Capital Flows, Firm Heterogeneity and Asset Securitization:

The Role of Finance

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Finally, I dedicate this thesis to my dear grandfather Ivan Iliev.

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List of Abbreviations

ABS	Asset-Backed Securities
AR(1)	First-Order Autoregressive Process
AR(2)	Second-Order Autoregressive Process
AREAER	Annual Report on Exchange Arrangements and Exchange Restrictions
CEE	Central and Eastern Europe
CEEC	Central and Eastern European Countries
CDO	Collateralized Debt Obligations
CLO	Collateralized Loan Obligations
DiD	Difference-in-Difference
ECB	European Central Bank
EU	European Union
FE	Fixed-Effects Estimation
FICO	Fair Isaac Credit Score
FDI	Foreign Direct Investment
FDIC	Federal Deposit Insurance Corporation
GDP	Gross Domestic Product
GLS	Generalized Least Squares
GMM	Generalized Method of Moments Estimation
i.i.d.	independently and identically distributed random variable
IMF	International Monetary Fund
IV	Instrumental Variable Estimation

L1.(x)	First Lag of Variable x
LDV	Lagged Dependent Variable
LP	Levinsohn and Petrin Estimation Technique
MBS	Mortgage-Backed Securities
MIT	Massachusetts Institute of Technology
NBER	National Bureau of Economic Research, Inc.
NFA	Net Foreign Assets
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares Estimation
OP	Olley and Pakes Estimation Technique
PPP	Purchasing Power Parity
RE	Random-Effects Estimation
RWA	Risk-Weighted Assets
SIC	Standard Industrial Classification
SME	Small and Medium-sized Enterprises
TFP	Total Factor Productivity
TRAINS	Trade Analysis and Information System
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
US	United States
USD	United States Dollar
WDI	World Development Indicators
WITS	World Integrated Trade Solution
WTO	World Trade Organization

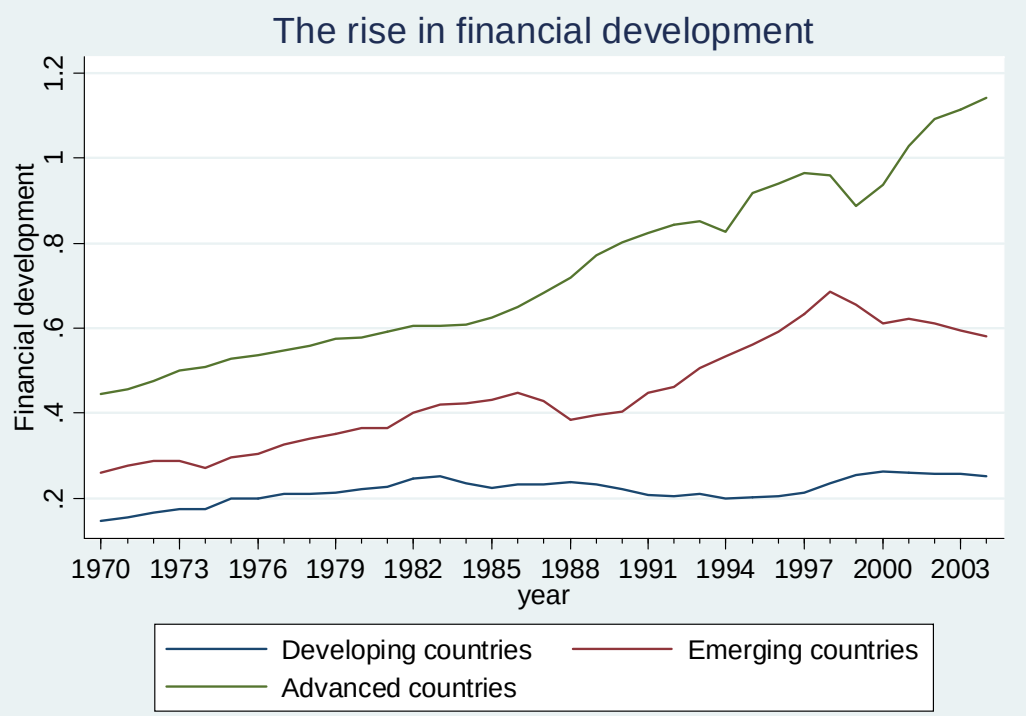
Chapter 1

Introduction and Summary

> *"Finance is powerful. As the last few years demonstrate, financial innovations can be used as tools of economic destruction. But the last few centuries demonstrate that financial innovation is crucial, indeed indispensable, for sustained economic growth and prosperity."*[1]
>
> *Ross Levine, February 23rd, 2010*

During the last decades the development of the financial system has received growing attention among academics, policymakers and the general public. The United States has been considered a prototype of a well-functioning economic system, for which a sophisticated financial industry is one of the key factors for a strong economic prosperity. Financial markets and the banking system provide vital services that allow productive enterprises to seize new business opportunities and expand them to desirable levels. Levine (2005) describes the role of *finance* as providing the following essential services: "(i) production of ex ante information about possible investments, (ii) monitoring of investments and implementation of corporate governance,

[1] See Levine (2010).



Notes: The figure shows the evolution of the mean of financial development for 3 major country groups. Financial development is measured by the amount of private credit by deposit money banks and other financial institutions as a ratio to GDP. Data come from Beck et al. (2000). Advanced economies are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States. Emerging economies are: Argentina, Brazil, Chile, China, Colombia, Egypt, Hong Kong SAR, India, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, the Philippines, Singapore, South Africa, Thailand, Turkey and Venezuela. Developing economies are: Algeria, Bangladesh, Benin, Bolivia, Botswana, Burkina Faso, Burundi, Cameroon, Costa Rica, Côte d'Ivoire, the Dominican Republic, Ecuador, El Salvador, Gabon, Ghana, Guatemala, Haiti, Honduras, Jamaica, Kenya, Mauritius, Nicaragua, Niger, Nigeria, Panama, Papua New Guinea, Paraguay, Senegal, Sri Lanka, the Syrian Arab Republic, Togo, Tunisia and Uruguay.

Figure 1.1: Global patterns of financial development

(iii) trading, diversification, and management of risk, (iv) mobilization and pooling of savings, and (v) exchange of goods and services".[2]

However, the quality and scale of financial services differ widely across countries. Figure 1.1 depicts the evolution of financial development, measured by the level of domestic credit to private sector as a ratio to GDP, for advanced, emerging and developing countries during the period 1970-2004. Obviously, there is a pecking order of country groups, which starts with de-

[2]See Levine (2005), p. 870.

veloping countries having the least developed financial institutions and ends with advanced countries having the strongest ones. Moreover, since the mid 1980s the observed gap between the 3 country groups even widened. Developing economies showed almost no improvements in their financial system, while emerging market economies experienced a nearly 50% increase in their private credit measure, and advanced countries even doubled their level of financial development. Therefore, a natural question is whether these observed differences across countries may have contributed to the different economic development. Levine (2005) surveys the empirical literature on finance and growth and concludes that there is indeed a "strong positive link between the functioning of the financial system and long-run economic growth".[3]

While in general economists do not doubt that financial services are indispensable for a well-functioning market economy, the recent global financial crisis demonstrated that these services may be used as a "tool of economic destruction".[4] In particular, advanced countries like the US and the UK have been the indisputable leaders in financial innovation during the last decades. The financial systems of these countries provided new, innovative instruments for firms and households to cover their borrowing and saving needs. For example, households now widely use credit cards and home equity loans to borrow money whereas they invest in diverse assets, such as stocks, bonds, mutual funds and derivatives.[5] Further, enterprises have access to bond and stock markets in addition to their traditional bank borrowing in order to fund their investments.[6] Firms also rely on many different financial instruments to hedge their exposure to interest rate or exchange rate risk. Finally, banks found a way to fund their activities not only through traditional deposits but also via the securitization of assets.

[3]See Levine (2005), p. 921.
[4]See Levine (2010).
[5]See International Monetary Fund (2006), p. 105.
[6]See International Monetary Fund (2006), p. 105.

Tufano (2003) refers to "addressing persistent agency concerns and information asymmetries" as one of the key functions of financial innovation.[7] However, considering the recent global financial crisis, which erupted in 2008, one of the crucial questions which arises is whether some of the recent financial innovations really alleviate the problem of asymmetric information? Asset securitization, the creation of new liquid securities out of less-liquid assets, arised as a new financial innovation in the 1970s. Originally, this technique aimed at improving the risk-sharing opportunities for financial institutions, especially banks, and was considered as an alternative way of efficient financing. However, the excessive use of this financial innovation, in particular in the US housing market, is blamed to have triggered the financial crisis which turned into the most severe global economic crisis since the Great Depression in the 1930s.

In this thesis I empirically investigate the role of finance in explaining the patterns of international capital flows and differences in productivities across firms as well as their export participation. Futhermore, I research how a particular financing technique - asset securitization - affects the behavior of banks.

Chapter 2 looks on the link between financial development and the direction and composition of cross-border capital flows. Recent empirical patterns of international capital flows can hardly be explained by traditional models with neoclassical features. Over the 1984-2004 period there is evidence that foreign direct investments (FDI) flow on net to emerging or developing countries but at the same time significant net flows of portfolio debt investments are directed to developed countries. Recent theoretical literature emphasizes the importance of financial system development in explaining these global patterns. Using a 21-year panel of up to 122 developing, emerging and developed countries this chapter provides consistent evidence that the

[7] See Tufano (2003), p. 308.

cross-country differences in financial development influence the direction and composition of global capital flows. Using dynamic panel estimation techniques that are able to account for unobserved heterogeneity and endogeneity issues I find that ceteris paribus countries with a better developed financial system observe on average net FDI outflows and simultaneously net debt inflows. This finding is robust and independent of the impact of the quality of institutions other than financial ones.

Chapter 3 investigates the link between financial constraints, the productivity of firms and their export participation. Using a large panel of firms from 179 three-digit US SIC industries in up to 28 Western and Eastern European countries during the period 1995-2004, this chapter provides evidence that financial constraints are an important determinant of firm-level total factor productivity as well as firms' export participation. The results are consistent with newly established trade literature on heterogeneous firms and credit constraints. These models argue that firms entering export markets face substantial fixed costs, e.g. for marketing, advertising, distribution etc., which have to be paid before revenues are generated. Since firms typically do not have enough liquidity to finance them, they have to rely on external finance. Using a difference-in-difference approach this chapter shows that, other things being equal, firms operating in more credit-constrained industries are on average more productive and are more likely to export in countries with a better developed financial system.

Finally, chapter 4, which is a joint work with Desislava Andreeva, provides evidence on the driving forces behind banks' securitization as well as on the incentive effects which arise with the decision of banks to securitize. Contrary to most previous studies we find evidence of a regulatory arbitrage motive in securitization using panel data on large US commercial banks. We propose a corrected measure for capital adequacy that does not suffer from endogeneity and using it our results suggest the following pattern of secu-

ritization activities: while capital arbitrage drives both the extensive and intensive margins, access to debt capital at lower costs via securitization seems to be important only for the intensive margin. The data also suggest that securitization impairs the incentives for screening and monitoring by originating institutions. The commonly used techniques for overcoming such incentive problems - seller-provided credit enhancements - do not help remedy moral hazard and adverse selection. Sufficient levels of capital at credit institutions rather than the retention of a first-loss piece leads to the origination and securitization of better quality assets. Our research indicates that capital adequacy regulation is a double-edged sword: whereas loopholes in the regulatory framework can seduce banks to securitize assets just for the sake of not having to hold regulatory capital, sufficient levels of capital do give banks the right incentives for prudent behavior.

In summary, chapters 2 and 3 emphasize the positive role of financial institutions in channeling efficiently international savings to profitable international investment projects and providing sufficient amount of external finance to financially constrained firms. In contrast, chapter 4 casts doubts on the belief that all financial innovations alleviate the problem of asymmetric information in financial relationships, based on the particular case of asset securitization. Should we therefore blame further developments in the financial system to be destructive? Levine (2010) points out that financial innovation (development) like all innovations bears risks. He puts it that way: "... drugs are dangerously abused. But just as we should not conclude that medical research does not promote human health because of drug abuse, we should not conclude that financial innovation does not promote economic growth because of the devastatingly costly crisis through which we are now suffering." Therefore, in my view financial system development is essential for sound economic prosperity. However, appropriate regulations and policies should fight excesses in financial markets to prevent future financial crises.

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Chapter 2

Financial Development and the Composition and Direction of Capital Flows: Evidence from Panel Data

2.1 Introduction

During the last three decades a gradual liberalization of goods and financial markets led to a significant increase in worldwide trade and capital flows. In particular, a remarkable surge in cross-border capital flows has been documented in the literature. According to Lane and Milesi-Ferretti (2007) the scale of international financial integration, measured by the ratio of the sum of foreign assets and liabilities to GDP, jumped from the year 1970 to the year 2004 by about 700%.[1] Moreover, this growth in worldwide financial flows even outpaced the growth in the trade of goods and services. This was especially driven by the asset trade of industrialized countries. Whereas in the early 1970s the stock of cross-border asset holdings by these countries was less than 200% of trade flows it rose to more than 700% in 2004 with a remarkable acceleration since the 1990s.[2]

At the same time interesting and important patterns of international financial flows emerged, which in general turn out to be not consistent with theoretical predictions. Standard neoclassical models assume that only one type of capital exists and predict that capital-abundant (rich) countries will export capital to capital-scarce (poor) countries. Therefore, we should observe only one-way capital flows. However, empirically different types of capital, e.g. FDI, portfolio equity, bank loans, bonds, etc., may flow in the same or in different directions, so one can observe simultaneous capital in- and outflows. Further, even the same type of capital may flow in and out of the country in the same period. For example, horizontally motivated FDIs between developed countries lead to two-way capital flows, whereas simultaneous in- and outflows may emerge when investors buy foreign equities or bonds for reasons of international diversification of their portfolios. Even when one focuses on the *total* flows the picture drawn by neoclassical theory

[1] See Lane and Milesi-Ferretti (2007), p. 235, Figure 3.
[2] See Lane and Milesi-Ferretti (2007), p. 236, Figure 4.

may be misleading. Lucas (1990) states in his influential paper that there is an empirical *paradox* because the theoretically implied rates of return on capital would lead to large capital flows from rich to poor countries. However, in reality we do not observe such patterns.[3]

However, the lack of capital flows is not the only failure of neoclassical theory. Prasad et al. (2006) point out a "new" paradox of total capital even flowing in the opposite *direction*, i.e. from poor to rich countries.[4] While FDI patterns are generally consistent with the theoretical prediction, i.e. they flow from rich to poor countries, the total flows do not seem to be. Therefore, looking at aggregate figures only may mask important developments of different types of flows. Lane and Milesi-Ferretti (2007) investigate the *composition* of international capital flows. They draw a general picture of advanced economies that are "short debt and long equity", pointing out the observation that they import on net debt capital and at the same time export portfolio equity capital and FDI. On the other hand, many developing and emerging market economies are "short equity", i.e. they are net recipients of FDI and equity flows. Hereby, there is another important observation. Most of these countries had positive net debt liabilities in 2004, which is explained by the heavy reliance on and accumulation of debt finance of these countries until the mid 1980s. However, since this time the net debt liability position of developing and emerging countries has been shrinking, which suggests that they export debt capital on net. Therefore, in summary, since the mid 1980s we observe advanced countries exporting FDI and equity on net, but importing debt. Emerging and developing countries display the opposite pattern.

Standard neoclassical models are thus unable to explain these "perverse"

[3]Lucas resolves this puzzle by including human capital as a missing factor of production in these models, which lowers the rate of return differentials between poor and rich countries.

[4]Equivalent evidence is that poor countries run current account surpluses whereas advanced economies run current account deficits.

empirical patterns. Mendoza et al. (2009) argue that the observed "global financial imbalances" may result from an increased financial integration combined with cross-country differences in financial markets' development. Indeed, despite a gradual improvement in financial development during the last decades for both developed and emerging economies, there is still a large gap between the two groups with advanced countries ranked on the top.[5] Recent theoretical models, e.g. that of Ju and Wei (2007) among others, depart from the assumption of perfect capital markets made by standard neoclassical theory and show that the empirical patterns of capital flows may be explained by cross-country differences in financial market development. In this model capital-scarce countries offer good investment opportunities because the (effective) marginal product of capital is high. However, savings cannot be efficiently intermediated by the local undeveloped financial system. The inefficient financial system is bypassed by two-way capital flows where domestic capital is invested abroad in the form of debt while domestic projects are financed by FDI. It is therefore interesting to test the predictions of the model.

Using a 21-year panel of up to 122 developing, emerging and developed countries this paper provides consistent evidence that the cross-country differences in financial development influence the direction and composition of global capital flows. Applying dynamic panel estimation techniques to account for endogeneity issues I find that ceteris paribus countries with a better developed financial system observe on average net FDI outflows and simultaneously net debt inflows. Moreover, the quality of financial institutions is a distinct determinant of capital flows in addition to "property rights institutions".[6] Improvements in the quality of other institutions lead ceteris

[5] See Mendoza et al. (2009), p. 374, Figure 1.

[6] Property rights institutions are an additional important parameter in the Ju and Wei (2007) model. Recent empirical literature, for example Alfaro et al. (2008) among others, highlights the role of the quality of other institutions, like the rule of law, that influence the direction of capital flows.

paribus to more FDI and debt inflows on net. Overall, the data match the predictions of the Ju and Wei (2007) model.

This paper contributes to the existing literature in several ways. First, it provides evidence that differences in financial development across countries are important determinants of the direction and composition of international capital flows where empirical studies that look at this relationship in a systematic way are rather scarce. Second, this paper does not focus only on particular country groups, e.g. developing countries. It utilizes a large sample of up to 122 advanced, emerging and developing countries in order to provide evidence on the worldwide empirical patterns. Third, previous studies find it difficult to account for the endogeneity of various explanatory variables with respect to capital flows because they use a pure cross section and the instruments proposed in the estimation can hardly meet the "exclusion restriction" of having no direct effect on the dependent variable.[7] Instead, I use panel data and apply a dynamic generalized method of moments (GMM) estimation technique proposed by Arellano and Bond (1991), which deals with endogeneity arising from unobserved heterogeneity across countries and other simultaneity issues that typically lead to biased estimates and thus invalid inference. Finally, unlike other studies I focus on *net* rather than gross financial flows in order to match the observed empirical patterns more precisely.[8]

Understanding the determinants of the empirical patterns of the direction and composition of capital flows has important implications. On the

[7]See for example Wei (2006), Alfaro et al. (2008) and Faria and Mauro (2009).

[8]Moreover, looking only at gross inflows may be problematic for the following reasons. First, in terms of additional financing of potential profitable investment projects in a country, the net value is the correct measure. Second, gross values of one type of flow may be inflated when countries are highly involved in portfolio diversification or when they act as "intermediation centers" redirecting capital to other countries. Finally, theoretical models show that cross-country differences in the quality of financial and other institutions generate a sort of "comparative advantage" that has a *net* effect on different types of capital flows.

one hand, different policies to reduce the "current account imbalances" have been widely discussed in recent years.[9] For example, increased protectionism by setting higher trade barriers in advanced countries is aimed to reduce the trade and current account deficits in those countries while shrinking the surpluses in developing and emerging countries like China. However, implementing such a policy may even exacerbate the imbalances, as shown by Antràs and Caballero (2009). Therefore, policy makers should know the correct causes of such imbalances in order to make the right decision. On the other hand, until recently researchers widely ignored the fact that not only the direction but also the *composition* of capital flows matters for several reasons. First, the literature has found higher volatility of debt flows relative to FDI flows. Thus, the probability of a reversal (capital flight) and hence a financial crisis is smaller, the greater is the share of FDI of the total inflows.[10] Second, FDI brings relative to other flows in addition technological and managerial knowledge, which improves growth.[11] Third, FDI (and equity) have better risk-sharing properties, because foreign investors bear some of the country investment risk. However, even though FDIs have such advantages, they come at a cost to the recipient country, which has to pay higher returns (risk premium) to this type of capital.[12] Finally, the global imbalances literature emphasizes the role of valuation effects.[13] The idea is that different types of capital flows have different rates of return. Then the composition of the external position would matter. For example, the US has its liabilities mostly in low-return debt, whereas its assets are mostly in high-

[9]There is a large amount of literature on the causes and sustainability of large current account deficits of advanced countries, especially the US, and of the corresponding large current account surpluses of emerging and developing countries like China. See Obstfeld and Rogoff (2004), Bernanke (2005) and Caballero et al. (2008) among others.

[10]See Frankel and Rose (1996).

[11]See Borensztein et al. (1998).

[12]See Lane and Milesi-Ferretti (2000).

[13]See for example Gourinchas and Rey (2007) on the role of valuation effects in the sustainability of current account deficits.

return FDI or equity. This leads to positive capital income for US residents even though the US is a net debtor, i.e. it has higher external liabilities than assets, which allows the US to run larger trade deficits.

The rest of the paper is organized as follows. Section 2.2 provides a review of the related theoretical and empirical literature. The subsequent section 2.3 provides a brief look at the dataset and the definition and measurement of key variables, as well as some stylized facts about the direction of capital flows for different country groups. In section 2.4 I present the empirical model and estimation results on how financial system development affects the direction and composition of capital flows. This section provides additional robustness checks, too. Finally, section 2.5 concludes.

2.2 Related theoretical and empirical literature

In this section I present the most related theoretical literature that derives testable predictions on the link between the financial development of countries and the direction and composition of capital flows. Subsequently some related empirical evidence is reviewed.

Standard neoclassical models predict that capital should flow from rich to poor countries. These models rely on the assumption that countries produce the same, single good with the same constant returns technology and labor and capital markets are perfect. Then poor countries that have a low capital-labor ratio have a higher rate of return on capital due to the law of the decreasing marginal product of capital. In perfectly integrated financial markets international investors will therefore export capital from high-income countries to low-income countries until the rate of return differentials vanish. According to Lucas (1990), the theoretically implied capital flows are much

higher than the observed ones. He tries to explain this lack of capital flows to developing countries by including human capital as a missing factor of production in the standard neoclassical model. Given that rich countries are abundant in human capital this generates rates of return across advanced and developing countries that may even equalize. Alfaro et al. (2008) point out other factors that involve the technological advantage of rich countries, capital controls, different tax policies as well as the quality of property rights institutions. All these fundamentals may reduce the rate of return gap between countries such that there is less motivation for cross-border capital flows. The next explanation of the Lucas paradox may be international capital market imperfections due to asymmetric information. For example, Gertler and Rogoff (1990) use a standard open-economy intertemporal trade model where they introduce cross-country differences in domestic financial market efficiency. They show that in this setting international capital flows from rich to poor countries may be muted and even reversed. Informational asymmetries between lenders and borrowers lead to a higher spread of lending rates over the riskless rate especially in poorer countries, because there borrowers have only a small amount of wealth and thus can promise to lenders only lower payment in bad states. Therefore, investment and hence capital inflows in poor countries are lower than the first-best levels without informational frictions. In a similar setting Matsuyama (2005) shows that poor corporate governance and contractual enforcement in the south lead to capital flows from the poor south to the rich north.

In terms of the composition of capital flows the literature differentiates mostly between foreign direct investments and foreign portfolio investments. Albuquerque (2003) uses the idea of differences in the risk of expropriation across countries. His theoretical model shows that financially constrained countries should borrow more through FDI than through financial capital. The reason is that FDIs are less prone to expropriation risk since they involve

the transfer of intangible assets, like human and organizational capital.[14] Therefore, given the lack of enforcement of international contracts, the default premium for FDI flows demanded by foreign investors is lower than for portfolio investments. He shows further empirically that the share of FDI in total inflows is higher in countries with poor country risk ratings. Razin and Sadka (2007) present an information-based model where FDI investors have a comparative advantage relative to domestic investors and foreign portfolio investors to cream-skim high-productivity domestic firms. This advantage comes from an industry-specific superior knowledge to extract the information about the true value of the acquired firm.[15] Further, it is shown to be more pronounced when the host country has poor corporate transparency and capital market institutions. Therefore, the prediction of their model is that FDI inflows relative to portfolio inflows will be larger when the target country has a lower degree of transparency.

The most closely related theoretical papers are those of Mendoza et al. (2009) and especially Ju and Wei (2007), whose predictions match the observed patterns of the direction and composition of capital flows.[16] Mendoza et al. (2009) build a two-country dynamic general equilibrium growth model with ex ante identical agents who use financial contracts to insure against idiosyncratic endowment and investment shocks. Countries differ only in their financial development, which measures the degree of enforcement of financial contracts.[17] In the presence of incomplete contracts agents can divert part of their incomes from creditors. Allowing for perfect capital mobility the following pattern emerges: in the country with a less developed financial system there is an excess demand for assets; therefore, asset prices are

[14] Albuquerque calls FDI "inalienable".

[15] This special knowledge leads to lower screening costs for foreign FDI investors. Razin and Sadka (2007) argue that this sort of comparative advantage may explain two-way FDI flows between developed countries.

[16] Therefore, I want to present the results of these models in more detail.

[17] The key assumption is that the access to insurance of agents depends on the local financial system.

high and the rate of return low. After integration there is a flow of financial (debt) capital to the more financially developed country. On the other hand, there are also net FDI inflows in the less developed country, because foreign direct investors are able to insure (almost) perfectly against the investment risk compared with domestic investors, who rely on the domestic inefficient financial system. In summary, there are riskless net debt outflows from the less financially developed country but simultaneously there are risky net FDI inflows.

In contrast to the previous model Ju and Wei (2007) use a simple static framework. They make the neoclassical assumption of the decreasing marginal product of capital where countries differ in their abundance with physical capital. However, they augment the standard one-sector neoclassical model by incorporating two kinds of inefficiencies.[18] On the one hand, the existence of inefficient property rights institutions implies that a slice of the marginal product of capital, i.e. the total return of the investment, may be expropriated. On the other hand, an inefficient financial intermediation yields that a slice of the marginal product of capital goes to the bank, when agents choose a financial investment instead of a direct investment, i.e. to be entrepreneurs.[19] There are two implications due to these inefficiencies. First, both direct and financial investors have ceteris paribus a lower return on capital in the country with poor property rights institutions. Second, financial investors (but not entrepreneurs) receive ceteris paribus a lower interest rate in the country with the underdeveloped financial system. After opening to capital flows financial investors would invest in the country with a higher interest rate, whereas direct investors would invest in the country with the

[18]Without these inefficiencies the model would predict that capital will flow from rich (capital-abundant) countries to poor (capital-scarce) economies.

[19]There is a third parameter in the model, which is based on the moral hazard between investors and entrepreneurs. In the country with a lower quality of corporate governance a higher share of the total return is diverted by entrepreneurs. The effect of corporate governance is qualitatively the same as that of poor financial intermediation.

higher effective, i.e. after accounting for the risk of expropriation, marginal product of capital. The case of two-way capital flows emerges when the effective marginal product of capital is greater in the poor country, i.e. when the risk of expropriation is not so large, and when the differences in financial system development are relatively large, such that the interest rate for financial investors in the poor country is lower in this country. In a sense there is a "bypass effect" where capital first leaves the financially underdeveloped country and is absorbed by the foreign financial system. Afterwards it enters this country again, albeit in the form of FDI.

The empirical literature on capital flows focuses mainly on gross *in*flows or gross external *liabilities* of a particular country group, mostly developing and emerging countries. In general, "push" and "pull" factors are considered as determinants of these inflows. Push factors are external determinants like US interest rates as well as US GDP growth, whereas pull factors are domestic fundamentals as well as domestic policies.[20] In terms of the composition of capital flows researchers focus on the share of FDI in the total inflows. For example, Montiel and Reinhart (1999) look at the composition of capital inflows to Asian and Latin American emerging market economies during the 1990s. They identify capital controls and sterilized central bank interventions to alter the composition of capital flows. Explicit restrictions to capital inflows lead to a higher share of FDI relative to short-term and portfolio inflows, whereas sterilized interventions lower this share.

Lane and Milesi-Ferretti (2000) investigate different determinants of the size and composition of gross external liability stocks in 1997. They show that higher trade openness is associated robustly with more debt and FDI liabilities as well as a higher share of FDI in the total liabilities. Further, more financially developed countries, measured by the share of the mone-

[20]See Calvo et al. (1993), who emphasize the role of external factors during the 1980s and early 1990s, for capital flows to Latin American countries.

tary aggregate M2 to GDP, have significantly higher debt liabilities in the sample of industrial countries, whereas for developing countries the coefficient on this variable is negative but insignificant. Finally, better developed stock markets promote the accumulation of FDI liabilities. Faria and Mauro (2009) also focus on the composition of external liabilities in a cross section of average stocks during the period 1996-2004. They use data from Lane and Milesi-Ferretti (2007) and stress that the share of FDI plus equity in the total liabilities depends positively and robustly on the quality of institutions.[21] In order to address endogeneity issues they perform instrumental variable (IV) regressions using a smaller set of countries where colonial settler mortality, the population density in 1500, ethnolinguistic fractionalization and legal origin are used as instruments for the quality of institutions.[22] The last and most closely related empirical paper is that of Wei (2006). He uses a cross section of the composition of foreign liabilities in 2003. Wei focuses on the different impacts of financial institutions compared with those of other institutions.[23] His main regressions are based on a sample of 65 economies. Similarly to Faria and Mauro (2009), Wei (2006) tries to deal with endogeneity by using legal origin and settler mortality as instruments for both institutional variables. The main results indicate that higher levels of corruption (and an index of institutional quality) discourage both FDI and debt investments. On the other hand, better financial development is associated with significantly less FDI. There is further little evidence that

[21] Alfaro et al. (2008) also highlight the importance of overall institutions. However, they focus only on the direction of capital flows. Using a cross-section regression with capital flows per capita as a dependent variable averaged over 1970-2000 they provide evidence that the paradox of poor to rich capital flows may be explained by the cross-country difference in institutional quality.

