidence in support of this hypothesis. We show that the effect of private credit on economic growth is stronger when a larger fraction of private credit has long-term maturity. Our empirical evidence fits well with papers showing that the effect of finance on growth depends on the economic and institutional environment of a country. For example, Rousseau and Wachtel (2002), Choi, Smith, and Boyd (1996), Haslag and Koo (1999), Khan and Senhadji (2000), and Boyd, Levine and Smith (2001) show that the effect of credit on growth is diminished in high inflation countries. It is, however, not clear what function of the financial system is blocked in high inflation environments. Our results suggest that credit has a smaller effect on growth (at least partly) because the financial system shifts resources toward short-term, less productive assets.

---

[2] The notion that long-term lending enhances growth is not universally accepted. Sissoko (2006) combines the monetary and the financial role of intermediaries into a growth model where agents can buy and sell a cash-in-advance constraint. This gives rise to growth enhancing short-term credit, but the author does not test this prediction for lack of data on credit maturity. Also, in Flannery (1986) firms that are not concerned about reevaluation by the credit markets (good firms) will borrow short-term, while firms that fear reevaluation (bad firms) will want to borrow long-term. Therefore, short-term credit could have a positive effect on growth as more short-term credit implies more efficient investments. However, the more realistic setting of Titman (1992) with uncertain interest rate and financial distress costs motivates good firms to use long-term credit despite the lower contractual cost on short-term debt. Diamond (1991) also shows that good firms borrow short- *and* long-term to extract the benefits of good news while lowering liquidity risk.

Before we present that evidence, in order to become more familiar with credit maturity, we investigate its determinants by testing a number of empirical hypotheses drawn from the literature. The data show that credit maturity varies substantially across countries, even if the countries have a similar level of financial and economic development. We show that credit maturity is shorter in countries with lax rule of law, high inflation, less developed financial markets, and greater economic volatility.

The rest of the chapter is structured as follows. We describe the data in the following section. Section 2 draws empirical hypotheses from the literature and investigates the determinants of credit maturity. Section 3 present results for the effect of credit maturity on economic growth and section 4 concludes.

Data on credit maturity

We use data on lending by banks to the private sector in 74 countries spanning the period from about 1990 to 2005, depending on data availability for the individual countries. The data were collected from a variety of sources including publications by central banks and multilateral organizations. Table 1 provides variable definitions and details the sources of the data. The sample includes all countries for which we could identify a consistent data source. The summary statistics of our private credit variable, shown in Table 2, match closely those from the widely used World Bank data set on financial structure (see Beck, Demirgüç-Kunt, and Levine 2000) for the entire sample and for each individual country. However, because our sample spans only more recent years, the summary statistics reveal a higher level of financial development compared to the World Bank data that begin in 1960.

Table 1. Variable Definitions and Sources

Variable	Definition	Sources
Credit / GDP	Credit by deposit money banks and other financial institutions to the private sector divided by GDP.	Central Bank of West African States: Benin, Burkina, Guinea Bissau, Ivory Coast, Mali, Niger, Senegal, and Togo; Economic and Monetary Community of Central Africa: Cameroon, Central African R., Chad, Congo, Equatorial Guinea, Gabon; Eurostat: Austria, Belgium, Cyprus, Czech R.*, Denmark, Finland, France*, Greece*, the Netherlands*, Norway, Poland*, Spain, and Sweden; and FDIC Statistics on Depository Institutions for the United States. For the remaining countries (and as second source for countries with * above) source was corresponding central bank (official publications and website).
Long-Term Credit / GDP	Long-Term Credit is credit by deposit money banks and other financial institutions to the private sector with the original contractual maturity longer than one year divided by GDP.	
Short-Term Credit / GDP	Short-Term Credit is credit by deposit money banks and other financial institutions to the private sector with the original contractual maturity of one year or less divided by GDP.	
Percent Long-Term Credit	Credit with an original contractual maturity longer than one year divided by credit.	
Real per capita GDP Growth	The percent increase in real per capita GDP from the previous year.	International Financial Statistics (IFS) database of International Monetary Fund (IMF). In some cases data were retrieved from Eurostat database and Euromonitor International's World Marketing Data and Statistics (Plus) which uses IMF's World Economic Outlook, United Nations, as well as national statistics in addition to IFS.
Per Capita GDP	The real per capita GDP in US dollars.	
Inflation	The increase in the annual CPI.	
Trade / GDP	Sum of imports and exports of goods and services as a share of GDP.	
Gov. / GDP	General government consumption as share of GDP.	
Rule of Law	Index that measures "the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement."	World Bank data set "Governance Matters VI" by Kaufmann, Kraay, and Mastruzzi (2007).
Banking Industry Conc.	The assets of three largest banks as a share of assets of all commercial banks.	World Bank data set "A new database on financial development and structure" by Beck, Demirgüç-Kunt, and Levine (2000).
Stock Market Turnover Ratio	Stock market volume traded during a year divided by the stock market capitalization at the end of the year.	
Credit Information Sharing	Dummy variable: 1 if public credit registry or private credit bureau operates in a country during a year, 0 otherwise.	Author constructed from Djankov, McLiesh, and Shleifer (2007), Miller (2003), and Brown, Japelli, and Pagano (2007).
Manuf. Share of Output	Value added by manufacturing divided by total value added.	United Nations' National Accounts Main Aggregates Database.
Output Volatility	Root mean squared errors from $Growth_t = \alpha + \varepsilon_t$, using data from the preceding 10 years.	Author constructed from data on Real per capita GDP Growth.

Table 2. Summary Statistics

	Real per capita GDP Growth	Credit / GDP	Percent Long-Term Credit	Per Capita GDP	Inflation	Gov. / GDP	Trade / GDP	Rule of Law	Banking Industry Conc.	Stock Market Turnover Ratio	Credit Info. Sharing	Output Volatility	Manuf. Share of Output
Panel A: Descriptive Statistics													
Mean	2.98	53.04	54.14	9,676	11.82	16.55	90.67	0.33	0.72	0.63	0.64	4.32	4.32
Maximum	13.69	206.61	99.32	52,228	1,058.37	30.68	321.7	2.12	1	16.02	1	21.78	21.78
Minimum	-12.81	0	1.51	82	-9.62	3.91	23.33	-1.94	0.24	0	0	0.56	0.56
Std. Dev.	3.8	44.7	24.35	10,943	55.24	5.47	44.76	1.05	0.2	1.06	0.48	3.73	3.73
Observations	659	659	659	659	652	653	637	510	528	403	659	554	554
Panel B: Correlations													
Growth	1.00												
Credit / GDP	-0.07	1.00											
Percent Long-Term Credit	0.13*	0.57*	1.00										
Per Capita GDP	-0.08*	0.61*	0.45*	1.00									
Inflation	-0.25*	-0.12*	-0.16*	-0.13*	1.00								
Gov. / GDP	-0.04	0.32*	0.32*	0.37*	-0.06	1.00							
Trade / GDP	0.16*	0.20*	0.18*	0.17*	-0.03	0.05	1.00						
Rule of Law	-0.10*	0.72*	0.61*	0.85*	-0.13*	0.50*	0.25*	1.00					
Bank. Ind. Conc.	-0.12*	-0.05	-0.02	-0.10*	0.05	0.08	-0.10*	0.00	1.00				
Stock Mkt. TOR	-0.08	0.07	0.04	0.09	-0.09	0.11*	-0.13*	0.05	0.03	1.00			
Credit Info. Sharing	-0.04	0.17*	0.09*	0.11*	-0.17*	0.07	-0.20*	0.20*	-0.06	0.14*	1.00		
Output Volatility	0.25*	-0.46*	-0.32*	-0.41*	0.07	-0.28*	0.11*	-0.52*	0.03	-0.14*	-0.38*	1.00	
Manuf. Share of Output	0.10*	0.31*	0.26*	0.11*	0.02	0.12*	0.20*	0.35*	-0.15*	0.04	-0.02	-0.00	1.00

Notes: * indicates statistical significance at the 5 percent level. See Table 1 for variable definitions.

Credit is decomposed into two categories: short-term credit that has contractual maturity of one year or less and long-term credit that has contractual maturity longer than one year. Some countries, most notably many of the transition economies, provide more detailed data on credit maturity–up to one year, one to five years and longer than 5 years. Some countries report maturity longer than 7 or even 15 years. While it would be interesting to investigate credit with different maturity structures (e.g., medium-term, long-term, and "very long-term" credit), the only categorization that is consistent across all countries is the one that divides credit into short-term credit with maturity of one year or less and other credits. Therefore, we proceed with this definition of short-term and long-term debt but we also explore other maturity structures in the following chapter with a smaller sample.

Table 3 shows large differences in terms of financial development measured as private credit as percent of GDP. For example, in Albania, Azerbaijan, Chad and several other countries, private credit is below 10 percent of GDP whereas in Ireland, the Netherlands, Portugal, Taiwan and several other countries it is well over 100 percent of GDP. Table 4, which reports the credit averages for three groups of countries based on income, shows that private bank credit has the lowest level in low income countries (25.01 percent of GDP), compared to middle income countries (58.31 percent of GDP) and high income countries (93.81 percent of GDP).

On average, 54.14 percent of bank credit to the private sector has long-term maturity. There are, however, large differences between countries. Long-term credit is less than 30 percent of total credit in a number of countries including Bangladesh, The Central African Republic, Niger and Lesotho and it is greater than 70 percent of total

Table 3. Country Averages of Credit and Credit Maturity

Country	Credit / GDP	Long-Term Credit / GDP	Short-Term Credit / GDP	Percent Long-Term Credit	Country	Credit / GDP	Long-Term Credit / GDP	Short-Term Credit / GDP	Percent Long-Term Credit	Country	Credit / GDP	Long-Term Credit / GDP	Short-Term Credit /GDP	Percent Long-Term Credit
Albania	5.72	2.99	2.73	45.79	Georgia	8.16	3.73	4.44	35.08	Norway	77.45	66.99	10.45	86.44
Armenia	34.47	21.86	12.61	63.41	Germany	95.36	79.18	16.18	82.82	Poland	15.32	9.09	6.23	59.41
Austria	115.33	86.88	28.45	75.28	Greece	49.15	24.83	24.33	49.18	Portugal	126.82	91.98	34.84	69.32
Azerbaijan	0.08	0.02	0.06	25.44	Guinea Bissau	2.22	0.38	1.84	14.21	Romania	16.48	5.99	10.49	34.9
Bahamas, The	69.18	62.74	6.44	90.6	Hungary	72.23	54.87	17.36	75.41	Russia	14.22	6.51	7.7	47.59
Bangladesh	38.98	5.47	33.5	14.01	Iceland	92.66	31.92	60.75	35.28	Saudi Arabia	29.46	10.09	19.37	33.12
Belgium	101.5	67.62	33.88	66.86	Ireland	119.13	93.2	25.93	77.41	Senegal	19.69	7.26	12.43	37
Benin	13.4	3.94	9.46	29.36	Italy	73.88	39.29	34.59	52.66	Serbia, Rep.	56.97	14.86	42.11	31.44
Bolivia	36.84	27.12	9.72	73.77	Ivory Coast	14.01	3.52	10.49	25.1	Singapore	66.34	41.59	24.75	60.9
Bosnia&Herzegov.	39.75	28.98	10.77	72.56	Jordan	79.9	27.23	52.67	33.74	Slovak Rep.	25.76	17.36	8.39	67.26
Bulgaria	19.13	14	5.12	68.09	Kazakhstan	16.3	9.84	6.46	49.13	Slovenia	28.02	17.02	11	59.68
Burkina	13.55	4.14	9.41	30.39	Kyrgyz Rep.	2.31	0.34	1.97	13.9	Spain	91.64	71.33	20.31	77.31
Cameroon	10.27	2.91	7.36	28.31	Latvia	28.44	21.68	6.77	65.21	Sri Lanka	25.07	10.11	14.96	40.2
Cent. African Rep.	6.88	0.59	6.29	8.76	Lesotho	8.28	2.29	5.99	21.76	Sweden	112.06	109.18	2.88	97.45
Chad	5.82	0.62	5.2	11.45	Lithuania	17.95	11.66	6.29	58.21	Taiwan	143.59	99.66	43.93	69.37
China	106.76	38.89	67.87	36.24	Luxembourg	97.36	58.24	39.12	59.87	Togo	14.97	6.13	8.83	41.47
Congo	11.11	1.13	9.98	21.4	Macau	65.17	39.89	25.28	61.77	Tunisia	65.34	30.35	34.99	46.35
Cyprus	199.09	184.72	14.37	92.77	Macedonia	13.03	6.56	6.47	46.36	Turkey	57.23	52.59	4.64	91.62
Czech Republic	49.27	31.4	17.86	65.02	Malaysia	126.31	60.04	66.27	47.83	Ukraine	7.07	3.72	3.35	27.36
Denmark	23.54	10.03	13.51	40.98	Mali	19.23	4.67	14.55	24.24	United States	62.24	27.58	34.66	44.01
Equatorial Guinea	2.78	0.58	2.2	21.42	Mongolia	23.7	5.39	18.31	20.65	Uruguay	58.8	32.16	26.64	52.16
Estonia	41.37	36	5.37	82.52	Mozambique	14.19	6.12	8.07	44.05	Yemen	5.08	0.28	4.81	5.53
Finland	81.66	74.34	7.32	91.05	Netherlands	134.8	100.64	34.16	74.37					
France	86.22	72.98	13.24	84.64	Nicaragua	24.04	12.92	11.12	53.81	*Sample*	*53.04*	*34.88*	*18.16*	*54.14*
Gabon	12.41	5.41	7.01	43.66	Niger	5.95	1.42	4.54	23.26					

Notes: Presented are country averages for the available years. See Table 1 for variable definitions.

credit in Austria, Cyprus, Finland, Norway, and several other countries. Table 4 shows that there are systematic differences in credit maturity between countries at different levels of economic and financial development. In low income countries, the percent long-term credit is 40.38 percent, whereas in middle income and high income countries it is, respectively, 63.17 percent and 72.39 percent. More developed economies have more private credit and, also, a greater portion of their credits have long-term maturity. However, notice in Table 2 that the correlation coefficient of the level of credit and credit maturity is not very large in magnitude (0.57), i.e., credit maturity can differ across countries with the same levels of financial development. For example, credit is about 95 percent of GDP in Germany and Belgium. However, the percent long-term credit is about 83 percent in Germany and about 66 percent in Belgium. Also, private credit is about 40 percent of GDP in both Bangladesh and Estonia. However, in Estonia long-term credit is about 83 percent of total credit and in Bangladesh it is only about 14 percent of total credit.