[22] These instruments originate from the growth and development literature, e.g. Acemoglu et al. (2001) among others, where researchers show that property rights institutions influence strongly the economic development of countries. However, recently Albouy (2008) found that the original settler mortality variable is measured incorrectly. Using an updated measure he shows that IV estimation suffers from the weak instrument problem and therefore the estimates are not reliable.

[23] In a sense he tests the predictions of the Ju and Wei (2007) model.

financial development positively influences the share of debt (or loans) in the total liabilities.[24] Depending on the specification the coefficient on this variable changes the sign as well as its statistical significance. There are several problems in Wei's study. First, his IV results rely only on 33 countries. This may be a problem since instrumental variable regressions are known to produce biased estimates in such small samples. Second, the instrumental variables he uses may not be appropriate. The fundamental problem of these instruments lies in the untestable assumption that for example legal origin has an impact on capital flows only through financial development. However, this instrument is likely to affect capital flows either *directly* or through other channels. Therefore, this instrument may not meet the exclusion restriction to be a valid instrument. Finally, Wei uses only *gross* stocks of a country's liabilities. However, we observe increased holdings of assets and liabilities even for the same type of investments. This can artificially blow up his measures of the composition of stocks for example for countries that have simultaneously a huge stock of debt assets as well as a huge stock of debt liabilities. Then the debt share in the total liabilities will automatically be high and this may lead to misleading results. Moreover, the previously presented theoretical predictions apply to *net* flows (stocks) because the quality of financial and other institutions generates a sort of comparative advantage. Therefore, looking at net positions would be more in line with the theory.

In summary, the theoretical and empirical literature identifies countries' fundamentals, capital controls, trade openness and the quality of financial as well as property rights institutions as potential determinants of the direction and composition of capital flows.

[24] Wei (2006) separates portfolio debt holdings from foreign loans.

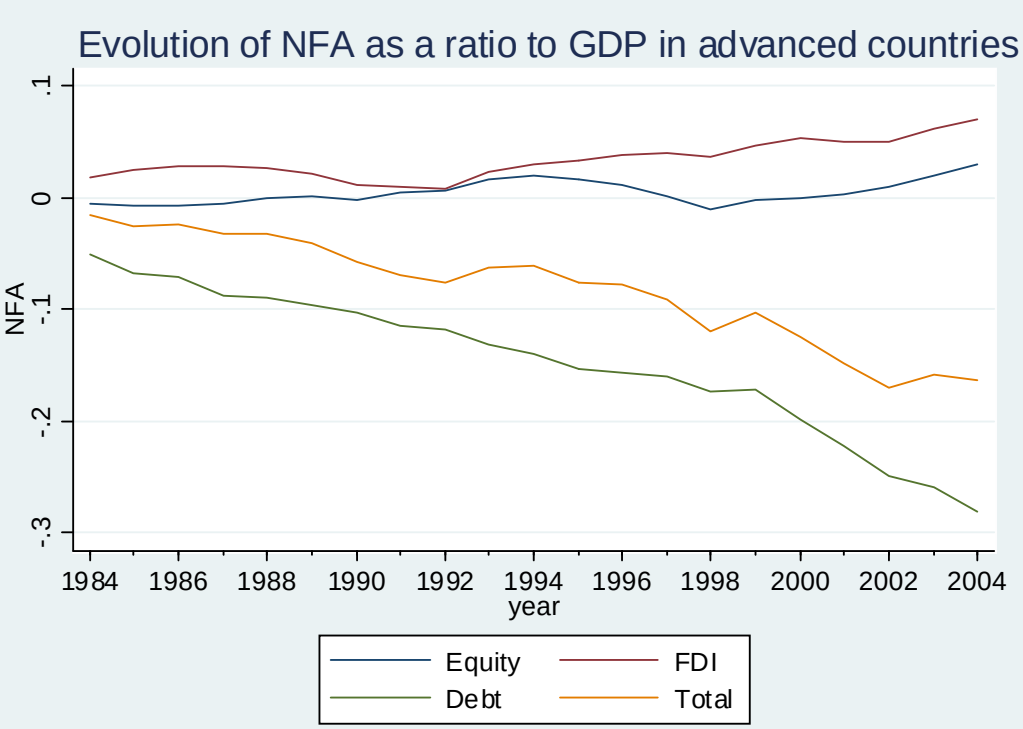
2.3 Data and summary statistics

The major data source is Lane and Milesi-Ferretti (2007), who provide a panel dataset for 3 broad foreign asset and liability positions: stocks of FDI, portfolio debt (including loans) and portfolio equities.[25] This dataset covers up to 145 developing, emerging and developed countries during the period 1970-2004. Table 2.7 in Appendix A provides a full list of these countries. The estimates of the external assets and liabilities are based primarily on balance of payments statistics from the IMF. Additional national and international sources have been used to create the series and to check extensively for inconsistencies of the IMF data. More importantly, in contrast to the original data, Lane and Milesi-Ferretti incorporate valuation effects of the stocks of foreign assets and liabilities. These effects arise when for example exchange rates and asset prices change. Valuation effects generate capital gains and losses, which are increasingly important for the dynamics of capital flows because countries accumulate large stocks of gross assets and liabilities such that small changes in asset prices may lead to large changes in the value of the stocks.[26] A further advantage of this dataset is the better coverage with more countries and more years.[27] From the underlying *stocks* of assets and liabilities I calculate net in- or out*flows* of each type of investment. In particular, the net foreign assets (NFA) of a country are defined as the difference

[25]The remaining categories are financial derivatives and official reserves. Since I am interested in the decision of private agents, I focus on private capital flows only. Therefore, reserve assets are not considered. Further, even though financial derivatives gained much attention in recent years and in the course of the global financial crisis that started in 2008, I do not explore the patterns of such flows. The main motivation is that financial derivatives play only a minor role for developing and emerging countries, especially until the end of 2004. Exploring the determinants of such flows for advanced economies would be interesting; however, it is beyond the scope of this paper.

[26]On the role of valuation effects see Gourinchas and Rey (2007) among others.

[27]This dataset has recently been used by Faria and Mauro (2009). An older, smaller but similar dataset constructed again by Lane and Milesi-Ferretti (2001) has been utilized by Alfaro et al. (2008) to study the effects of the quality of institutions on the capital inflows.



Notes: The figure shows the ratio of net foreign assets to GDP for the following advanced economies: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States.

Figure 2.1: Evolution of net foreign assets for advanced economies

between assets and liabilities. A positive net assets position indicates that this country is a net creditor. Further, an increase in the NFA represents a net capital outflow in a particular year.

Figures 2.1, 2.2 and 2.3 show the evolution of the total NFA position as well as its main components, i.e. FDI, portfolio equity and portfolio debt, for three different country groups. Derivative net assets as well as official reserve assets are omitted for the sake of clarity. For every year the net FDI, net debt or net equity assets are summed for each group and then divided by the total size of this group, i.e. the sum of GDP. I group countries into three sets: advanced, emerging and developing economies. Hereby I follow the definition by Prasad et al. (2003).[28]

[28]See Prasad et al. (2003), p. 72. Emerging economies are called more financially

The following global patterns of the direction and composition of capital flows emerge. I focus on the developments since the early 1980s when the process of financial globalization started.[29] Cross-border capital was allowed to flow more freely to regions with profitable investment opportunities. Figure 2.1 reports that during the 1984-2004 period there is a trend development in the NFA position of advanced economies indicating a rise in FDI and equity NFA whereas a worsening of the debt NFA takes place.[30] Therefore, advanced countries observe simultaneously net FDI and portfolio equity outflows, but net portfolio debt inflows. In total there are net inflows of capital that are explained by the dominances of debt inflows relative to equity-like outflows.[31]

Figure 2.2 shows the patterns of capital flows for the group of emerging economies. Initially these countries have negative net investment positions, which indicates that these countries were net recipients of equity-like and debt investments. During the period 1984-2004 emerging market economies experienced further substantial net FDI inflows, which intensified in the 1990s.[32] However, simultaneously since 1984 the net debt liabilities of this group fell by around 3 times from 28% to 10% of GDP. This implies that substantial net debt outflows took place during the 20-year period. As a result we observe the total net outflows of capital, i.e. an improvement in the total NFA, for emerging countries because the debt outflows outpaced the FDI and equity inflows.

The last country group consists of 32 developing countries. Figure 2.3 shows the empirical patterns of capital flows for this group. It delivers a

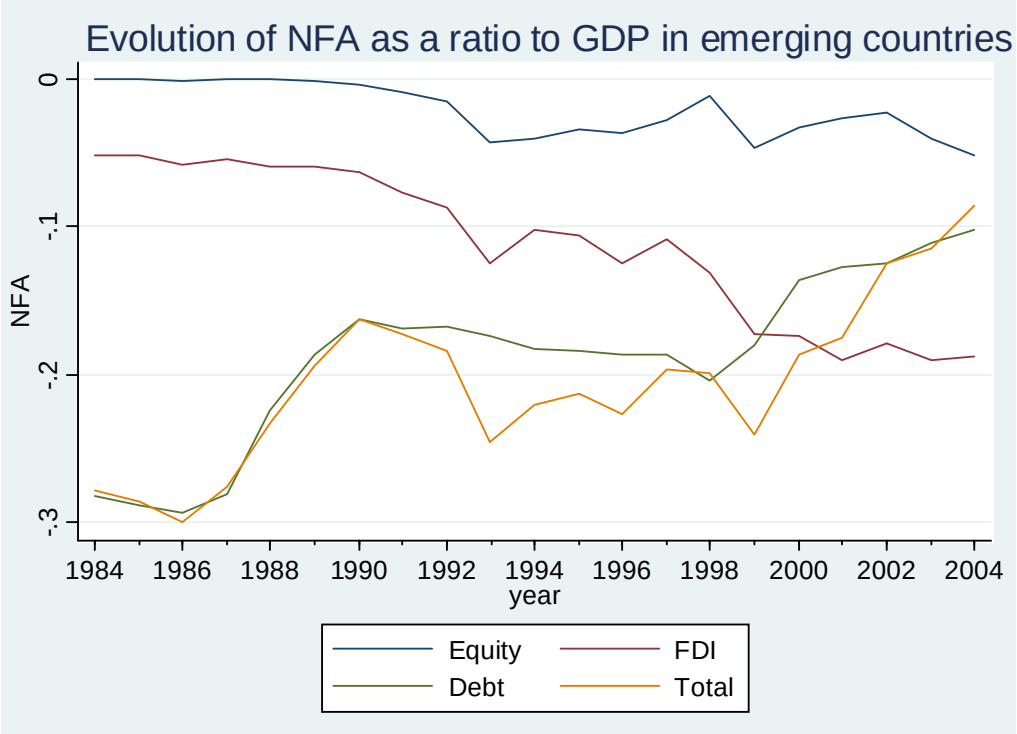
integrated developing countries.

[29] See Mendoza et al. (2009).

[30] Within 20 years net debt liabilities rose more than 5 times from 5% to 28% of GDP, whereas net FDI assets almost quadrupled from 1.8% to 7% of GDP.

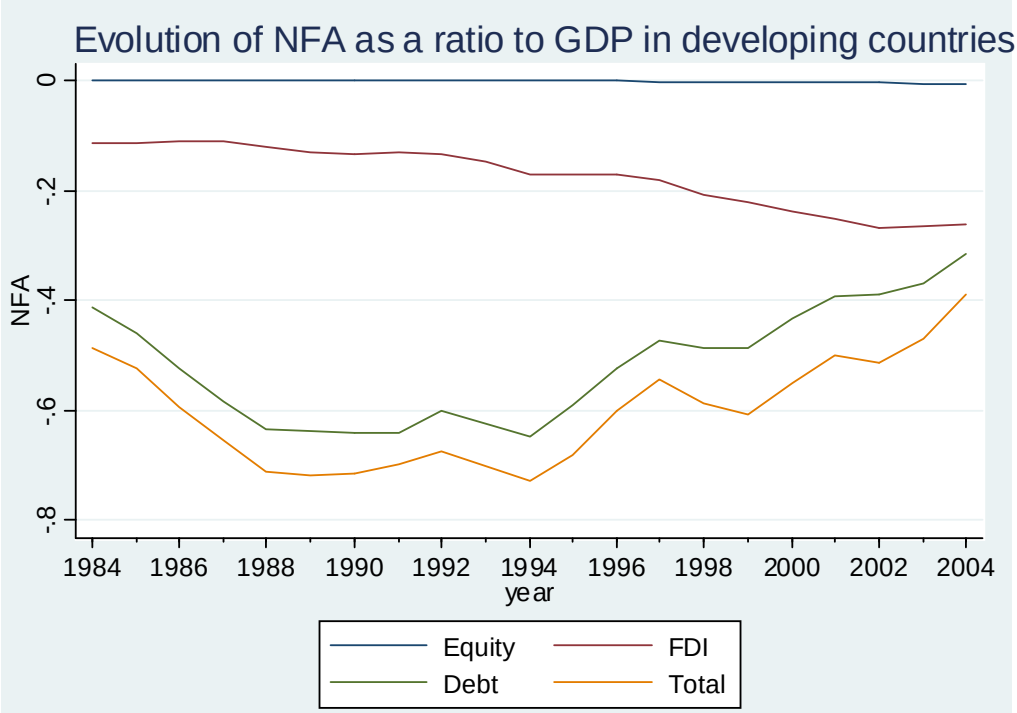
[31] This pattern is not driven by the inclusion of the US. When I exclude the US from the sample the drop in the debt NFA is somewhat smaller, but still significant.

[32] Within 20 years the FDI NFA position worsened from -5% to -19% of GDP. Qualitatively the same picture emerges for portfolio equity investments.



Notes: The figure shows the ratio of net foreign assets to GDP for the following emerging economies: Argentina, Brazil, Chile, China, Colombia, Egypt, Hong Kong SAR, India, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, the Philippines, Singapore, South Africa, Thailand, Turkey and Venezuela.

Figure 2.2: Evolution of net foreign assets for emerging economies



Notes: The figure shows the ratio of net foreign assets to GDP for the following developing economies: Algeria, Bangladesh, Benin, Bolivia, Botswana, Burkina Faso, Burundi, Cameroon, Costa Rica, Côte d'Ivoire, the Dominican Republic, Ecuador, El Salvador, Gabon, Ghana, Guatemala, Haiti, Honduras, Jamaica, Kenya, Mauritius, Nicaragua, Niger, Nigeria, Panama, Papua New Guinea, Paraguay, Senegal, Sri Lanka, the Syrian Arab Republic, Togo, Tunisia and Uruguay.

Figure 2.3: Evolution of net foreign assets for developing economies

qualitatively similar picture to those of the emerging market economies. In the year 1984 this group accumulated on net a significant amount of debt liabilities and a smaller stock of FDI liabilities. Until the begin of the 1990s these countries continued to rely on debt inflows as a major sort of external finance. However, since the begin of the 1990s there has been a trend development in NFA for developing countries, which indicates a worsening in FDI NFA and a simultaneous improvement of the debt NFA position.[33] Therefore, substantial FDI inflows combined with much higher net debt outflows took place.[34] As a result developing countries exported total capital on net during the 1984-2004 period.

In summary, the global patterns of capital flows draw a general picture of advanced countries that import debt and export FDIs on net, whereas emerging and developing countries act exactly in the opposite way by exporting portfolio debt and importing FDIs.

Now I turn to the description of the potential determinants of these patterns. The main explanatory variable highlighted by theory is financial system development. I use data on domestic credit to private sector as a ratio to GDP from WDI (2006), which is available for almost all the countries belonging to the sample of Lane and Milesi-Ferretti (2007).[35] This measure is widely used in the growth and development literature, where people show that financially more developed countries grow faster on average, e.g. King and Levine (1993) and Rajan and Zingales (1998) among others. Private

[33]Within 20 years the net debt liabilities were reduced from 41% to 31.6% of GDP, whereas the net FDI liabilities rose from 11% to 26% of GDP.

[34]Net portfolio equity flows do not seem to be important for these countries. One reason is that developing economies have poorly developed stock markets.

[35]Alternatively Beck et al. (2000) provide a database on financial development indicators, which includes a measure of private credit. However, in order to maximize the sample size, WDI (2006) is preferred. Nevertheless, the two private credit measures are highly correlated.

Table 2.1: Cross-country differences in financial development

Variable	**Advanced**	**Emerging**	**Developing**
GDP per capita	20274	4365	1367
Private credit by deposit money banks to GDP	0.73	0.46	0.22
Private credit by financial institutions to GDP	0.87	0.53	0.23
Domestic credit to private sector as a share of GDP	0.86	0.56	0.25
Stock market capitalization to GDP	0.57	0.47	0.14
Stock market value traded to GDP	0.40	0.24	0.01
Stock market turnover ratio	0.61	0.54	0.07
Central bank's assets to total financial assets	0.03	0.13	0.23
Deposit banks' assets to central bank assets	0.95	0.85	0.72
Deposit banks' assets to GDP	0.89	0.58	0.28
Other financial institutions' assets to GDP	0.61	0.17	0.05

Notes: The table shows for each country group the sample means of the variables during the period 1984-2004. "Domestic credit to private sector as a share of GDP" is taken from WDI (2006). All the other variables come from Beck et al. (2000).

credit is the most preferred measure of financial development in the literature for the following reasons. First, Levine et al. (2000) argue that this measure captures the comparative advantage of intermediaries in reducing informational asymmetries. This is exactly the key feature of the Ju and Wei (2007) model, the predictions of which are tested here. Second, it is available for a larger set of countries and longer time periods. Finally, other measures that describe the development of the stock markets (e.g. stock market capitalization to GDP) are less suitable indicators of financial development especially for developing and emerging markets. The reason is that their financial system is mostly bank-based as opposed to the market-based US system and these countries have only small and illiquid stock markets during the period 1984-2004. Therefore, I use private credit in the regression analysis.

Table 2.1 compares various measures of financial development across country groups. Compared with emerging and especially developing countries advanced economies have higher levels of private credit to GDP, which indicates increased activity of financial intermediaries. Moreover, they have

bigger and more liquid stock markets. Finally, the importance of the central banks compared with private financial institutions, indicated by their relative assets, in providing financial services in the economy is lower for advanced countries.[36] In summary, all the indicators in the table give a consistent view that rich countries have a more developed financial system than poor countries. Following the theoretical predictions of Ju and Wei (2007) I expect a positive impact of financial development on FDI outflows and a negative impact on debt outflows.

I obtain further the variable log of real GDP per capita in PPP from the WDI (2006) database. It is used to proxy for the capital abundance of a country. Ideally, physical capital per capita and human capital per capita should be preferred to capture the physical and human capital abundance of a country, which is a key feature of neoclassical models. However, reliable estimates of the physical and human capital stocks for all countries in the sample are hardly available. Nevertheless, using data from Manova (2008) for 81 countries over the period 1980-1998 I confirm that GDP per capita is highly correlated with estimates of both physical capital per capita and human capital per capita, with correlation coefficients of 0.96 and 0.86, respectively. Therefore, in a regression setting GDP per capita would capture the effect of differences in capital abundance across countries.[37] Neoclassical models predict that ceteris paribus capital should flow from capital-abundant countries to capital-scares countries, because the implied rate of return in the latter is higher. Therefore, I expect a positive relationship between GDP per capita and capital outflows. However, Lucas (1990) shows that this implication is not consistent with the empirical evidence. In reality there is a lack of

[36] In developing countries central banks typically act as a substitute for the poor private financial system.

[37] GDP per capita captures further differences in the unobserved total factor productivity (TFP), which influence the rate of return to capital. Since TFP estimates are not available for all the countries and years in the sample using GDP per capita seems to be more advantageous than using capital abundance measures only.

capital flows to poor, capital-scarce economies. A statistically insignificant impact of this variable on capital flows would be consistent with the "Lucas paradox". However, as shown previously, in recent years there is evidence of a new paradox, where international capital even flows from poor to rich countries. This is shown to be driven by debt outflows in emerging and developing economies. Therefore, the sign may be even negative.

The next two important determinants of capital flows are financial and trade openness. These variables may have a direct impact on capital flows because barriers to trade and finance limit the international activities of companies and investors.[38] Traditional theories of FDI suggest that countries with liberalized trade would attract more vertical FDI where multinational corporations separate their stages of production into different countries to exploit factor price differentials. However, horizontal FDI, which aims to overcome trade barriers, may be discouraged because its attractiveness decreases compared with servicing the market through exports. Moreover, highly trade-open economies may attract more foreign direct investors to use the country as an "export platform".[39] Therefore, the direction of the impact of trade openness on capital flows is generally undetermined. My trade openness variable is defined as the sum of exports and imports of goods and services as a ratio to GDP and is calculated using data from WDI (2006). Figure 2.5 in Appendix A shows all three country groups becoming increasingly integrated into international trade during the 1984-2004 period. Especially

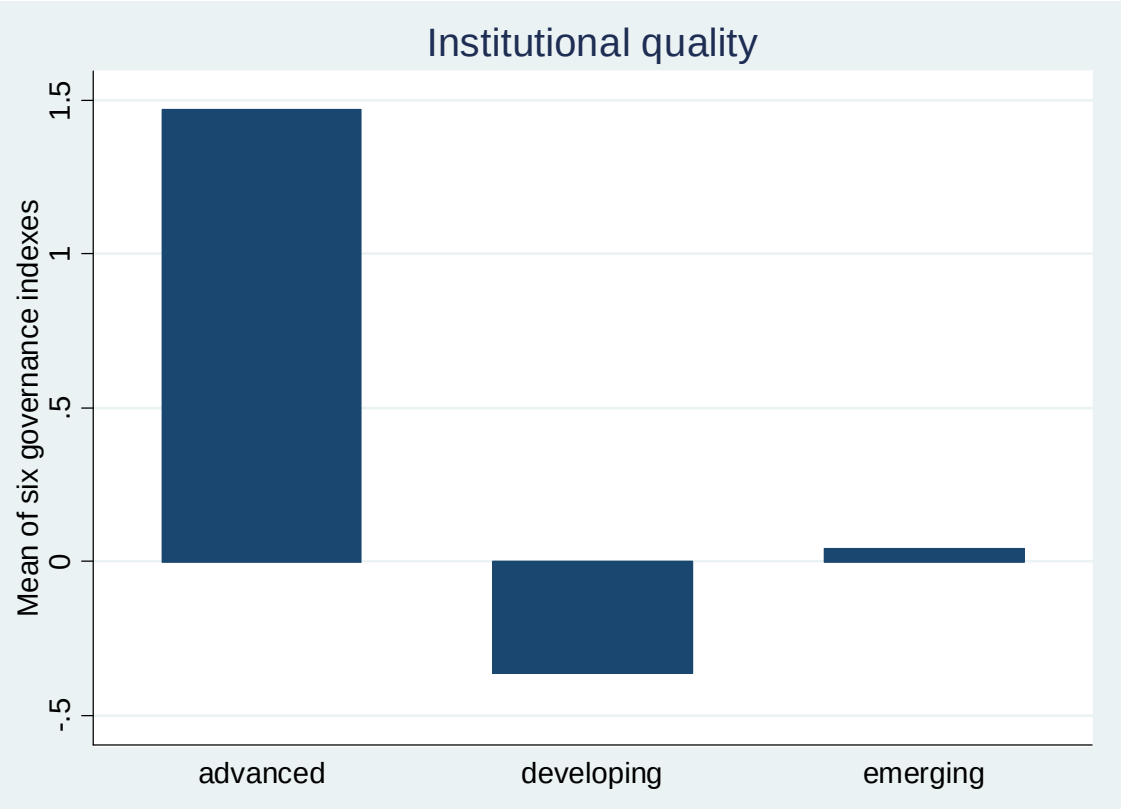
[38]Further, it seems to be a good strategy to include these variables as controls in order to reduce the impact of omitted variable bias due to a potential correlation between both openness variables and financial system development. Rajan and Zingales (2003) develop a political economy model that explains global patterns of cross-country difference in financial development. In their model opening to financial and trade flows will drive incumbent firms and financial institutions to vote for improvement in financial development. Chinn and Ito (2006) and Baltagi et al. (2009) provide evidence on the link between financial development and trade and capital account openness.

[39]Hanson et al. (2001) argue that alongside typical "horizontal" foreign affiliates US multinational enterprises have many affiliates that produce in the host country but then sell *outside* this country. They call them "export platforms". The authors provide empirical evidence that higher trade barriers impede such FDI.

emerging market economies almost doubled their average trade openness.

Capital account controls are also likely to limit the activity of international investors. However, their net effect is ambiguous depending on whether capital controls are set for incoming and/or outgoing investments. When one makes a plausible assumption that the government of the recipient country may favor inward FDI whereas outward FDI may be hindered, I expect a negative impact on FDI outflows. This expectation is consistent with the evidence by Montiel and Reinhart (1999), who find that higher capital controls increase the share of FDI relative to portfolio flows. I use a capital account openness index constructed by Chinn and Ito (2008), which is a "de jure" measure of capital account restrictions. The index of financial openness is based on four dummy variables reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). These indicate the presence of multiple exchange rates, the existence of restrictions on current account transactions, the presence of restrictions on capital account transactions and the requirement of the surrender of export proceeds. The index is available for 181 countries during the period 1970-2005. Compared with the binary nature of the underlying information from AREAER this index has the advantage of measuring not only the presence but also the *intensity* of openness in cross-border financial transactions. The higher the value of the index, the more open a country is to international capital transactions. Figure 2.6 in Appendix A shows the gradual rise in worldwide financial integration during the 1984-2004 period. Despite a significant increase in financial openness for developing and emerging countries there is still a large gap between these two groups and the group of advanced economies.

The last set of variables is obtained from Kaufmann et al. (2006). The authors provide 6 measures of governance quality: voice and accountability, political stability and absence of violence, government effectiveness, regula-



Notes: The figure shows the mean of the index of institutions over the period 1990-2004 for three country groups: advanced, emerging and developing economies.

Figure 2.4: Comparison of the quality of institutions across country groups

tory quality, rule of law and control of corruption. They capture the stance of the institutional environment in a particular country beside that of the financial system, which can influence the attractiveness of a country to international investors. The indicators are indexes that are computed using hundreds of different variables. Each index of governance is normalized to take values between -2.5 and 2.5 with higher values indicating better quality. I constructed an institutional quality index ("Institutions"), which is the simple average of all 6 measures.[40] This measure is used as a proxy for the "risk of expropriation" variable from the theoretical model of Ju and Wei (2007), which is a distinct determinant of capital flows and therefore should be included as an additional explanatory variable. Figure 2.4 shows the cross-country differences in institutional quality between developing, emerging and advanced economies. As expected, the pecking order of countries starts with developing countries having the least developed institutions and ends with advanced countries having the strongest institutions. Following the theoretical predictions I expect that the quality of institutions should have a negative impact on both FDI and debt outflows.

After presenting the observed pattern of capital flows as well as the key characteristics of advanced, emerging and developing countries I explore in the next section the causal link between financial development and the direction and composition of capital flows.

2.4 Financial development and capital flows

2.4.1 Empirical model and estimation strategy

Usually previous studies on capital flows have built time averages for every country and estimated a cross section in order to capture a sort of long-run,

[40] Indexes are available for the years 1996, 1998, 2000, 2002, 2003 and 2004 only. For the missing years I linearly interpolate the data.

steady-state relationship.[41] However, this typically leads to a substantial loss of information. Instead I exploit both the cross-sectional and time-series variation in the data and apply panel estimation techniques. Baltagi et al. (2009) point out that building time averages does not necessarily describe a steady-state equilibrium while identification becomes more difficult due to a loss of information. Another clear advantage of panel data is the possibility of ruling out biases due to the presence of unobserved time-constant country-specific heterogeneity in the data. For example, some countries traditionally receive more capital inflows than others and simultaneously they have a more developed financial system. Omitting a factor like geography, which may influence both capital flows and financial development, leads to the well-known omitted variable bias. In contrast, cross-sectional studies rely on the inclusion of "as many as possible" control variables or they try to find a good instrument to estimate consistently the coefficient of interest. However, typically good, valid (external) instruments are difficult to find. Even though researchers may show that their instrument is exogenous and not weak, they usually have problems arguing why the instrumental variable meets the exclusion restriction. It requires the instrument to have an effect on the dependent variable *solely* through the variable that is instrumented. However, in many cases the instrumental variable has a direct effect, such that the untestable assumption for a valid instrument fails in practice. Finally, there is another advantage of panel data in terms of the use of instrumental variables. Panel data allow the use of *internal* instruments to account for other types of endogeneity. Internal instruments like lagged values are typically naturally correlated with the variable of interest due to the underlying time-series process. They are also likely to be uncorrelated with the error term, which is a testable assumption. Finally, they are more likely to meet the untestable exclusion restriction, because for example past levels

[41] See for example Alfaro et al. (2008).

of financial development may not influence current capital flows once the current state of financial development is accounted for. Therefore, internal instruments are potential valid instruments that I exploit in the estimation.

In the next step I present the empirical model of the link between financial system development and the direction and composition of capital flows. As dependent variables I use net FDI or portfolio debt outflows as a ratio to GDP. I rely on this measure for the following reasons. First, looking at the composition of capital flows ratios of *net* FDI (debt) flows to total *net* flows may be considered. However, both the nominator and the denominator of these ratios may be negative and they may have different signs. Therefore, the interpretation of the change in these ratios will be misleading.[42] Further, a lagged dependent variable is included in the model to account for sluggish adjustment of the series over time. Typically capital flows do not react fully in a particular year to changes in the variable of interest, which makes them persistent over time. The inclusion of a lagged dependent variable creates a dynamic panel data model of the form:

$$F_{it} = \mu + \alpha F_{i,t-1} + \beta FinDev_{it} + \boldsymbol{x}_{it}\boldsymbol{\gamma} + \omega_t + \psi_i + \xi_{it} \tag{2.1}$$

where F_{it} is defined as net outflows of FDI (debt) as a ratio to nominal GDP for country i at year t. By dividing net flows by GDP I am able to account for potential non-stationarity of the level series as well as for country size effects.[43] $FinDev_{it}$ is domestic credit to the private sector as a ratio to GDP and measures the level of financial development of country i at time t. x_{it} represents a vector of control variables, like GDP per capita, poten-

[42]Ratios of net stocks may have the same problems. Since previous studies use only *gross* inflows or stocks of liabilities they do not have these problems. For example, Wei (2006) and Faria and Mauro (2009) use ratios of *gross* liabilities only. Montiel and Reinhart (1999) and Albuquerque (2003) use for example FDI inflows as a share of the total gross inflows. In the case of net values, however, the use of such ratios is inappropriate.

[43]Non-stationarity is strong and more problematic for stocks of capital, but flows are persistent over time as well. Hence, this seems to be a good strategy.

tially correlated with FinDev. Country fixed effects ψ_i capture unobserved time-invariant heterogeneity across countries, whereas time fixed effects ω_t subsume all the time-varying factors common to all the countries in the sample, like worldwide macroeconomic shocks. Further, the disturbance ξ_{it} is assumed to be independently and identically distributed with a zero mean and constant variance. Finally, μ is a constant term. The main advantage of this specification as opposed to a cross-sectional model is that here I can partially account for the heterogeneity between countries using country fixed effects. They capture factors like "geography, climate, ethno-linguistic characteristics, as well as all unchanging political economy factors".[44] Moreover, this dynamic model allows me to test whether the regressors are exogenous and hence whether the predictions are valid. Using the model in (2.1) I test the main hypothesis of the models by Ju and Wei (2007) and Mendoza et al. (2009), namely that countries with a more developed financial system should experience ceteris paribus higher net FDI outflows (or lower net FDI inflows) and simultaneously lower net debt outflows (or higher net debt inflows). Therefore, the coefficient capturing the effect of FinDev on net FDI outflows is expected to be positive, i.e. $\beta_{FDI} > 0$. On the other hand, the coefficient for the effect of FinDev on net debt outflows is expected to be negative, i.e. $\beta_{debt} < 0$.

Estimating the above relationship via simple OLS and treating $\psi_i + \xi_{it}$ as the composite error term is problematic in several ways. The first reason is that ψ_i and $F_{i,t-1}$ are mathematically related and this will lead to biased estimates. A solution would be to eliminate the country fixed effects via within-group transformation, where I subtract the time mean for each country i. However, a problem still remains, because although the fixed effects are eliminated, the transformed term of the lagged dependent variable is correlated with the transformed error term through their means. Nickell (1981)

[44] See Baltagi et al. (2009), p. 287.

shows that this introduces a bias into the estimates. Clearly this bias will disappear only if the number of periods $T \to \infty$. Further, Judson and Owen (1999) find that this bias is important (around 20%) even for $T = 30$. Since I have a small, fixed T sample I introduce techniques that solve this problem. In order to eliminate the fixed effects first differences are taken from both sides of equation (2.1):

$$F_{it} - F_{i,t-1} = \alpha(F_{i,t-1} - F_{i,t-2}) + \beta(FinDev_{it} - FinDev_{i,t-1}) + \\ +(\boldsymbol{x}_{it} - \boldsymbol{x}_{i,t-1})\boldsymbol{\gamma} + (\omega_t - \omega_{t-1}) + (\xi_{it} - \xi_{i,t-1}) \quad (2.2)$$

Again there is a correlation between the $F_{i,t-1} - F_{i,t-2}$ term and the transformed error term $\xi_{it} - \xi_{i,t-1}$. The idea in this case, first proposed by Anderson and Hsiao (1982), is to use an instrumental variable estimator to solve the endogeneity problem. They propose the lagged level $F_{i,t-2}$ or the lagged difference $F_{i,t-2} - F_{i,t-3}$ as natural instruments for $F_{i,t-1} - F_{i,t-2}$, because they are correlated with it, but not with the error term.[45] The instruments are valid if $\xi_{it} - \xi_{i,t-1}$ is not first-order autocorrelated or equivalently the level ξ_{it} doesn't follow a second-order autoregressive process.[46]

Holtz-Eakin, Newey and Rosen (1988) and Arellano and Bond (1991) propose a generalized method of moments (GMM) estimation of equation (2.2), which is more efficient than that of Anderson and Hsiao (1982). The reason is that as we go further in time more lagged values can serve as instruments. This leads to more moment conditions that can be used to improve efficiency. The GMM framework allows me in addition to test for the exogeneity of the instrument set, because the system of equations is

[45] Instrumenting in this manner does not work with the within-group transformation.

[46] The first-difference representation introduces serial correlation of the transformed errors (assuming no autocorrelation in levels), but this can be easily treated by using robust variance-covariance estimators.

potentially overidentified.[47]

The following moment conditions can be used in the estimation:

$$E[F_{i,t-l}(\xi_{it} - \xi_{i,t-1})] = 0 \quad \text{for each } t \geq 3 \text{ and } l \geq 2 \tag{2.3}$$

I decide to exploit the "collapsed" version following Roodman (2009b) in order to reduce the problem of "too many instruments" and thus the following moment conditions[48] are used:

$$E[F_{i,t-l}(\xi_{it} - \xi_{i,t-1})] = 0 \quad \text{for each } l \geq 2 \tag{2.4}$$

The additional usual moment conditions are of the form:

$$E[(\boldsymbol{x}_{it} - \boldsymbol{x}_{i,t-1})'(\xi_{it} - \xi_{i,t-1})] = \mathbf{0} \quad \text{for } t \geq 2 \tag{2.5}$$

where the row vector $\boldsymbol{x}$ contains all strictly exogenous explanatory variables including financial development. If some of the covariates are potentially predetermined or endogenous I use suitable lagged levels to instrument the difference $x_{it} - x_{i,t-1}$.[49]

[47] Arellano and Bover (1995) and Blundell and Bond (1998) point out that "difference" GMM may perform poorly when the time series are very persistent. In this case lagged levels are poor instruments of first differences, which produce a "weak instrument problem". They propose the so-called "system" GMM estimator, where an equation in levels is added to the system of differenced equations. The intuition here is to instrument levels with lagged differences. However, a crucial and non-trivial assumption requires the covariance $E[F_{it}\psi_i]$ to be constant over time (stationary) so that $E[(F_{it} - F_{i,t-1})\psi_i] = 0$. This assumption of initial stationarity of the series is problematic especially for capital flows. In the sample period of 1984-2004 there were several shocks to the world economy, e.g. the overall process of globalization, the fall of the "Iron Curtain" and the subsequent process of Eastern enlargement, the Asian crisis of 1997, the "dot-com bubble" and its bursting in 2000, etc. They represent substantial, persistent shocks to the economic activities in most countries in the sample. Therefore, it is very likely that the capital flow series are initially far from their steady states, making the Blundell and Bond estimator inappropriate.

[48] This problem arises because as I go further in time there are more lags of the dependent variable that can potentially serve as instruments.

[49] I start to treat these variables as strictly exogenous and perform Difference-in-Hansen tests of exogeneity of instrument subsets. If these reject the null hypothesis of exogeneity I use appropriate lagged levels instead.

I address the following issues in the estimation. First, I decide to perform the so-called "one-step" GMM estimation, where an arbitrary (e.g. homoskedastic) variance-covariance matrix of residuals is used. However, since I am aware of possible serial correlation of the residuals within country groups and heteroskedasticity across countries, this will lead to incorrect inference. To produce appropriate test statistics I apply the cluster-robust estimator of the variance-covariance matrix of residuals, which allows for arbitrary correlation within countries and heteroskedasticity across countries.[50] Second, I test for AR(1) and AR(2) in first-differenced errors in order to check whether the instruments are valid. In theory there is a negative first-order autocorrelation in first differences, but there must be no second- (or higher-) order autocorrelation. I therefore perform the Arellano-Bond test for autocorrelation. Third, I conduct a Hansen (1982) test of overidentifying restrictions to test for exogeneity of the instrument set as a whole. In addition, to test whether my financial development measure is exogenous, I perform a Difference-in-Hansen test. I check further using the same test whether all the other strictly exogenous explanatory variables are indeed orthogonal to the residuals.[51] Finally, I address the problem of "too many instruments" as noted above. In the dynamic panel literature there is no guidance on how many instruments are good. Since I have a relatively small sample of countries I am aware of "overfitting" endogenous variables when I use too many moment conditions.[52] Therefore, I decide to restrict the lag length to using

[50] In theory "two-step" GMM estimation produces a heteroskedasticity- and autocorrelation-robust variance-covariance matrix and is more efficient than the one-step approach. However, as Arellano and Bond (1991) and Roodman (2009a) point out, standard errors can be severely downward biased in small samples. In this case standard errors can then be adjusted using the finite-sample correction of Windmeijer (2005), but since this is only an approximation I stick to the one-step results.

[51] I do not present them in the table for the sake of clarity.

[52] Roodman (2009b) emphasizes that the available instruments may rise quadratically with the number of time periods. For my basic sample of 21 years the maximum potentially available moment conditions amount to $(21-2)(21-1)/2 = 380$. As a rule of thumb Roodman (2009b) recommends that the number of instruments should be lower than the number of countries.

only up to the first three available lags. In addition I "collapse" them into a smaller instrument set. As a consequence my system of equations has two overidentifying restrictions.[53]

2.4.2 Baseline results

Due to data availability and in order to capture the beginning of the financial globalization process I choose for the regression analysis a 21-year period from 1984 to 2004. The panel of countries is unbalanced. The basic sample includes 122 countries, which is a fairly good size compared with previous empirical studies.[54] In order to reduce the influence of extreme outliers I winsorize the upper 95th percentile and the lower 5th percentile of the distribution of the dependent variables. Beside the lagged dependent variable the main regressors are private credit as a ratio to GDP, the logarithm of GDP per capita as well as trade and capital account openness. Tables 2.8 and 2.9 in Appendix A provide summary statistics of the variables as well as pairwise correlations of the regressors. All the explanatory variables are positively correlated with the highest correlation coefficients between private credit, institutions and GDP per capita, which range from 0.69 to 0.84.

Tables 2.2 and 2.3 present the baseline estimation results.[55] Standard errors are robust to an arbitrary correlation within countries as well as to heteroskedasticity across countries. Throughout all the specifications in both the tables the Arellano-Bond test suggests the existence of negative first-order serial correlation in the first-differenced residuals at the 1% significance level,

[53]The number of overidentifying restrictions may be higher when I instrument other explanatory variables.

[54]Table 2.7 in Appendix A provides a list of all the countries. From the original 145 countries from Lane and Milesi-Ferretti (2007) 23 countries have been excluded due to missing data on the explanatory variables or because they have only a small number of yearly observations.

[55]I use the *xtabond2* routine in Stata provided by Roodman (2009a) to obtain my results.

Table 2.2: FDI outflows and financial development: basic sample

Dependent Variable:	**Net FDI outflows to GDP**				
	(1)	(2)	(3)	(4)	(5)
L1.(Net FDI outflows to GDP)	0.081*	0.085**	0.084**	0.082**	0.090**
	(0.041)	*(0.041)*	*(0.042)*	*(0.041)*	*(0.042)*
Private credit to GDP	0.035**	0.034**	0.034**	0.034**	0.033**
	(0.014)	*(0.014)*	*(0.014)*	*(0.014)*	*(0.014)*
Log of real GDP per capita in PPP		-0.012			-0.013
		(0.013)			*(0.013)*
Trade openness			-0.021**		-0.021**
			(0.0083)		*(0.0082)*
Capital account openness				-0.0076	-0.0076
				(0.0049)	*(0.0047)*
Year dummies	yes	yes	yes	yes	yes
Observations	2064	2064	2064	2064	2064
Number of country clusters	122	122	122	122	122
Number of instruments	25	26	26	28	30
F statistic	3.83	4.10	5.01	4.83	6.42
F-Test (p-value)	0.00	0.00	0.00	0.00	0.00
AR(1) Test	-6.82	-6.80	-6.91	-6.90	-6.99
AR(1) Test (p-value)	0.00	0.00	0.00	0.00	0.00
AR(2) Test	-0.45	-0.41	-0.35	-0.45	-0.32
AR(2) Test (p-value)	0.66	0.68	0.73	0.65	0.75
Hansen-J statistic	2.00	2.14	2.03	2.86	2.88
Hansen-J (degrees of freedom)	2	2	2	4	4
Hansen-J (p-value)	0.37	0.34	0.36	0.58	0.58
Diff-in-Hansen statistic for private credit	2.00	2.14	0.16	0.08	0.01
Diff-in-Hansen (p-value)	0.16	0.14	0.69	0.78	0.92

Notes: Robust standard errors adjusted for clustering on the country level in parentheses. Estimates are one-step difference GMM. In all the columns L2-L4.(Net FDI outflows to GDP) are used as instruments for the (differenced) lagged dependent variable. In columns (4) and (5) the (differenced) capital account openness is instrumented with L1-L3 of its level. The table shows the Arellano-Bond test for first- and second-order autocorrelation of the first-differenced residuals. The null hypothesis is no autocorrelation. A heteroskedasticity-robust test of overidentifying restrictions (Hansen-J test) is performed. The null hypothesis is that the instrument set as a group is exogenous. A Difference-in-Hansen test for exogeneity of the instrument subset (here of private credit) is performed. Under the null the instrument excluded is exogenous. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 2.3: Debt outflows and financial development: basic sample

Dependent Variable:	**Net debt outflows to GDP**				
	(1)	(2)	(3)	(4)	(5)
L1.(Net debt outflows to GDP)	0.096***	0.090**	0.096***	0.096***	0.091**
	(0.035)	*(0.035)*	*(0.036)*	*(0.035)*	*(0.036)*
Private credit to GDP	-0.051**	-0.051**	-0.051**	-0.050**	-0.050**
	(0.022)	*(0.021)*	*(0.022)*	*(0.022)*	*(0.022)*
Log of real GDP per capita in PPP		-0.072			-0.070
		(0.044)			*(0.044)*
Trade openness			-0.0076		-0.0076
			(0.030)		*(0.031)*
Capital account openness				0.015	0.014
				(0.014)	*(0.014)*
Year dummies	yes	yes	yes	yes	yes
Observations	2063	2063	2063	2063	2063
Number of country clusters	122	122	122	122	122
Number of instruments	25	26	26	28	30
F statistic	11.2	11.1	10.8	11.2	10.6
F-Test (p-value)	0.00	0.00	0.00	0.00	0.00
AR(1) Test	-7.56	-7.68	-7.55	-7.52	-7.64
AR(1) Test (p-value)	0.00	0.00	0.00	0.00	0.00
AR(2) Test	-0.16	-0.19	-0.15	-0.18	-0.20
AR(2) Test (p-value)	0.87	0.85	0.88	0.85	0.84
Hansen-J statistic	0.35	0.26	0.37	1.87	1.66
Hansen-J (degrees of freedom)	2	2	2	4	4
Hansen-J (p-value)	0.84	0.88	0.83	0.76	0.80
Diff-in-Hansen statistic for private credit	0.27	0.21	0.31	0.08	0.03
Diff-in-Hansen (p-value)	0.61	0.65	0.58	0.78	0.86

Notes: Robust standard errors adjusted for clustering on the country level in parentheses. Estimates are one-step difference GMM. In all the columns L2-L4.(Net debt outflows to GDP) are used as instruments for the (differenced) lagged dependent variable. In columns (4) and (5) the (differenced) capital account openness is instrumented with L1-L3 of its level. The table shows the Arellano-Bond test for first- and second-order autocorrelation of the first-differenced residuals. The null hypothesis is no autocorrelation. A heteroskedasticity-robust test of overidentifying restrictions (Hansen-J test) is performed. The null hypothesis is that the instrument set as a group is exogenous. A Difference-in-Hansen test for exogeneity of the instrument subset (here of private credit) is performed. Under the null the instrument excluded is exogenous. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

which is expected by construction. The test cannot, however, reject the null hypothesis of the absences of AR(2) in the first-differenced residuals. It indicates that my lagged levels of the dependent variable are valid instruments. Further, the p-value of the Hansen-J test ranges between 0.34 and 0.88. Therefore, the null hypothesis of exogeneity of the instrument set as a whole cannot be rejected. This indicates that endogeneity is not driving my results. I performed further a Difference-in-Hansen test for the exogeneity of private credit. The test statistic is $\chi^2(1)$ distributed. The p-value ranges from 0.14 to 0.92 and indicates that the null hypothesis of exogeneity of my financial development measure cannot be rejected.

Looking at column (1) of Table 2.2, private credit has a positive and at the 5% level statistically significant impact on FDI outflows as a share of GDP. This suggests that in line with the theory countries with a better developed financial system export FDI on net. Throughout all 5 specifications the coefficient almost does not change quantitatively and remains significant. In the next three columns (2) to (4) I include the other explanatory variables one by one. Column (5) uses all the regressors together.[56] Since the estimated coefficients remain unchanged I interpret only column (5). The estimated coefficient on GDP per capita is negative and shows that poor countries observe more FDI outflows (or fewer FDI inflows). However, it is not statistically significant. Further, trade openness has a negative impact on FDI outflows, which is significant at the 5% level. This result is either consistent with the vertical integration motive for FDIs where multinational firms look for cheap production locations or it may be explained by the "export platforms" suggestion by Hanson et al. (2001) where multinationals establish large distribution networks in order to serve foreign markets better. Finally, as expected, capital account restrictions impede net FDI inflows. The coef-

[56]In columns (4) and (5) the capital account openness index is instrumented with appropriate lags because the Difference-in-Hansen test for this variable indicated endogeneity problems. As a consequence there are four instead of only two overidentifying restrictions.

ficient is negative though only marginally significant at the 11% level.

A natural question to ask is what is the economic significance of the impact of financial development? To quantify the effect I compare a country at the 75th percentile of the distribution of private credit, like Australia, with a country at the 25th percentile, like Turkey.[57] The latter has an approximately 50 percentage points lower level of private credit as a percentage of GDP. The coefficient of 0.033 suggests that Australia will have 1.65 percentage points higher net FDI outflows as a percentage of GDP. However, since I have a dynamic model, the coefficient represents only the contemporaneous effect. The long-run impact is given by $\beta/(1-\alpha)$. Given the estimate for α of 0.09, the long-run effect amounts to about $1.65/(1-0.09) = 1.8$ percentage points. Moreover, let's compare this value with the observed difference between the 75th and the 25th percentiles of the distribution of net FDI outflows to GDP, which is around 2.7 percentage points.[58] Therefore, the effect of financial development would "explain" about two-thirds of this difference. In contrast, the same exercise for the other statistically significant variable, trade openness, leads to a lower long-run effect of 1.1 percentage points, which makes up around 41% of the interquartile range of the distribution of net FDI outflows to GDP.[59] In summary, financial system development has not only a statistically but also an economically significant impact on net FDI flows.

Table 2.3 presents the results for net debt outflows. Since the estimated coefficients differ only slightly across specifications I interpret the estimates in column (5) only. Private credit has a negative impact on net debt outflows as a share of GDP. Further, the estimated coefficient is significant at

[57] In 1994 private credit in Turkey was around 16% of GDP whereas it was around 66% for Australia.

[58] This represents the interquartile range of the distribution.

[59] The difference between a country at the 75th percentile of trade openness distribution and a country at the 25th percentile is 0.48. The long-run impact is therefore $0.48 * 0.021/(1-0.09) = 0.011$

the 5% level. Therefore, as postulated by the theory, financially less developed countries export portfolio debt capital on net. The economic effect of financial development is sizable for net debt flows as well. Improving the availability of private credit in Turkey to the level in Australia leads to a $0.5 * 0.05/(1 - 0.091) = 2.75$ percentage points increase in net debt inflows as a percentage of GDP over the long run. Furthermore, the interquartile range of net debt outflows amounts to around 6.5% of GDP. As a result the effect of financial system development makes up around 42% of this range. Therefore, the quality of the financial system has an economically significant effect on net portfolio debt flows. Further, the coefficient on the variable GDP per capita is negative; however, it is only marginally significant at the 11.4% level. This is against the prediction of purely neoclassical models because it indicates that high-income countries import capital on net.[60] However, this estimate is consistent with the "paradox" of capital flows from poor to rich countries, because empirically in the period 1984-2004 portfolio debt investments were directed on net to rich countries. Finally, the last two explanatory variables, trade and capital account openness, do not have a significant impact on net debt flows. Nevertheless, the positive coefficient on financial openness is consistent with the fact that the patterns of debt flowing from developing to more advanced countries started in the mid 1980s after the beginning of the global capital account liberalization process.

2.4.3 Robustness

In this part of the paper I perform different robustness checks in order to show that the estimated effect of financial development on capital flows is not driven by the choice of country sample. More importantly, I further confirm

[60] As suggested before GDP per capita may capture the impact of human capital abundance of countries. As shown by Lucas (1990), a better-educated workforce in advanced economies increases the rate of return on physical capital and therefore the attractiveness of investments there. Hence, capital flows would not flow to poor, capital-scarce countries.

that the estimated impact is independent of the effect of the quality of other institutions highlighted by theoretical models as well as previous empirical studies.

As a first step I address the sample robustness in Tables 2.4 and 2.5.[61] I construct 3 different samples and compare them with the basic sample. The first one excludes 12 offshore financial centers. These countries are Bahrain, Costa Rica, Cyprus, Hong Kong, Israel, Malta, Mauritius, the Netherlands, Panama, the Philippines, Singapore and Uruguay.[62] Typically, offshore financial centers are "de facto pure intermediaries"[63] characterized by extraordinary high *gross* capital in- and outflows. Even though the *net* flows are not necessarily large these countries may have a different composition of their net flows compared with other countries. The second robustness check drops 16 oil exporters from the main sample. The oil-producing countries are Algeria, Azerbaijan, Bahrain, Congo, Ecuador, Gabon, Iran, Kuwait, Nigeria, Norway, Oman, the Russian Federation, Saudi Arabia, the Syrian Arab Republic, Turkmenistan and Venezuela.[64] These economies are typically large creditors. Since fluctuations in the oil prices may lead to a large accumulation of assets, it is interesting to see whether the exclusion of this group changes the results qualitatively. Finally, the third sample focuses on developing and emerging market economies in order to see whether the higher level of financial development in developed countries drives my results. It therefore excludes 19 advanced economies. The advanced countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States.[65]

[61] Table 2.4 presents the results for net FDI outflows whereas Table 2.5 shows those for net debt outflows.

[62] The definition of those countries follows Mauro and Faria (2009).

[63] See Lane and Milesi-Ferretti (2007), p. 231.

[64] The definition of these countries comes from International Monetary Fund (2007), chapter 1, p. 16, figure 1.13.

[65] The definition of these countries comes from Prasad et al. (2003).

Table 2.4: FDI outflows and financial development: sample robustness

Dependent Variable:	Net FDI outflows to GDP					
Sample excluding:	offshore financial centers		oil producers		advanced economies	
	(1)	(2)	(3)	(4)	(5)	(6)
L1.(Net FDI outflows to GDP)	0.091*	0.11**	0.084*	0.092**	0.087*	0.094**
	(0.049)	*(0.050)*	*(0.045)*	*(0.046)*	*(0.045)*	*(0.046)*
Private credit to GDP	0.031*	0.030*	0.044***	0.043***	0.028*	0.026*
	(0.016)	*(0.016)*	*(0.016)*	*(0.017)*	*(0.015)*	*(0.015)*
Log of real GDP per capita in PPP		-0.020*		-0.017		-0.012
		(0.012)		*(0.014)*		*(0.014)*
Trade openness		-0.020**		-0.023**		-0.022**
		(0.0099)		*(0.0100)*		*(0.0083)*
Capital account openness		-0.0094		-0.00056		-0.0083**
		(0.0059)		*(0.0057)*		*(0.0041)*
Year dummies	yes	yes	yes	yes	yes	yes
Observations	1840	1840	1798	1798	1676	1676
Number of country clusters	110	110	106	106	103	103
Number of instruments	25	30	25	30	25	30
F statistic	3.89	5.68	3.91	5.94	4.68	9.36
F-Test (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
AR(1) Test	-6.34	-6.48	-6.38	-6.43	-6.22	-6.32
AR(1) Test (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
AR(2) Test	-0.21	-0.15	0.28	0.44	0.096	0.14
AR(2) Test (p-value)	0.83	0.88	0.78	0.66	0.92	0.89
Hansen-J statistic	2.95	4.08	3.35	4.23	0.89	1.97
Hansen-J (degrees of freedom)	2	4	2	4	2	4
Hansen-J (p-value)	0.23	0.39	0.19	0.38	0.64	0.74
Diff-in-Hansen statistic for private credit	0.10	0.21	2.76	0.00	0.20	0.55
Diff-in-Hansen (p-value)	0.75	0.65	0.10	0.97	0.65	0.46

Notes: Robust standard errors adjusted for clustering on the country level in parentheses. Estimates are one-step difference GMM. In all the columns L2-L4.(Net FDI outflows to GDP) are used as instruments for the (differenced) lagged dependent variable. In columns (2), (4) and (6) the (differenced) capital account openness is instrumented with L1-L3 of its level. The table shows the Arellano-Bond test for first- and second-order autocorrelation of the first-differenced residuals. The null hypothesis is no autocorrelation. A heteroskedasticity-robust test of overidentifying restrictions (Hansen-J test) is performed. The null hypothesis is that the instrument set as a group is exogenous. A Difference-in-Hansen test for exogeneity of the instrument subset (here of private credit) is performed. Under the null the instrument excluded is exogenous. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 2.5: Debt outflows and financial development: sample robustness

Dependent Variable:	Net debt outflows to GDP					
Sample excluding:	offshore financial centers		oil producers		advanced economies	
	(1)	(2)	(3)	(4)	(5)	(6)
L1.(Net debt outflows to GDP)	0.10**	0.098**	0.12***	0.11***	0.068*	0.065*
	(0.041)	*(0.041)*	*(0.035)*	*(0.035)*	*(0.038)*	*(0.039)*
Private credit to GDP	-0.053***	-0.052***	-0.049**	-0.046**	-0.073**	-0.073**
	(0.018)	*(0.018)*	*(0.023)*	*(0.022)*	*(0.034)*	*(0.034)*
Log of real GDP per capita in PPP		-0.037		-0.078*		-0.067
		(0.038)		*(0.046)*		*(0.044)*
Trade openness		0.0055		-0.012		-0.0045
		(0.031)		*(0.036)*		*(0.031)*
Capital account openness		0.0035		0.015		-0.0011
		(0.012)		*(0.014)*		*(0.013)*
Year dummies	yes	yes	yes	yes	yes	yes
Observations	1839	1839	1797	1797	1675	1675
Number of country clusters	110	110	106	106	103	103
Number of instruments	25	30	25	30	25	30
F statistic	10.6	9.68	11.2	11.2	13.4	12.7
F-Test (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
AR(1) Test	-7.13	-7.18	-7.09	-7.19	-6.86	-6.92
AR(1) Test (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
AR(2) Test	0.64	0.60	1.49	1.43	-0.30	-0.29
AR(2) Test (p-value)	0.52	0.55	0.14	0.15	0.77	0.77
Hansen-J statistic	0.70	1.26	3.47	6.78	0.13	1.79
Hansen-J (degrees of freedom)	2	4	2	4	2	4
Hansen-J (p-value)	0.70	0.87	0.18	0.15	0.94	0.78
Diff-in-Hansen statistic for private credit	0.70	0.07	3.46	1.75	0.03	0.01
Diff-in-Hansen (p-value)	0.40	0.79	0.06	0.19	0.87	0.98

Notes: Robust standard errors adjusted for clustering on the country level in parentheses. Estimates are one-step difference GMM. In all the columns L2-L4.(Net debt outflows to GDP) are used as instruments for the (differenced) lagged dependent variable. In columns (2), (4) and (6) the (differenced) capital account openness is instrumented with L1-L3 of its level. The table shows the Arellano-Bond test for first- and second-order autocorrelation of the first-differenced residuals. The null hypothesis is no autocorrelation. A heteroskedasticity-robust test of overidentifying restrictions (Hansen-J test) is performed. The null hypothesis is that the instrument set as a group is exogenous. A Difference-in-Hansen test for exogeneity of the instrument subset (here of private credit) is performed. Under the null the instrument excluded is exogenous. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Comparing column (2) in both Tables 2.4 and 2.5 with the baseline results we see that the coefficients on private credit change only marginally and remain statistically significant. Therefore, the presence of offshore financial centers in the basic sample does not have a qualitative impact on the results.[66] Column (4) in both tables presents the results when I drop oil producers. Again the estimates of the coefficient on my financial development measure do not seem to be qualitatively different. Actually, the statistical significance is now stronger. Further, in column (4) of Table 2.5 GDP per capita now has a significant impact on net debt outflows at the 10% level. This supports the evidence that poor economies are net exporters of portfolio debt capital. Finally, let's consider the developing and emerging sample in column (6) of both tables. Table 2.4 shows that the exclusion of advanced countries does not change the results qualitatively. The only small difference is that now capital account openness has a significant negative impact on net FDI outflows at the 10% level. Finally, column (6) of Table 2.5 shows that within emerging and developing countries private credit is still strongly and negatively associated with net debt outflows. In summary, the baseline estimation results are independent from the choice of the country sample. Financial system development is a key determinant of the direction and composition of capital flows.