Table 4. Income and Bank Credit Maturity

	Real per capita GDP Growth	Credit / GDP	Long-Term Credit / GDP	Short-Term Credit / GDP	Percent Long-Term Credit
Low income countries	2.64	25.01	12.08	12.93	40.38
Middle income countries	3.04	58.31	39.91	18.40	63.17
High income countries	2.20	93.81	69.16	24.65	72.39

Notes: Presented are the average values for each variable for three income groups defined as low income if per capita GDP is below $1,715, middle income if it is between $1,715 and $10,800, and as high income if it is above $10,800. See Table 1 for variable definitions.

The determinants of credit maturity

Building on Modigliani and Miller (1958), Stiglitz (1974) shows that in a perfect world the maturity of credit, as any other financing decision, is irrelevant. Subsequent research has added transaction costs, informational asymmetries, liquidation costs, and taxes to that framework as a result of which maturity becomes an important factor in financing decisions. There is a large empirical literature on the determinants of credit maturity from individual (mostly industrialized) countries reviewed by Ravid (1996).

In terms of cross country evidence, Qian and Strahan (2007) and Demirgüç-Kunt and Maksimovic (1999) investigate the determinants of credit maturity in samples of, respectively, 43 and 30 countries with a particular focus on the effect of legal institutions. We stay close to their analysis in terms of the selection of the country-level explanatory variables but we expand the number of countries substantially and we also include additional explanatory variables such as economic volatility and banking system concentration. Furthermore, we use the maturity of bank credit to the entire private sector whereas Demirgüç-Kunt and Maksimovic (1999) and Qian and Strahan (2007) analyze the borrowing by publicly traded companies only. Using the total private bank credit allows us to link the results to the finance and growth literature which has used that variable extensively.

Empirical hypotheses

Legal Institutions

The literature provides substantial evidence that weak legal institutions are a primary reason for the underdevelopment of financial markets as lenders cannot

effectively monitor and exert control over borrowers (La Porta et al. 1997; 1998). Inefficient protection of creditor rights leads to a reduction in the volume of external financing provided by financial institutions to the private sector. Furthermore, institutions affect the terms of credits and the maturity of credit in particular. Diamond (1991; 1993) and Rajan (1992) show that short-term lending facilitates the enforcement of credit contracts as it limits the period during which an opportunistic firm can exploit its creditors without being in default. Diamond (2004) argues that "maturity acts as a substitute contracting tool to control borrower risk," and that bank loan maturity is "especially sensitive to the legal environment." Giannetti (2003) also argues that if the law does not guarantee creditor rights, lenders would prefer short-term debt to control entrepreneurs' opportunistic behavior by using the threat of not renewing their loans. In line with these theories, we expect to find that weak institutions contribute to shorter maturity.

High Inflation

Similar to weak institutions, high inflation is detrimental to the development of the financial system as it limits the amount of external financing available to borrowers (Huybens and Smith 1998, 1999). Furthermore, similar to institutions, high inflation affects credit maturity. Boyd, Levine, and Smith (2001) point out that financial intermediaries are less willing to engage in long-run financial commitments in high inflation environments. Rousseau and Wachtel (2002) also argue that high inflation will "discourage any long term financial contracting and financial intermediaries will tend to maintain very liquid portfolios. In this inflationary environment intermediaries will be

less eager to provide long-term financing for capital formation and growth." Therefore, we expect that high inflation reduces the fraction of credits with long-term maturity.

Stock Market Development

Stock market development has an ambiguous effect on credit maturity. According to one view, a well functioning stock market could be a substitute source of long-term financing and would therefore reduce the demand for long-term bank financing. Diamond (1997) argues that increased participation in markets causes the banking sector to shrink, primarily through reduced holdings of long-term assets. An alternative view holds that a developed stock market increases the ability of firms to obtain long-term financing as it helps reveal information about the borrowers and reduces information asymmetries (Grossman 1976; Grossman and Stiglitz 1980). Therefore, theoretically the effect of stock market development on long-term bank financing is ambiguous.

Banking Sector Competition

Banking sector competition can have a dual effect on the provision of external financing and the provision of long-term financing in particular. A high level of concentration in the banking sector may raise the cost of funds and thus reduce external financing (Pagano 1993). Alternatively, high concentration in the banking industry may foster close relationships between banks and borrowers which reduces information asymmetries and the cost of monitoring borrowers (Mayer 1988; Mayer and Hubbard 1990; Petersen and Rajan 1995). Therefore, the theoretical effect of banking system

concentration on debt maturity is ambiguous.[3] Testing the bank-firm relationship hypothesis Giannetti (2003) finds that, contrary to (her) expectations, maturity is shorter in countries where the banking system is more concentrated.

Overall Level of Bank Credit

Diamond (1984) highlights the function of banks as "delegated monitors" that emerge to reduce the cost of monitoring borrowers by exploiting economies of scale. In the absence of banks, individual savers would incur the cost of assessing and monitoring investment projects. With economies of scale, a larger banking system would have lower monitoring costs, which reduces lending risk and increases the supply of long-term debt. There is, however, an additional effect related to the volume of credit extended in an economy. Diamond and Rajan (2000) argue that a larger pool of smaller, riskier, and less collateralized borrowers would obtain access to external financing with the expansion of the financial system. As most of the credits to these riskier borrowers are short-term, the proportion of short-term debt in total debt would increase as overall lending increases. Thus, the theoretical effect of credit levels of credit maturity is ambiguous.

Real Per Capita GDP

Ravid (1996) points to the "industry paradigm" of matching maturities introduced by Morris (1976) where a firm with long-term assets should use long-term debt. If the maturity of debt is longer than the asset life, the borrower might have a problem finding

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[3] Cetorelli and Gambera (2001) investigate whether the market structure of the banking sector has empirical relevance for economic growth, finding that banking system concentration has a non-trivial impact on growth, but that competition in banking does not necessarily dominate monopoly and vice versa.

new assets to invest in but will have to continue servicing the debt. If debt maturity is shorter than the asset life, then the borrower is exposed to the risk of being short on cash when debt payments are due. Stohs and Mauer (1996) find evidence for this on the firm level. Following Demirgüç-Kunt and Maksimovic (1999), we use per capita GDP to proxy for the amount of fixed assets in a country, with richer countries having a larger stock of long-term assets. Thus, higher GDP per capita is expected to be associated with longer debt maturity.

Credit Information Sharing

Empirical researchers have shown that countries with institutions that gather and share information about borrowers have higher private credit to GDP ratios (Brown, Jappelli, and Pagano 2007; Djankov, McLiesh, and Shleifer 2007; Jappelli and Pagano 2002).[4] Furthermore, because lack of information reduces the supply of long-term credit (Diamond 2004), information sharing is also expected to lengthen debt maturity. Zhang and Sorge (2007) provide a direct link between credit information sharing and credit maturity in a model where information sharing is used by banks as a screening device and leads to an equilibrium where short-term contracts are not preferred. Empirically, Zhang and Sorge (2007) confirm their main hypothesis using data from publicly traded companies to show that information sharing leads to longer credit maturity. We expect to find the same effect.

[4] Information sharing overcomes adverse selection (Pagano and Jappelli 1993) and moral hazard problems (Padilla and Pagano 2000) in the credit markets. While, theoretically, the impact of information sharing on aggregate lending is ambiguous, the increase in lending to safe borrowers is certain.

Real Per Capita GDP Growth

Smith and Watts (1992) note that GDP growth rates can serve as a proxy for investment opportunities: the demand for external financing would increase in boom times and will recede in recession periods. It is not clear, however, whether expansions would stimulate the demand for long-term and short-term credit in different ways. Nonetheless, we follow the literature (Demirgüç-Kunt and Maksimovic 1999; Qian and Strahan 2007) and include the growth rate of per capita GDP in our estimations.

Output Volatility

Booth, Demirgüç-Kunt, and Maksimovic (2001) look at the variability of the return-on-assets to proxy for business risk expecting that an increase in variability would shorten the maturity of credit as it proxies for the short-term operational component of business risk. Giannetti (2003) notes that controlling for such risk has been neglected in the previous cross-country research, at least partly because of lack of suitable empirical proxies. The author uses a similar variable, but at the sectoral level, and shows that the percent short-term debt increases with higher volatility of the return-on-assets of the corresponding sector in that country. It is more difficult to account for such risks at the country level. Nevertheless, if per capita GDP growth is a suitable proxy for investment opportunities as noted in the previous literature, then its variability can be used as a measure of business risk.[5]

[5] In the context of international lending, Valev (2007) relies on the same proxy and shows that higher volatility of per capita GDP growth in a country leads U.S. banks to shorten the maturity of credit to that country.

Manufacturing Share of Output

Barclay and Smith (1995) and Scherr and Hulburt (2001) show that the maturity of credit differs substantially across economic sectors with manufacturing firms having a larger fraction of long-term credit as percent of their overall credit. We include the percent of manufacturing in total output as a proxy for the importance of the manufacturing sector on the country level. We expect that credit in countries with a larger manufacturing sector will have longer maturity.

The correlations in Panel B of Table 2 show that inflation and output volatility are negatively and significantly correlated with the percent long-term credit. Also, rule of law, credit information sharing, and GDP per capita are positively and significantly correlated with the percent long-term credit. The correlation between economic growth and the percent long-term credit is positive and significant as is the correlation between the credit level and the percent long-term credit.

Methodology

By construction private credit and the percent long-term credit are determined jointly and, therefore, we need to control for the endogeneity of private credit. Following the literature, we use countries' legal origin as external instruments for the level of credit. However, for those to be valid instruments, we would have to assume that legal origin does not have an impact on credit maturity, except through its effect on credit. This may not be the case as Demirgüç-Kunt and Maksimovic (1999) and Qian and Strahan (2007) find that legal origin influences credit maturity. In addition, we would be constrained to using a random effects model (since the legal origin does not change over time) even

though the Hausman test reveals that the explanatory variables used in the random-effects model are correlated with the country specific effects and, therefore, we have to use a fixed-effects estimation. To resolve these problems, we implement the Hausman-Taylor (1981) estimator that corrects for correlation between the explanatory variables and the country-level random-effects, and does not require the use of outside instruments.[6]

When explaining the percent long-term credit one concern that arises is that the dependent variable is a ratio (between 0 and 100 percent) making OLS problematic as the predicted values might lay outside the unit interval (Papke and Wooldridge 1996). This may require the transformation of the dependent variable using a log-odds transformation ($\log(y/1-y)$). However, the coefficient estimates using the log-odds ratio are difficult to interpret in a panel setting and therefore we follow the previous literature (Demirgüç-Kunt and Maksimovic 1999; Rodrik and Velasco 1999; Valev 2006; 2007) and do not perform the transformation. Furthermore, less than 1 percent of the predicted values from the models fall outside the unit interval.

Results

Table 5 presents the empirical results regarding determinants of credit maturity. We start with a benchmark equation where the percent long-term debt is explained by rule of law, inflation, financial and economic development, and economic growth. Then we add, one at a time, a dummy variable for credit information sharing, banking system

[6] For robustness, Table C1in the appendix presents a set of empirical results where we use a random-effects estimator, a fixed-effects estimator, GLS estimators that control for a heteroskedastic error structure and allow for AR(1) autocorrelation, as well as a two-stage least squares random-effects estimator. The estimated effects are similar across the various estimations.

Table 5. Determinants of Credit Maturity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rule of Law	5.308	5.041	4.490	6.925	4.197	8.331	6.857
	(0.035)	(0.043)	(0.145)	(0.044)	(0.105)	(0.003)	(0.047)
Inflation	-3.939	-3.364	-2.455	-12.418	-2.848	-3.861	-11.418
	(0.000)	(0.000)	(0.006)	(0.021)	(0.002)	(0.000)	(0.070)
Growth	0.266	0.220	0.138	-0.045	0.137	0.261	0.194
	(0.081)	(0.148)	(0.424)	(0.823)	(0.369)	(0.099)	(0.334)
Credit	11.006	10.443	11.291	14.962	13.465	11.516	15.098
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Income	0.311	0.362	0.698	0.270	0.148	0.109	0.334
	(0.248)	(0.175)	(0.029)	(0.388)	(0.580)	(0.711)	(0.300)
Credit Information Sharing		6.940					6.573
		(0.001)					(0.001)
Banking Industry Concentration			1.504				5.092
			(0.632)				(0.140)
Stock Market Turnover Ratio				-0.952			0.142
				(0.168)			(0.832)
Output Volatility					-0.678		0.003
					(0.595)		(0.999)
Manufacturing Share of Output						-1.010	-0.611
						(0.000)	(0.038)
U.K. Legal Origin	5.141	7.888	12.948	-2.505	-1.218	0.506	-0.281
	(0.658)	(0.495)	(0.366)	(0.844)	(0.915)	(0.969)	(0.983)
French Legal Origin	9.606	10.718	15.879	1.866	3.427	4.217	3.905
	(0.400)	(0.345)	(0.256)	(0.877)	(0.762)	(0.740)	(0.746)
German Legal Origin	11.818	12.313	15.010	6.453	8.347	14.710	10.642
	(0.394)	(0.375)	(0.379)	(0.660)	(0.581)	(0.360)	(0.491)
Socialist Legal Origin	23.087	26.770	32.466	26.432	16.725	24.301	32.692
	(0.055)	(0.026)	(0.029)	(0.056)	(0.161)	(0.068)	(0.017)
Constant	48.685	40.788	39.351	52.309	59.692	67.446	55.856
	(0.000)	(0.001)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)
Hausman test: χ^2 (d.f.)	6.41 (5)	5.43 (6)	8.83 (6)	4.87 (6)	3.46 (6)	2.09 (6)	0.88 (10)
p-value	0.268	0.490	0.183	0.561	0.749	0.911	0.909
Observations	504	504	419	322	483	418	284
Countries	71	71	67	48	68	65	45

Notes: See Table 1 for variable definitions. Results are based on Hausman-Taylor estimation, where Credit is endogenous. *P*-values are reported in parentheses below coefficients. Credit is treated as endogenous. The Hausman test has a null hypothesis that the explanatory variables are not correlated with the country-specific random-effects.

concentration, stock market development measured by the stock market turnover ratio, output volatility, and the share of the manufacturing sector in GDP. In column (7) we report the estimations from a regression where we include all explanatory variables.