In the final step I check whether the inclusion of the quality of institutions other than financial ones has an impact on my baseline results. I use an index of institutions constructed with data from Kaufmann et al. (2006) described in section 2.3. Data on institutions are available only for the period from 1996 to 2004; therefore, all the estimates apply to this sample period.[67]

[66]The only apparent difference in column (2) of Table 2.4 is that now GDP per capita is significant at the 10% level, which indicates that rich countries observe fewer FDI outflows. Even though this is not consistent with the general evidence, GDP per capita may capture the positive impact of human capital abundance in attracting FDI inflows.

[67]Nevertheless, the results show that the choice of the sample period does not have a qualitative impact on the estimated effect of financial development.

Table 2.6: Capital outflows and institutional quality during the period 1996-2004

Dependent Variable:	**Net FDI outflows to GDP**		**Net debt outflows to GDP**	
	(1)	(2)	(3)	(4)
Lagged dependent variable	0.073	0.070	0.014	0.010
	(0.067)	*(0.068)*	*(0.062)*	*(0.061)*
Private credit to GDP	0.045*	0.046*	-0.046**	-0.042**
	(0.024)	*(0.025)*	*(0.020)*	*(0.020)*
Log of real GDP per capita in PPP	0.0062	0.013	-0.068	-0.046
	(0.023)	*(0.024)*	*(0.054)*	*(0.051)*
Trade openness	-0.029**	-0.031***	0.027	0.022
	(0.011)	*(0.011)*	*(0.024)*	*(0.023)*
Capital account openness	-0.010	-0.0099	0.0044	0.0042
	(0.0077)	*(0.0081)*	*(0.018)*	*(0.018)*
Institutions		-0.026**		-0.036*
		(0.013)		*(0.021)*
Year dummies	yes	yes	yes	yes
Observations	831	831	830	830
Number of country clusters	117	117	117	117
Number of instruments	19	20	19	20
F statistic	4.61	4.89	7.68	8.68
F-Test (p-value)	0.00	0.00	0.00	0.00
AR(1) Test	-6.28	-6.26	-5.34	-6.36
AR(1) Test (p-value)	0.00	0.00	0.00	0.00
AR(2) Test	0.46	0.43	-1.24	0.55
AR(2) Test (p-value)	0.65	0.67	0.21	0.58
Hansen-J statistic	4.19	3.94	5.90	5.20
Hansen-J (degrees of freedom)	6	6	6	6
Hansen-J (p-value)	0.65	0.69	0.43	0.52
Diff-in-Hansen statistic for private credit	0.00	0.09	2.35	2.19
Diff-in-Hansen for private credit (p-value)	0.97	0.76	0.13	0.14
Diff-in-Hansen statistic for institutions		0.29		1.62
Diff-in-Hansen for institutions (p-value)		0.59		0.20

Notes: Robust standard errors adjusted for clustering on the country level in parentheses. Estimates are one-step difference GMM. In columns (3) and (4) a forward orthogonal deviations transformation is used instead of first differences. In all the columns L2-L4.(dependent variable) are used as instruments for the (transformed) lagged dependent variable and capital account openness is instrumented with L2-L6 of its level. The table shows the Arellano-Bond test for first- and second-order autocorrelation of the first-differenced residuals. The null hypothesis is no autocorrelation. A heteroskedasticity-robust test of overidentifying restrictions (Hansen-J test) is performed. The null hypothesis is that the instrument set as a group is exogenous. A Difference-in-Hansen test for exogeneity of the instrument subset (here of private credit or institutions) is performed. Under the null the instrument excluded is exogenous. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

This institutional index is a proxy for "property rights institutions" from the model of Ju and Wei (2007) with higher values indicating better developed institutions. Table 2.6 presents the estimation results. Columns (1) and (2) use net FDI outflows as a dependent variable whereas columns (3) and (4) use net debt outflows. Due to data availability 117 of the 122 countries from the basic sample are used in this estimation. Throughout all the specifications the overall Hansen test of overidentifying restrictions as well as the individual tests for both private credit and institutions cannot reject the null hypothesis of exogeneity of the explanatory variables. Unfortunately, the estimated coefficient on the lagged dependent variable is not statistically significant.[68] Therefore, I interpret only contemporaneous effects.

As previously stated the theory predicts that countries with better property rights institutions should experience fewer net FDI outflows as well as fewer net debt outflows. Therefore, the coefficient for the effect of the quality of institutions on net FDI (debt) outflows should be negative. Columns (2) and (4) of Table 2.6 show that the estimated coefficients indeed have a negative sign and are statistically significant at the 5% or 10% levels, respectively. Furthermore, the *economic* effect of the institutional quality index is sizable. The difference in this variable between a country at the 75th percentile of institutions like Lithuania and a country at the 25th percentile like the Kyrgyz Republic is 1.363. The impact of institutional quality on FDI outflows is therefore about $1.363 * 0.026 = 3.54$ percentage points, which represents 81% of the interquartile range of net FDI flows to GDP.[69] Now let's compare this effect with the impact of private credit. Given the estimate of 0.046 the impact of financial development accounts for 64.5% of the observed interquartile range of net FDI flows to GDP. Accordingly, it is a little lower

[68] Even though the lagged dependent variable has no significant impact, which may indicate a static model, I still rely on GMM as the correct estimation technique because I have to use instruments for the potentially endogenous capital account openness.

[69] This range is around 4.37 percentage points.

than the effect of the institutional index.[70] For debt outflows in column (4) a similar picture emerges. Improving the quality of institutions in the Kyrgyz Republic to the level in Lithuania leads to a 4.9 percentage points increase in net debt inflows.[71] This represents around 71.4% of the 6.86 percentage points interquartile range of net debt outflows as a percentage of GDP. In contrast, the effect of financial system development is smaller and amounts to $0.614 * 0.042 = 2.58$ percentage points, which make up 37.6% of the observed interquartile range.

In summary, the quality of institutions has a positive, statistically and economically significant impact on both net FDI and portfolio debt inflows. The effect of the quality of the financial system in this respect is smaller, but still economically significant and more importantly independent from it. Therefore, as suggested by the model of Ju and Wei (2007), both financial and property rights institutions are key determinants of the direction and composition of international capital flows.

2.5 Conclusion

This paper provides empirical evidence that financial development is a key determinant of recent empirical patterns of worldwide capital flows. Since the mid 1980s there is evidence that FDIs flow on net to emerging and developing countries but simultaneously significant net flows of portfolio debt capital are directed to developed countries. While traditional neoclassical theory is unable to explain these "paradoxical" developments recent theoretical literature emphasizes the role of financial market frictions. In such a setting differences in financial system development across countries combined

[70] For this sample the difference in private credit between a country on the 75th percentile and a country on the 25th percentile is 0.614. The impact is therefore $0.614 * 0.046 = 2.82$ percentage points.

[71] The effect is $1.363 * 0.036 = 4.9$ percentage points.

with an increased international financial integration generate a sort of comparative advantage that alters the direction and composition of capital flows. In particular, using a panel dataset of up to 122 developing, emerging and developed countries, I show that the degree of financial development influences different types of capital flows in different ways. As suggested by recent models, e.g. that of Ju and Wei (2007) among others, good financial institutions are ceteris paribus associated on net with debt inflows and FDI outflows. Further, better property rights institutions attract more FDI and more debt inflows on net. As suggested by theory, the effect of financial institutions is independent of the impact of the quality of other institutions. Using the dynamic difference GMM estimator proposed by Arellano and Bond (1991) I confirm that these results are not driven by endogeneity due to omitted variables or reverse causality.

The findings in this paper have important economic implications. First, the increased worldwide financial integration allows domestic savers in developing countries to "bypass" the inefficient, underdeveloped financial system and simultaneously enables foreign investors to run profitable investment projects in those countries, which are not financed through the domestic financial system. Second, the observed recent patterns of current account imbalances may be rationalized by cross-country differences in financial development in a financially globalized world.[72] As shown by Antràs and Caballero (2009), policy makers should be cautious in raising trade barriers in order to reduce these "imbalances", because these actions may even exacerbate them. Finally, the global financial crisis that started in 2008 indicated that increased cross-border holdings of assets may be dangerous for the stability of the global financial system. It showed that negative local shocks, i.e. the collapse of the sub-prime mortgage market in the US, are likely to

[72]See Mendoza et al. (2009). In a different model Caballero et al. (2008) show as well that such "imbalances" may arise as an equilibrium response to different shocks, whereas financial system development is a key feature of the model.

be transmitted quickly and powerfully to foreign countries, which bear the risk of holding "toxic" US assets and as a result not only the US but also the global economy is affected. Therefore, although growing capital flows across countries may be advantageous, they may increase the vulnerability of the global financial system.

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A Appendix to Chapter 2

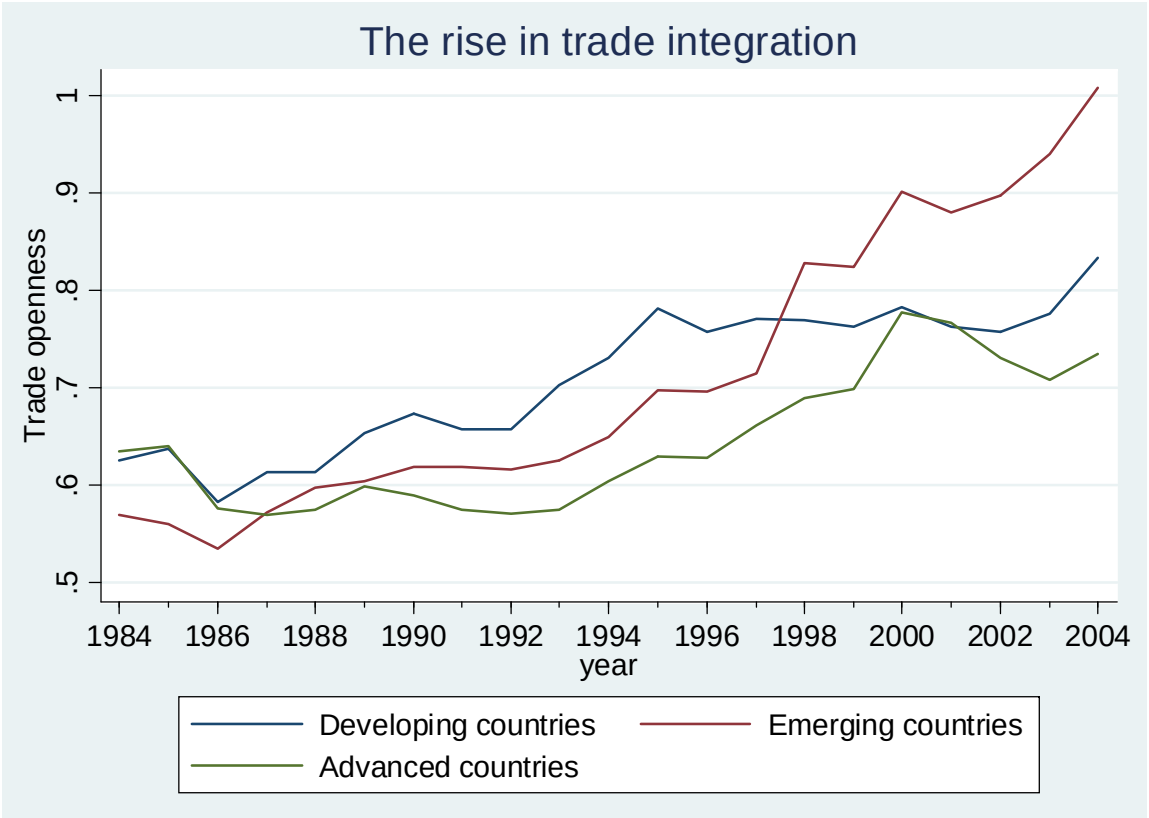
Table 2.7: Country description

Country name	**Country ISO code**	**Country name**	**Country ISO code**
Albania*	ALB	Estonia	EST
Algeria	DZA	Ethiopia	ETH
Angola*	AGO	Fiji	FJI
Argentina	ARG	Finland	FIN
Armenia	ARM	France	FRA
Australia	AUS	Gabon	GAB
Austria	AUT	Georgia	GEO
Azerbaijan	AZE	Germany	DEU
Bahrain	BHR	Ghana	GHA
Bangladesh	BGD	Greece	GRC
Belarus*	BLR	Guatemala	GTM
Belgium	BEL	Guinea	GIN
Benin	BEN	Haiti	HTI
Bolivia	BOL	Honduras	HND
Bosnia and Herzegovina	BIH	Hong Kong, China	HKG
Botswana	BWA	Hungary	HUN
Brazil	BRA	Iceland	ISL
Brunei*	BRN	India	IND
Bulgaria*	BGR	Indonesia	IDN
Burkina Faso	BFA	Iran, Islamic Rep.	IRN
Cambodia	KHM	Ireland	IRL
Cameroon	CMR	Israel	ISR
Canada	CAN	Italy	ITA
Chad	TCD	Jamaica	JAM
Chile	CHL	Japan	JPN
China	CHN	Jordan	JOR
Colombia	COL	Kazakhstan	KAZ
Congo, Dem. Rep.*	ZAR	Kenya	KEN
Congo, Rep.	COG	Korea, Rep.	KOR
Costa Rica	CRI	Kuwait	KWT
Cote d'Ivoire	CIV	Kyrgyz Republic	KGZ
Croatia	HRV	Lao PDR	LAO
Cyprus	CYP	Latvia	LVA
Czech Republic	CZE	Lebanon*	LBN
Denmark	DNK	Libya*	LBY
Dominican Republic	DOM	Lithuania	LTU
Ecuador	ECU	Luxembourg*	LUX
Egypt, Arab Rep.	EGY	Macedonia, FYR	MKD
El Salvador	SLV	Madagascar	MDG
Equatorial Guinea	GNQ	Malawi	MWI

Table 2.7 - Continued

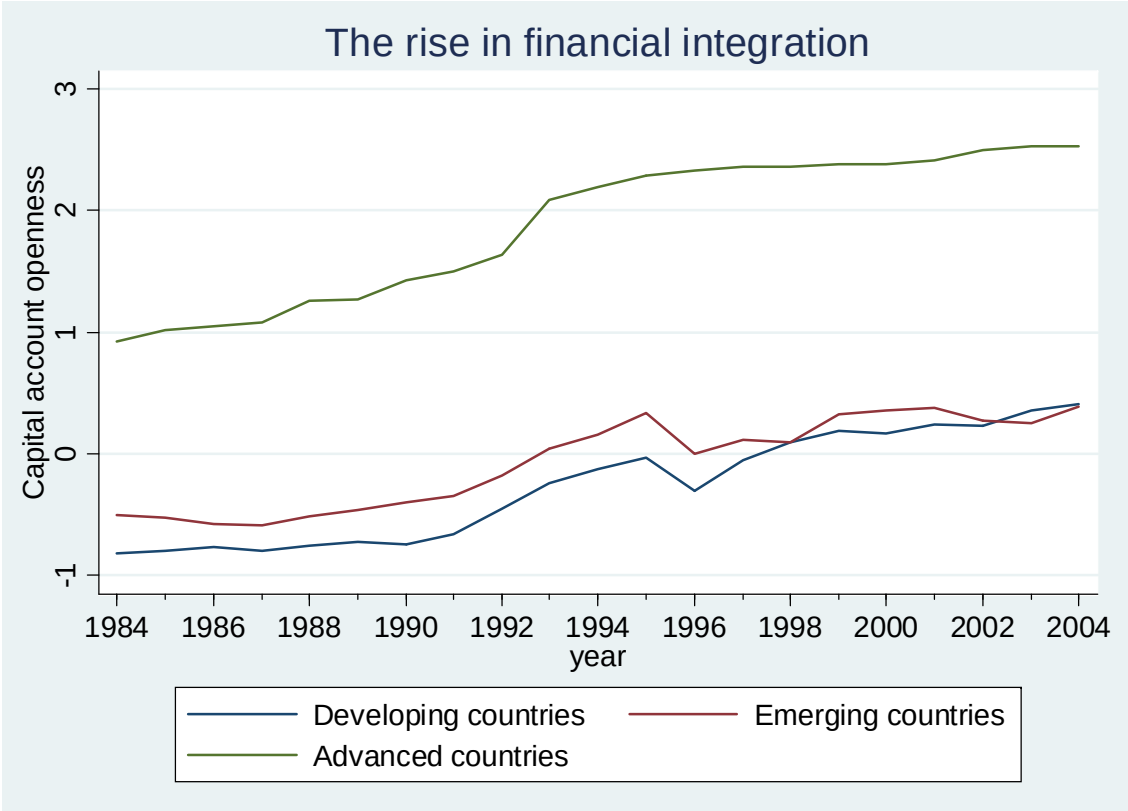
Country name	Country ISO code	Country name	Country ISO code
Malaysia	MYS	Swaziland	SWZ
Mali	MLI	Sweden	SWE
Malta	MLT	Switzerland*	CHE
Mauritius	MUS	Syrian Arab Republic	SYR
Mexico	MEX	Taiwan*	TWN
Moldova	MDA	Tajikistan*	TJK
Morocco	MAR	Tanzania	TZA
Mozambique	MOZ	Thailand	THA
Myanmar*	MMR	Togo	TGO
Namibia	NAM	Trinidad and Tobago	TTO
Nepal	NPL	Tunisia	TUN
Netherlands	NLD	Turkey	TUR
New Zealand	NZL	Turkmenistan*	TKM
Nicaragua*	NIC	Uganda	UGA
Niger	NER	Ukraine	UKR
Nigeria	NGA	United Arab Emirates*	ARE
Norway	NOR	United Kingdom	GBR
Oman	OMN	United States	USA
Pakistan	PAK	Uruguay	URY
Panama	PAN	Uzbekistan*	UZB
Papua New Guinea	PNG	Venezuela, RB	VEN
Paraguay	PRY	Vietnam*	VNM
Peru	PER	Yemen, Rep.*	YEM
Philippines	PHL	Zambia	ZMB
Poland*	POL	Zimbabwe	ZWE
Portugal	PRT		
Qatar*	QAT		
Romania	ROM		
Russian Federation	RUS		
Rwanda	RWA		
Saudi Arabia	SAU		
Senegal	SEN		
Serbia and Montenegro*	YUG		
Singapore	SGP		
Slovak Republic*	SVK		
Slovenia	SVN		
South Africa	ZAF		
Spain	ESP		
Sri Lanka	LKA		
Sudan	SDN		

Notes: Sample of 145 countries from Lane and Milesi-Ferretti (2007). 23 countries marked with an asterisk (*) are excluded from the basic estimation sample.



Notes: The figure shows the average of trade openness, defined as the sum of exports and imports of goods and services over GDP, over the period 1990-2004 for three country groups: advanced, emerging and developing economies.

Figure 2.5: Trade integration over the period 1984-2004



Notes: The figure shows the average of capital account openness index from Chinn and Ito (2008) over the period 1990-2004 for three country groups: advanced, emerging and developing economies.

Figure 2.6: Financial integration over the period 1984-2004

Table 2.8: Pairwise correlations of explanatory variables

	Private credit to GDP	Log of real GDP per capita in PPP	Trade openness	Capital account openness	Institutions
Private credit to GDP	1.00				
Log of real GDP per capita in PPP	0.69	1.00			
Trade openness	0.22	0.24	1.00		
Capital account openness	0.48	0.59	0.26	1.00	
Institutions	0.71	0.84	0.24	0.61	1.00

Notes: The table shows the pairwise correlations between the main explanatory variables used in section 2.4.2.

Table 2.9: Summary statistics

Variable	Obs	Mean	Std Dev.	Min	Max
Net FDI outflows to GDP	2064	-0.015	0.027	-0.084	0.024
Net debt outflows to GDP	2064	-0.013	0.060	-0.145	0.130
Private credit to GDP	2064	0.454	0.390	0.010	2.492
Log of real GDP per capita in PPP	2064	8.521	1.146	6.185	10.504
Trade openness	2064	0.735	0.484	0.056	4.169
Capital account openness	2064	0.256	1.568	-1.767	2.603
Institutions	831	0.132	0.878	-1.608	1.938

Notes: The table shows descriptive statistics for the main variables used in section 2.4.2. For institutions the sample period spans 1996-2004, for all other variables it is 1984-2004.

Chapter 3

Credit Constraints in Europe: Firm Productivity and Export Status

3.1 Introduction

After the fall of the "Iron Curtain" Eastern European countries showed remarkable performance. The gradual opening to trade and capital flows surrounding the preparation for the enlargement of the European Union allowed not only Eastern but also Western European countries to gain from larger markets, technological improvements and an increased number of product varieties. This process was accompanied by a surge in trade flows across countries and an improvement in productivity levels, which raised the welfare in all the participating countries. Even though the labor productivity growth during the period 1999-2004 was stronger in Central and Eastern European Countries (CEEC), their productivity *level* is still about half of that in Western European states.[1]

It is the consensus in the literature on economic growth to emphasize the importance of property rights and contracting institutions for economic development.[2] As countries develop further and property rights strengthen, financial institutions gain more attention for explaining differences in economic development between emerging and advanced economies. Although there have been significant improvements in the financial systems of many emerging economies in the last decade, cross-country differences between Eastern and Western Europe as well as within the group of Western European countries remain significant. Levine (2005) points out the major role of financial development as providing improvements in the "(i) production of ex ante information about possible investments, (ii) monitoring of investments and implementation of corporate governance, (iii) trading, diversification, and management of risk, (iv) mobilization and pooling of savings, and (v) exchange of goods and services". Thus, by reducing financial frictions, financial development facilitates economic development.

[1] See Alam et al. (2008), p. 73, figure 2.7.
[2] See Acemoglu and Johnson (2005).

Are financial frictions really important for entrepreneurial activities? The financial crisis that started in 2008 gave us the correct, affirmative answer. According to the October 2008 euro area bank lending survey of the European Central Bank (ECB), there has been "a significant increase in the net tightening of credit standards for loans to enterprises in the third quarter of 2008."[3] Subsequent surveys show that these tight conditions remained at high levels. At the same time GDP in the euro area slumped by 3.9% in 2009, while CEEC experienced a 4.3% drop.[4] This suggests that financial conditions are indeed important for economic activity. A further survey on the access to finance of small and medium-sized enterprises (SMEs) published by the ECB reports that for the first half of 2009 especially SMEs found it difficult to access finance compared with large corporations.[5] SMEs report two main reasons why credit conditions have worsened: deterioration of the economic outlook and an increase in collateral requirements. This suggests that the availability of assets that can serve as collateral is an important determinant of the access to external finance for firms. In addition, SMEs reported reduced availability of internal funds as factors for their external financing needs.[6]

The next relevant question is whether financial frictions are important for international trade flows. In a recent press release the World Trade Organization (2010) reports that in the financial crisis year of 2009, the global trade flows fell by 12.2%, the sharpest decline since World War II. The World

[3]See European Central Bank (2008).

[4]See International Monetary Fund (2010).

[5]See European Central Bank (2009). The survey covers 6,000 SMEs as well as large firms in the euro area. Around 43% of SMEs in the euro area reported a worsening in the availability of credit. Moreover, the smaller the enterprise, the higher is the percentage of firms reporting deterioration in the readiness of banks to provide credit. This survey is interesting insofar as the sample of firms I am using in the empirical analysis consists of around 95% SMEs (fewer than 250 employees) and even around 99% of all firms do not have access to stock markets.

[6]These observations are consistent with how the existing literature measures financial constraints.

Trade Report 2009[7] suggests that one of the main causes is the financial crisis, which led to "a sharp decline in credit to finance imports and exports."[8] There are several theoretical considerations for why exporting firms rely on external finance. Beyond the domestic financing needs, firms entering export markets face substantial fixed costs, e.g. for marketing research, advertising, product development and customization, setting-up of new distribution networks abroad etc., which typically have to be paid before export revenues are generated.[9] Since firms typically do not have enough cash flow to finance them, they rely on external finance. Moreover, Auboin (2007) argues that more than 90% of trade transactions involve some form of credit, insurance or guarantee. Hence, banks or other financial institutions play a key role in enabling firms to export or import at desirable levels.

Using a large panel of firms active in up to 28 Eastern and Western European countries from 179 three-digit US SIC industries during the period 1995-2004, this paper provides evidence that financial constraints are an important determinant of firm-level total factor productivity (TFP) as well as firms' export participation. My results generally match the predictions of theoretical models on heterogeneous firms, credit constraints and trade, e.g. Manova (2006) among others, which show how financial frictions shape trade patterns and productivity differentials. That is, other things being equal, firms operating in more financially dependent industries and/or industries that have less tangible assets are on average more productive *and* are more likely to export in countries with a better developed financial system. These findings are independent of the effects of traditional comparative advantage as well as the effects of non-financial institutions. One interesting further

[7]See World Trade Organization (2009).

[8]Chor and Manova (2009) provide evidence that during the crisis countries with tighter credit conditions exported less to the US.

[9]See Manova (2009). These costs can be sunk or per period. In addition to fixed costs, variable costs for duties and transportation are important and may require external finance.

result states that credit constraints operate through different channels when one differentiates between manufacturing and services industries. While insufficient cash flow constrains manufacturing firms, the availability of collateral seems to be more important for services. This finding is consistent with the notion that service activities usually involve transfers of relatively more intangible assets, which cannot be used as collateral for financing purposes. Therefore, financial institutions may be more reluctant to provide sufficient credit to service companies compared with manufacturing enterprises.

This paper contributes to the existing literature in several ways. First, it provides firm-level evidence that credit constraints are an important determinant of both TFP and export behavior where firm-level studies are rather scarce. Second, it focuses on a larger and more homogeneous set of countries, which are mostly members or candidates of the European Union.[10] Third, most previous studies consider in their analysis solely manufacturing industries. However, it is interesting to study services for two reasons. The share of services in total value added and employment has grown over time and is significantly bigger than the rest of the economy for both Western and Eastern European countries.[11] For CEEC the share in value added rose significantly from 40% in 1999 to 60% in 2005.[12] Moreover, the expansion of services relative to agriculture and manufacturing boosted the aggregate labor productivity level during the period 1999-2004.[13] Therefore, ignoring the important role of services does not allow us to understand fully significant developments in the economy. Finally, previous firm-level studies using trade data do not effectively account for the endogeneity of firm-level measures of financial health with respect to the export decision. Using exogenous measures of financial vulnerability and applying a difference-in-difference methodology

[10] In contrast, firm-level studies like Gatti and Love (2008) or Greenaway et al. (2007) focus on individual countries only.

[11] See Alam et al. (2008), p. 72.

[12] See Alam et al. (2008), p. 14.

[13] See Alam et al. (2008), p. 15.

I am able to establish a causal relationship from credit constraints to a firm's export participation.[14]

The rest of the paper is organized as follows. Section 3.2 provides a review of the related theoretical and empirical literature. The subsequent section 3.3 provides a brief look at the dataset and the definitions and measurement of the key explanatory variables. Section 3.4 describes how firm-level total factor productivity is estimated. In sections 3.5 and 3.6 I present the empirical models and estimation results for how credit constraints affect TFP and the export status of the firm, respectively. These sections provide additional robustness checks, too. Finally, section 3.7 concludes.

3.2 Related literature and theoretical predictions of heterogeneous firms models with credit constraints

This paper provides evidence on the effects of financial constraints on firms' TFP as well as their export activities. It can be related to two broad areas of research: the first one is the more traditional literature on finance and growth and the second one is the newly established but growing literature on finance and trade.

The finance and growth literature emphasizes the role of the availability of external funds and the efficiency of the financial system for facilitating economic growth.[15] The industry-level analysis of Rajan and Zingales (1998) among others provides strong evidence that firms from financially dependent industries have higher growth rates of value added in countries with better developed financial systems. The firm-level studies on that topic are rather

[14] A recent exception is Manova et al. (2009).