It is immediately clear that the rule of law has a statistically significant and robust effect on the maturity of credit. Greater rule of law is associated with longer debt maturity. Looking at the estimations from the benchmark equation, a decrease in the rule of raw by one standard deviation leads to a decrease of the percent long-term credit by 5.57 percentage points (1.05*5.308). This result compares well with previous findings. In Demirgüç-Kunt and Maksimovic (1999), a decrease of the Law & Order index by 1.05 index points decreases the percent long-term debt by 5.78 percentage points.[7] To illustrate, if the Slovak Republic (where the rule of law index is 0.288) had the rule of law level of Austria (1.891), its long-term credit would increase by 8.51 percentage points.

Inflation also affects credit maturity in significant ways with higher inflation leading to shorter credit maturity in all specifications. We explore the size of the effect of inflation in more detail later. Countries with deeper financial markets have a greater fraction of long-term credits. The estimates from the benchmark equation in column (1) suggest that if Slovakia (where private credit is 25.67 percent of GDP) had the level of private credit of Hungary (72.22 percent), it would also have 11.38 percentage points greater percent long-term credit. Thus, the process of financial deepening is accompanied by lengthening of the maturity of credit as suggested by Diamond (1984).

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[7] Demirgüç-Kunt and Maksimovic (1999) use a different index to measure rule of law but their index has a nearly identical definition to ours ("the degree to which citizens of a country are able to utilize the existing legal system to mediate disputes and enforce contracts"). In addition, their index has a similar standard deviation (1.597) and a similar range (4.286).

To test whether information sharing affects credit maturity, we follow Qian and Strahan (2007) and include a dummy variable that equals 1 if a country had either a public credit registry or a private credit bureau in a particular year, and 0 otherwise. Credit information sharing is statistically significant when included in the base estimation model and in the full model. The more conservative yet statistically significant estimate in column (7) suggests that if Luxembourg had established a credit information sharing institution, the percent long-term credit would increase from 59.72 percent to 66.30 percent, bringing it to the same percentage long-term credit as in Belgium. Using the same estimate, if China had not established a credit information sharing institution in 2003, the average percent long-term credit would have remained at 29.48 percent, a level below Congo or Burkina. Instead, the percent long-term credit in China increased to 36.24 percent.

China is not the only country that established a credit information sharing institution during the years covered by our data–Norway implemented one in 1998, Bulgaria in 1999, and Romania in 2000, to name a few. Figure 1 shows that, perhaps not coincidentally, the percent long-term credit increased in all countries that implemented a credit information sharing institution (except Serbia, where the implementation coincided with financial liberalization, closure of major banks, and overall reduction in credit). This was particularly true in countries that started at a relatively low percent of long-term credit. For example, the percent long-term credit in Romania doubled after the introduction of a public credit registry.

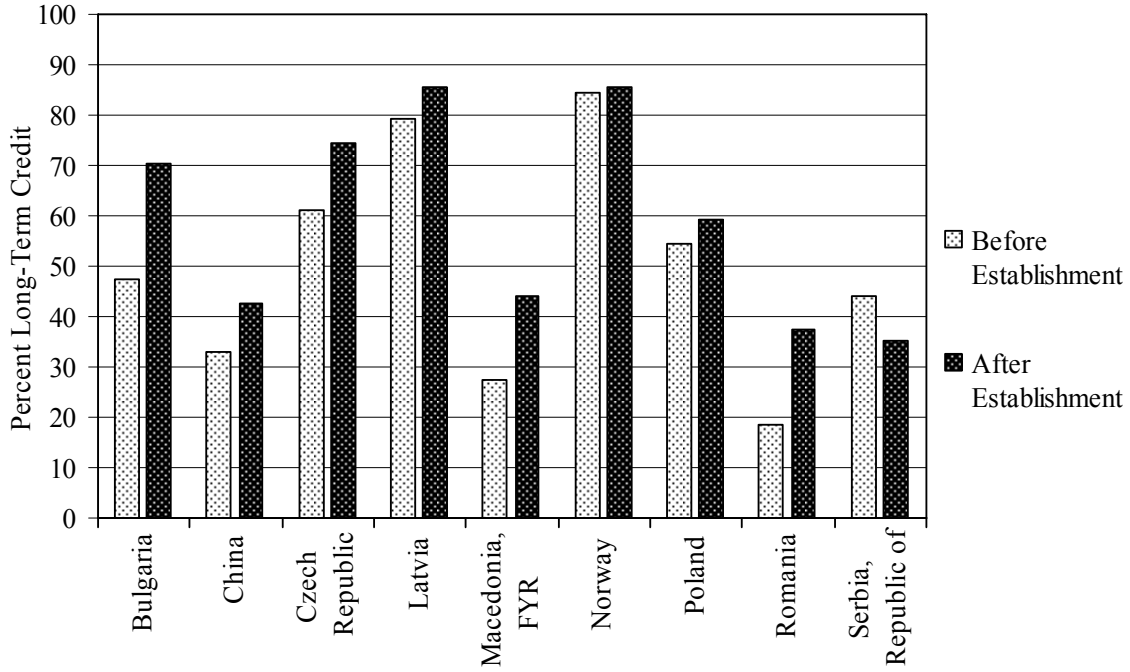

Figure 1. Credit Information Sharing Institutions and Credit Maturity. Plotted are the averages of the percent long-term credit for the period before and after the establishment of credit information sharing institutions. The years included vary by country depending on data availability. For The Czech Republic each period includes 5 years; for Latvia, Poland, Romania, and Republic of Serbia 4 years; for Bulgaria and China 3 years; for FRY Macedonia 2 years; and for Norway 1 year.

Economic development measured by per capita GDP, which was included to proxy for the importance of long-term capital and to test the hypothesis of maturity matching is not statistically significant. This result differs from Demirgüç-Kunt and Maksimovic (1999) who find evidence for maturity matching on the firm level. The difference in results may be attributed to the imprecise measure of fixed assets that we employ compared to Demirgüç-Kunt and Maksimovic who use a direct measure of fixed assets as a share of total assets. Similar to us, Qian and Strahan (2007) use per capita GDP to control for economic development and report an insignificant impact on maturity.

GDP growth has mostly a positive coefficient, which implies that faster growing countries have more long-term credit. However, the coefficient is significant at the accepted confidence levels only when we control for the manufacturing share of output in column (6) and therefore we refrain from making stronger claims. Nevertheless, with the results on inflation, we interpret this finding in line with Booth, Demirgüç-Kunt, and Maksimovic (2001): agents can borrow to invest in more productive, longer gestation projects against real, but not against inflationary growth prospects.

The rest of the results suggest that banking industry concentration, stock market development, and output volatility do not affect bank credit maturity. Contrary to expectations, a greater share of manufacturing is associated with less long-term credit. Unfortunately data limitations prevent us from investigating whether this effect is driven by particular non-manufacturing sectors, e.g., utilities, transportation, and/or construction.

Inflation and Credit Maturity

To examine further the relationship between inflation and credit maturity, we reestimated the regression reported in column (7) using 40 subsamples ordered by the rate of inflation as in Rousseau and Wachtel (2002) and Boyd, Levine, and Smith (2001). Both papers investigate the effect of inflation on financial sector activity and not on the maturity of credit specifically. However, the authors explain that the effect of financial development on economic growth diminishes with inflation because high inflation limits long-term financial contracting. Here we provide direct evidence for that idea.

Rousseau and Wachtel (2002) find that inflation reduces the availability of bank credit at low inflation rates but after some threshold (which they estimate to be around 16 percent) the negative effect of additional inflation on credit activity disappears. Similarly, Boyd, Levine, and Smith (2001) conclude that, while there is a statistically significant and economically important negative relationship between inflation and banking sector development, the marginal impact of inflation on bank lending activity diminishes rapidly. The threshold inflation rate above which inflation has no effect on credit market activity in Boyd, Levine, and Smith (2001) is very close to that in Rousseau and Wachtel (2002): 15 percent. Boyd, Levine, and Smith (2001) conclude that until this threshold is reached "the damage to the financial system has already been done, [and] further increases in inflation will have no additional consequences for financial sector performance or economic growth." This is consistent with the anecdotal evidence from Brazil provided by Demirgüç-Kunt and Maksimovic (1999) who explain that an inflationary environment gives rise to the indexation of financial contracts (and the dollarization of financial assets) reducing the negative impact of additional high inflation on credit markets.

To examine these ideas using our data set, we sorted all observations according to the rate of inflation and estimated repeatedly the full model from column (7) in Table 4 starting with observations 1 through 244, then on 2 through 245, continuing until the last subsample that includes observations 40 through 284. The estimated coefficients of inflation, along with the 95 percent confidence intervals, are plotted in Figure 2. Looking at Figure 2, we can identify three regions in terms of the effect of inflation on the percent long-term credit. Inflation significantly reduces the percent long-term credit until

inflation reaches about 14 percent. After that point, the effect of inflation on the percent long-term credit declines markedly. When the inflation rate reaches about 25 percent, the negative effect of inflation on credit maturity increases again.

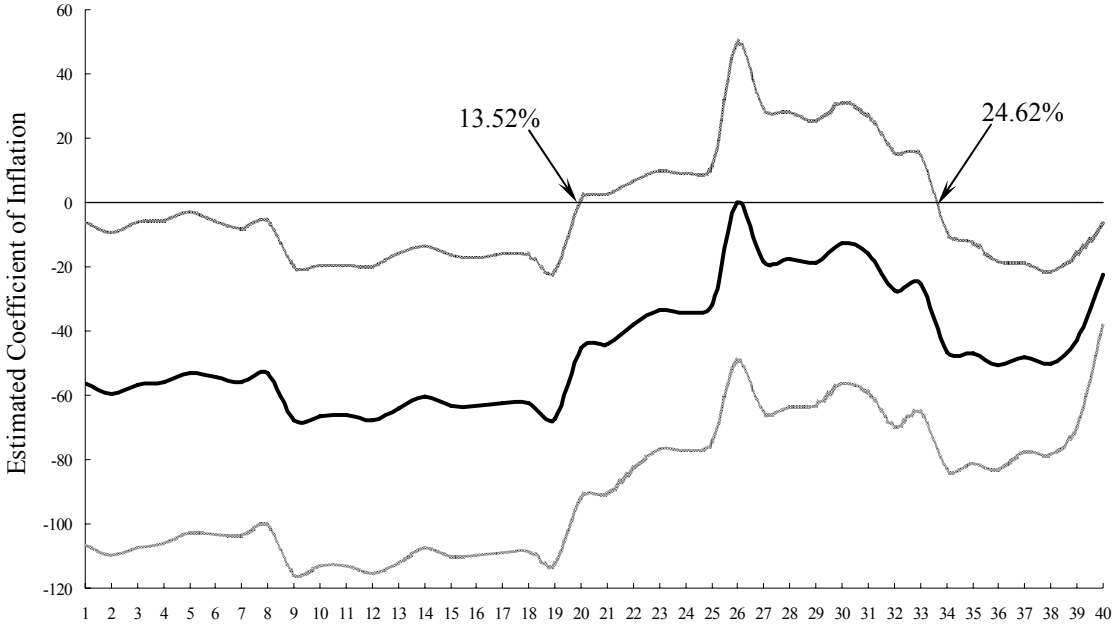

Figure 2: Impact of Inflation on Credit Maturity at Different Inflation Levels. Plotted are the estimated coefficients of inflation and 95 percent confidence intervals when we use subsamples ordered by inflation. Each subsample contains 244 observations. The values on the abscissa correspond to the subsamples used in the estimations, while values on the ordinate represent the coefficient (and confidence intervals) estimates of inflation for the corresponding subsample.

The low range of inflation until about 14 percentage points is very close to the ranges reported by Rousseau and Wachtel (2002) and Boyd, Levine, and Smith (2001). However, our estimations suggest that the negative effect of high inflation reappears at "high" inflation rates. It is possible that the indexations of financial contracts cannot sufficiently reduce the uncertainty about the real value of nominal payments when

inflation becomes too high (and too volatile). In addition, Demirgüç-Kunt and Maksimovic (1999) note that very high inflation rates reveal a deterioration of institutions other than central banking. For example, even efficient legal systems take time to enforce contracts. As Demirgüç-Kunt and Maksimovic argue, while payments can be indexed, borrowers and lenders cannot "index judgment."

To recount, the major determinants of the maturity composition of bank credit to the private sector are rule of law, inflation, the existence of institutions for credit information sharing, and the size of the financial system. These effects are robust across various estimation techniques and specifications of the models. They are also robust to substituting the rule of law measures with alternative indexes (e.g., the ICRG variables and an index of corruption), to different definitions of the credit information sharing variable (public vs. private agencies) and to the inclusion of additional control variables such as the share of foreign banks and the share of government owned banks (which reduce the sample size substantially and are not statistically significant). The next section builds on these results to examine the effect of credit maturity (and its determinants) on economic growth.

Credit Maturity and Economic Growth

The literature usually investigates the effect of finance on growth by averaging data over 5 years to reduce the impact of business cycles and to concentrate on long-term growth. Proceeding in the same fashion would reduce the number of observations in our data set substantially as the sample period for most countries is about 10 years long. Fortunately, the literature has dealt with this issue. Bekaert, Harvey, and Lundblad (2005)

investigate the impact of equity market liberalization on economic growth by using overlapping data. The five-year averages are constructed as 1990-95, then 1991-96, 1992-97, and so on, producing 6 five-year averages from any 10 years of annual data. While this ingenious methodology increases the number of observations, it calls for the adjustment of the moving average component in the residuals as introduced by Newey and West (1987). Without the adjustment, the standard t-tests lead to a slight over-rejection (Bekaert, Harvey, and Lundblad 2001). The procedure provides serial-correlation and heteroskedasticity consistent standard errors.[8] Following the literature, e.g., Beck, Levine, and Loayza (2000) and Levine, Loayza, and Beck (2000), we estimate the growth equations using dynamic panel generalized-method-of-moments (GMM) techniques to address the potential endogeneity of credit and other explanatory variables. The technique is described in appendix A.

Results

Column (1) in Table 6 reports the results of an equation where economic growth is explained by private sector credit, initial GDP per capita, government size, openness to trade, and inflation. This is a standard specification from the finance and growth literature (Beck, Levine, and Loayza 2000). Financial development is expected to lead to faster economic growth. High inflation is an indicator of macroeconomic instability and is expected to slow down economic growth. More open economies are expected to growth faster. A large government size is taken as an indicator of inefficient use of resources and

[8]Ranciere, Tornell, and Westermann (2003) also use overlapping averages to provide long-term predictions of the finance and growth relationship and adjust their standard errors according to Newey and West (1987). Petersen (2007) finds that about 7 percent of authors who use panel data in overall finance literature adjust their standard errors using the Newey-West procedure.

is expected to reduce economic growth. Initial income is included to test for income convergence.[9]

Table 6. Bank Credit Maturity and Economic Growth
(GMM System Estimation, 5-year Averages)

	(1)	(2)	(3)	(4)
Credit	2.296	2.015	0.342	2.469
	(0.031)	(0.095)	(0.682)	(0.016)
Percent Long-Term Credit		6.020	6.824	6.267
		(0.001)	(0.000)	(0.100)
Stock Market Value Traded			6.979	
			(0.001)	
Initial income per capita	-2.164	-2.555	-3.638	-4.747
	(0.031)	(0.012)	(0.000)	(0.000)
Government size	0.709	1.698	-3.508	0.178
	(0.800)	(0.545)	(0.122)	(0.940)
Openness to trade	17.751	15.090	8.541	12.699
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	-2.607	-0.645	-7.650	-8.647
	(0.173)	(0.761)	(0.000)	(0.000)
Constant	44.624	-34.207	-3.282	-68.554
	(0.424)	(0.016)	(0.677)	(0.000)
Sargan test (*p*-value)	0.204	0.263	0.645	0.962
Serial correlation test (*p*-value)	0.639	0.207	0.098	0.103
Observations	499	499	387	361
Countries	64	64	44	62

Notes: The dependent variable is the average yearly increase in real per capita GDP. Stock Market Value Traded is defined as stock market value traded during a year divided by yearly GDP, while other variables are defined in Table 1. Credit, Percent Long-Term Credit, Government size, Openness to trade, and Initial income per capita enter the regression as log(variable). Inflation enters the regression as log(1 + Inflation). *P*-values based on Newey-West adjusted heteroscedastic-serial consistent standard errors are reported in parentheses below the coefficients. The Sargan test has the null hypothesis that the instruments are not correlated with the residuals. The serial correlation test has a null hypothesis that the errors in the first difference regressions do not exhibit second order serial correlation.

[9] We could not obtain recent data on education levels for many countries for the later years in our sample. We carried out all estimations with a smaller sample including education and obtained qualitatively similar, but less statistically significant results on all variables.

The results show that private credit has a positive and statistically significant effect on economic growth. Besides being statistically significant, private credit also has a large economic effect, similar to the effect reported in the previous literature. To illustrate, we compare our results with the estimates of Beck, Levine, and Loayza (2000): a 10 percent exogenous increase in private credit leads to an additional 0.216 percentage points of economic growth per year using our estimated coefficient,[10] and to 0.228 percentage point of additional yearly growth using the estimated coefficient of Beck, Levine, and Loayza (2000). The coefficients on all control variables except government size have the expected signs. Openness to trade and initial income per capita are statistically significant at the accepted confidence levels. The specification tests confirm the validity of our results: we cannot reject the null hypothesis of the Sargan tests or of the serial-correlation test at the accepted confidence levels in all specifications.

In column (2) we add the percent long-term credit. Credit maturity has a positive and statistically significant effect on economic growth as predicted by Bencivenga and Smith (1991). In terms of economic size a 10 percent increase in the portion of long-term credit leads to an additional 0.574 percentage points of economic growth per year.[11] As the average growth rate in the sample is 2.98 percent, the impact of an increase in credit maturity on growth is large (an increase of over 19 percent).

Consider the following example to illustrate the economic impact of credit maturity. Private credit in Italy is 71.11 percent of GDP which is well above the sample average of 53.04 percent. Thus, by the standard measure of financial development, Italy

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[10] The calculation is as performed follows: 2.296 * ln(1.1) = 0.216.

[11] The calculation is as follows: 6.02 * ln(1.1) = 0.574; where 6.02 is the coefficient of the percent long-term credit in column (2).

has above average financial development. However, only 52.66 percent of private credit in Italy is long-term which is below the sample average of 54.14 percent. Thus, Italian banks extend relatively large volumes of credit but much of the credit is short-term compared to other countries. If private credit in Italy declined to the sample average, economic growth in Italy would decline by 0.310 percentage points. However, if the percent long-term credit in Italy increased to the sample average, economic growth would increase by 0.167 percentage points. Therefore, if most of the reduction in credit originated from a decline in short-term credits, the negative impact of reduced credit to the private sector would be countered to some extent by the longer maturity of credit.

For robustness, in column (3) we add the stock market value traded as a measure of stock market development. The stock market is an alternative source of long-term financing and its inclusion in the model might reduce the effect of credit maturity on economic growth. Although the sample size decreases from 64 to 44 countries, the coefficient on credit maturity remains statistically significant. Similar results were obtained using alternative measures for stock market development such as the turnover ratio and stock market capitalization.

The determinants of credit maturity and economic growth

Section 3 shows that credit maturity is longer in countries that have strong institutions, low inflation, and institutions for sharing credit information among financial institutions. These characteristics also influence economic growth through their impact on credit maturity. Furthermore, the impact is large. Using the estimations in column (2) in Table 5, we obtained the predicted values for the percent long-term credit. Then, we

reestimated the growth equation using the predicted values for the percent long-term credit. These results are reported in column (4) of Table (6).

Putting together the estimates from sections 3 and 4, we estimate that an increase in the rule of law index by 1 index point would increase economic growth (via credit maturity) by 0.586 percentage points a year.[12] A decrease of inflation by one standard deviation leads to a 0.246 percentage points faster economic growth.[13] The establishment of a credit information sharing institution in a country would raise economic growth by 0.718 percentage points.[14] These effects on economic growth via credit maturity are separate from other channels through which strong institutions, low inflation and institutions for credit information sharing might affect growth.

Conclusion

This chapter is an investigation into one of the important functions of the banking system: to transform short-term liquid deposits into long-term illiquid financial assets that can fund long gestation activities and, thus, raise the rate of economic growth. The results show that the extent to which banks perform this function well has an important effect on

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[12] 1.00 increase in rule of law leads to (5.308 * 1.00 =) 5.31 percentage points increase in percent long-term credit. At the average of 54.14 percent long-term credit, this leads to an increase in yearly GDP growth of (6.27 * (ln(0.541+ 0.053) – ln(0.541))=) 0.586 percentage points.

[13] 0.55 decrease in inflation leads to (3.939 * 0.55 =) 2.17 percentage points increase in percent long-term credit. At the sample average of 54.14 percent long-term credit, this leads to an increase in yearly GDP growth of (6.27 * (ln(0.5414 + 0.0217) – ln(0.5414))=) 0.246 percentage points. Please note that this calculation ignores the independent impact of inflation on growth.

[14]The establishment of a credit information sharing institution would increase the percent long-term credit by 6.573 percentage points. At the average of 54.14 percent long-term credit, this leads to an increase in yearly GDP growth of (6.27*(ln(0.7604+0.06573) – ln(0.7604)=) 0.718 percentage points.

the relationship between the financial system and economic growth. Economic growth is faster in countries where the banking system extends more long-term credits.

Furthermore, the results show that credit maturity depends on a number of institutional and economic factors. Greater rule of law, low inflation, and schemes for sharing of credit information between financial institutions contribute to lengthening the maturity of bank credit. From a policy perspective, the institutions for sharing credit information probably present the most interest because their establishment is a policy choice. We show that such institutions can increase the effectiveness of credit in terms of economic growth by making it easier for financial intermediaries to extend long-term credits.

CHAPTER FOUR

THE DETERMINANTS OF CREDIT MATURITY IN TRANSITION ECONOMIES

The second chapter described how the maturity transformation function of the banking sector leads to an increase in output growth from a theoretical perspective. The previous chapter presented empirical evidence on the maturity of credit and growth relationship and has confirmed the theoretical prediction that longer credit maturity increases the rate of economic growth. In addition, the chapter draws on the previous literature to formulate hypotheses about the determinants of credit maturity and confirms several of them in a broad sample of countries. The main limitation of the previous chapter is the definition of long-term credit as credit with contractual maturity longer than one year. This chapter overcomes this limitation by looking at the determinants of credit maturity by isolating the portion of credit with contractual maturity of one year or less, the portion of credit with contractual maturity longer than one year, and the portion of credit with contractual maturity longer than five years. Thus, we can investigate short-term, long-term, and very long-term credit. Credit data that allow such categorization are available for 14 transition countries. This is a smaller but more homogeneous sample of countries. We also have more frequent quarterly observations compared to the yearly data used in the previous chapter.

We find that most results on the determinants of the portion of credit with maturity longer than one year obtained in the previous chapter still hold. For example, the rule of law remains a significant determinant of credit maturity and the magnitude of the estimated coefficients is similar. Similarly, financial deepening is accompanied by lengthening of the maturity of credit in both samples. Inflation is a much more significant determinant in a broader set of countries, while per capita GDP growth and stock market activity are more significant in the set of countries examined here. In addition, we find that the portion of credit with maturity longer than five years is driven by similar determinants as the portion of credit with maturity longer than one year, but the significance and magnitude of each determinant differs. For example, weak rule of law reduces the portion of credit with maturity longer than five years more than it does the portion of credit with maturity longer than one year. Interestingly, inflation has a larger effect on the portion of credit with maturity longer than one year.

In addition to the determinants discussed in the previous chapter, we also investigate whether state and foreign ownership of banks influences credit maturity, and find that, credit maturity is longer in countries with more privately owned domestic banks. We also look in more detail at credit information sharing institutions and find that the quality of information and the ownership structure of such institutions (public vs. private) have an important impact on maturity.

We describe the data in the following section. The literature on financial development during transition suggests several additional testable hypotheses on the determinants of credit maturity in this particular sample and we review them, along with

the determinants studied in the previous chapter, in section 2. Section 3 presents the results and section 4 concludes.

Data

We use quarterly data on lending by banks to the private sector in 14 countries spanning the period from about 1995 to 2006, depending on data availability for the individual countries. Table 7 provides variable definitions and details the sources of the data for all variables. The sample includes all countries for which we could identify a consistent data source. Credit is decomposed into three categories: short-term credit that has contractual maturity of one year or less, medium-term credit that has contractual maturity between one year and five years, and long-term credit that has contractual maturity longer than five years.

Table 7. Variable Definitions and Sources

Variable	Definition	Sources
Credit / GDP	Credit by deposit money banks and other financial institutions to the private sector divided by quarterly GDP.	Central bank of the corresponding country. Consulted were the official publications and websites.
Portion of Credit with Maturity Longer than One Year	Credit with the original contractual maturity longer than one year divided by total credit.	
Portion of Credit with Maturity Longer than Five Years	Credit with the original contractual maturity longer than five years divided by total credit.	
Short-Term Credit	Credit with the original contractual maturity of one year or less divided by quarterly GDP.	
Medium- and Long-Term Credit	Credit with an original contractual maturity longer than one year divided by quarterly GDP.	
Real Per Capita GDP Growth	The percent increase in real per capita GDP during the previous year.	The official statistical institute or the central bank of the corresponding country. Data were cross checked with IMF's IFS, Eurostat, and OECD's quarterly national accounts.
Per Capita GDP	The real per capita GDP in US dollars at the beginning of a year.	
Inflation	The increase in the CPI from previous quarter.	
Rule of Law	Index that measures "the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement."	Kaufmann, Kraay, and Mastruzzi (2007).
Banking Industry Concentration	The assets of three largest banks as a share of assets of all commercial banks.	Beck, Demirgüç-Kunt, and Levine (2000).
Credit Information Sharing	Dummy taking 1 if public credit registry or private credit bureau operates in a country during a year, 0 otherwise.	Author constructed from Brown, Japelli, and Pagano (2007).
State Banks' Asset Share	Share of majority state-owned banks' assets in total bank sector assets.	EBRD "Structural change indicators."
Foreign Banks' Asset Share	Share of total bank sector assets in banks with foreign ownership exceeding 50 percent.	
Stock Market Turnover	Stock Market volume traded during a quarter divided by quarterly GDP.	Official stock exchange of corresponding country.
Output Volatility	Root mean squared errors from $y_t = \alpha + \varepsilon_t$, using data from the preceding 10 quarters, where y is Real GDP growth.	Author constructed from data on Real GDP growth.

Table 8 lists the time period for the 14 countries in the sample. There are, on average, 35 observations per country. Latvia has the longest time series of 58 quarters, from the fourth quarter of 1992 to the first quarter of 2007. The earliest observation is in Slovenia (first quarter of 1992), while the most recent observations are in the Slovak Republic and Ukraine (second quarter of 2007). The shortest time series of only 11 quarters is from Albania. Although detailed credit data are available for most countries, the unavailability of some controls limited the sample. For example, although quarterly credit data for Bosnia and Herzegovina are available from 1997 to 2007, we were unable to obtain GDP data for the same period.