[15] For a comprehensive survey of the theoretical and empirical literature on finance and growth see Levine (2005).

scarce. Beck et al. (2004) use survey data from 54 countries and demonstrate that financing obstacles negatively impact on the growth of firms' sales. While these papers look at the link between the *growth rate* of value added and financial constraints, I focus instead on how the level of total factor productivity by individual firms is affected for the following reasons. First, Easterly and Levine (2001) provide evidence that TFP accounts for most of the cross-country differences in the *level* and growth of GDP per capita.[16] Second, firm-level studies on the link between the level of TFP and financial constraints are rather scarce. One example is Gatti and Love (2008), who find that Bulgarian firms that have better access to credit feature higher TFPs. The potential problem of simultaneity is present in their study because for example whether the firm has a credit line depends clearly on its overall performance (productivity). Even though the authors use two-stage least-squares estimation to address this problem, one can doubt the results. Their instrument "positive past sales growth" clearly does not meet the exclusion restriction because it influences directly the contemporaneous level of TFP.

The studies above have nothing to say about the link between finance and export patterns. Here comes the role of the literature on finance and trade. The seminal theoretical work is by Kletzer and Bardhan (1987), who use a two-country, two-sector, two-factor Heckscher-Ohlin framework to study the link between credit markets and international trade patterns. This model shows that financial development can generate a comparative advantage even in the absence of technological and endowment differences or economies of scale. The studies of Beck (2002, 2003) among others[17] give empirical support and show that countries with better developed financial systems have

[16]Rioja and Valev (2004) give the more differentiated view that finance accelerates primarily TFP growth for advanced countries, whereas it boosts capital accumulation in developing countries.

[17]Similar studies on the country or country-industry level are Becker and Greenberg (2005), Svaleryd and Vlachos (2005) and Hur et al. (2006).

higher export shares, especially in industries that rely more on external finance. Although these studies give consistent evidence that financial constraints affect export behavior, they are not able to provide a more exact, disaggregated view of what drives the exports in a particular industry and at the same time they do not generate predictions about TFP differences across countries and industries. Here comes the role of heterogeneous firms models, which depart from the assumption that all the firms in an industry are identical. Chaney (2005) introduces liquidity constraints in a Melitz (2003)-type model where firms differ in their productivity levels. Manova (2006) uses the Melitz framework as well but in addition to Chaney explicitly models financial contracts and sectoral dependence on finance, which generates richer predictions about trade patterns. In both models financial frictions (the lack of liquidity or external financing) prevent less efficient potential exporters from entering export markets.

Let me focus on the theoretical predictions of the richer model of Manova (2006), which is a multi-country, multi-sector partial equilibrium model. The key assumption is that firms face substantial fixed costs of exporting, e.g. for marketing, advertising, distribution etc., which are typically paid up-front before entering the export market. Since export revenues are not realized yet, some parts of these fixed costs should be financed externally.[18] *Conditional* on a country's level of economic development, which captures the fact that the productivity distribution may differ on average across countries, opening to trade induces the following two effects. First, in financially constrained sectors firms are more likely to enter export markets if they are settled in the financially developed country.[19] Second, Manova's model has a partial

[18]In the original Melitz (2003) model firms pay the fixed exporting cost using solely their internal funds.

[19]This is a consequence of the result that the "export productivity cut-off" is lower in countries with a better developed financial system. Manova (2006, 2008) provides strong cross-country-industry level evidence that credit constraints indeed impact on trade patterns using the variation in the country's development of the financial system as well

equilibrium framework and it does not show the differential effect of credit constraints on the average productivity across industries but only how export activity is affected. Extending it to a general equilibrium as long as there is selection into exporting, the following additional effect on average productivity arises: there will be more intensive entry of firms into export markets in the better financially developed countries, which will lead to a stronger competition for purely domestic firms in those countries.[20] On the labor market this will drive up the wage rate more strongly, thus leading to a higher increase in costs. This lowers the ex-post profits of non-exporters, since they do not face the foreign demand in addition to their domestic one. Therefore, firm selection will be stronger in the financially developed country. As a consequence the least efficient firms will exit the domestic market, which means that on average more productive companies survive in this industry. This effect is then stronger in the financially developed country. However, if one extends the model by assuming in addition that the fixed entry costs should be financed by external funds, the predictions of the model would be different. Now firms are still more likely to be exporters in the financially developed country, but also purely domestic firms are more likely to enter the market, because access to external finance is easier.[21] The survival of less efficient firms would lower the average productivity.[22] Hence, the effect of financial constraints on the average productivity is theoretically ambiguous, which is the starting point for my empirical analysis.

as shocks to the availability of finance due to equity market liberalizations.

[20]The "zero-profit productivity cut-off" will be higher in countries with a better developed financial system.

[21]Which means that the "zero-profit productivity cut-off" would be lower in the financially advanced country.

[22]Recent literature on trade liberalization argues that beside between-firm reallocations there can be significant within-firm productivity improvements (Melitz and Costantini (2008)). In the empirical analysis I am not going to answer the question of whether within- or between-firm productivity gains drive the average productivity. Alam et al. (2008) find for CEEC that among industries dominated by SMEs (fewer than 250 employees), reallocation plays a more important role than within-firm productivity improvements for aggregate productivity growth (Alam et al. (2008), p. 120).

The last related theoretical paper is by Bernard et al. (2007b), who introduce differences in the relative abundance of human capital into a Melitz (2003) model. Even though this paper does not explain the link between finance, TFP and trade patterns, it shows that traditional sources of comparative advantage can simultaneously influence firm productivity and exports. The authors demonstrate that trade liberalization induces reallocations of resources not only across but also within industries. In general equilibrium the probability of exporting is shown to be higher in the comparative advantage sector relative to the comparative disadvantage sector because export opportunities are greater in this sector. Further, this generates higher competition in comparative advantage sectors, which leads to a stronger exit of unproductive domestic firms. As a result the average productivity in this sector rises by more. These results suggest that along with financial constraints traditional comparative advantage can drive both observed productivity levels and export participation, which should be accounted for in empirical studies.[23]

While there are several empirical studies on credit constraints and trade that use aggregated data, firm-level studies on that topic are rather scarce. Greenaway et al. (2007) use a sample of UK manufacturing firms and show that exporters have better financial health (high liquidity and low leverage) than non-exporters, whereas interestingly there is no evidence of a selection effect of ex-ante more financially healthy firms into exporting. Even the opposite is found to be true. In contrast, Muûls (2008) and Berman and Héricourt (2008) provide evidence that firms are more likely to become exporters if they are initially more productive and if they are less financially

[23]It is worth emphasizing that overall heterogeneous firm models predict that the *level* of TFP and not the growth rate of TFP should be a function of country and industry characteristics. This is the reason why I depart from the finance and growth literature. Moreover, as already noted, Alam et al. (2008) estimate that even though the labor productivity growth during the period 1999-2004 was stronger in CEEC, the productivity level was more than twice as low as in Western EU member states. Therefore, looking at the cross-country differences in productivity levels seem to be more interesting.

constrained.[24] However, all three studies use firm-level balance sheet measures of credit constraints or the company's credit ratings, which are likely to be endogenous to the decision of the firm to export. Therefore, their results should be viewed with caution. Recently, Manova et al. (2009) provided evidence on the link between exports and financial frictions using Chinese firm-level data. Unlike the previous studies, they use industry-specific measures of financial vulnerability that are exogenous to the firm's export decision.[25]

To summarize, the existing firm-level empirical literature on the link between credit constraints and firm productivity or a firm's export participation finds it difficult to establish causality. In the next section I present the data that are used in the empirical analysis and show how I deal with the potential endogeneity of firm-level measures of financial constraints.

3.3 Data and summary statistics

3.3.1 Firm-level data

In order to perform a comprehensive empirical analysis I use different data sources. The AMADEUS database (2005) from Bureau van Dijk Electronic Publishing (BvDEP) serves as the main source of information.[26] It provides comprehensive data on different balance sheet and income statement items for a large number of firms in all European countries, except Albania and

[24] Muûls (2008) focuses on a sample of Belgian manufacturing firms whereas Berman and Héricourt (2008) use Investment Climate Surveys data from the Worldbank on 5000 firms from 9 developing and emerging economies (China, India, Bangladesh, Indonesia, the Philippines, Thailand, Vietnam, Morocco and South Africa).

[25] This is also the way I proceed. While I focus on the participation decision (extensive margin) they use firm-level data by export destinations and are able to explore the intensive margin of exports.

[26] This database is widely used in empirical studies on European firms. For example, Helpman et al. (2004) use this data to estimate productivity distributions while Klapper et al. (2006) use data on market entry rates in different industries.

the former CIS. In the 2005 edition 40 European countries are covered.[27] I use the medium-size database, which focuses on the top 1.5 million companies. AMADEUS uses the following criteria for the inclusion of firms in this database: for the UK, Germany, France, Italy, Spain, Ukraine and the Russian Federation companies must satisfy at least 1 of the following 3 criteria:

1. operating revenue equal to at least 1.5 million euro;
2. total assets equal to at least 3 million euro;
3. number of employees equal to at least 20.

For all other countries these criteria are:

1. operating revenue equal to at least 1 million euro;
2. total assets equal to at least 2 million euro;
3. number of employees equal to at least 15.

From the 1.5 million firms I sample only unconsolidated accounts, namely I exclude consolidated statements of parent firms and their subsidiaries, which are included in the database. This prevents double counting of firms. Firms are selected further so as to have non-missing data on value added, sales, total revenues, fixed assets, total assets, number of employees and material cost. These data are required to estimate total factor productivities (TFP) at the firm level. In order to use a more homogeneous sample I focus on countries that are currently members of the European Union (plus

[27] The countries are: Austria (AT), Belarus (BY), Bulgaria (BG), Belgium (BE), Bosnia and Herzegovina (BA), Croatia (HR), Cyprus (CY), Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (GR), Hungary (HU), Iceland (IS), Ireland (IE), Italy (IT), Latvia (LV), Liechtenstein (LI), Lithuania (LT), Luxembourg (LU), Macedonia (MK), Malta (MT), Moldova (MD), Monaco (MC), the Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Romania (RO), the Russian Federation (RU), Serbia and Montenegro (CS), the Slovak Republic (SK), Slovenia (SI), Spain (ES), Sweden (SE), Switzerland (CH), Ukraine (UA) and the United Kingdom (GB).

Switzerland and Norway) or are EU candidates. After applying the above selection criteria I end up with 28 countries, of which 16 are Western European and 12 belong to the group of Central and Eastern Europe (CEE). Table 3.12 in Appendix B provides a list of the country coverage. The available sample period spans the years 1995 and 2004. The panel of companies is unbalanced with an average of 5 to 6 yearly observations per firm. With respect to the industry coverage the following sample selection was performed. Primary sectors are not included in the sample, because their existence highly depends on countries' abundance of natural resources.[28] Finance, real estate and insurance industries (SIC codes 600-699) were also dropped because financial and profitability measures are hardly comparable with those of other firms. As a result the final sample consists of up to 539,015 firms active in 179 three-digit US SIC industries.[29] Table 3.1 shows the distribution of firms across broad industry divisions. Most of the companies come from manufacturing and wholesale trade, whereas firms from transportation, communication etc. services represent the minority group in the dataset. As a whole secondary industries cover around 42% of the firms while 58% are tertiary industries.

Table 3.1: Industry coverage in the sample

Industry Division	**SIC codes**	**Percentage**
Construction	152-179	12.7
Manufacturing	201-399	29.6
Transportation, Communication, etc. Services	401-495	7.3
Wholesale Trade	501-519	24.8
Retail Trade	523-599	11.5
Other Services	701-874	14.1

Notes: The table shows by industry division the total number of active firms during the sample period of 1995-2004.

[28] Gold and silver ores are the only exception. Leaving out this industry does not alter all the results presented in the paper.

[29] Table 3.14 in Appendix B provides a full description of all 179 industries.

Analyzing the role of credit constraints for export activity in section 3.6 requires firm-level data on export turnover reported in the AMADEUS database. Unfortunately, this information is relatively scarce. From the 28 countries sampled before only 6 countries collect and report this data. After applying some sample selection criteria I am left with the countries France, the United Kingdom, Sweden and Croatia. Section 3.6 provides summary statistics on the export sample.

3.3.2 Industry-level data

In the empirical analysis I use different measures of industry characteristics. The most important data are on financial constraints. The primary data source is the Worldscope Database (2008) by Thomson Financial. This database provides detailed balance sheets and income statements of 8915 listed US companies over the period 1995-2004. This database is used to calculate measures of financial vulnerability following the methodology developed by Rajan and Zingales (1998) and Braun (2003).[30]

Rajan and Zingales (1998) identify a particular channel through which credit affects economic activity, i.e. via the dependence on external finance. They argue that not every firm (industry) benefits from a better supply of credit. Only those who are "naturally" more dependent on external finance will be able to gain. However, there is a typical identification problem in capturing empirically the (natural) demand for credit because only equilibrium quantities are actually observed. Therefore, country-specific firm-level measures of the credit usage may constitute poor measures of financing needs. For example, in economies with poor credit supply firms are likely to respond endogenously with less external financing. The economic effects of an

[30]These measures have been extensively used by many researchers, e.g. Manova (2006) for export activity, Klapper et al. (2006) or Aghion et al. (2007) for the market entry of new firms, Kroszner et al. (2007) or Dell'Ariccia et al. (2005) for the effect of banking crises on growth of industry value added, etc., when looking at the effects of credit constraints.

increased credit supply would therefore be underestimated. A solution to this problem arises only if the supply of credit is nearly perfectly elastic, so that the demand for credit determines the actually observed amount. Rajan and Zingales argue that publicly listed US companies are good candidates because they face such conditions for two reasons. First, among all countries the US has one of the most developed financial systems. Second, within the US publicly quoted companies face the least barriers to external funding. In order to use this measure for all other countries the assumption made by Rajan and Zingales is that the natural demand for credit of a company within an industry depends mainly on the technological characteristics of the production process of that particular industry.[31] This assumption does not mean that the financial dependence of industries does not vary across countries. It requires only that the relative ranking of industries with respect to this measure does not change across countries.

The second alternative measure of tight credit constraints is introduced by Braun (2003). He argues that in the presence of incomplete contracting (captured by the level of financial development) higher asset tangibility serves as collateral (protection) to banks (outside investors). Only those firms that have (naturally) more tangible assets that can serve as collateral will be able to access credit markets and gain from a higher credit supply. The same problem of identification arises when one uses country-specific firm-level measures. In economies with poor credit supply companies are likely to compensate endogenously for this country's disadvantage by holding more tangible assets on their balance sheets. This would underestimate the economic effects of the availability of credit. To overcome this problem

[31]For Western European countries this is clearly a good assumption. I argue that this is mainly the case for Eastern European countries as well for the following reasons. After the fall of the "iron curtain" the old production technologies were replaced with new ones because firms were not competitive compared with the Western European imported goods. Moreover, the transition process to a market economy in Eastern European countries was guided by technology transfer from Western Europe through inward FDI. This was particularly important after 1995, which is the start of my sample period.

again publicly listed US companies are good candidates for "estimating" the natural financial "vulnerability" of a particular sector.

Rajan and Zingales (1998) and Braun (2003) calculate the variables only for the manufacturing sector, which incorporates up to 36 three-digit industries. Moreover, these measures are based on data for the period before my starting year of 1995. Since I am considering up to 179 manufacturing *and* non-manufacturing industries and the financial conditions in the 1995-2004 period are likely to be different from those in previous periods, I construct these two measures with new data.[32] Rajan and Zingales's measure is called *external financial dependence* of industry j ($FinDep_j$). It represents the fraction of a firm's investment (capital expenditures, $CapExp$) that is not financed by the internal net cash flow ($CashFlow$) from operations. The financial dependence of industry j is calculated by the following formula:

$$FinDep_j = Median_j \left\{ \frac{\sum_t (CapExp_{ijt} - CashFlow_{ijt})}{\sum_t CapExp_{ijt}} \right\}$$

First, I obtain a firm-specific, time-invariant ratio of the capital expenditures not covered by internal cash flow as a ratio of total capital expenditure. This is achieved by summing for each firm i the use of external finance over time and dividing it by the sum of $CapExp$ over the same period. This strategy reduces the effects of the business cycle on these flow variables. In order to obtain an industry-specific measure, Rajan and Zingales consider the median value of the distribution of all i firm-specific measures within an industry j. The median has an advantage over the sample mean because it is not sensitive to the presence of big outliers in the data. The higher $FinDep$ is, the more credit is demanded by the firm/industry.

[32]Rajan and Zingales (1998) and Braun (2003) use the Compustat database of Standard and Poors for variable calculation. However, as reported by Ulbricht and Weiner (2005), after the year 1998 Worldscope's firm coverage is significantly higher than that of Compustat, which leads to better representativity.

The measure of asset tangibility ("asset hardness") is calculated following Braun (2003):

$$Tang_j = Median_j \left\{ \frac{1}{t} \sum_t \frac{(Net\ Property,\ Plant\ and\ Equipment)_{ijt}}{Total\ Assets_{ijt}} \right\}$$

Again, for each firm i an asset tangibility measure is constructed by dividing the "Net Property, Plant and Equipment" balance sheet item, which represents the tangible assets of the firm, by the total assets and averaging it over the sample period. The industry tangibility measure is the median value of the firm-specific ratios. The higher this measure is, the more collateral can be pledged to outside investors (banks) and the more likely it is that credit can be granted.

The second and third columns of Table 3.15 in Appendix B include the calculated measures of credit constraints. For example, a highly financially dependent industry is engines and turbines (SIC 351), while the cigarettes industry (SIC 211) is less dependent on external finance. Further, the miscellaneous personal services industry (SIC 729) has a relatively low level of asset tangibility, while hotels and motels (SIC 701) have a very high ratio of tangible to total assets.

The AMADEUS database is used to compute other variables. For robustness and comparability checks I construct two firm-level asset tangibility measures. Again, whereas the industry-specific US measure is exogenous, the firm-specific one is likely to be endogenous. The first one, Tang1, is defined as the ratio of tangible fixed assets to total assets averaged over time. The second one, Tang2, is the ratio of tangible and financial fixed assets to total assets again averaged over the years 1995-2004. Unfortunately, I cannot build a firm-level financial dependence measure since AMADEUS does not report capital expenditure figures.

For robustness checks I construct two industry-specific asset tangibility measures using UK data as a benchmark from AMADEUS. The reason lies in the fact that the United Kingdom is considered to have one of the most developed financial systems in Europe, which is comparable to that of the US. Hence, the Rajan and Zingales's (1998) and Braun's (2003) assumption of nearly perfectly elastic credit supply is likely to hold for the UK. The first measure is the ratio of tangible fixed assets to total assets averaged over time for the median UK firm. The second one is the median value of the ratio of tangible and financial fixed assets to total assets for UK enterprises. The correlation of the US and UK asset tangibility measures is high at around 0.67, which indicates that indeed technological characteristics of the particular industry common across countries determine the measures.

Table 3.2: Firm- vs. industry-level asset tangibility measures

Measure	**Eastern Europe**	**Western Europe**
Tang (US)	0.26	0.24
Tang1 (UK)	0.23	0.22
Tang2 (UK)	0.27	0.25
Tang1 (firm-level)	0.37	0.20
Tang2 (firm-level)	0.39	0.24
Observations	130,726	1,410,871

Notes: The table shows by country group the means of the variables using the estimation sample from section 3.5.

In Table 3.2 I compare the firm-level asset tangibility measures with the exogenous industry-specific measures using the US or the UK as reference countries. The expectation is that in countries with unsound financial conditions like the Eastern European countries enterprises will endogenously react to these conditions by holding more collateralizable assets than are needed for technological reasons. Obviously, the measures for Western European

countries are very similar. Tang (US), Tang2 (UK) and Tang2 (firm-level) are almost identical and equal to around 0.24. However, for Eastern Europe the firm-level tangibility measures are much higher than the "estimated" ones. Tang (US) and Tang2 (UK) are on average equal to 0.26 compared with 0.39 for Tang2 (firm-level).[33] Therefore, this evidence indeed supports the argument that firm-level financial constraint measures are not suitable for consistent estimation of their effects on TFP or export participation.

In the next step two industry-level measures of human capital intensity (HumInt) and physical capital intensity (CapInt) are calculated using AMADEUS data on UK firms as a benchmark. These measures are used in the empirical analysis in order to make sure that the estimated effects of financial constraints do not capture other sources of comparative advantage. Following Braun (2003), Hur et al. (2006) and Manova (2006) among others, human capital intensity is proxied by the average wage (in million USD per employee) of the median firm in each UK industry. The intuition is that since high-skilled workers are more productive than low-skilled ones then the relative wage compensation for skilled employees will be higher. Physical capital intensity (otherwise called the capital to labor ratio) is defined as the value of fixed assets (in millions USD) per employee for the median UK firm. These measures are, like the others, time-invariant and industry-specific. The United Kingdom is used as a reference country because it has one of the most liberalized (flexible) labor markets in Europe. Since firms face nearly perfectly elastic factor supply, the relative factor prices (wages) would therefore capture the true "technological" demand for skilled and unskilled labor and physical capital.[34] Again, like for the financial constraint measures, even

[33] A further comparison of the industry-level measures across Eastern and Western Europe suggests that in the sample there are on average more tangible industries selected in Eastern Europe. This can be explained by the survival of more financially healthy industries in countries with unsound financial conditions. This hypothesis is in addition supported by the observation that in the same sample Eastern European industries are also less financially dependent than Western European ones (0.004 vs. 0.05 on average).

[34] Literature on relative wages and trade, e.g. Davis (1998), shows that the combination

though these two quantities are not required to be exact across countries, the assumption needed is that the ranking of industries remains unchanged across the European countries in the sample.[35] The last two columns of Table 3.15 present the calculated measures of physical and human capital intensities. For example, a low-skill-intensive industry is knitting mills (SIC 225), while firms from the communications equipment (SIC 366) industry employ more skilled workers. Further, personnel supply services (SIC 736) have a relatively low physical capital intensity, while air transportation (SIC 451) companies have a very high physical capital to labor ratio.

Table 3.16 in Appendix B calculates the pairwise correlation between the four industry-specific variables. Interestingly, asset tangibility is only slightly negatively correlated with financial dependence, which is not significantly different from zero. This suggests that they capture two different characteristics of financial constraints, which can be jointly exploited as potential determinants in a regression framework. The physical and human capital intensities are not significantly correlated with each other, either.

Finally, the World Integrated Trade Solution (2009) database is used to obtain tariff rates, which are shown to be important determinants of trade patterns and productivity differences. It combines several data sources in an integrated solution. The tariff data come originally from the UNCTAD TRAINS (Trade Analysis and Information System) database. For each reporter country and in each three-digit manufacturing and construction industry within this country I obtain a simple average or a weighted average of the import tariffs. Tariffs are effectively applied tariff rates (the lowest available). The partner countries (exporting countries) for which these tariffs are calculated are all other countries (the rest of the world). These tariffs then

of exposure to international trade and rigid wages for unskilled labor would artificially drive the demand for skilled labor and its relative wage. Hence, countries with regulated labor markets are not suitable for "estimating" the "natural" factor intensity of an industry.

[35]For robustness checks I recalculate the HumInt measure using French, Spanish and German data. The pairwise correlation with the UK lies between 0.57 and 0.70.

capture the intensity of import competition in each of the country-industry pairs.

3.3.3 Country-level data

The country-level variables used in the paper are taken from three different sources. Table 3.13 in Appendix B provides summary statistics on the key country variables.

The most important data source is Beck et al. (2000). They provide a database on financial development indicators for a large group of countries. I use two measures of the availability of funds in an economy. These are private credit by deposit money banks as a share of GDP and a more broader definition, i.e. private credit by deposit money banks and other financial institutions as a share of GDP. These credit availability measures are widely used in the finance and growth literature, e.g. Rajan and Zingales (1998) and Kroszner et al. (2007) among others, as well as in the trade and finance literature, e.g. Beck (2002, 2003) and Manova (2006) among others. Other measures that describe the development of the stock markets (e.g. stock market capitalization to GDP or private bond market capitalization to GDP) are less suitable indicators of the availability of funds for the following reasons. First, the AMADEUS sample consists primarily of small and medium-sized enterprises, which heavily use loans instead of debt securities issuance or equity issuance. Second, the European financial system is bank-based as opposed to the market-based US. Finally, Eastern European countries have only very small, illiquid and underdeveloped stock markets during the sample period.[36]

[36]Another alternative to quantity-based financial indicators are price-based ones like interest rates. I argue that these indicators can perform poorly or they can even be misleading. For example during the current financial crisis starting in 2008 central banks set very low interest rates to fight back bad liquidity conditions on money markets. Nevertheless, credit conditions remained very restrictive. So, using interest rates will be not suitable for such situations.

The World Development Indicators (2006) database reports country-level aggregate variables. These are not considered alone as controls, since I am not interested in those effects, but they are used to compute interaction effects with industry characteristics. The first variable I obtain from the database is real GDP per capita in PPP, which is used to proxy for the capital abundance of a country. Clearly it captures other differences but reliable estimates of the physical capital stocks for all Western and Eastern European countries are hardly available. The second variable is the tertiary school enrollment as a percentage of gross school enrollment for each country. It is used to proxy for a country's human capital abundance.[37] Third, the wholesale price index for each country is used to convert nominal variables into real ones. Finally, a PPP conversion factor is used to compare TFP levels across countries.

The last set of country-level variables is obtained from Kaufmann et al. (2006). The authors provide 6 measures of governance quality: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption. They capture the stance of the institutional environment in a particular country beside that of the financial system, which can facilitate economic activity. The indicators are indexes that are computed using hundreds of different variables. Each index of governance is normalized to take values between -2.5 and 2.5 with higher values indicating better quality. I construct an average governance index ("Institutions") which is the simple average of all 6.[38]

[37]Barro and Lee (2001) argue that there are three possible proxies for human capital that are based on educational attainment: school enrollment ratios, literacy rates and average years of schooling. They provide these measures but they are available only for the years 1995 and 2000. Tertiary school enrollment is widely used in the literature, e.g. Egger and Pfaffermayr (2004) among others. Other studies, e.g. Manova (2006), use average years of schooling to proxy for human capital abundance. But again since this variable is not available in a panel I stick to using the school enrollment ratio. Another disadvantage of using average years of schooling is that it is an estimate and hence can be plagued by estimation error.

[38]Indexes are available for the years 1996, 1998, 2000, 2002, 2003 and 2004 only. For

3.4 TFP estimation

The analysis of how financial constraints influence firm-level TFP is performed in two stages. In the first stage it is required to estimate consistently firm's productivity level. After this has been achieved I proceed to the second stage where I investigate how financial factors influence the TFP levels across firms, industries and countries.

Total factor productivity is measured as the residual from a production function estimation, i.e. after netting out the contribution of observed production input factors. This in turn requires consistent estimates of the input elasticities, which are performed in this section.

There is a large amount of literature on how to obtain consistent estimates of these elasticities. The TFP literature starts by using the standard assumption that a firm i uses a Cobb-Douglas production function of the form:

$$Y_{it} = e^{\psi_{it}} K_{it}^{\beta_k} L_{it}^{\beta_l} \tag{3.1}$$

where Y_{it} represents the firm's value added generated at time t, L_{it} is the labor input and K_{it} is the capital input. The parameters β_k and β_l are the elasticities of output with respect to capital and labor, respectively. ψ_{it} represents a firm-specific time-varying technology parameter.

Taking natural logs from both sites of equation (3.1) and denoting natural logs with small letters I have:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \psi_{it} \tag{3.2}$$

I am interested in the unobserved (log of) total factor productivity ψ_{it}, which can be calculated as the "residual" of equation (3.2):

the missing years I linearly interpolate the data.

$$\psi_{it} = y_{it} - \beta_k k_{it} - \beta_l l_{it} \tag{3.3}$$

Following Ackerberg et al. (2006) I assume that the TFP term can be split into two components:

$$\psi_{it} = \omega_{it} + \xi_{it} \tag{3.4}$$

where both ξ_{it} and ω_{it} cannot be observed by econometricians. The crucial difference is that whereas ξ_{it} is an i.i.d. shock unobserved by the firm, ω_{it} is known (or predicted) by the firm at the time it chooses the inputs.[39] This generates the well-known simultaneity problem, because ω_{it} and hence the TFP term are correlated with the labor and/or capital inputs. A simple *ordinary least squares* (OLS) estimation that ignores this potential correlation will lead to inconsistent estimates of the labor and capital elasticities and as a result an inconsistent estimate of the firm's TFP.

If one assumes that the productivity shock ω_{it} is constant over time, i.e. $\omega_{it} = \omega_{i,t-1} = \omega_i$, I can consistently estimate the parameters of the production function using the *fixed-effects* (FE) estimator. It eliminates the constant ω_i term and hence the correlation between the TFP and the input factors. However, this assumption may often fail in practice and as a consequence the FE estimator will not provide consistent TFP estimates.

Another possibility for dealing with the endogeneity problem is to use instrumental variable estimators. The dynamic panel *generalized method of moments* (GMM) estimator of Blundell and Bond (2000) uses the idea of substantial adjustment costs, which makes the input and output choice persistent, e.g. this period choice depends highly on the last period's decision. Given that assumption lagged levels of inputs can serve as valid

[39] For example one can think of ω_{it} representing some production process improvement, which is known by the management of the firm.

instruments in an estimation in first differences, the method can deal with problems arising from the presence of firm fixed effects as well as first-order serial correlated TFP shocks. The Blundell and Bond (2000) approach follows the literature on dynamic panel estimation, Arellano and Bond (1991), and more closely Arellano and Bover (1995) and Blundell and Bond (1998). Arellano and Bond's (1991) difference-GMM estimator is found to perform poorly if the input and output series are highly persistent. The reason is that in this case lagged levels are only weakly correlated with subsequent differences, which in turn leads to the well-known "weak instruments" problem. Therefore, Arellano and Bover (1995) and Blundell and Bond (1998) improve this estimation technique by considering *in addition* to instrument the levels with lagged differences. This is usually referred to as the system-GMM estimator. Unfortunately, as pointed out by Roodman (2009), this estimation procedure is only valid under a much stronger and non-trivial assumption of initial stationarity of the series. In the sample period of 1995-2004 the fall of the "iron curtain" and the subsequent process of Eastern enlargement represent substantial, persistent shocks to the market activity of European firms. Therefore, it is very likely that the data series are initially far from their steady states, making the Blundell and Bond estimator inappropriate for this dataset.

The last set of techniques is *semiparametric* estimators proposed by Olley and Pakes (1996) and Levinsohn and Petrin (2003). Their approach is more structural in nature, because they suggest "making" the unobserved productivity shock ω_{it} observable. Concretely, they use the firm's investment decision and intermediate input choice, respectively, to *proxy* for the unobserved productivity.[40] Levinsohn and Petrin (2003) argue that the intermediate inputs proxy has two advantages over the investment proxy. On

[40]Recently, Wooldridge (2005) and Ackerberg et al. (2006) proposed different improved estimation procedures based on this idea.

the one hand in many datasets firms report zero investment.[41] However, the estimation procedure relies only on non-zero observations. Therefore, using investment as a proxy requires dropping many of the firm observations, which in some datasets can be severe. By contrast, firms almost always report positive intermediate inputs, like electricity or materials. On the other hand, in the presence of adjustment costs intermediate inputs may respond more fully to productivity shocks than investment does. This makes the Olley and Pakes (OP) procedure problematic, because some correlation between the error term and the regressors still remains.[42]

Given these advantages I present the Levinsohn and Petrin (LP) approach. Let's start again with equation (3.2) rewritten in the extended form:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \xi_{it} \tag{3.5}$$

Levinsohn and Petrin assume that the demand for the intermediate input m_{it} (e.g. materials or energy) depends on the state variables k_{it} and ω_{it}:

$$m_{it} = m_t(\omega_{it}, k_{it}) \tag{3.6}$$

where the function $m_t(.)$ must be strictly monotonically increasing in ω_{it}. Given that assumption one can invert-out the productivity term ω_{it}:

$$\omega_{it} = m_t^{-1}(m_{it}, k_{it}) = \omega_t(m_{it}, k_{it}) \tag{3.7}$$

The unobserved ω_{it} is now an unknown function of observables. Putting equation (3.7) in equation (3.5) leads to the following estimable equation:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \omega_t(m_{it}, k_{it}) + \xi_{it} \tag{3.8}$$

[41] Levinsohn and Petrin (2003) find in their panel dataset on Chilean plants that fewer than 50% of the observations have non-zero investments, whereas more than 99% report material use (intermediate inputs).

[42] See Levinsohn and Petrin (2003), p. 321.

Estimation is performed in two stages, where the function $\omega_t(.)$ is treated non-parametrically. In the first stage only β_l, but not β_k, is identified, because the first k_{it} term is collinear with the non-parametric term $\omega_t(m_{it}, k_{it})$. This is achieved by using the following equation:

$$y_{it} = \beta_l l_{it} + \phi_t(m_{it}, k_{it}) + \xi_{it} \tag{3.9}$$

with

$$\phi_t(m_{it}, k_{it}) = \beta_k k_{it} + \omega_t(m_{it}, k_{it}) \tag{3.10}$$

representing a joint term.

Following Petrin et al. (2004) I approximate the function $\omega_t(m_{it}, k_{it})$ by a third-order polynomial.[43] Again using equation (3.9) I can estimate β_l. The second stage uses those estimates to identify β_k. As a first step I can compute the estimated value of $\phi_t(m_{it}, k_{it})$ as

$$\widehat{\phi}_t = \widehat{y}_{it} - \hat{\beta}_l l_{it} \tag{3.11}$$

Therefore, using equation (3.10) the predicted value of the productivity term ω_t becomes:

$$\widehat{\omega}_t = \widehat{\phi}_t - \beta_k k_{it} \tag{3.12}$$

Until now the only unknown term in equation (3.12) is $\widehat{\omega}_t$. In a next step I use the assumption of Olley and Pakes (1996) and Levinsohn and Petrin (2003) that the productivity shock ω_t follows a first-order Markov process. One can thus approximate the unknown $\widehat{\omega}_t$ by running the regression:

$$\omega_t = \gamma_0 + \gamma_1 \omega_{t-1} + \gamma_2 \omega_{t-1}^2 + \gamma_2 \omega_{t-1}^3 + \upsilon_{it} \tag{3.13}$$

[43] For a complete and extensive formal exposition and implementation in Stata see Petrin et al. (2004), pp. 115-120.

and computing the predicted value of ω_t. After completing this step, β_k can now be identified from equation (3.12), which completes the second stage of the LP procedure.

Beside the simultaneity problems when estimating input elasticities, there is the issue of the so-called "selection bias". It arises mainly in balanced panels of firms. Theoretical models such as Melitz (2003) show that firm selection, e.g. firm entry and exit, is important and a consequence of between-firm productivity differences. For example, firms having higher capital stock are likely to survive after being hit by a negative productivity shock. Hence, considering only a balanced panel will leave only those surviving firms. This will further lead to a correlation between the unobserved productivity and the capital input, which in turn makes estimates of β_l and β_k inconsistent. Olley and Pakes (1996) deal with this problem in their estimation procedure. However, as they show, allowing for an unbalanced panel as in my case reduces the problem considerably.[44]

I consider using 3 different estimators in my analysis: OLS, fixed-effects (FE) and Levinsohn-Petrin (LP) semiparametric estimators.[45] The decision to use these estimators is mainly driven by data availability[46] and the existing discussion in the literature about different production function estimators.[47]

[44]Probably this is why Levinsohn and Petrin do not incorporate a selection bias correction into their estimation procedure. Following these findings I use an unbalanced panel of firms and do not explicitly address the potential "selection bias" issue.

[45]The Levinsohn-Petrin estimator is implemented using the *levpet* routine in Stata provided by Petrin et al. (2004).

[46]The alternative estimation procedure by Olley and Pakes (1996) cannot be performed here because OP relies on information about (positive) investments, which is missing in AMADEUS.

[47]Ackerberg et al. (2006) argue that the LP (as well as OP) technique may be problematic for collinearity reasons. This estimator relies on the assumption that only the material choice but not the labor choice depends on productivity (and capital), which is criticized by Ackerberg et al. If one relaxes this assumption, there is no possibility to identify the labor elasticity in their first-stage regression. As a solution Ackerberg et al. propose a different estimator, which extends the semi-parametric techniques of OP and LP, but the "success" of this estimator in applied work still depends crucially on the data quality. Therefore, I stick to using the OLS, FE and LP in the following section and report the results separately in order to ensure that the results of interest are not driven by the

Compared with OLS or FE the LP estimation is performed for a smaller subset of countries because 5 countries, i.e. Cyprus, Denmark, the UK, Ireland and Iceland, do not report data on material costs, which are required for this estimation technique.[48] The dependent variable is firm value added.[49] The two input variables are labor, which is measured by the number of employees, and capital, defined as the value of fixed assets. All the variables are deflated using country-specific wholesale price indexes.[50] Estimation is performed for each of the 179 three-digit US SIC industries separately by pooling the data over all the countries. This strategy is also followed by Corcos et al. (2007). The main assumption requires that the factor intensity of the particular industry is the same across countries. In contrast, total factor productivity is allowed to vary across countries. In a sense technological progress is assumed to be Hicks-neutral, which is a good assumption supported by the evidence provided by Trefler (1995). This idea is implemented by including country and year dummies in the production function equation in order to capture differences of TFP levels across countries and time.[51]

Table 3.17 in Appendix B shows the estimated coefficients on the input factors, capital and labor, using a value-added Cobb-Douglas production function. In general one can observe differences in the estimated elasticities

choice of estimator.

[48]Croatia has to be dropped from the sample because AMADEUS does not report value added. Therefore, I effectively use 27 countries. I reestimate the TFPs using my own measure of value added, which is the difference of firm sales and material costs. The estimated TFP measures are highly correlated with those using AMADEUS's own value added. For section 3.6, where Croatia is included in the sample of exporting firms, I rely on the TFP measure using value added defined as firm sales minus material costs.

[49]Ackerberg et al. (2006) and Bond and Söderbom (2005) argue that the alternative gross output estimation has a disadvantage because it can be hard to identify coefficients when both labor and intermediate inputs (materials) are perfectly variable (and not persistent) inputs.

[50]Firm-level TFP estimation requires firm-level price deflators. Unfortunately, these are typically not available, as in my case. Alternatively, one can use industry-specific deflators, which in my case are again not available for all the countries, industries and years.

[51]An alternative way is to use country-year-specific dummies instead to capture these differences. I confirm that this strategy delivers very similar estimates of TFP.

that are consistent with the findings in the literature. The following overall picture emerges:[52] the estimated elasticities on capital and labor are smaller than one, suggesting that there are positive but decreasing marginal productivities. Comparing LP with OLS the coefficients on labor as well as those on capital are clearly upward biased. This observation is fully consistent with the results of Levinsohn and Petrin (2003). On the other hand, the fixed-effects (within) estimator indicates that the labor elasticity is upward biased, but the capital elasticity is downward biased. This result is also consistent with the findings of Olley and Pakes (1996). Despite these differences all three TFP measures are highly correlated. Table 3.18 in Appendix B shows that the pairwise correlation between those measures is higher than 0.86. Therefore, it will be less likely that the choice of estimator will drive the results presented next.

After obtaining consistent estimates for the firm-level TFP I proceed to the second stage in Section 3.5 where I show how productivity is related to financial constraints, controlling for other factors.

3.5 TFP and financial constraints

3.5.1 Baseline results

Before I start with a multivariate regression analysis let's take a look at the following graphs, which compare the TFP level of a financially developed country like the United Kingdom with that of the financially weak country Bulgaria. In line with the theoretical predictions I focus on the difference in levels across industries in both countries.[53] Figures 3.1 and 3.2 depict

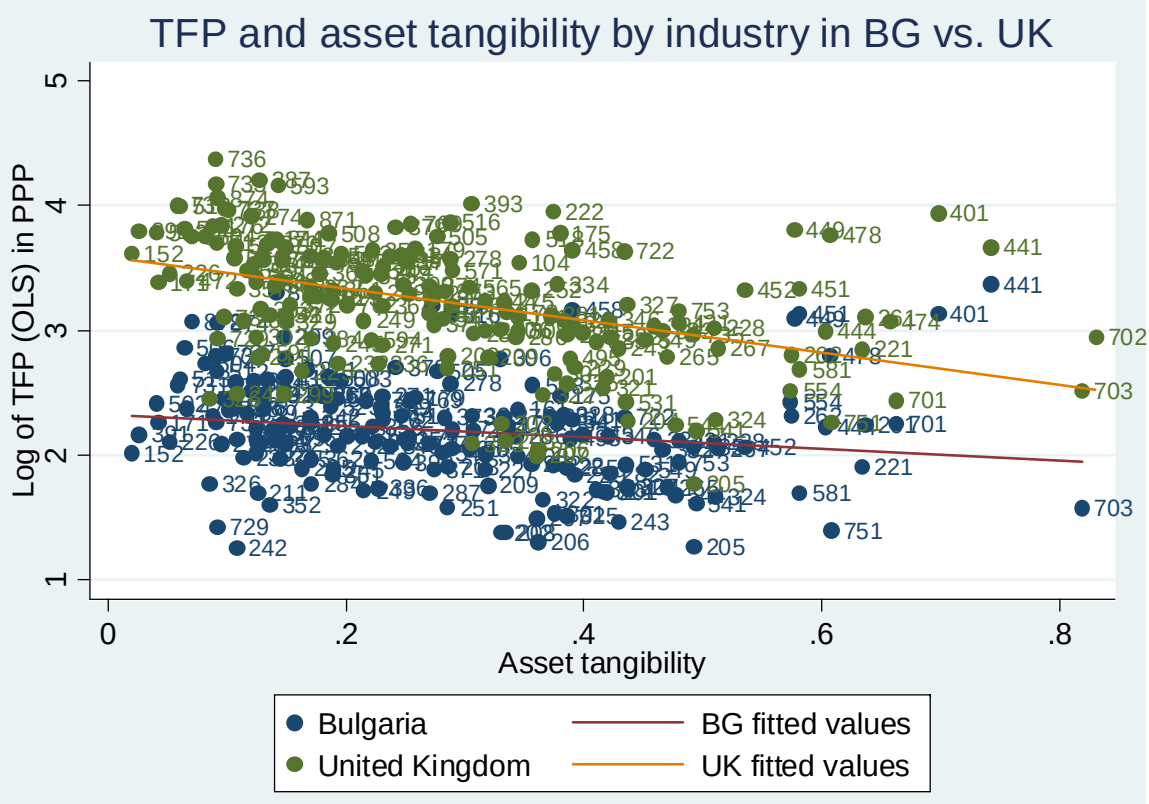
[52]Here I pick for example one industry from construction (SIC 152), manufacturing (SIC 239), transportation (SIC 478), wholesale trade (SIC 501), retail trade (SIC 541) and services (SIC 735), respectively.

[53]From the individual TFP levels I calculate industry averages. These are converted into PPP levels to make the country comparison reasonable.

the differences in TFPs for industries that differ in their asset tangibility and financial dependence, respectively. Both figures include a linear fit in order to capture the average tendency of the data. Obviously and consistent with the expectations the productivity of the average firm in UK industries is higher than the average productivity of Bulgarian firms. This can be attributed to the difference in the overall economic development of both countries. However, the productivity advantage is uneven across industries. Looking at the regression lines the TFP advantage of UK firms is more pronounced in industries that are at lower levels of asset tangibility. The same picture emerges if I rank the same industries according to their financial dependence, shown in Figure 3.2. Again on average UK firms are more productive than Bulgarian companies, especially in industries that rely more on external finance.

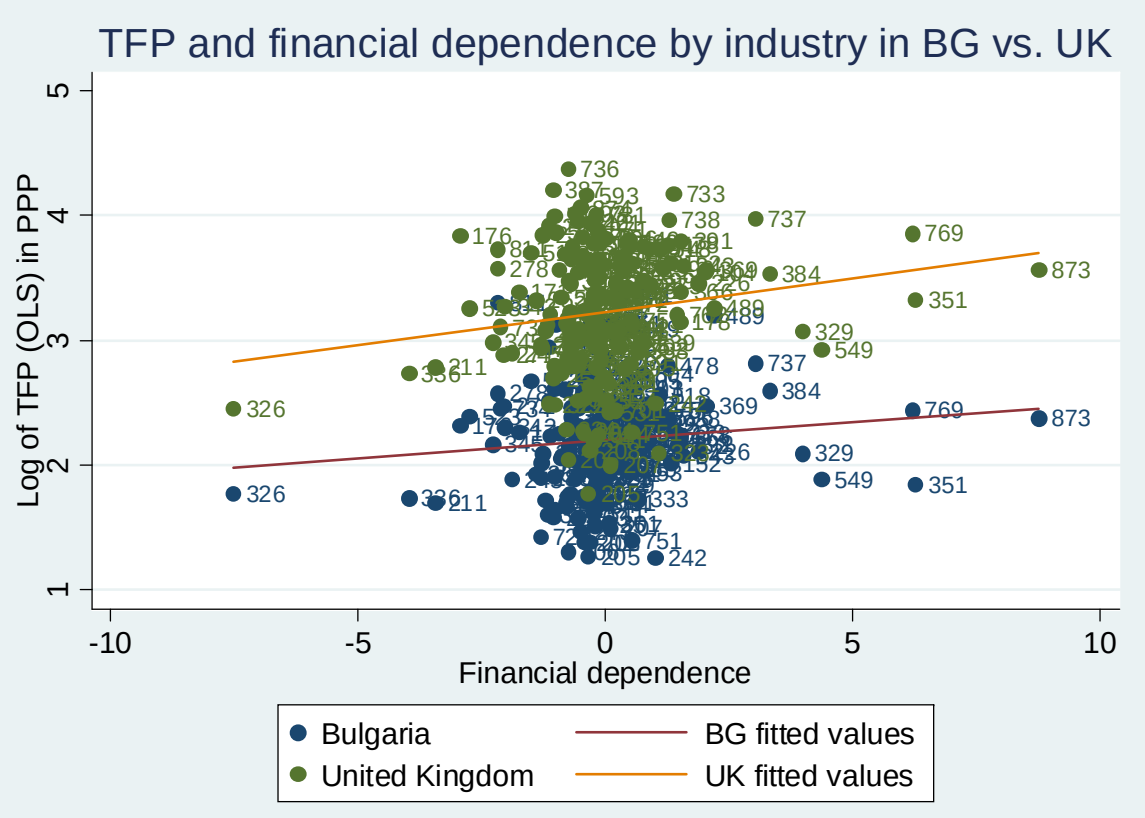
In order to make the overall picture more clearer and in order to explain how the empirical strategy applied below works I pick only two sectors. Their productivity differences across the UK and Bulgaria are presented in figures 3.3 and 3.4. They compare the difference in TFP for highly financially constrained firms with those of less credit-constrained firms. As one can see again the TFP advantage of companies located in the UK is stronger in the more financially vulnerable sector dyeing and finishing textiles (SIC 226) than in the less financially vulnerable sector for bakery products (SIC 205).[54] The empirical model presented below will intuitively compare those two differences. The effect of financial development is estimated by subtracting the productivity advantage in industries that rely less on external finance from the productivity advantage in more financially vulnerable sectors. This strategy will net out differences across countries that may influence the observed productivity advantage but are not related to financial system development. Intuitively, such differences are obvious for sectors that do not

[54]Financially vulnerable sectors are those with high FinDep and/or low Tang.



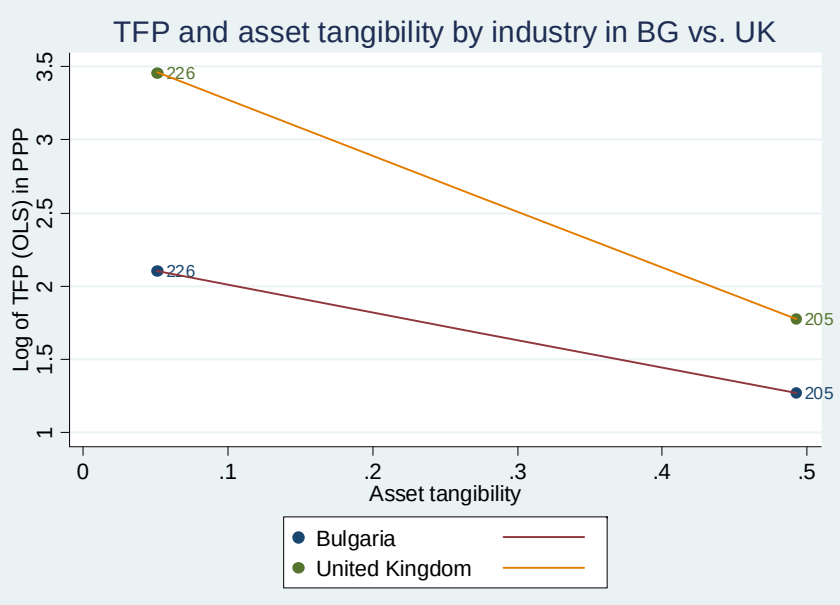
Notes: The figure shows the industry average of the estimated logarithm of TFP in PPP.

Figure 3.1: TFP and asset tangibility by US SIC industry in Bulgaria compared with the United Kingdom



Notes: The figure shows the industry average of the estimated logarithm of TFP in PPP.

Figure 3.2: TFP and financial dependence by US SIC industry in Bulgaria compared with the United Kingdom



Notes: The figure shows the industry average of the estimated logarithm of TFP in PPP.

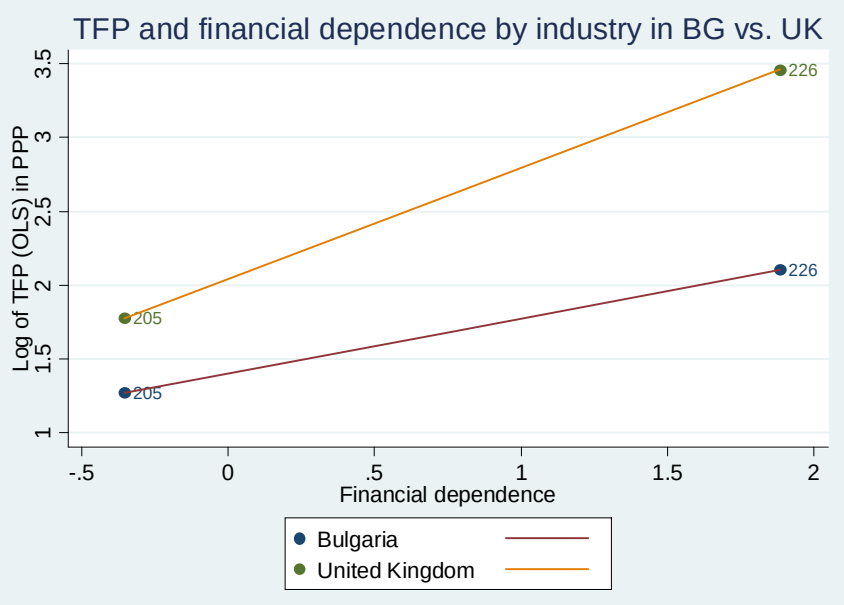
Figure 3.3: TFP and asset tangibility by US SIC industry in Bulgaria compared with the United Kingdom

benefit directly from a better credit supply, like the bakery sector in this example.

Building on the theoretical predictions of heterogeneous firms models presented in section 3.2 and consistent with the graphical representation above I assume that the firm's TFP is given by the following empirical model:

$$ln(TFP_{ijct}) = \alpha_1 FinDev_{ct} * FinDep_j + \alpha_2 FinDev_{ct} * Tang_j + \\ + \boldsymbol{x}_{ijct}\boldsymbol{\kappa}_1 + \boldsymbol{z}_{jct}\boldsymbol{\kappa}_2 + \mu_{ct} + \eta_j + \epsilon_{ijct} \quad (3.14)$$

where $FinDev_{ct}$ is the measure of financial development in country c at year t and $FinDep_j$ and $Tang_j$ are the industry-specific measures of external financial dependence and asset tangibility, respectively. Along the first two interaction terms capturing the effect of credit constraints I con-



Notes: The figure shows the industry average of the estimated logarithm of TFP in PPP.

Figure 3.4: TFP and financial dependence by US SIC industry in Bulgaria compared with the United Kingdom

dition on a vector of other firm-specific ($\boldsymbol{x}_{ijct}$) variables like firm size and industry-country-specific ($\boldsymbol{z}_{jct}$) covariates like comparative advantage or import competition exposure (tariffs). These variables are likely to influence the productivity of firms and may be correlated with the two interaction terms. Omitting these determinants might lead to biased estimates. In addition, a full set of country-year dummies (μ_{ct}) and industry dummies (η_j) capture differences in economic development or policies across countries over time and technological differences of industries common to all countries, respectively.[55]

[55]These dummies subsume the separate effects of FinDev, FinDep and Tang on TFP. Using country-year dummies controls for more than only pure time effects common to all countries and pure state effects common to one country over the time period. This is a better strategy for two reasons. First, they capture for example country-specific policies or changes in laws in a particular year that influence directly the economic performance of enterprises. Second, they control for various external and internal shocks to countries, e.g. the banking crisis in Bulgaria in 1996-1997 or the Kosovo war in 1998-1999, which affected countries from the Balkan region, or even the Russian crisis that is likely to have affected the economies of the Baltic states. Therefore, this strategy ensures that such events do not drive my results.

Finally, ϵ_{ijct} represents the error term, which may include a firm-specific but time-invariant component along with a well-behaved random term.

The coefficients of interest are those on the interaction terms and I expect that $\alpha_1 > 0$ and $\alpha_2 < 0$. They indicate that a higher level of financial development will have greater effects on the productivity for firms that are more dependent on external finance and/or that have less tangible assets. This difference-in-difference (DiD)[56] methodology reduces omitted variable bias due to the presence of reverse causality, i.e. more productive firms demand more credit, which raises the aggregate measure of FinDev in a country, and due to omitted variables, i.e. other factors like non-financial institutions (e.g. rule of law), could spur the productivity of firms and simultaneously the further development of the financial system. An alternative solution to the DiD methodology would be to apply an instrumental variable estimation technique. However, this has its own problems. First, researchers should find an exogenous and not weak instrument. Second, one should make the most important and non-testable assumption that the instrument itself is not directly influencing the TFP level, i.e. the so called "exclusion restriction". In order for DiD to fail in practice there should be both endogeneity driving financial development as well as endogeneity driving the financial dependence of industries. Even though financial development is potentially endogenous, using the US as a reference country I obtain a reasonable exogenous financial dependence measure.[57]

Table 3.3 shows estimates using the preferable LP productivity measure

[56]This method relates to the literature on policy evaluation. The (continuous) treatment is given here by the availability of credit in a country; the treatment group includes the firms with higher financial dependence or fewer tangible assets, whereas the control group is the other firms. The coefficients of interest on the interaction terms α_1 and α_2 capture the difference of the treatment effect on the treatment group minus the effect on the control group.

[57]This means in the DiD context that the assignment of firms to the treatment and control groups is exogenous and not related to treatment itself. On the contrary, when country-specific firm-level financial measures are used this assignment is clearly endogenous.

Table 3.3: Productivity and financial constraints

Dependent Variable:	TFP_LP			
	(1)	(2)	(3)	(4)
FinDev*FinDep	0.011		0.0094	0.029***
	(0.0094)		*(0.0091)*	*(0.0094)*
FinDev*Tang		-0.17**	-0.17**	-0.37***
		(0.073)	*(0.072)*	*(0.078)*
(Y/L)*CapInt				-0.51
				(1.44)
(H/L)*HumInt				-0.38***
				(0.064)
Firm size	0.25***	0.25***	0.25***	0.25***
	(0.0061)	*(0.0061)*	*(0.0061)*	*(0.0061)*
Country*year dummies	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes
Observations	1290959	1290959	1290959	1290959
Number of firms	386145	386145	386145	386145
Number of clusters	3011	3011	3011	3011
R-squared	0.345	0.345	0.345	0.346

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

as the dependent variable. Tables 3.21 and 3.22 in Appendix B present comparable estimates using the OLS and FE productivity estimates instead. Since the results are qualitatively similar I interpret only those using the LP TFP measure.[58] The regressions use the whole sample of firms for the period 1999-2003.[59] There are two reasons why I choose this period. First, the proxy variable for a country's human capital abundance is available only for this period. Second, the representativity of the sample increases around the

[58]In unreported regressions I further confirm that all of the results hold when I use labor productivity, defined as value added per worker, instead of TFP. The correlation with the TFP measures ranges between 0.60 for FE and around 0.81 to 0.83 for LP and OLS, respectively.

[59]Table 3.19 in Appendix B provides descriptive statistics of all variables used in section 3.5.

years 1999-2000. When there is a shift in the industry or country structure of the sample this can influence my results.[60] I further perform a fixed-effects within estimation. Even though unobserved time-invariant firm characteristics can be correlated with countries' financial development they are not likely to affect the $FinDep$ or $Tang$ measures since these are exogenous to the firm. Nevertheless, if for some reasons firms with highly skilled managers or employees are sampled in the financially constrained sectors of financially developed countries then estimates can be inconsistent. I thus use fixed firm-level effects. Further, standard errors are clustered by country-industry pair to account for the possible correlation of residuals within clusters, which is not controlled for by firm-level covariates. This strategy is important for the following reason. The potential problems of cluster sampling were largely ignored by applied econometricians until recently. The best-known example is Moulton (1990), who illustrates how regressing firm-level outcomes on aggregate/grouped (i.e. on a higher aggregation level) explanatory variables and ignoring the correlation of the disturbances may lead to seriously downward-biased estimates of the standard errors. The result is an incorrect interpretation of economic impacts, which in reality are not present. How important this problem is in applied work is shown by Bertrand et al. (2004). They surveyed 92 papers published in 6 leading journals (e.g. *American Economic Review*) in the period 1990-2000 that use a difference-in-difference methodology. The authors found that most of those papers had potential problems with grouped error terms and very few of them dealt with this appropriately. Finally and most importantly, Moulton (1990) shows that the bias can be large even if the within-group correlation of the residuals is small. The bias becomes larger when the cluster size rises and when the explanatory variable is highly correlated within clusters. This is the case in my sample where I

[60] I further confirm that using the sample period of 2000-2003 instead does not change the results qualitatively.

have many firms within industry-country clusters and the interaction term is highly positively correlated within these clusters. Following Bertrand et al. (2004) and Wooldridge (2006) I use a cluster-robust correction of the standard errors with an industry-country pair representing the cluster unit. The asymptotic validity of this correction depends on the number of industry-country clusters. Since I have more than 3000 clusters, this cluster-robust correction is appropriate for my sample.