Table 8. Bank Credit and Bank Credit Maturity by Country

Country	Country Average Values			Coverage	
	Credit as a Share of GDP	Percent of Credit with Maturity		From	To
		over 1 year	over 5 years		
Albania	9.32	52.03	17.42	Q3/2003	Q1/2006
Bulgaria	124.48	62.95	20.96	Q4/1999	Q1/2007
Czech Republic	195.96	64.46	39.64	Q1/1993	Q1/2007
Estonia	151.02	80.93	42.79	Q1/1994	Q1/2007
Hungary	85.73	52.60	34.40	Q4/1995	Q1/2007
Latvia	105.13	62.80	22.30	Q4/1992	Q1/2007
Lithuania	71.53	60.66	53.55	Q1/1995	Q4/2004
Macedonia, FYR	65.81	52.87	-	Q4/2000	Q4/2006
Poland	101.12	63.28	34.80	Q4/1996	Q1/2007
Romania	57.61	44.41	15.41	Q4/1997	Q1/2007
Serbia, Republic of	100.80	56.09	-	Q1/1999	Q1/2007
Slovak Republic	210.14	41.49	25.52	Q4/2002	Q2/2007
Slovenia	120.37	59.83	-	Q1/1992	Q1/2006
Ukraine	89.23	39.73	-	Q4/1996	Q2/2007
Sample	*112.32*	*59.02*	*31.59*		

Notes: For variable definitions, please see Table 7.

Table 8 shows large differences in terms of financial development measured as private credit as a share of quarterly GDP. In Albania, private credit is below 10 percent whereas in the Slovak Republic it is over 200 percent of quarterly GDP. [15] Credit as a share of quarterly GDP increased over time in most countries. Figure 3 presents this trend for several countries over the past 11 years.

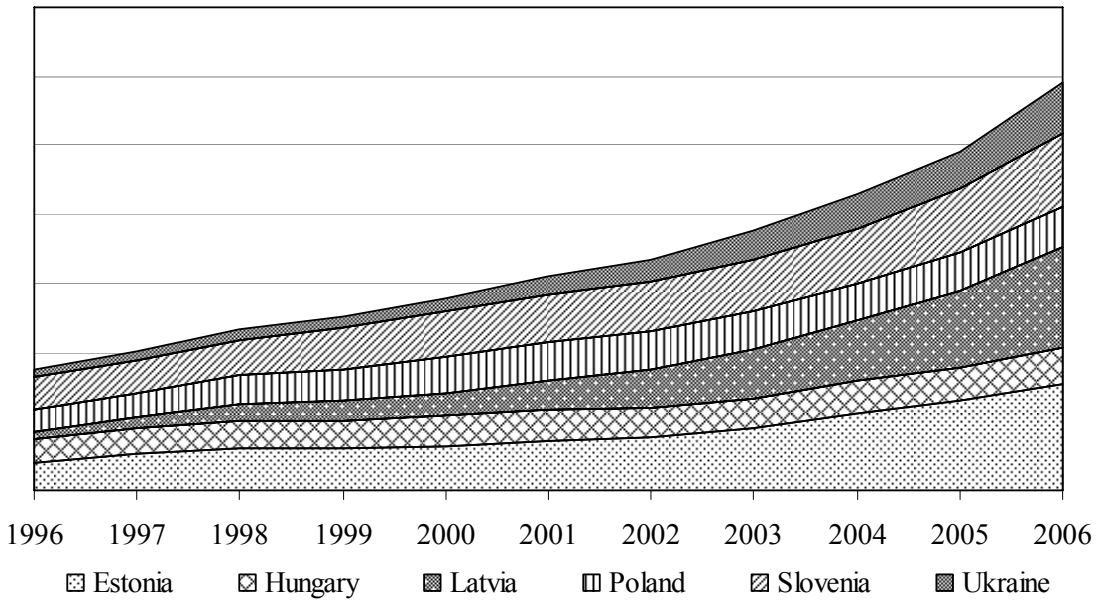

Figure 3. Credit as a Share of GDP. Presented are yearly average values of credit divided by quarterly GDP for selected countries and time periods.

The banking system during the early transition period was characterized by state ownership of banks, which were forced to extend loans to inefficient state owned enterprises under contract terms determined by politics and not by the soundness of projects (Drakos 2003; Eller and Haiss 2003; Fink et al. 1998). To increase the efficiency

[15] Please note that we divide the stock of credit by quarterly, not by yearly GDP. Therefore, the numbers are about four times greater than when we divide the stock of credit by yearly GDP as in the previous chapter.

of capital allocations, almost all countries privatized banks and increased the share of foreign owned banks (Berglof and Bolton 2002; Eller, Haiss, and Steiner 2005; Naaborg et al. 2003). Figure 4 makes apparent the trend of growing asset share of private and foreign owned banks over time.

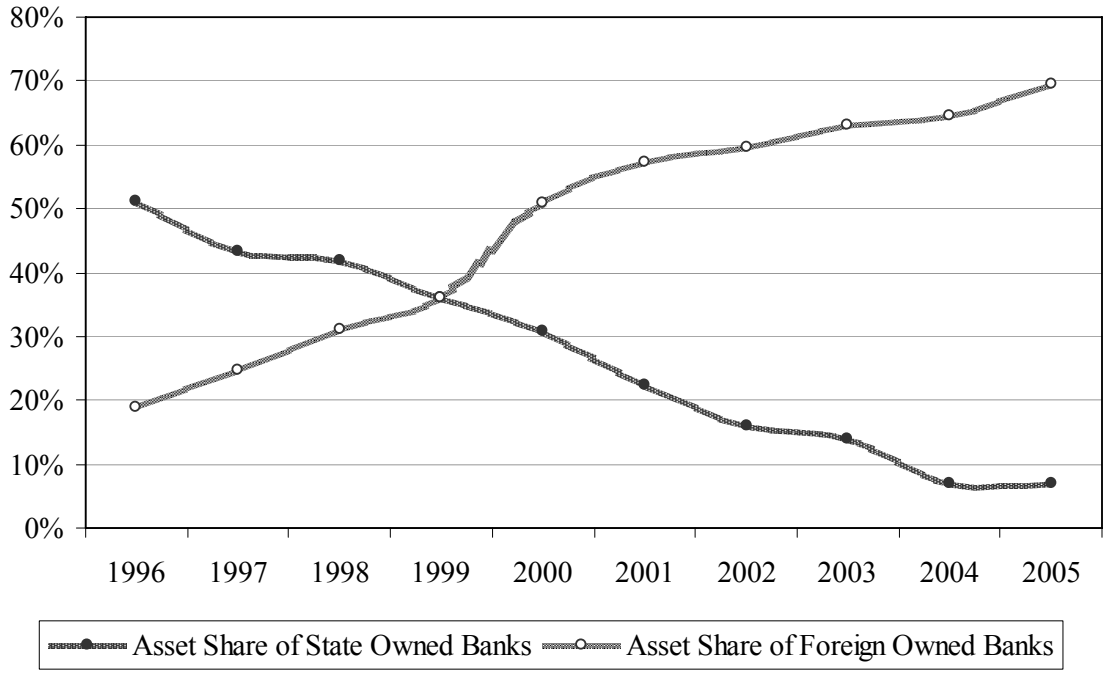

Figure 4. State and Foreign Ownership of Banks. Presented are assets owned by each type of banks as a share of all bank assets. These are averages across countries.

Table 9 shows descriptive statistics and the correlations of the variables used in the estimations. On average, 59.02 percent of bank credit to the private sector has maturity longer than one year, while 31.59 percent has maturity longer than five years.[16] There are, however, large differences between countries as shown in Table 8. Less than

[16] This compares well with the data used in previous chapter, as the average portion of credit with maturity longer than one year was 54.14 percent.

30 percent of credit in Ukraine has maturity longer than one year, while in Estonia such credit is over 80 percent. Credit with maturity longer than five years is only 15.41 percent of all credit in Romania, while it is 53.55 percent in Lithuania. Figure 5 makes these differences clear by presenting credit levels and the percent of credit with maturity longer than one year across the sample countries.

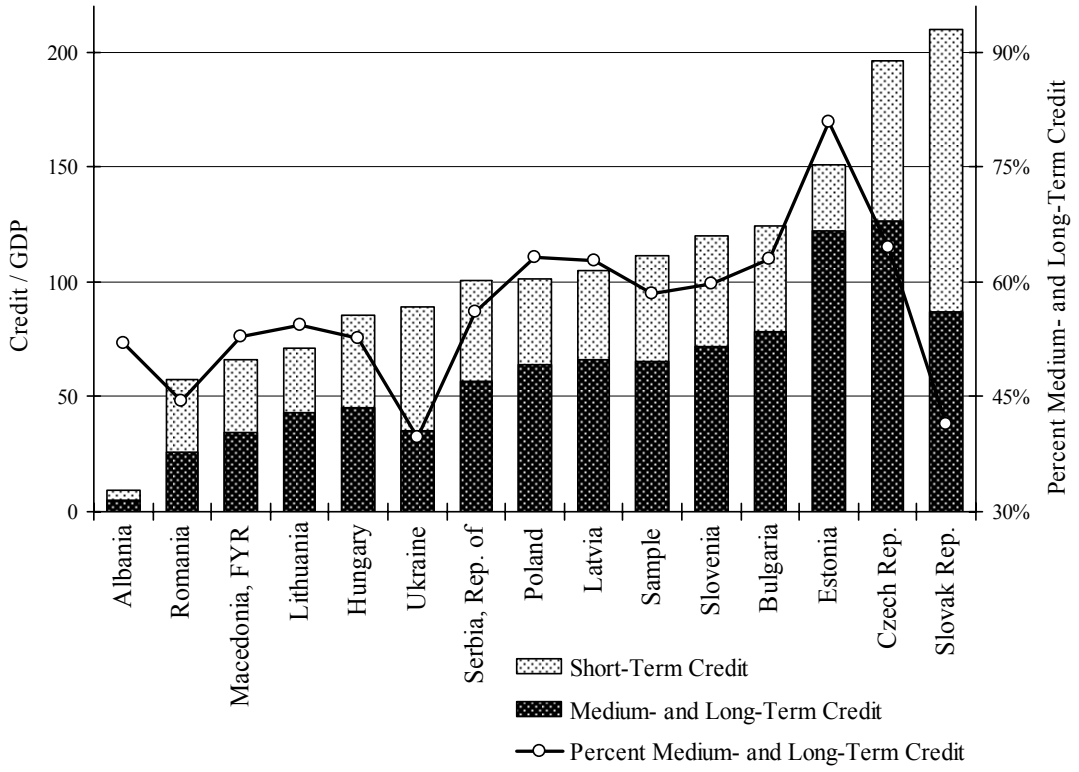

Figure 5. Bank Credit and Bank Credit Maturity by Country. Values on the left ordinate correspond to bars showing credit relative to GDP, while values on the right ordinate correspond to a line showing percent of medium- and long-term credit

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Table 9. Summary Statistics

	Credit / GDP	Credit w/ Maturity over 1 year(%)	Credit w/ Maturity over 5 years(%)	Real Per cap. GDP Growth	Per Capita GDP	Rule of Law	Inflation	Credit Info. Sharing	State Banks' Asset Share	Foreign Banks' Asset Share	Banking Industry Conc.	Output Volatility	Stock Market Turnover
Panel A: Descriptive Statistics													
Mean	112.32	59.02	31.59	3.92	3,903	0.18	13.75	0.69	22.16	50.45	0.71	2.66	0.10
Minimum	6.14	4.12	1.04	-31.34	590	-1.14	-1.65	0	0	0	0.36	0.44	0
Maximum	371.55	92.95	69.50	37.13	11,382	1	331.09	1	90.90	99.40	1	13.09	0.89
Std. Dev.	66.46	17.22	17.10	5.71	2,323	0.58	29.82	0.46	22.96	31.16	0.18	2.19	0.14
Panel B: Correlations													
Credit / GDP	1.00												
Maturity over 1 year (%)	0.47*	1.00											
Maturity over 5 years (%)	0.66*	0.81*	1.00										
Growth	0.17*	0.42*	0.40*	1.00									
Per Capita GDP	0.43*	0.33*	0.75*	0.00	1.00								
Rule of Law	0.48*	0.46*	0.72*	0.07	0.82*	1.00							
Inflation	-0.20*	-0.29*	-0.40*	-0.45*	-0.07	-0.35*	1.00						
Credit Info. Sharing	0.08	0.23*	0.38*	0.18*	0.27*	0.36*	-0.26*	1.00					
State Banks	0.06	-0.29*	-0.24*	-0.31*	0.04	-0.23*	0.51*	-0.30*	1.00				
Foreign Banks	0.09	0.40*	0.41*	0.24*	-0.09	0.28*	-0.43*	0.26*	-0.62*	1.00			
Bank. Ind. Conc.	0.13*	0.11*	0.18*	-0.16*	0.04	0.15*	0.16*	0.19*	0.10*	0.09	1.00		
Output Volatility	-0.33*	-0.24*	-0.36*	0.20*	-0.45*	-0.53*	0.55*	-0.11*	0.46*	-0.19*	0.12*	1.00	
Stock Market	0.02	0.02	0.26*	0.04	0.04	0.24*	-0.07	0.16*	-0.2*	0.17*	0.16*	-0.13*	1.00

Notes: * denotes significance at the 5 percent. For variable definitions, please see Table 7.

Determinants of bank credit maturity

Following the discussion in the previous chapter, we employ the rule of law, inflation, per capita GDP growth, the level of credit, per capita GDP, credit information sharing, banking industry concentration, stock market development, and output volatility as potential determinants of credit maturity. The rule of law is included as a measure of the quality of contract enforcement and overall institutional quality, while inflation is a measure of disincentives for long-term contracting. Per capita GDP and its growth are included, respectively, as a proxy for fixed assets and as a measure of investment opportunities. The level of private credit is included as a measure of economies of scale in collecting information and as a measure of the potential exhaustion of long-term lending opportunities. Credit information sharing is included as a proxy for better information, while banking industry concentration is included to control for fewer informational asymmetries (resulting from closer firm-bank relationship) or credit market inefficiencies (resulting from the monopolization of the banking sector). Stock market development is included as a measure of an additional information revelation mechanism and as an alternative source of long-term financing. Finally, output volatility is included as a measure that proxies for business risk.

Recall that the empirical hypotheses regarding the effect of these variables on the percent long-term credit are as follows:

$$\begin{array}{c}\text{Percentage of}\\ \text{Long-Term Credit}\end{array} = f\left(\begin{array}{l} \overset{+}{\text{rule of law}},\ \overset{-}{\text{inflation}},\ \overset{+}{\text{credit info. sharing}},\\ \overset{+}{\text{growth}},\ \overset{+/-}{\text{banking industry concentration}},\\ \overset{+/-}{\text{credit}},\ \overset{+/-}{\text{stock market}},\ \overset{-}{\text{output volatility}}\end{array}\right).$$

While most variables have the same definition as in the previous chapter, we note that we use different measures of per capita GDP growth and stock market development. Per capita GDP growth in the previous chapter was measured contemporaneously with the maturity variables, while now we use per capita GDP growth during the previous year as data are unavailable at the quarterly level. In the previous chapter, we measured stock market development using the stock market turnover ratio (defined as the volume traded divided by capitalization), while in this chapter stock market development is measured using stock market turnover (defined as volume traded divided by GDP).

Additional determinants of credit maturity

We incorporate several additional explanatory variables, some of which have a particular relevance for the transition economies. Demirgüç-Kunt and Maksimovic (1999) note that, besides ensuring the stability of the national currency and strong institutions, the government can also promote long-term financial contracting by "granting implicit loan guarantees when it adopts a policy of subsidizing loss-generating firms" (Demirgüç-Kunt and Maksimovic 1999). The authors find that government

subsidies to the corporate sector lengthen credit maturity, as these affect the financial structure by permitting "some [, mostly small,] firms to obtain long-term loans on favorable terms" (Demirgüç-Kunt and Maksimovic 1999). La Porta, Lopez-de-Silanes, and Shleifer (2002) note that the government ownership of banks has the advantage over subsidization policies as the government has more power in choosing projects, while letting the more efficient private sector implement them. According to this "development view," the ownership of banks enables the government to direct funds "toward strategic long-term projects" (La Porta, López-de-Silanes, and Shleifer 2002). However, the authors note that the government, through the ownership of banks, can also direct lending to achieve political goals. Therefore, only if the development view holds, we expect longer-term credit in countries where the state controls a large fraction of the banking system. To capture the extent to which the government controls the banking system we use the banking system assets owned by state banks as a share of all banking sector assets.

We also include the asset share of foreign owned banks. Berglof and Bolton (2002) and Eller, Haiss, and Steiner (2005) argue that foreign owned banks introduce efficiency into the financial sector of the transition countries. In a relatively weak banking system, foreign banks enhance transparency and corporate governance, as they show a stronger commitment in these areas compared to domestic private banks and state owned banks (Naaborg et al. 2003). Foreign-owned banks also possess greater risk management expertise and can diversify risk across several countries where they operate (de Haas and van Lelyveld 2006). All of those may contribute to the availability of long-

term credit. However, foreign owned banks may also limit the long-term financing to unprofitable project that were previously funded in a less transparent environment.

The literature (e.g. Fink, Haiss, and Mantler 2005; Fink, Haiss, and Vukšić 2004) also points out that the stage of transition is important with more advanced economies having more developed financial sectors. We include a dummy variable for EU membership as an indicator of transition progress.

Methodology

By construction private credit and the percent of credit with maturity longer than one year (or longer than five years) are determined jointly and, therefore, we need to control for the endogeneity of private credit. One empirical strategy applied in the previous chapter was using countries' legal origin as external instruments for the level of credit in random-effects instrumental variable estimation. However, as all countries considered in this chapter have socialist legal origin, this approach cannot be applied. Therefore, we proceed by first applying fixed-effects estimator to eliminate country specific effect. Then we estimate the model using a generalized least squares (GLS) random-effects estimator that controls for a heteroscedastic error structure. However, the Hausman test reveals that the explanatory variables used in the GLS model are correlated with the country specific effects and, therefore, we implement the Hausman-Taylor (1981) estimator. This estimator corrects for the correlation between the explanatory variables and the country-level random-effects, and is suitable as it does not require the

use of external instruments. In addition, the coefficient estimates from the Hausman-Taylor estimations are similar to ones obtained using fixed-effects.[17]

Results

Table 10 presents the empirical results regarding the determinants of the portion of credit with maturity longer than one year and the portion of credit with maturity longer than five years using the Hausman-Taylor estimation.[18] For each dependent variable we use a simple set of determinants and a full set of determinants.

It is immediately clear that the rule of law has a statistically significant and robust effect on either maturity measure, with greater rule of law being associated with longer-term credit. Looking at the results in column (2), a decrease in the rule of raw by one standard deviation (0.58) that would bring the rule of law in Poland to the one in Bulgaria leads to a decrease of the portion of credit with maturity longer than one year by 5.16 percentage points (0.58*8.905). Looking at column (4), the same decrease in the rule of law decreases the portion of credit with maturity longer than five years by 6.23 percentage points (0.58*10.744). The results reveal that weak rule of law reduces the

[17] As in the previous chapter, one additional concern is that each dependent variable is a ratio (between 0 and 100 percent). When we explain the portion of credit with maturity longer than one year, the predicted values rarely fall out of the unit interval using any estimator. However, when we explain the portion of credit with maturity longer than five years using the fixed-effects estimator, as much as 17 percent of the predicted values are outside the unit interval. We follow the previous literature (Demirgüç-Kunt and Maksimovic 1999; Rodrik and Velasco 1999; Valev 2006; 2007) and proceed without transforming the dependent variable.

[18] Tables C2 and C3 in the appendix present the results from fixed-effects and GLS estimations. In addition, Tables C4 and C5 present same results when the dependent variables are, respectively, the portion of short-term credit (maturity of one year or less) and the portion of medium-term credit (with maturity from one year up to [and including] five years).

portion of credit with maturity longer than five years more than it does the portion of credit with maturity longer than one year.

Table 10. Determinants of Credit Maturity

		Percentage of Credit with Maturity Longer than 1 year		Percentage of Credit with Maturity Longer than 5 years	
		(1)	(2)	(3)	(4)
Rule of Law		9.577	8.905	11.840	10.744
		(0.012)	(0.009)	(0.001)	(0.004)
Inflation		-1.660	-21.541	-6.867	-14.898
		(0.642)	(0.000)	(0.030)	(0.048)
Previous Year GDP Growth		0.401	1.236	-0.084	-0.052
		(0.000)	(0.000)	(0.531)	(0.692)
Credit		3.430	3.764	2.419	3.208
		(0.008)	(0.005)	(0.020)	(0.021)
Per Capita GDP		6.028	2.122	13.682	15.609
		(0.000)	(0.036)	(0.000)	(0.000)
Credit Information Sharing			2.642		-2.597
			(0.024)		(0.019)
Banking Industry Concentration			-3.587		2.386
			(0.309)		(0.439)
Stock Market Turnover			-6.257		-8.758
			(0.042)		(0.009)
Output Volatility			0.170		-0.059
			(0.537)		(0.861)
State Banks' Asset Share			-0.264		-0.113
			(0.000)		(0.007)
Foreign Banks' Asset Share			-0.034		-0.025
			(0.129)		(0.242)
EU Member		-18.219	-11.792	-35.417	-30.835
		(0.138)	(0.404)	(0.060)	(0.000)
Constant		44.253	57.806	8.485	
		(0.000)	(0.000)	(0.636)	
Hausman Test:	χ^2 (d.f.)	0.22 (5)	1.05 (11)	1.33 (5)	0.37 (11)
	p-value	0.989	0.999	0.931	1.000
Observations		461	317	278	211
Countries		14	11	10	9

Notes: See Table 7 for variable definitions. Results are based on Hausman-Taylor estimation, where Credit is endogenous. *P*-values are reported in parentheses below coefficients. Hausman test has a null hypothesis that explanatory variables are not correlated with the country-specific random-effects.

Higher inflation leads to relatively less credit with maturity longer than one year, but the results are less robust as the estimated coefficient on inflation is insignificant in the simple set of determinants. Higher inflation also leads to less credit with maturity longer than five years. Looking at the statistically significant coefficient in column (2), an increase in inflation by one standard deviation (0.298) decreases the portion of credit with maturity longer than one year by 6.42 percentage points (-21.541*0.298). Looking at the comparable coefficient in column (4), the same increase in inflation decreases the portion of credit with maturity longer than five years by 4.44 percentage points (-14.898*0.298). When statistically significant, inflation has a greater effect on the portion of credit with maturity longer than one year.

Per capita GDP growth significantly increases the portion of credit with maturity longer than one year, while it is not a significant determinant of the portion of credit with maturity longer than five years. This is an intuitive result: while an increase in GDP growth (an indicator of investment opportunity) increases medium-term lending, long-term lending is not influenced by overall expectations, and the financing of projects with longer gestation is unaffected by the current economic performance.

The level of credit as percent of GDP has a positive and statistically significant effect on both maturity measures. Countries with deeper financial markets have a greater fraction of credit with maturity longer than one year and longer than five years. To illustrate, if FYR Macedonia (where private credit is 65.81 percent of quarterly GDP) had the level of private credit of Bulgaria (124.48 percent), it would have 2.21 percentage points greater fraction of credit with maturity longer than one year, based on column (2), and it would also have 1.88 percentage points greater fraction of credit with maturity

longer than five years, based on column (4). Thus, the process of financial deepening is accompanied by lengthening of the maturity of credit. This result is in line with Diamond (1984) who suggests that larger banking sectors have economies of scale in obtaining information and monitoring borrowers. This result contradicts Diamond and Rajan (2000) who argue that maturity shortens with the expansion of the banking sector, as a larger pool of smaller, riskier, and less collateralized borrowers would obtain access to external financing.

The coefficient estimate of per capita GDP, used as a proxy for the amount of fixed assets in a country, is a significant determinant of both maturity measures. However, the coefficients have much larger magnitude when we explain the portion of credit with maturity longer than five years (13.7 to 15.6) when compared to the corresponding coefficients for the portion of credit with maturity longer than one year (2.1 to 6.0).[19] The results are intuitive, as the amount of fixed assets is particularly important for the long-term financing. An increase in per capita GDP of $1,000 (an increase that would bring income in Ukraine to the level of Bulgaria) would result in an increase in the portion of credit with maturity longer than five years by between 13.68 and 15.61 percentage points. As in Demirgüç-Kunt and Maksimovic (1999), the results suggest that maturity matching is an important determinant of credit maturity in this set of countries.

To test whether information sharing affects credit maturity, we follow Qian and Strahan (2007) and include a dummy variable that equals 1 if a country had either a public credit registry or a private credit bureau at the beginning of the year. Our results

[19] In addition, when explaining portion of credit with maturity y longer than one year, the coefficient estimate of per capita GDP is negative in GLS estimation as shown in Table C2.

suggest that credit information sharing institutions increase the portion of credit with maturity longer than one year, while the effect on the portion of credit with maturity longer than five years is the opposite. The results suggest that the effect on each portion is about 2½ percentage points. We provide further discussion later on in this section.

Stock market turnover is negatively associated with both measures of maturity. Moreover, this negative effect is greater in magnitude (by about 40 percent) for the portion of credit with maturity longer than five years. Therefore, the results suggest that stock market activity in the transition countries can be considered as an alternative source for long-term financing. The asset share of state owned banks has a negative and significant effect on both measures of maturity, but the effect has greater magnitude on the portion of credit with maturity longer than one year. The asset share of foreign owned banks also has a negative effect, but much lower significance. Nevertheless, the two results suggest that privately owned domestic banks tend to lengthen the credit maturity. Therefore, in this set of countries we find the evidence that opposes the "development view," where the government owned banks direct funds toward strategic long-term projects. The negative coefficient estimate of the EU membership dummy suggest that countries at the earlier stage of transition have a greater portion of credit with maturity longer than five years, while the effect on the portion of credit with maturity longer than one year is insignificant. Output volatility and the banking industry concentration are not significant determinants of credit maturity.[20]

[20] We briefly compare the results on the determinants of the portion of credit with maturity longer than one year obtained here to the results obtained in the previous chapter using broader set of countries. Rule of law and the level of credit remain significant determinants of maturity. Inflation is a more significant determinant in a broader set of countries, while per capita GDP and its growth are more significant here. Credit information sharing has positive impact, but the estimated coefficient in a broad set of countries has a greater magnitude (about 130 percent greater).

In summary, the portions of credit with maturity longer than one year and longer than five years are driven by similar determinants. Strong rule of law, the higher level of financial development, and low government ownership of banks significantly increase both portions of credit. Inflation has a greater negative effect on the portion of credit with maturity longer than one year, while the stock market turnover has a greater negative effect on the portion of credit with maturity longer than five years. Per capita GDP growth significantly increases the portion of credit with maturity longer than one year, while per capita GDP significantly increases the portion of credit with maturity longer than five years. Credit information sharing increases the medium-term credit, as it lengthens the overall maturity but decreases the portion of very long-term credit.

Credit Information Sharing and Credit Maturity

For each country in this chapter Brown, Jappelli, and Pagano (2007) collected information about the year when a public credit registry or a private credit bureau was established. In addition, the authors identify whether these institutions collect information on consumers and/or firms, positive and/or negative information, how long the information is kept, and what is the minimum amount of loans for which data are collected. We use this information to construct a quality index for both types of institutions, similar to the one in Brown, Jappelli, and Pagano (2007). If the institution is present, the index takes on a value of 1, and 0 otherwise. If the institution existed for at least six consecutive quarters, an additional point is added to the index. If information is kept on both firms and consumers, an additional point is added to the index. Similarly, an additional point is added if both positive and negative information is reported. An

additional point is added if information is kept for at least two years. The final point is added if the minimum amount of a loan for which the institution collects data is below yearly per capita GDP (or if the threshold does not exist). Therefore, the quality index for each type of institution ranges from 0 (if the institution does not exist) to 6 (if it meets all criteria listed above). The quality index for the public credit registry and the private credit bureau are added together to form an overall quality index.