Column (1) of Table 3.3 reveals the well-known observation that bigger firms are on average more productive. The coefficient on firm size is positive and significant at the 1% level. Even though the coefficient on the interaction of financial development with financial dependence has the correct positive sign it seems to be initially not statistically significant. Further, columns (2) and (3) show that consistent with the expectations the estimated effects of asset tangibility are negative and significant at the 5% level. Compared with the first three columns, following Bernard et al. (2007b), the last specification (4) uses two traditional sources of comparative advantage, i.e. the country's abundance of physical and human capital, which influence the entry and exit of firms and hence the observed firm productivity. Now the estimated coefficients α_1 and α_2 have the right sign and are statistically significant at the 1% level. These two effects are separate and show that firms in industries that are either more dependent on external finance or have less tangible assets have higher productivities in financially more developed countries. The estimated coefficients on the interaction terms capturing traditional comparative advantage are both negative whereas only human capital seems to have a statistically significant impact on TFP. These results are against the expectation that firms from human-capital-intensive industries will have higher productivity in countries abundant in human capital.[61] Ac-

[61] The counterintuitive negative coefficients on the interaction terms of physical and human capital are also present in some specifications in Braun (2003), Becker and Greenberg (2005) and Manova (2006).

cording to Table 3.20 in Appendix B, the simple correlation between TFP measures and the interaction of human capital abundance and human capital intensity is positive. This is exactly what one expects. However, it seems that after controlling for country-specific, industry-specific and other factors in the regression framework the sign changes. This negative sign remains even when financial constraints are excluded from the regression. The last observation concerns the increase in absolute value of the estimated effects of financial constraints after comparative advantage is included. This can be explained technically by the negative correlation between (H/L)*HumInt and FinDev*Tang as well as the positive correlation between (H/L)*HumInt and FinDev*FinDep in the sample. Omitting the effect of human capital on TFP therefore leads to a bias in $\hat{\alpha_1}$ as well as $\hat{\alpha_2}$ towards zero. Overall the differences in the estimated coefficients on financial constraints in columns (3) and (4) suggest that traditional comparative advantage always has to be included in the empirical analysis in order to reduce the econometric problem due to omitted variables.

After presenting the qualitative results a last and natural question is whether credit constraints have an economically significant impact on firms' productivity. One natural interpretation of the results is to ask what would happen with TFP when a financially dependent sector "sanitary services" (SIC 495, 75th percentile) relative to the financially less-dependent sector "cleaning preparations" (SIC 284, 25th percentile) was located in the financially developed Austria (75th percentile) instead of the financially less-developed Hungary (25th percentile). Then the estimate of 0.029 means that the productivity of sanitary services would rise by $\hat{\alpha_1} * \Delta FinDev * \Delta FinDep = 0.029 * 0.7 * 1.1 = 2.2\%$ more than the productivity of cleaning preparations. Similarly, if a low tangibility sector "legal services" (SIC 811, 25th percentile) relative to the high tangibility sector "shipping containers" (SIC 341, 75th percentile) was relocated from the financially less-developed

Hungary to the financially more-developed Austria, then its productivity would rise by $\hat{\alpha_2} * \Delta FinDev * \Delta Tang = 0.37 * 0.7 * 0.25 = 6.5\%$ more than the productivity of shipping containers.

3.5.2 Robustness

In this subsection I perform several robustness checks in order to show that the estimated impact of financial constraints on firms' TFP is not driven by the choice of the sample or the choice of financial measures.

The first five columns of Table 3.4 use different measures of asset tangibility.[62] If we compare column (1), which uses the US benchmark measure, with the alternative two UK-based measures in columns (2) and (3), the estimates of α_1 and α_2 remain with the correct signs and statistical significance. Therefore, using the US as a benchmark economy represents a good approximation of the true financing needs of European firms. The next columns (4) and (5) use firm-level asset tangibility measures instead of the exogenous industry-specific measures. As previously stated I expect an endogenous response of firms located especially in financially underdeveloped countries. Specifically, they will keep on average more collateralizable assets on their balance sheets in order to be more likely to receive sufficient credit. This endogenous reaction will lead to a bias in α_2 towards zero. Let's compare columns (2) and (4), which have the same variable definition. It is evident that the coefficient on the firm-level measure is smaller in size than the exogenous industry measures. A decrease in Tang1 (UK) from its value on the 75th to its value on the 25th percentile comparing Austria with Hungary results in an effect of $0.47 * 0.7 * 0.25 = 8.2\%$. In contrast, the same exercise using Tang1 (firm-level) would yield an impact of $0.21 * 0.7 * 0.25 = 3.7\%$. Therefore, the downward bias amounts to about 55% $(= (0.082 - 0.037)/0.082)$,

[62] Tables 3.23 and 3.24 in Appendix B show comparable results using the OLS and FE productivity estimates.

Table 3.4: Productivity and financial constraints: robustness

Dependent Variable:	**TFP_LP**							
Financial Development measure	Private credit by deposit money banks (% of GDP)							Private credit by banks and other financial institutions (% of GDP)
Asset Tangibility measure	Tang (US)	Tang1 (UK)	Tang2 (UK)	Tang1 (firm-level)	Tang2 (firm-level)	Tang (US)	Tang (US)	Tang (US)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FinDev*FinDep	0.029***	0.030***	0.031***	0.028***	0.027***	0.028***	0.031***	0.029**
	(0.0094)	*(0.0094)*	*(0.0093)*	*(0.0097)*	*(0.0096)*	*(0.0095)*	*(0.0099)*	*(0.014)*
FinDev*Tang	-0.37***	-0.47***	-0.47***	-0.21***	-0.37***	-0.36***	-0.50***	-0.53***
	(0.078)	*(0.100)*	*(0.096)*	*(0.041)*	*(0.042)*	*(0.073)*	*(0.11)*	*(0.12)*
Institutions*FinDep						-0.0080		
						(0.013)		
Institutions*Tang						0.48***		
						(0.17)		
(Y/L)*FinDep							-0.014	
							(0.035)	
(Y/L)*Tang							1.02**	
							(0.50)	
(Y/L)*CapInt	*-0.51*	*0.081*	*0.24*	*-1.38*	*-0.94*	*-0.73*	*-2.38*	*-0.44*
	(1.44)	(1.40)	(1.40)	(1.46)	(1.42)	(1.41)	(1.73)	(1.41)
(H/L)*HumInt	*-0.38***	*-0.42***	*-0.41***	*-0.33***	*-0.34***	*-0.37***	*-0.35***	*-0.36***
	(0.064)	(0.066)	(0.065)	(0.064)	(0.063)	(0.063)	(0.059)	(0.066)
Firm size	*0.25***	*0.25***	*0.25***	*0.25***	*0.25***	*0.25***	*0.25***	*0.25***
	(0.0061)	(0.0061)	(0.0061)	(0.0061)	(0.0061)	(0.0061)	(0.0061)	(0.0061)
Country*year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1290959	1290959	1290959	1290880	1290887	1290959	1290959	1290959
Number of firms	386145	386145	386145	386108	386110	386145	386145	386145
Number of clusters	3011	3011	3011	3011	3010	3011	3011	3011
R-squared	0.346	0.346	0.346	0.346	0.346	0.346	0.346	0.346

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. Asset tangibility measures are defined in Appendix B. Institutions is an index of governance quality and is defined in Appendix B. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

which is a big number. This result suggests that firm-level measures of financial vulnerability are not suitable for consistent estimation of the effects of credit constraints on firm productivity. In the next step I make sure that my estimates do not capture the effects of other non-financial institutions that may influence the TFP. These other factors are only problematic here when for some reasons industries relying heavily on external finance are for example simultaneously more dependent on the legal enforcement of contracts or on property rights protection.[63] I use in column (6) an institutional index that measures the quality of governance in each country. In column (7) the GDP per capita serves as a proxy for the overall quality of institutions. These country-specific variables are then interacted with the industry measures of financial vulnerability and included in the estimation as additional explanatory variables. In both cases my baseline results remain robust. The coefficients almost do not change in column (6), whereas in column (7) the estimated α_2 even increases in size. These results suggest that the effect of financial constraints on firm productivity are separate from the effects of other non-financial institutions. Finally, column (8) uses an alternative measure of financial development. It represents a broader measure of credit supply and captures the private credit provided by banks and other financial institutions. This variable reflects more comprehensively all the available funding opportunities, especially in better developed economies. Using this definition of financial development the estimates of interest remain with the correct sign and are statistically significant. To summarize, the results presented above indicate that the baseline results are not driven by the choice of financial measures and are robust to the inclusion of other non-financial institutions that potentially affect the economic efficiency of firms.

The second set of robustness tests concerns the selected European coun-

[63]For example young innovative firms simultaneously need more external finance and demand more protection for their intellectual property. Therefore, they are likely to expand more if they operate in a country with a better financial as well as legal system.

Table 3.5: Productivity and financial constraints: country sample robustness

Dependent Variable:	TFP_LP							
Country Sample	**All**	**West**	**East**	**Sample1**	**Sample2**	**exclude IT**	**exclude ES**	**exclude FR**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FinDev*FinDep	0.029***	0.026***	0.035	0.029***	0.029***	0.026***	0.025**	0.029***
	(0.0094)	*(0.0088)*	*(0.063)*	*(0.0094)*	*(0.0094)*	*(0.0073)*	*(0.011)*	*(0.0096)*
FinDev*Tang	-0.37***	-0.30***	0.63	-0.37***	-0.37***	-0.27***	-0.30***	-0.37***
	(0.078)	*(0.074)*	*(0.62)*	*(0.078)*	*(0.078)*	*(0.071)*	*(0.081)*	*(0.079)*
(Y/L)*CapInt	-0.51	-3.52	1.00	-0.57	-0.50	-0.35	0.66	-0.24
	(1.44)	*(2.18)*	*(1.99)*	*(1.46)*	*(1.44)*	*(1.55)*	*(1.46)*	*(1.49)*
(H/L)*HumInt	-0.38***	-0.30***	-0.78***	-0.38***	-0.38***	-0.24***	-0.40***	-0.39***
	(0.064)	*(0.063)*	*(0.19)*	*(0.064)*	*(0.064)*	*(0.076)*	*(0.071)*	*(0.065)*
Firm size	0.25***	0.25***	0.27***	0.25***	0.25***	0.25***	0.25***	0.25***
	(0.0061)	*(0.0067)*	*(0.014)*	*(0.0061)*	*(0.0061)*	*(0.0076)*	*(0.0069)*	*(0.0061)*
Country*year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1290959	1162291	128668	1289463	1290557	935743	955972	1039445
Number of firms	386145	339176	46969	385307	385944	292275	298294	299848
Number of clusters	3011	1851	1160	2665	2886	2832	2832	2832
R-squared	0.346	0.195	0.645	0.346	0.346	0.405	0.374	0.358

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. "Sample1" excludes the following countries: CY, IE, IS, LU, LV, MK, CH, HU, AT. "Sample2" excludes the following countries: CY, IE, IS, LU, LV, MK. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

tries. Table 3.5 shows estimates using different country samples.[64] In columns (2) and (3) I split the sample into firms from Eastern and Western Europe. The estimates for the Western European sample do not differ qualitatively from the whole sample. Unfortunately, within Eastern Europe financial constraints lose their significant impact on firm productivity.[65] The coefficient on the interaction term of financial development and financial dependence is positive and even higher in size than the baseline estimate. However, standard errors are much higher, which leads to an insignificant coefficient. The coefficient on FinDev*Tang has the reverse positive sign and is statistically not significant. One possible explanation for this result is the lack of cross-country variation in financial development across Eastern European states. This explains the very large standard errors, which are more than seven times larger than those in the Western European sample.

Finally, columns (4) to (8) check whether the exclusion of some countries renders the baseline results. "Sample1" and "Sample2" exclude countries with relatively small numbers of firms. On the other hand, the last three columns of the table exclude countries with a relatively large number of active firms. Overall, these changes in the sample do not have a qualitative impact on the estimated coefficients. Therefore, the main results are not sensitive to the inclusion of countries that have either bigger or smaller weights in the estimation sample.

The last set of robustness checks looks at the different impacts of credit constraints across industry groups. In order to carry this out I split the sample into two groups. The first includes manufacturing and construction firms with SIC codes from 150 to 399. The remaining firms from industries with SIC codes 400-599 and 700-874 are grouped into the services sample. Table 3.6 shows estimates using firms from the manufacturing and construction

[64]Tables 3.25 and 3.26 in Appendix B show comparable results using the OLS and FE productivity estimates.

[65]The results do not change when I drop countries one by one from this sample.

Table 3.6: Productivity and financial constraints in manufacturing and construction industries

Industry Sample:	**Manufacturing + Construction**					
Dependent Variable:	**TFP_OLS**		**TFP_FE**		**TFP_LP**	
	(1)	(2)	(3)	(4)	(5)	(6)
FinDev*FinDep	0.026***	0.027***	0.031***	0.032***	0.032***	0.032***
	(0.0096)	*(0.0096)*	*(0.0095)*	*(0.0095)*	*(0.0089)*	*(0.0089)*
FinDev*Tang	-0.046	-0.011	-0.071	-0.028	0.022	0.065
	(0.11)	*(0.11)*	*(0.11)*	*(0.11)*	*(0.13)*	*(0.13)*
(Y/L)*CapInt	2.80	2.97	0.30	0.45	3.76	3.95
	(4.36)	*(4.33)*	*(4.05)*	*(4.02)*	*(4.50)*	*(4.45)*
(H/L)*HumInt	-0.33***	-0.32***	0.043	0.053	-0.20*	-0.20*
	(0.11)	*(0.11)*	*(0.11)*	*(0.11)*	*(0.12)*	*(0.11)*
Firm size	0.080***	0.080***	0.085***	0.085***	0.21***	0.21***
	(0.0081)	*(0.0081)*	*(0.012)*	*(0.012)*	*(0.0083)*	*(0.0083)*
Tariff rate (simple average)	0.0025		0.0040		0.0023	
	(0.0021)		*(0.0029)*		*(0.0024)*	
Tariff rate (weighted average)		0.0052		0.0063		0.0062
		(0.0034)		*(0.0046)*		*(0.0045)*
Country*year dummies	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes
Observations	463963	463963	463963	463963	399980	399980
Number of firms	134918	134918	134918	134918	116134	116134
Number of clusters	1866	1866	1866	1866	1628	1628
R-squared	0.204	0.204	0.121	0.121	0.288	0.288

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

industries. Compared with the baseline specification this regression includes additionally the average tariff rate for each industry, which is a measure of import competition. This strategy is justified by the large literature on trade liberalization and its impact on firm productivity.[66] In the standard Melitz (2003) model falling tariff rates have a positive impact on firm productivity because they lead to increased foreign competition, which forces less efficient firms to exit. This leads to an increase in the average productivity in an industry. Therefore, I expect a negative sign on the tariff rate measure. Unfortunately, Table 3.6 does not confirm this prediction. The estimated coefficients have a positive sign and are not statistically significant. One possible explanation is that manufacturing industries across and within countries do not differ much in their import competition exposure and tariff rates have low time variation. The mean tariff rate is small at around 3% whereby the standard deviation across time is only 0.93, which may be problematic for the fixed-effects within estimator. Compared with the baseline results asset tangibility does not seem to play a significant role in the manufacturing sample. In the first 4 columns α_2 is negative but insignificant, whereas in the case with the TFP LP measure as the dependent variable the sign is even positive though again not significant. This result may be explained by the notion that firms from secondary sectors are typically better endowed with assets that can be used to secure debt financing. Hence, collateral requirements are probably more easily met by such companies. Therefore, better credit supply does not have an impact on TFP through this particular channel. It seems that manufacturing firms are only significantly affected when they rely more on external finance.

Table 3.7 shows estimates using the sample of service firms. Compared

[66]For example, Pavcnik (2002) finds evidence that trade liberalization led to productivity improvements of Chilean manufacturing firms. These are mainly attributed to the reshuffling of resources to more efficient firms. Further, Amiti and Konings (2007) show with Indonesian data that productivity improvements can additionally arise because trade liberalization lowers the prices of imported intermediate inputs used in the production.

Table 3.7: Productivity and financial constraints in services industries

Industry Sample:	**Services**		
Dependent Variable:	**TFP_OLS**	**TFP_FE**	**TFP_LP**
	(1)	(2)	(3)
FinDev*FinDep	0.017**	0.0068	0.014
	(0.0083)	*(0.010)*	*(0.014)*
FinDev*Tang	-0.15**	-0.30***	-0.27***
	(0.068)	*(0.083)*	*(0.087)*
(Y/L)*CapInt	-0.63	-1.99	-0.98
	(1.15)	*(1.33)*	*(1.21)*
(H/L)*HumInt	-0.13*	-0.069	-0.30***
	(0.071)	*(0.070)*	*(0.083)*
Firm size	0.14***	0.19***	0.26***
	(0.0086)	*(0.012)*	*(0.010)*
Country*year dummies	yes	yes	yes
Firm fixed effects	yes	yes	yes
Observations	864748	864748	702818
Number of firms	265470	265470	216076
Number of clusters	1371	1371	1132
R-squared	0.232	0.202	0.339

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. The services sample includes transportation and communication services, wholesale trade, retail trade and other services. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

with the manufacturing sample financial development improves firm productivity mainly via the availability of hard assets rather than the dependence on external finance. The estimated α_2 is for all TFP measures negative and statistically significant at the 1% or 5% level. However, the estimate of α_1 though positive is significant only for the regression with the OLS TFP measure as the dependent variable. This finding is generally in line with the notion that service activities include more intangible assets that cannot be used as collateral when firms apply for credit. Hence, those service industries that are naturally more equipped with such assets are likely to be less credit constrained. Therefore, improvements in the financial development will mainly have an impact on the productivity of service firms when there is a lack of sufficient collateral.

To summarize, there is evidence in Europe that financial constraints operate for manufacturing industries through the "financial dependence" channel, while for service sectors they act through the "collateral requirements" channel.

3.6 Export status and financial constraints

Until now I have shown how credit constraints influence the total factor productivity of firms. In this part of the empirical analysis I test the predictions of heterogeneous firms models presented in section 3.2 regarding how export behavior is affected by financial frictions.

From the previous dataset described in Table 3.12 the 2005 edition of the AMADEUS database reports information on export turnover only for 6 European countries: France, the United Kingdom, Sweden, Croatia, Hungary and Switzerland. The following sample selection is performed. Since Hungary and Switzerland have too few export observations I decided to exclude these countries from the analysis. In order to have comparable results only those

firms remain in the sample that have data on productivity and financial constraints. After applying these restrictions I am left with 765,617 yearly observations of more than 174,000 firms in 4 countries (France, the United Kingdom, Sweden and Croatia) and 179 industries (703 country-industry clusters). Around 36 % of the firms report positive exports during the sample period 1995-2004, whereby 47.59% are never-exporters and 19.22% always export.

Before I proceed to the regression analysis let's look at the following figures and tables, which capture systematic differences between exporters and purely domestic firms, i.e. non-exporters. The trade literature on exports and productivity makes the general observation that exporters are bigger and they are more efficient than non-exporters.[67] However, there is less agreement regarding the question of the causal link between export status and productivity, i.e. whether the observed productivity differences are evident before or after enterprises enter export markets. Most of the studies support the "selection into exporting" hypothesis, e.g. Bernard and Jensen (1999) for US companies, while the minority find evidence of the "learning by exporting" hypothesis, e.g. De Loecker (2007) for Slovenian firms.

Table 3.8 compares the mean characteristics of exporters versus non-exporters in my sample. Consistent with the literature exporters are bigger than purely domestic firms, i.e. they have on average a higher value of total assets and they have a higher number of employees. The size advantage in terms of total assets is about 75%[68] while the employment of exporters is about 38% higher than those of non-exporters. Figure 3.5 compares the whole distribution of firm size measured by the total assets across

[67] See for example Bernard and Jensen (1999) and Bernard et al. (2007a) for the US, Mayer and Ottaviano (2007) for European countries as well as Wagner (2007) for a survey of studies from countries all over the world.

[68] $= (e^{8.46} - e^{7.9})/e^{7.9}$

Table 3.8: Exporters vs. non-exporters mean comparison

	Exporters	Non-exporters
Firm size	8.46	7.90
Log of TFP (OLS)	3.43	3.32
Log of TFP (FE)	3.90	3.68
Publicly quoted (in %)	1.84	0.64
Employees	160	116
Debt ratio	0.88	0.92
Asset tangibility 1 (firm-level)	0.16	0.21
Asset tangibility 2 (firm-level)	0.20	0.25
Observations	278,120	487,497

Notes: The table shows the sample mean by variable for the exporter and non-exporter samples. Firm size is measured by the logarithm of real total assets. For all the variables a simple unpaired t-test rejects the null hypothesis that the sample mean for exporters is equal to the sample mean for non-exporters at the 1% significance level.

both groups. Clearly, the shapes of the distributions are very similar, with those for exporters shifted to the right. The next observation refers to firms' productivity. Using two measures of TFP the mean productivity advantage of exporting enterprises ranges between 11% and 22%. However, inspecting carefully Figure 3.6, which compares the two distributions of productivities, it seems that the productivity leadership of exporters is not so obvious as it is for the size measure. Nevertheless, these observations generally match the evidence of previous literature.[69] The last observation concerns the financial health of exporters evident from the lower part of Table 3.8. On the one hand, exporters exhibit a lower debt to assets ratio than non-exporters, indicating that they are less financially constrained. On the other hand, they have lower asset tangibility ratios, which suggest that they may be more financially vulnerable. Again, using these firm-level measures to capture the true financing needs of firms is likely to be misleading because there are potential endogeneity problems. For example, since exporters have access to foreign markets they may generate enough revenues to cover their capital

[69]See for example Mayer and Ottaviano (2007), p. 19, Table 5 for French firms.

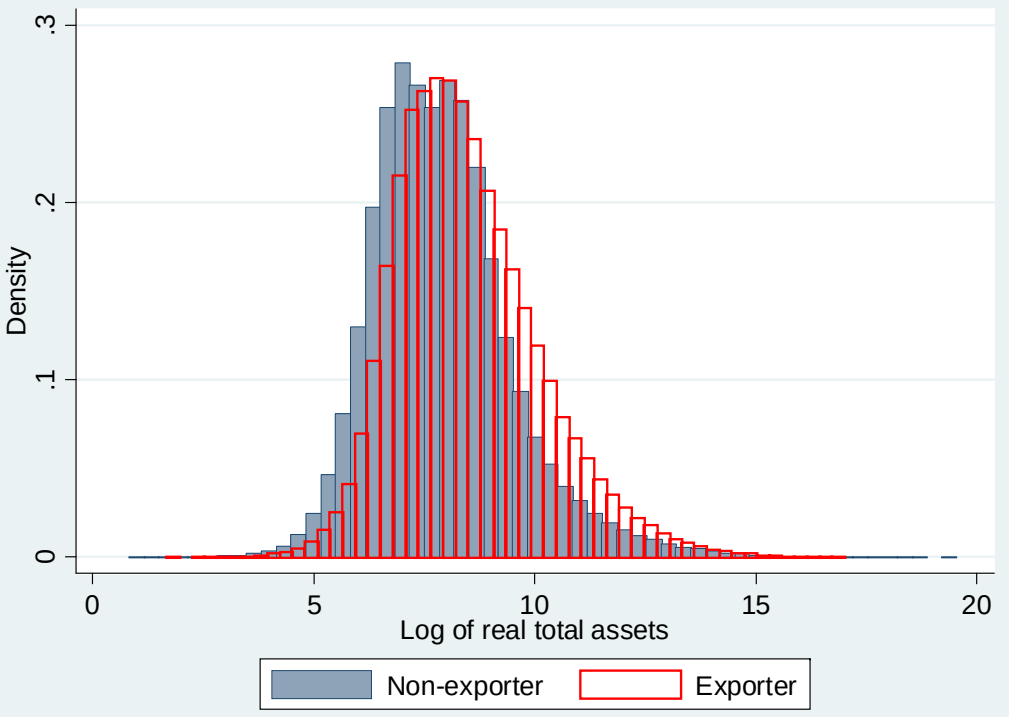


Figure 3.5: Size distribution of exporters vs. non-exporters

expenditures. Therefore, they may not need to raise additional debt, which may explain the lower debt ratio. Further, exporters may face lower collateral requirements by banks because they generate higher revenues and are more likely to repay their credit. Thus, the observable lower level of asset tangibility that is chosen by the firm does not indicate higher financial vulnerability but rather the opposite is true. In summary, firm-level financial measures are not appropriate for capturing the causal link from lower credit constraints to higher export probability because the export status itself affects the financial health of the firm.

In the next step I present the empirical strategy in order to identify the effects of credit constraints on export participation. It uses the variation in export status across countries at different levels of financial development and between industries that differ in their financial vulnerability. Table 3.9

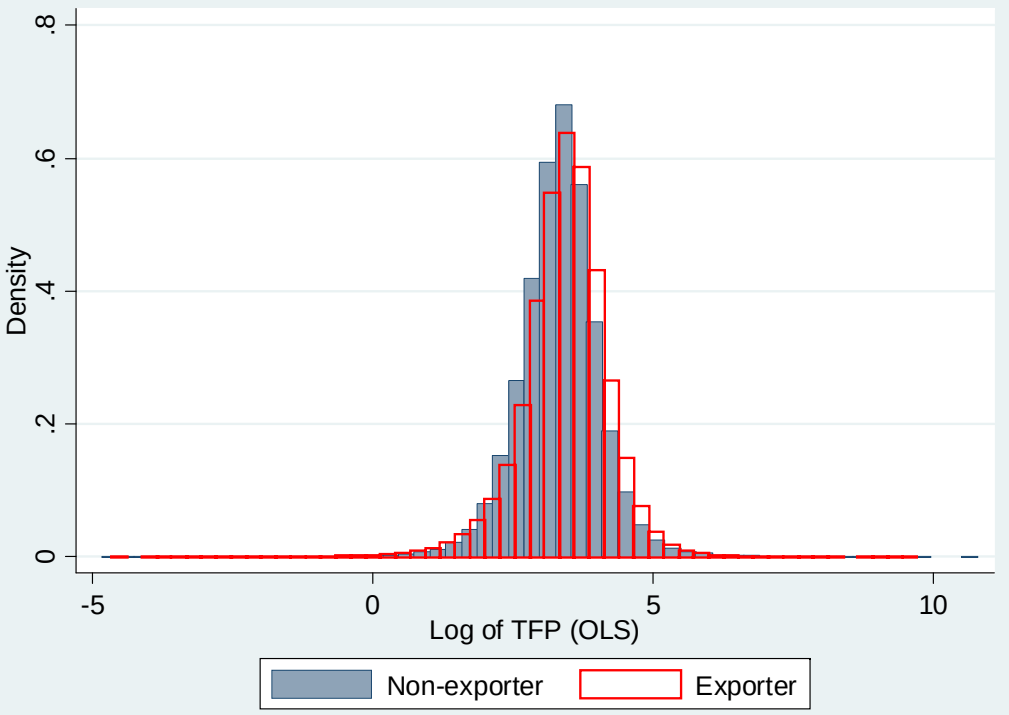


Figure 3.6: Productivity distribution of exporters vs. non-exporters

compares the export probabilities across two sectors (SIC 226 and 205) and two countries, Sweden and the United Kingdom. The United Kingdom is more financially developed than Sweden,[70] whereas the dyeing and finishing textile sector (SIC 226) is more financially vulnerable, i.e. it is more externally financially dependent and it has less tangible assets than the sector of bakery products (SIC 205). Again, as in the previous section, in order to determine the differential effect of financial development, one can build a double difference of the export probabilities. This difference-in-difference of $18.62 = (41.78 - 22.72) - (21.43 - 20.99)$ indicates that companies from the textile industry compared with bakery products firms are about 19 percentage points more likely to become exporters if they are settled in the more financially developed United Kingdom relative to Sweden.[71]

Table 3.9: Export probability comparison across sectors and countries

	Sweden	United Kingdom
Bakery products (SIC 205)	20.99	22.72
Dyeing and finishing textiles (SIC 226)	21.43	41.78
All industries	16.24	27.41

Notes: The table shows the exporting probability as a percentage.

The empirical model presented below builds on the theoretical predictions of a Melitz (2003)-type model with credit constraints by Manova (2006). As

[70] Both countries have relatively similar levels of GDP per capita. Therefore, differential effects of financial development in both countries are not likely to be driven by factors capturing the overall economic development.

[71] Another reasonable check is to compare the dyeing and finishing textile sector with the "average" industry. In the UK it has about a $41.78 - 27.41 = 14.4$ percentage points higher probability, whereas in Sweden only around a $21.43 - 16.24 = 5.2$ percentage points higher probability than the average. The differential impact is then about 9.2 percentage points.

already mentioned in section 3.2, this model predicts that in the presence of imperfect capital markets firms are more likely to become exporters when they operate in a country with a sound financial system.[72] An identification problem might arise when along with credit constraints other sources of comparative advantage drive the decision of firms to enter export markets. Empirically this could result in the well-known omitted variable bias. Bernard et al. (2007b) support this issue and show that firms from comparative advantage industries are more likely to become exporters than firms from comparative disadvantage industries. Following their theoretical predictions I control for two sources of comparative advantage, namely the physical and human capital abundance of a country.