Table 11 presents the results when we estimate the impact of different measures of credit information sharing on both maturity measures. The results are based on a full set of determinants, but for brevity we do not report the coefficients of the other determinants. Columns (1) and (5) correspond to the estimated coefficients from columns (2) and (4) from Table 10. The presence of credit information sharing institutions

Table 11. Credit Maturity and Credit Information Sharing

		Percentage of Credit with Maturity Longer than 1 year				Percentage of Credit with Maturity Longer than 5 years			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit Information Sharing	Presence	2.642				-2.597			
		(0.024)				(0.019)			
	Public Credit Registry		0.603				1.586		
			(0.664)				(0.235)		
	Private Credit Bureau		3.869				-7.067		
			(0.002)				(0.000)		
	Quality Index (Overall)			0.628				-0.828	
				(0.003)				(0.000)	
	Quality Index (Public)				1.178				-1.818
					(0.001)				(0.000)
	Quality Index (Private)				-0.033				0.601
					(0.932)				(0.115)

Notes: Estimation based on Hausman-Taylor model with a full set of determinants. *P*-values are reported in parentheses below coefficients.

increases the portion of credit with maturity longer than one year, while it decreases the portion of credit with maturity longer than five years. When we look separately at the presence of a public credit registry and a private credit bureau in columns (2) and (6), we see that both results are driven by the presence of private credit bureaus. The presence of a public credit registry does not have any significant influence on either maturity measure.

Similar results are obtained in columns (3) and (7) when we use the index of overall quality, as defined above, instead of an indicator for the existence of an institution. The greater quality of the information sharing mechanisms increases the portion of credit with maturity longer than one year, while it decreases the portion of credit with maturity longer than five years. When the overall quality index is decomposed into a quality index of public credit registries and a quality index of private credit bureaus, we see new interesting result in columns (4) and (8). Namely, the increase in the portion of credit with maturity longer than one year and the reduction in the portion of credit with maturity longer than five years are both driven by the quality of public credit registries. The quality of private credit bureaus does not have a significant influence on either measure of maturity.

In summary, the portion of credit with maturity longer than one year and the portion of credit with maturity longer than five years are both influenced by the credit information sharing mechanisms. Credit information sharing increases the portion of credit with maturity longer than one year, while it decreases the portion of credit with maturity longer than five years. One explanation for this finding is the theoretical prediction of Diamond (1991) where, in a setting with private information, good firms

borrow short- and long-term to extract the benefits of good news while lowering liquidity risk. With credit information sharing mechanisms information is no longer private. Therefore, firms reduce short-term debt to lower the liquidity risk (as firms do not have to reveal information) and they decrease long-term to lower the contractual cost. Furthermore, our results suggest that effects arise through the establishment of private credit bureaus or increased quality of public credit registries.

Institutions and Credit Maturity

To assess the robustness of the impact of rule of law as a measure of institutions, we substitute it with alternative indexes of institutional quality. We use indexes of government effectiveness (measuring the quality of public services, the quality of the civil service and the degree of its independence from political pressures), political stability (measuring perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means), control of corruption (measuring the extent to which public power is exercised for private gain), regulatory power (measuring the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development), and EBRD reform index (measuring banking reform and interest rate liberalization). The first four indexes come from Kaufmann, Kraay, and Mastruzzi (2007) and they range from -2.5 to 2.5. The last index comes from the EBRD transition indicators, and this index ranges from 1 to 5.

Table 12 presents the results when we substitute the rule of law with different institutional measures. The results are based on a full set of determinants, but for brevity

Table 12. Credit Maturity and Alternative Institutional Measures

Dependent Variable	Rule of Law	Government Effectiveness	Political Stability	Control of Corruption	Regulatory Power	EBRD Reform Index
Percentage of Credit with Maturity Longer than 1 year	8.905	17.026	2.909	16.171	10.101	11.061
	(0.009)	(0.000)	(0.160)	(0.000)	(0.000)	(0.000)
Percentage of Credit with Maturity Longer than 5 years	10.744	14.024	9.556	14.648	3.671	7.767
	(0.004)	(0.000)	(0.000)	(0.000)	(0.217)	(0.000)

Notes: Estimation based on Hausman-Taylor model with a full set of determinants. *P*-values are reported in parentheses below coefficients.

we do not report the coefficients of the other determinants. The results suggest that, similar to the rule of law, the alternative institutional measures increase both measures of maturity. However, the statistical significance and the magnitude of the impact on the two maturity measures differ. The impact of political stability on the portion of credit with maturity longer than five years is greater than the effect on the portion of credit with maturity longer than one year.

Other indexes have a greater impact on the portion of credit with maturity longer than one year. The impact of control of corruption on the portion of credit with maturity longer than one year is 10 percent greater than the impact on the portion of credit with maturity longer than five years, the impact of government effectiveness is 21 percent greater, while the impact of EBRD reform index is 42 percent greater. The impact of regulatory power on the portion of credit with maturity longer than five years is not statistically significant. Despite some differences, the results suggest that institutions are important determinant of credit maturity. Our results suggest that strong institutions lengthen the maturity of credit. This impact is similar for the portion of credit with maturity longer than one year and for the portion of credit with maturity longer than five

years. Therefore, ours results suggest that strong institutions lengthen the maturity of credit primarily through the positive impact on the long-term credit with maturity longer than five years.[21]

Conclusion

The previous chapter shows that the extent to which banks perform their maturity transformation function has an important effect on the relationship between the financial system and economic growth. The availability of long-term credit is particularly important, as economic growth is faster in countries where the banking system extends more long-term credits. However, the data limitations allowed only the investigation of the determinants of credit with maturity longer than one year.

In this chapter, we overcome this problem by looking at the portion of credit with maturity longer than five years. We show that the maturity of bank credit to the private sector is longer in countries with strong rule of law, low inflation, larger financial system, higher level of economic development, less liquid stock markets, and smaller relative size of state owned banks. These effects are robust across two definitions of maturity and across various estimation techniques and model specifications. The effect of alternative institutional measures is similar to one of rule of law. Credit information sharing tends to increase the portion of credit with maturity longer than one year, while it tends to reduce the portion of credit with maturity longer than five years. This effect is strong if private credit bureaus exist or if public credit registries have greater quality of information.

[21] The Hausman-Taylor estimation in Table C5 shows the negative impact on the medium-term credit when the rule of law is used as an institutional measure. These findings suggest that the positive impact on medium- and long-term credit arises primarily through the effect on long-term credit.

CHAPTER FIVE

CONCLUSION

This dissertation is an investigation into one of the important functions of the banking system: to transform short-term liquid deposits into long-term illiquid financial assets that can fund long gestation activities and, thus, raise the rate of economic growth. Using a new data set on the maturity of bank credit to the private sector in 74 countries, the dissertation shows that the extent to which banks perform their maturity transformation function has an important effect on the relationship between the financial system and economic growth. The dissertation shows that the availability of long-term credit is particularly important, as economic growth is faster in countries where the banking system extends more long-term credits. Bank credit maturity has a significant effect on economic growth even after controlling for stock market as an alternative source of long-term financing.

Furthermore, the dissertation shows that credit maturity depends on a number of institutional and economic factors. Greater rule of law, low inflation, deeper financial sector, and schemes for sharing of credit information between financial institutions contribute to lengthening the maturity of bank credit. From a policy perspective, the institutions for sharing credit information probably present the most interest because their establishment is a policy choice. We show that such institutions can increase the

effectiveness of credit in terms of economic growth by making it easier for financial intermediaries to extend long-term credits.

The dissertation uses an additional data set on the maturity of bank credit to the private sector in 14 transition countries. This data set provides several definitions of maturity and allows for the investigation of the determinants of short-term credit, long-term credit, and very long-term credit. There are several additional interesting results obtained using this data set. The results of rule of law, inflation, financial deepening, and credit information sharing being significant determinants of credit maturity obtained in a broad set of countries still hold. Furthermore, the additional results suggest that credit maturity is longer in countries at the higher level of economic development, with less liquid stock markets, and with more privately owned domestic banks. The results suggest that credit information sharing mechanisms lengthen the maturity of credit if credit information sharing institutions are privately owned or have greater quality of information. Furthermore, the alternative institutional measures have robust effect on maturity, similar to the one of rule of law.

The results presented in this dissertation are, to my knowledge, the first empirical test of an important theoretical idea–that banks contribute to economic growth by providing liquidity services. The dissertation provides an important missing link between the theoretical and empirical literature on financial development and economic growth by investigating a particular channel through which financial development affects economic growth–an effort that is usually severely hampered by data availability.

Hopefully, future work can illuminate empirically the determinants of other channels though which finance affects growth, e.g., by distinguishing between good and

bad risk, by monitoring borrowers, by aggregating savings into large-size investments, and by cross sectional risk diversification. Ideally, we would be able to compare the channels through which finance affects growth in various institutional and economic environments. We would also be able to investigate whether lax rule of law diminishes the positive effect of credit on the economy because banks 1) cannot assess risk; 2) monitor and influence the behavior of borrower; and/or as we show here 3) curtail long-term financing. We would be able to investigate how the relative importance of different channels evolves as the financial system develops. In summary, investigating the channels through which finance affects growth presents a number of exciting research opportunities.

APPENDIX A

GMM METHODOLOGY

Let y_{it} be the logarithm of real per capita GDP in country *i* at time *t*. We are interested in the following equation:

$$y_{i,t} - y_{i,t-1} = (\alpha - 1) y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t}, \tag{1}$$

where $y_{i,t} - y_{i,t-1}$ is the growth rate in real per capita GDP, $X_{i,t}$ is a set of explanatory variables, including our measures for financial development, η_i captures unobserved country-specific effects, and ε_{it} is an error term. We rewrite equation (1) as:

$$y_{i,t} = \alpha y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t}, \tag{2}$$

and take first differences to eliminate the country-specific effect, as it is correlated with lagged dependent variable:

$$y_{i,t} - y_{i,t-1} = \alpha \left(y_{i,t-1} - y_{i,t-2} \right) + \beta' \left(X_{i,t} - X_{i,t-1} \right) + \left(\varepsilon_{i,t} - \varepsilon_{i,t-1} \right). \tag{3}$$

By construction, in equation (3), the lagged difference in per capita GDP is correlated with the error term, which along with the potential endogeneity of the explanatory variables *X*, requires the use of instruments. The GMM *difference* estimator

uses the lagged levels of the explanatory variables as instruments under the conditions that the error term is not serially correlated and that the lagged levels of the explanatory variables are weakly exogenous (i.e.,, they are uncorrelated with future error terms). Then the following moment conditions are used to calculate the difference estimator:

$$E\left[y_{i,t-s}\left(\varepsilon_{i,t}-\varepsilon_{i,t-1}\right)\right]=0 \quad \text{for} \quad s\geq 2; t=3,....,T, \tag{4}$$

$$E\left[X_{i,t-s}\left(\varepsilon_{i,t}-\varepsilon_{i,t-1}\right)\right]=0 \quad \text{for} \quad s\geq 2; t=3,....,T. \tag{5}$$

Since persistence in the explanatory variables may adversely affect the small-sample and asymptotic properties of the difference estimator (Blundell and Bond 1998), the difference estimator is further combined with an estimator in levels to produce a *system* estimator. The inclusion of a levels equation also allows us to use information on cross-country differences, which is not possible with the *difference* estimator alone.

The equation in levels uses the lagged differences of the explanatory variables as instruments under two conditions. First, the error term is not serially correlated. Second, although there may be correlation between the levels of the explanatory variables and the case-specific error term, there is no correlation between the difference in the explanatory variables and the error term. This yields the following stationarity properties:

$$E\left[y_{i,t+p}\eta_i\right]=E\left[y_{i,t+q}\eta_i\right] \quad \text{and} \quad E\left[X_{i,t+p}\eta_i\right]=E\left[X_{i,t+q}\eta_i\right] \ \forall \ p \text{ and } q. \tag{6}$$

The additional moment conditions for the regression in levels are:

$$E\left[\left(y_{i,t-s}-y_{i,t-s-1}\right)\left(\eta_i+\varepsilon_{i,t}\right)\right]=0 \quad \text{for} \quad s=1, \tag{7}$$

$$E\left[\left(X_{i,t-s}-X_{i,t-s-1}\right)\left(\eta_i+\varepsilon_{i,t}\right)\right]=0 \quad \text{for} \quad s=1. \tag{8}$$

In summary, the GMM *system* estimator is obtained using the moment conditions in equations (4), (5), (7), and (8). In addition, as Beck and Levine (2004), we use alternative procedure developed by Calderon, Chong, and Loayza (2002) and Loayza, Chong, and Calerdon (1999) to control for the over-fitting by reducing the dimensionality of instruments. This procedure has one shortcoming: in order to perform it we loose one time period from the sample. Nevertheless, given the sample size, we are still able to make robust estimates.

As our data are constructed using overlapping averages, we need to adjust the moving average component in the residuals. We do this by adjusting standard errors according to Newey-West (1987) procedure, modified for the use in panel data. Petersen (2007) points that, unlike for the single time series, in the panel data context the weighting matrix is not necessary for the estimate of central term in covariance matrix to be positive semi-definite. Nevertheless, we follow Newey-West approach assuming that as the distance between observations goes to infinity, the correlation between residuals approaches zero. Therefore, we use weighting matrix which multiplies the covariance of lag l by $\left(1-\left(l-1\right)/\left(l_{\max}+1\right)\right)$, where $l_{\max}$ is the maximum lag order. Weighting matrix with such elements will weigh heaviest the adjacent observation, while the weights decrease as distance between observations increases. We adjust the dependence for up to

five lags (i.e., we set l_{max} to 5) and estimate correlations only between lagged residuals in the same cluster. As suggested by several papers, we have repeated the procedure by including up to T-1 lags, where T is the maximum number of years per country, but doing so leaves our standard errors almost unchanged. This procedure provides serial-correlation and heteroskedasticity consistent standard errors.

APPENDIX B

LIST OF COUNTRIES

Listed countries have been used in the estimations in chapter 3, while countries with * have been used in estimations in chapter 4.

Albania *
Armenia
Austria
Azerbaijan
Bahamas, The
Bangladesh
Belgium
Benin
Bolivia
Bosnia and Herzegovina
Bulgaria *
Burkina
Cameroon
Central African Republic
Chad
China
Congo
Cyprus
Czech Republic *
Denmark
Equatorial Guinea
Estonia *
Finland
France
Gabon
Georgia
Germany
Greece
Guinea Bissau
Hungary *
Iceland
Ireland
Italy
Ivory Coast
Jordan
Kazakhstan
Kyrgyz Republic
Latvia *
Lesotho
Lithuania *
Luxembourg
Macau
Macedonia, FYR *
Malaysia
Mali
Mongolia
Mozambique
Netherlands, The
Nicaragua
Niger
Norway
Poland *
Portugal
Romania *
Russia
Saudi Arabia
Senegal
Serbia, Republic of *
Singapore
Slovak Republic *
Slovenia *
Spain
Sri Lanka
Sweden
Taiwan
Togo
Tunisia
Turkey
Ukraine *
United States
Uruguay
Yemen

APPENDIX C

ADDITIONAL ESTIMATIONS

This appendix contains additional estimations from chapter 3 and chapter 4. Table C1 presents results from the additional estimation techniques regarding the determinants of credit maturity from chapter 3, as discussed in footnote 5. Tables C2 and C3 present results from the additional estimation techniques regarding the determinants of credit maturity, as discussed in footnote 18. Tables C4 and C5 present same set of results as in Tables C2 and C3, but the dependent variables are, respectively, the portion of credit with maturity of one year or less and the portion of credit with maturity from one year up to (and including) five years.

Table C1. Determinants of Credit Maturity – Additional Estimations

	Fixed Effects		GLS		GLS – AR(1)		2SLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rule of Law	5.607	4.431	6.407	16.879	5.061	5.173	3.008	5.291
	(0.196)	(0.515)	(0.000)	(0.000)	(0.000)	(0.005)	(0.317)	(0.152)
Inflation	-3.985	-9.321	-3.034	-27.937	-1.600	-6.242	-3.892	-10.247
	(0.014)	(0.360)	(0.092)	(0.000)	(0.025)	(0.323)	(0.000)	(0.126)
Growth	0.268	0.249	0.433	0.527	0.027	0.251	0.257	0.362
	(0.351)	(0.248)	(0.003)	(0.001)	(0.762)	(0.038)	(0.119)	(0.109)
Credit	10.615	14.280	11.748	9.896	10.758	14.238	15.575	14.463
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Income	0.684	0.457	-0.073	-0.352	0.200	0.050	-0.158	-0.210
	(0.066)	(0.268)	(0.429)	(0.001)	(0.104)	(0.729)	(0.533)	(0.437)
Credit Information		6.129		4.072		4.060		5.155
Sharing		(0.002)		(0.001)		(0.012)		(0.017)
Banking Industry		4.622		4.147		2.907		4.727
Concentration		(0.427)		(0.009)		(0.080)		(0.181)
Stock Market		0.044		0.492		1.152		-0.085
Turnover Ratio		(0.951)		(0.299)		(0.022)		(0.905)
Output Volatility		-0.864		5.362		0.777		0.382
		(0.545)		(0.000)		(0.441)		(0.837)
Manufacturing Share		-0.788		-0.544		-0.581		-0.647
of Output		(0.082)		(0.000)		(0.000)		(0.022)
U.K. Legal Origin			-8.452	-15.347	-10.670	-11.068		
			(0.038)	(0.001)	(0.022)	(0.032)		
French Legal Origin			-5.440	-10.414	-6.992	-8.857		
			(0.162)	(0.016)	(0.111)	(0.051)		
German Legal Origin			-0.223	-2.672	-1.164	2.929		
			(0.955)	(0.557)	(0.788)	(0.514)		
Socialist Legal Origin			9.951	13.151	10.342	15.960		
			(0.015)	(0.006)	(0.027)	(0.002)		
Constant	58.801	77.625	65.613	65.258	64.472	74.863	71.521	78.519
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hausman Test: χ^2			7.48	183.81	8.69	33.67	19.22	9.43
(d.f.)			(5)	(10)	(5)	(10)	(5)	(10)
p-value			0.187	0.000	0.122	0.000	0.001	0.492
Observations	504	284	504	284	504	281	504	284
Countries	71	45	71	45	71	42	71	45

Notes: See Table 1 for variable definitions. *P*-values are reported in parentheses below coefficients. In 2SLS, legal origin dummies are used as instruments for endogenous credit. Hausman test has a null hypothesis that explanatory variables are not correlated with the country-specific random-effects. Credit, Banking Industry Concentration, Stock Market Turnover Ratio, and Output Volatility enter the regression as log(variable), while Income is in thousands.

Table C2. Percentage of Credit with Maturity Longer than One Year (Additional Estimations)

	Fixed Effects		GLS		Hausman-Taylor	
	(1)	(2)	(3)	(4)	(5)	(6)
Rule of Law	9.919	8.663	3.474	13.757	9.577	8.905
	(0.016)	(0.015)	(0.092)	(0.000)	(0.012)	(0.009)
Inflation	-1.164	-20.679	-31.446	-53.893	-1.660	-21.541
	(0.843)	(0.061)	(0.000)	(0.000)	(0.642)	(0.000)
Previous Year GDP Growth	0.392	1.213	0.925	1.535	0.401	1.236
	(0.019)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Credit	2.867	3.312	9.834	9.605	3.430	3.764
	(0.060)	(0.039)	(0.000)	(0.000)	(0.008)	(0.005)
Per Capita GDP	6.590	2.690	-1.006	-1.412	6.028	2.122
	(0.000)	(0.045)	(0.000)	(0.001)	(0.000)	(0.036)
Credit Information Sharing		2.536		-0.128		2.642
		(0.010)		(0.907)		(0.024)
Banking Industry Concentration		-4.134		4.680		-3.587
		(0.259)		(0.153)		(0.309)
Stock Market Turnover		-5.823		-21.639		-6.257
		(0.009)		(0.000)		(0.042)
Output Volatility		0.119		1.258		0.170
		(0.682)		(0.001)		(0.537)
State Banks' Asset Share		-0.254		-0.404		-0.264
		(0.000)		(0.000)		(0.000)
Foreign Banks' Asset Share		-0.036		-0.087		-0.034
		(0.095)		(0.001)		(0.129)
EU Member			4.817	-5.148	-18.219	-11.792
			(0.019)	(0.180)	(0.138)	(0.404)
Constant	27.930	47.115	47.992	63.263	44.253	57.806
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hausman Test: χ^2 (d.f.)			84.31 (5)	8.99 (11)	0.22 (5)	1.05 (11)
p-value			0.000	0.6232	0.989	0.999
Observations	461	317	461	317	461	317
Countries	14	11	14	11	14	11

Notes: See Table 7 for variable definitions. *P*-values are reported in parentheses below coefficients. In the Hausman-Taylor estimation Credit is endogenous. Hausman test has a null hypothesis that explanatory variables are not correlated with the country-specific random-effects. Per Capita GDP is in thousands.

Table C3. Percentage of Credit with Maturity Longer than Five Years (Additional Estimations)

	Fixed Effects		GLS		Hausman-Taylor	
	(1)	(2)	(3)	(4)	(5)	(6)
Rule of Law	12.583	10.508	5.793	16.573	11.840	10.744
	(0.000)	(0.009)	(0.066)	(0.000)	(0.001)	(0.004)
Inflation	-6.788	-15.085	-1.696	-18.562	-6.867	-14.898
	(0.178)	(0.066)	(0.722)	(0.086)	(0.030)	(0.048)
Previous Year GDP Growth	-0.102	-0.080	0.872	0.786	-0.084	-0.052
	(0.370)	(0.429)	(0.000)	(0.000)	(0.531)	(0.692)
Credit	2.136	2.572	7.823	7.423	2.419	3.208
	(0.033)	(0.135)	(0.000)	(0.000)	(0.020)	(0.021)
Per Capita GDP	13.930	16.551	5.378	3.496	13.682	15.609
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Credit Information Sharing		-3.030		5.513		-2.597
		(0.004)		(0.000)		(0.019)
Banking Industry Concentration		1.870		6.347		2.386
		(0.535)		(0.073)		(0.439)
Stock Market Turnover		-8.744		-1.646		-8.758
		(0.007)		(0.767)		(0.009)
Output Volatility		-0.032		-0.029		-0.059
		(0.918)		(0.950)		(0.861)
State Banks' Asset Share		-0.109		-0.095		-0.113
		(0.014)		(0.023)		(0.007)
Foreign Banks' Asset Share		-0.030		0.002		-0.025
		(0.174)		(0.951)		(0.242)
EU Member			-15.453	-5.722	-35.417	-30.835
			(0.000)	(0.123)	(0.060)	(0.000)
Constant	-26.829	-33.942	10.640		8.485	
	(0.000)	(0.000)	(0.010)		(0.636)	
Hausman Test: χ^2 (d.f.)			40.90 (5)	201.14 (11)	1.33 (5)	0.37 (11)
p-value			0.000	0.000	0.931	1.000
Observations	278	211	278	211	278	211
Countries	10	9	10	9	10	9

Notes: See Table 7 for variable definitions. *P*-values are reported in parentheses below coefficients. In the Hausman-Taylor estimation Credit is endogenous. Hausman test has a null hypothesis that explanatory variables are not correlated with the country-specific random-effects. Per Capita GDP is in thousands.

Table C4. Percentage of Credit with Maturity of One Year or Less

	Fixed Effects		GLS		Hausman-Taylor	
	(1)	(2)	(3)	(4)	(5)	(6)
Rule of Law	-9.919	-8.663	-3.474	-13.757	-9.577	-8.905
	(0.016)	(0.015)	(0.092)	(0.000)	(0.012)	(0.009)
Inflation	1.164	20.679	31.446	53.893	1.660	21.541
	(0.843)	(0.061)	(0.000)	(0.000)	(0.642)	(0.000)
Previous Year GDP Growth	-0.392	-1.213	-0.925	-1.535	-0.401	-1.236
	(0.019)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Credit	-2.867	-3.312	-9.834	-9.605	-3.430	-3.764
	(0.060)	(0.039)	(0.000)	(0.000)	(0.008)	(0.005)
Per Capita GDP	-6.590	-2.690	1.006	1.412	-6.028	-2.122
	(0.000)	(0.045)	(0.000)	(0.001)	(0.000)	(0.036)
Credit Information Sharing		-2.536		0.128		-2.642
		(0.010)		(0.907)		(0.024)
Banking Industry		4.134		-4.680		3.587
Concentration		(0.259)		(0.153)		(0.309)
Stock Market Turnover		5.823		21.639		6.257
		(0.009)		(0.000)		(0.042)
Output Volatility		-0.119		-1.258		-0.170
		(0.682)		(0.001)		(0.537)
State Banks' Asset Share		0.254		0.404		0.264
		(0.000)		(0.000)		(0.000)
Foreign Banks' Asset Share		0.036		0.087		0.034
		(0.095)		(0.001)		(0.129)
EU Member			-4.817	5.148	18.219	11.792
			(0.019)	(0.180)	(0.138)	(0.404)
Constant	72.070	52.885	52.008	36.737	55.747	42.194
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
Hausman Test: χ^2 (d.f.)			84.31 (5)	8.99 (11)	0.22 (5)	1.05 (11)
p-value			0.000	0.623	0.998	0.999
Observations	461	317	461	317	461	317
Countries	14	11	14	11	14	11

Notes: See Table 7 for variable definitions. *P*-values are reported in parentheses below coefficients. In the Hausman-Taylor estimation Credit is endogenous. Hausman test has a null hypothesis that explanatory variables are not correlated with the country-specific random-effects. Per Capita GDP is in thousands.

Table C5. Percentage of Credit with Maturity from One Year up to (and Including) Five Years

	Fixed Effects		GLS		Hausman-Taylor	
	(1)	(2)	(3)	(4)	(5)	(6)
Rule of Law	-14.670	-10.568	7.429	5.235	-14.015	-10.348
	(0.000)	(0.000)	(0.006)	(0.028)	(0.000)	(0.002)
Inflation	-9.284	-51.884	-25.051	-95.924	-9.322	-52.583
	(0.214)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Previous Year GDP Growth	0.538	0.406	0.636	0.319	0.537	0.384
	(0.000)	(0.001)	(0.000)	(0.026)	(0.000)	(0.001)
Credit	-4.518	-2.215	-2.567	-2.533	-4.643	-2.836
	(0.000)	(0.066)	(0.000)	(0.000)	(0.000)	(0.015)
Per Capita GDP	-2.726	-7.475	-6.053	-5.906	-2.669	-6.640
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Credit Information Sharing		3.696		-2.984		3.238
		(0.000)		(0.001)		(0.001)
Banking Industry Concentration		-2.064		-4.137		-2.491
		(0.376)		(0.117)		(0.349)
Stock Market Turnover		2.624		5.414		2.733
		(0.322)		(0.201)		(0.346)
Output Volatility		0.407		2.202		0.457
		(0.218)		(0.000)		(0.118)
State Banks' Asset Share		-0.158		-0.391		-0.158
		(0.000)		(0.000)		(0.000)
Foreign Banks' Asset Share		-0.117		-0.241		-0.124
		(0.000)		(0.000)		(0.000)
EU Member			8.335	84.248	27.972	74.932
			(0.001)	(0.000)	(0.021)	(0.000)
Constant	51.265	79.467	47.325		22.602	
	(0.000)	(0.000)	(0.000)		(0.052)	
Hausman Test: χ^2 (d.f.)			243.33(5)	636.96 (11)	1.23 (5)	2.31 (11)
p-value			0.000	0.000	0.942	0.997
Observations	278	211	278	211	278	211
Countries	10	9	10	9	10	9

Notes: See Table 7 for variable definitions. *P*-values are reported in parentheses below coefficients. In the Hausman-Taylor estimation Credit is endogenous. Hausman test has a null hypothesis that explanatory variables are not correlated with the country-specific random-effects. Per Capita GDP is in thousands.

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