Building on theoretical predictions of heterogeneous firms models the probability of exporting is given by the following equation:

$$P(ExpD_{ijct} = 1) = G(\delta_1 FinDev_{ct} * FinDep_j + \delta_2 FinDev_{ct} * Tang_j + \\ + \boldsymbol{x}_{ijct}\boldsymbol{\kappa}_1 + \boldsymbol{z}_{jct}\boldsymbol{\kappa}_2 + \mu_{ct} + \eta_j + \epsilon_{ijct}) \quad (3.15)$$

where $ExpD_{ijct}$ is a binary choice variable, equal to 1 if a firm i from industry j in country c exports in year t and 0 otherwise. $G(.)$ is a cumulative distribution function. Along the first two interaction terms capturing the effect of credit constraints I condition on a vector of other firm-specific ($\boldsymbol{x}_{ijct}$) variables like firm size and industry-country-specific ($\boldsymbol{z}_{jct}$) covariates like comparative advantage or import competition exposure (tariffs). A full set of country-year dummies (μ_{ct}) and industry dummies (η_j) captures dif-

[72] Manova's model generates much richer predictions than only about the export status of the firm. For example, assuming that a part of the variable costs of exporting have to be financed externally, the model generates a prediction about the level of firm exports. Even though I have data on firm-specific export turnover, the volume of exports depends strongly on the demand conditions in export *destinations*. Since data on export destinations are not available I cannot explore this particular question and stick to explaining the extensive margin of firm exports.

ferences in economic development or policies across countries over time and technological differences of industries common to all countries, respectively. Finally, ϵ_{ijct} is a well-behaved random error term. I do not further include firm fixed effects like in the previous section, because most of the firms do not change their export status over time and therefore identification would be problematic. I still use firm-level variables like firm size and productivity to capture firm-level effects. By conditioning on the firm-specific TFP level I am able to isolate the "direct" effect of credit constraints on export participation, because I have previously shown that financial factors affect directly the productivity of firms.[73] For the model in equation (3.15) I expect that $\delta_1 > 0$ and $\delta_2 < 0$, namely that in financially vulnerable sectors the export probability will be higher in the more financially developed country.

Suitable econometric models of a firm's probability of exporting given by equation (3.15) are usually the probit and logit models, where $G(.)$ is the standard normal or the logistic cumulative distribution function, respectively. However, a crucial problem exists in interpreting coefficients on interaction and higher-order (e.g. quadratic) terms in non-linear models like probit and logit. Ai and Norton (2003) reviewed 72 articles published in 13 economic journals in the period 1980-1999 that use interaction effects in non-linear models. They found that none of these articles interpreted those coefficients correctly. Compared with the linear models the authors point out the following serious issues. First, the marginal effect of changing two explanatory variables (i.e. the cross derivative) is not the same as the marginal effects of the change in the interaction term of both variables. Second, there may be a significant interaction effect even if the coefficient on the interaction term is equal to zero. Third, statistical significance cannot be tested with a t-test

[73]This strategy is followed by Bernard and Jensen (1999) too. The main reason lies in the heterogeneous firms theory, which predicts that only firms that are sufficiently productive enter export markets. Since productivity captures different factors like the management ability unobservable to the econometrician, which in turn drive the export decision, including it in the estimation may be advantageous.

on the estimated coefficient of the interaction term. Finally, the sign of the coefficient on the interaction term is not necessarily the same as that of the interaction effect. Given these severe problems of non-linear models I decide to use a linear probability model, which is estimated by OLS. Even though OLS estimates are sensitive to outliers, having a large sample of more than 765,000 observations makes this problem negligible. Second, the problem of heteroskedastic errors in the case of linear probability models can be easily handled using a cluster-robust variance-covariance matrix. Finally, the linear model typically generates a good approximation of the probability for observations around the means of the covariates.[74]

Table 3.10 shows the main estimation results using the whole sample of firms. Additionally Table 3.27 in Appendix B provides summary statistics on the variables used in the estimation. Standard errors are corrected to account for a possible serial correlation within country-industry pairs and heteroskedasticity across these pairs. Columns (1) and (2) of Table 3.10 reveal that firms from financially more dependent sectors or sectors with lower asset tangibility are more likely to become exporters when they are settled in a financially more developed country. The estimated coefficients δ_1 and δ_2 have the expected sign and are significant at the 1% and 5% levels, respectively. Column (3) of the table confirms the previous results by jointly

[74]See Wooldridge (2002), pp. 454-457. To check the appropriateness of OLS estimation I perform a probit estimation of the model and compute the marginal effects on the means. The estimated effects of the non-interacted variables size, TFP, publicly quoted do not differ in terms of sign and significance from those of OLS and differ quantitatively only slightly. I consider further using the *inteff* routine for Stata of Norton et al. (2004). This routine computes the interaction effects using the correct formulas. Nevertheless, there is a fundamental problem in applying this routine to the model given in equation (3.15). Consider for example the interaction effect of a country's financial development and an industry's financial dependence. The formula for the interaction effect requires estimating the effects of both variables separately. However, these variables are not identified in the model since they are collinear to the full set of country-year and industry controls, respectively. Even though I could drop some of these dummies to estimate the coefficients on both variables, these estimates are arbitrary, depending on which controls are dropped. This is why I cannot compute the correct interaction effects for non-linear probit or logit and hence stick to the OLS estimates.

Table 3.10: Export participation and financial constraints

Dependent Variable:	**Exporter Dummy**						
Estimation:	**OLS**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FinDev*FinDep	0.032***		0.028**	0.030***	0.027**	0.027**	0.025**
	(0.012)		*(0.012)*	*(0.011)*	*(0.012)*	*(0.012)*	*(0.011)*
FinDev*Tang		-0.30**	-0.27*		-0.25*	-0.26*	-0.28**
		(0.15)	*(0.15)*		*(0.15)*	*(0.15)*	*(0.14)*
Tang1 (firm-level)				0.044			
				(0.064)			
FinDev*Tang1 (firm-level)				-0.19***			
				(0.067)			
TFP_OLS					0.039***	0.015***	0.027***
					(0.0060)	*(0.0053)*	*(0.0047)*
Firm size						0.054***	0.053***
						(0.0028)	*(0.0029)*
Publicly quoted						0.11***	0.11***
						(0.019)	*(0.020)*
(Y/L)*CapInt							-0.87*
							(0.48)
(H/L)*HumInt							-0.19**
							(0.094)
Country*year dummies	yes	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes	yes	yes
Observations	765617	765617	765617	765594	765617	765565	475729
Number of clusters	703	703	703	703	703	703	703
R-squared	0.226	0.226	0.227	0.228	0.229	0.251	0.263

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. Constant, country-year dummies and industry dummies are suppressed. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

estimating both effects. Thereby, the effects are slightly smaller but they are still statistically significant at the 10% level. Column (4) compares the effect of the firm-level asset tangibility measure of credit constraints with that of the arguably exogenous measure at the industry level in column (3). Previous firm-level studies on the link between financial constraints and export behavior find it hard to establish causality, because firm-level measures of financial health are likely to be endogenous for two reasons. First, as shown by Greenaway et al. (2007), exporters seem to be financially more healthy after entering export markets. Therefore, reverse causality is at play. Second, other unobserved firm-specific factors like product innovation can drive both the financial situation of the firm and its export decision. A comparison of the estimated coefficients on the interaction of financial development with asset tangibility reveals that those using the firm-level measure are smaller in absolute value. This indicates a bias towards zero. To be more precise the effect of a 1 standard deviation decrease in Tang (US) comparing the UK and Sweden returns a differential effect of $0.16 * 0.27 * 0.65 = 0.028$, i.e. a 2.8 percentage points higher probability, whereas a 1 standard deviation decrease in the firm-level measure returns a $0.19 * 0.19 * 0.65 = 2.3$ percentage points rise in export likelihood. Thus, the bias amounts to around 18 $(= (2.8 - 2.3)/2.8)$ percent. In column (5) I include the total factor productivity of the firm as a further explanatory variable. Consistent with the empirical literature more efficient companies are more likely to be exporters whereby the effect is significant at the 1% level.[75] In the next step, column (7) includes in addition to productivity other firm-level covariates. Consistent with the expectations bigger firms and firms having access to stock markets

[75]Here arises again the problem of the causal relationship between export status and productivity. Since I am not interested in this link I do not rely on instrumental variable estimation techniques. Researchers usually use lagged explanatory variables to account for simultaneity issues, but this strategy is less likely to be successful, because most of the firms do not change their export status over the sample period.

are more likely to export.[76] In the final specification in column (7) I control for comparative advantage effects. The interaction terms of human (physical) capital intensity with human capital (physical) abundance are statistically significant at the 5% (10%) level, but they have obviously the wrong negative sign. Even though this result is against the theoretical predictions, other studies like Becker and Greenberg (2005) and Manova (2006) find similar results.[77] Nevertheless, the estimates of the coefficients δ_1 and δ_2 change only marginally and remain statistically significant on the 5% level. Therefore, the results are robust to the inclusion of traditional comparative advantage as a determinant of export participation.

Although the interaction effects in Table 3.10 have a statistically significant impact on export probability a natural question is to ask what their economic significance is. Let's compare the financially more developed United Kingdom with the less financially developed Sweden. Then the estimate of 0.025 from column (7) means that the probability of exporting in the financially more dependent sector sanitary services (SIC 495, 75th percentile) would rise by $\hat{\delta_1} * \Delta FinDev * \Delta FinDep = 0.025 * 0.65 * 1.1 = 1.8$ percentage points more than the export probability of the less financially dependent sector cleaning preparations (SIC 284, 25th percentile), when firms relocate their business from Sweden to the UK. Similarly, if a low tangibility sector legal services (SIC 811, 25th percentile) relative to the high tangibility sector shipping containers (SIC 341, 75th percentile) is located in the financially developed United Kingdom instead of the financially less developed Sweden,

[76] Again, due to the endogeneity interpretation based on the causal link is problematic. However, using detailed French data Eaton et al. (2008) argue in favor of this "selection into exporting" hypothesis. They find evidence that companies' size in the domestic market, measured by total sales, is strongly related to firms' export market penetration. This means that only large and productive firms that are domestic "champions" are able to enter more export markets.

[77] Becker and Greenberg (2005) find a negative sign on the interaction of human or physical capital with a measure of fixed costs of an industry with respect to bilateral exports. Manova (2006) also finds a negative sign on physical capital per capita interacted with capital intensity.

then firms there would be $\hat{\delta_2} * \Delta FinDev * \Delta Tang = 0.28 * 0.65 * 0.25 = 4.6$ percentage points more likely to become exporters than companies from shipping containers. Given that UK firms are on average around 11 percentage points more likely to export than Swedish enterprises, the credit constraint effects of 1.8 and 4.6 percentage points increases in export probability are indeed economically significant.

In the next and final step I perform an additional robustness analysis where I split the data into two samples, one using manufacturing and construction firms and the other including only service firms. Table 3.11 presents the estimation results. Qualitatively the results for services in column (2) match the estimates for the whole sample. However, in this case the magnitude of the impact of financial constraints on export probability is higher. More precisely, comparing again the interquartile range of the distribution of both financial vulnerability measures for service industries across the more financially developed United Kingdom and the less financially developed Sweden, the following results apply: the differential effect using financial dependence is equal to $\hat{\delta_1} * \Delta FinDev * \Delta FinDep = 0.039 * 0.65 * 0.98 = 2.48\%$, whereas the differential effect regarding asset tangibility is $\hat{\delta_2} * \Delta FinDev * \Delta Tang = 0.44 * 0.65 * 0.36 = 10.3\%$. These are much larger than the benchmark effects of a 1.8 and 4.6 percentage points higher export probability, respectively. This finding suggests that financial factors are more important for the export participation of services enterprises.

Columns (3) to (6) of Table 3.11 show the estimates for the manufacturing and construction industries only. The following results emerge. First, for this sample I additionally use tariff rates to capture the impact of trade liberalization on the extensive margin of exports. Following Melitz (2003), tariff rate reductions lower the trade costs and lead to increased entry of firms into export markets. Thus, sectors that are more liberalized will exhibit a higher share of exporting firms. I use the simple or the weighted average of

Table 3.11: Export participation and financial constraints: industry robustness

Dependent Variable:	**Exporter Dummy**					
Estimation:	**OLS**					
Sample:	**Services**		**Manufacturing + Construction**			
	(1)	(2)	(3)	(4)	(5)	(6)
FinDev*FinDep	0.041***	0.039***	0.024**	0.023**	0.027**	0.026**
	(0.014)	*(0.013)*	*(0.0096)*	*(0.0096)*	*(0.011)*	*(0.011)*
FinDev*Tang	-0.39**	-0.44***	-0.18	-0.18	-0.15	-0.15
	(0.17)	*(0.15)*	*(0.17)*	*(0.17)*	*(0.17)*	*(0.18)*
TFP_OLS	0.032***	0.044***	-0.0068	-0.0068	-0.00062	-0.00061
	(0.0066)	*(0.0061)*	*(0.0057)*	*(0.0057)*	*(0.0056)*	*(0.0056)*
Firm size	0.045***	0.045***	0.072***	0.072***	0.070***	0.070***
	(0.0037)	*(0.0038)*	*(0.0042)*	*(0.0042)*	*(0.0044)*	*(0.0044)*
Publicly quoted	0.13***	0.14***	0.059***	0.059***	0.050**	0.050**
	(0.034)	*(0.035)*	*(0.020)*	*(0.020)*	*(0.022)*	*(0.022)*
(Y/L)*CapInt		-0.97*			-0.61	-0.72
		(0.56)			*(1.01)*	*(1.02)*
(H/L)*HumInt		-0.26***			0.12	0.11
		(0.092)			*(0.20)*	*(0.20)*
Tariff rate (simple average)			-0.0062**		-0.0068**	
			(0.0028)		*(0.0031)*	
Tariff rate (weighted average)				-0.0038**		-0.0023
				(0.0018)		*(0.0021)*
Country*year dummies	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes	yes
Observations	457125	285676	217557	217557	131865	131865
Number of clusters	270	270	382	382	381	381
R-squared	0.202	0.215	0.218	0.218	0.239	0.239

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. Constant, country-year dummies and industry dummies are suppressed. The service sample includes transportation and communication services, wholesale trade, retail trade and other services. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

the import tariff rate for each industry-country pair to capture this effect. Consistent with the theory, lower tariff rates increase the export probability of firms. Focusing on the full specifications in columns (5) and (6), the coefficient on the simple average tariff rate is negative and significant at the 5% level, though that on the weighted average tariff measure is negative but not statistically significant. Nevertheless, the economic significance of tariff reductions is rather small. The reason is due to the fact that the difference in the tariff rates for two industries at the 25th and the 75th percentile of the distribution is about 1.54 percentage points. This implies that the differential effect on export probability amounts only to 0.01 percentage points which is much lower than the impact of financial constraints. The second observation refers to the effects of credit constraints. The estimated δ_1 and δ_2 have the expected signs, though $\hat{\delta_2}$ is not statistically significant. This implies that asset tangibility considerations do not have a significant impact on the export probability of firms from secondary industries. This result is consistent with the notion that manufacturing (construction) companies have relatively more tangible assets than services firms such that collateral requirements by banks do not represent an obstacle to their external financing. Financial constraints impact on the export probability of manufacturing firms only through the external financial dependence. The differential impact on the export likelihood for the specification in column (5) is around $\hat{\delta_1} * \Delta FinDev * \Delta FinDep = 0.027 * 0.65 * 0.90 = 1.6$ percentage points, which is close to the effect for the whole sample. The final interesting result concerns the role of productivity differences. The estimated coefficient on the TFP measure is no more statistically significant and even has the wrong negative sign. One reasonable explanation for this result is that systematic productivity differences between exporters and non-exporters are captured solely by observable factors like firm size, financial constraints, comparative advantage and tariff rates. Therefore, productivity has no further economic

impact on the export participation of firms.

3.7 Conclusion

This paper provides empirical evidence that financial constraints are an important determinant of firm-level total factor productivity as well as of firms' export participation. Using a large panel of Eastern and Western European companies during the period 1995-2004 I found the following patterns in the data. First, firms in industries that are either more dependent on external finance or possess less tangible assets have on average higher productivities and are more likely to export in countries with a better developed financial system. Second, this finding is robust to the inclusion of traditional comparative advantage, to the effects of other non-financial institutions as well as to the effects of trade liberalization. Finally, the empirical results are consistent with newly established theoretical literature on heterogeneous firms, credit constraints and international trade, e.g. Manova (2006).

This paper contributes to the existing empirical literature in the following ways. First, it provides firm-level evidence on the role of credit constraints where micro-level studies are rather scarce. Second, unlike most of the previous firm-level studies, which fail to establish a causal link from financial constraints to export activity, this paper delivers consistent results by employing a difference-in-difference methodology and using exogenous measures of financial vulnerability. Finally, unlike the existing literature, this paper does not focus exclusively on manufacturing industries. Service sectors are becoming increasingly important for the overall performance in European economies. The results suggest that financial conditions influence the productivity and export participation of service enterprises mainly through the availability of hard, tangible assets that serve as collateral when companies apply for credit.

The findings in this paper have important economic implications. The severe financial crisis of 2008-2009 showed that sound financial conditions are important drivers of entrepreneurial activity as well as worldwide trade flows. The results in this paper suggest that the financial crisis will harm more heavily industries relying strongly on outside finance or having less tangible assets. Moreover, these effects are likely to be exacerbated by a lower valuation of firms' tangible assets and lower cash flow during the financial meltdown.

There is scope for further research. Probably the current financial crisis will provide us with a good "natural experiment", where one can study the effects of credit constraints on firm activities. However, from an econometric point of view it may be difficult to identify credit-constraint effects along with strong policy interventions of European governments during that period. Nevertheless, exploring how important financial frictions are for economic activity plays a key role in designing and implementing appropriate economic policies that will strengthen the financial systems of the countries.

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[77] Worldscope Database (2008), Thomson Financial, Thomson Reuters, http://thomsonreuters.com, online access on 25th of July 2008.

B Appendix to Chapter 3

Table 3.12: Countries in the sample

Country	**Country ISO code**	**Frequency**	**Percent**	**Cum.**
Austria	AT	752	0.14	0.14
Belgium	BE	12,184	2.26	2.40
Bulgaria	BG	11,532	2.14	4.54
Switzerland	CH	202	0.04	4.58
Cyprus	CY	33	0.01	4.58
Czech Republic	CZ	10,548	1.96	6.54
Germany	DE	3,734	0.69	7.23
Denmark	DK	8,522	1.58	8.81
Estland	EE	5,014	0.93	9.74
Spain	ES	97,764	18.14	27.88
Finland	FI	13,394	2.48	30.37
France	FR	107,373	19.92	50.29
United Kingdom	GB	42,358	7.86	58.14
Croatia	HR	5,901	1.09	59.24
Hungary	HU	902	0.17	59.41
Ireland	IE	35	0.01	59.41
Island	IS	52	0.01	59.42
Italy	IT	102,744	19.06	78.48
Luxembourg	LU	126	0.02	78.51
Latvia	LV	98	0.02	78.53
Macedonia	MK	71	0.01	78.54
Netherland	NL	7,908	1.47	80.01
Norway	NO	24,809	4.60	84.61
Poland	PL	11,836	2.20	86.81
Portugal	PT	4,009	0.74	87.55
Romania	RO	28,967	5.37	92.92
Sweden	SE	36,609	6.79	99.71
Slovak Republic	SK	1,538	0.29	100.00
Total		539,015	100.00	

Notes: The table shows by country the total number of active firms during the sample period 1995-2004.

Table 3.13: Country characteristics

Country ISO code	**Private credit by deposit money banks (% of GDP)**	**Private credit by banks and other financial institutions (% of GDP)**	**Y/L**	**H/L**	**Institutions**
AT	0.98	0.98	10.23	52.68	1.56
BE	0.74	0.74	10.18	58.23	1.28
BG	0.20	0.20	8.71	42.64	0.02
CH	1.60	1.60	10.31	40.30	1.85
CY	0.97	1.32	9.85	23.85	0.92
CZ	0.50	0.50	9.65	31.61	0.72
DE	1.11	1.11	10.12	49.28	1.52
DK	0.82	0.82	10.23	60.57	1.75
EE	0.22	0.22	9.16	58.88	0.81
ES	0.89	0.89	9.95	59.47	1.19
FI	0.56	0.56	10.10	84.25	1.85
FR	0.84	0.84	10.13	53.41	1.22
GB	1.24	1.24	10.16	60.51	1.62
HR	0.38	0.38	9.14	33.82	0.07
HU	0.28	0.28	9.45	41.35	0.83
IE	0.90	0.92	10.23	50.14	1.54
IS	0.81	0.81	10.21	49.70	1.67
IT	0.67	0.67	10.11	52.40	0.83
LU	0.98	0.98	10.83	10.83	1.75
LV	0.17	0.17	8.96	61.58	0.42
MK	0.22	0.22	8.65	24.58	-0.41
NL	1.64	2.02	10.22	54.77	1.79
NO	0.65	0.90	10.41	72.26	1.68
PL	0.23	0.23	9.21	53.05	0.62
PT	1.07	1.07	9.75	50.43	1.23
RO	0.09	0.09	8.77	28.48	-0.15
SE	0.59	0.95	10.12	71.84	1.72
SK	0.42	0.42	9.33	30.29	0.44
Average	0.71	0.75	9.79	48.61	1.08
p10	0.20	0.20	8.77	24.58	0.02
p25	0.28	0.28	9.33	40.30	0.72
p75	0.98	0.98	10.22	59.47	1.68
p90	1.24	1.32	10.31	71.84	1.79

Notes: The table shows by country the cross-sectional mean of each variable during the period 1995-2004. Y/L denotes the log of real GDP per capita in PPP, H/L is a human capital abundance measure. Institutions is an index of the quality of governance in a country, with higher values indicating better quality. p10, p25, p75 and p90 indicate the 10th, 25th, 75th and 90th percentile of the distribution, respectively.

Table 3.14: US SIC industry description

SIC code	Industry Description
104	Gold and Silver Ores
152	General Building Contractors-residential
161	Highway and Street Construction
162	Heavy Construction, Except Highway And Street
171	Plumbing, Heating and Air-Conditioning
173	Electrical Work
174	Masonry, Stonework, Tile Setting, and Plastering
175	Carpentry and Floor Work
176	Roofing, Siding and Sheet Metal Work
178	Water Well Drilling
179	Miscellaneous Special Trade Contractors
201	Meat Products
202	Dairy Products
203	Canned, Frozen, and Preserved Fruits, Vegetables, etc.
204	Grain Mill Products
205	Bakery Products
206	Sugar and Confectionery Products
207	Fats and Oils
208	Beverages
209	Miscellaneous Foods and Kindred Products
211	Cigarettes
221	Broadwoven Fabric Mills, Cotton
222	Broadwoven Fabric Mills, Manmade Fiber and Silk
225	Knitting Mills
226	Dyeing and Finishing Textiles, Except Wool Fabrics
227	Carpets and Rugs
228	Yarn and Thread Mills
229	Miscellaneous Textile Goods
232	Men's and Boys' Furnishings
238	Miscellaneous Apparel and Accessories
239	Miscellaneous Fabricated Textile Products
242	Sawmills and Planing Mills
243	Millwork, Veneer, Plywood, and Structural Wood
245	Wood Buildings and Mobile Homes
249	Miscellaneous Wood Products
251	Household Furniture
252	Office Furniture
261	Pulp Mills
262	Paper Mills
265	Paperboard Containers and Boxes
267	Miscellaneous Converted Paper and Paperboard Products
271	Newspapers: Publishing, or Publishing and Printing
272	Periodicals: Publishing, or Publishing and Printing

Table 3.14 - Continued

SIC code	Industry Description
273	Books
274	Miscellaneous Publishing
275	Commercial Printing
278	Blankbooks, Looseleaf Binders, and Bookbinding
281	Industrial Inorganic Chemicals
282	Plastics Materials and Synthetic Resins
283	Drugs
284	Soap, Detergents, and Cleaning Preparations; Perfumes, etc.
285	Paints, Varnishes, Lacquers, Enamels, and Allied
286	Industrial Organic Chemicals
287	Agricultural Chemicals
289	Miscellaneous Chemical Products
299	Miscellaneous Products of Petroleum and Coal
301	Tires and Inner Tubes
302	Rubber and Plastic Footwear
306	Fabricated Rubber Products, Not Elsewhere Classified
308	Miscellaneous Plastics Products
321	Flat Glass
322	Glass and Glassware, Pressed or Blown
323	Products of Purchased Glass
324	Cement, Hydraulic
325	Structural Clay Products
326	Pottery and Related Products
327	Concrete, Gypsum and Plaster Products
328	Cut Stone and Stone Products
329	Abrasive, Asbestos, and Miscellaneous
331	Steel Works, Blast Furnaces, and Rolling and Finishing Mills
332	Iron and Steel Foundries
333	Primary Smelting and Refining Of Nonferrous
334	Secondary Smelting and Refining Of Nonferrous
336	Nonferrous Foundries (Castings)
341	Metal Cans and Shipping Containers
342	Cutlery, Handtools, and General Hardware
343	Heating Equipment, Except Electric And Warm Air
344	Fabricated Structural Metal Products
345	Screw Machine Products, Bolts, etc.
346	Metal Forgings and Stampings
348	Ordnance and Accessories, Except Vehicles and Guided Missiles
349	Miscellaneous Fabricated Metal Products
351	Engines and Turbines
352	Farm and Garden Machinery and Equipment
353	Construction, Mining, and Materials Handling
354	Metalworking Machinery and Equipment
355	Special Industry Machinery, Except Metalworking

Table 3.14 - Continued

SIC code	Industry Description
356	General Industrial Machinery and Equipment
357	Computer and Office Equipment
362	Electrical Industrial Apparatus
363	Household Appliances
364	Electric Lighting and Wiring Equipment
365	Household Audio and Video Equipment
366	Communications Equipment
367	Electronic Components and Accessories
369	Miscellaneous Electrical Machinery, Equipment, and Supplies
371	Motor Vehicles and Equipment
372	Aircraft and Parts
373	Ship and Boat Building and Repairing
374	Railroad Equipment
375	Motorcycles, Bicycles and Parts
379	Miscellaneous Transportation Equipment
381	Search, Detection, Navigation, etc. and Equipment
382	Measuring and Controlling Instruments
384	Surgical, Medical, and Dental Instruments and Supplies
387	Watches, Clocks, Clockwork Operated Devices, and Parts
391	Jewelry, Silverware and Plated Ware
393	Musical Instruments
394	Dolls, Toys, Games and Sporting and Athletic
399	Miscellaneous Manufacturing Industries
401	Railroads
411	Local and Suburban Passenger Transportation
421	Trucking and Courier Services, Except Air
441	Deep Sea Foreign Transportation of Freight
444	Water Transportation of Freight, Not Elsewhere Classified
449	Services Incidental to Water Transportation
451	Air Transportation, Scheduled, and Air Courier
452	Air Transportation, Nonscheduled
458	Airports, Flying Fields, and Airport Terminal
461	Pipelines, Except Natural Gas
472	Arrangement Of Passenger Transportation
474	Rental of Railroad Cars
478	Miscellaneous Services Incidental To Transportation
489	Communications Services, Not Elsewhere Classified
495	Sanitary Services
501	Motor Vehicles, Parts and Supplies
502	Furniture and Home Furnishing
503	Lumber and Other Construction Materials
504	Professional and Commercial Equipment and Supplies
505	Metals and Minerals, Except Petroleum
506	Electrical Goods

Table 3.14 - Continued

SIC code	Industry Description
507	Hardware, Plumbing and Heating Equipment
508	Machinery, Equipment and Supplies
509	Miscellaneous Durable Goods
512	Drugs, Drug Proprietaries, and Druggists' Sundries
513	Apparel, Piece Goods and Notions
514	Groceries and Related Products
515	Farm-product Raw Materials
516	Chemicals and Allied Products
518	Beer, Wine, and Distilled Alcoholic Beverages
519	Miscellaneous Non-durable Goods
523	Paint, Glass and Wallpaper Stores
531	Department Stores
541	Grocery Stores
543	Fruit and Vegetable Markets
544	Candy, Nut and Confectionery Stores
549	Miscellaneous Food Stores
554	Gasoline Service Stations
565	Family Clothing Stores
566	Shoe Stores
571	Home Furniture and Furnishings Stores
572	Household Appliance Stores
581	Eating and Drinking Places
591	Drug Stores and Proprietary Stores
593	Used Merchandise Stores
594	Miscellaneous Shopping Goods Stores
596	Nonstore Retailers
599	Retail Stores, Not Elsewhere Classified
701	Hotels and Motels
702	Rooming and Boarding Houses
703	Camps and Recreational Vehicle Parks
722	Photographic Studios, Portrait
729	Miscellaneous Personal Services
731	Advertising
733	Mailing, Reproduction, Stenographic Services
734	Services to Dwellings and Other Buildings
735	Miscellaneous Equipment Rental and Leasing
736	Personnel Supply Services
737	Computer Programming, Data Processing, etc. Services
738	Miscellaneous Business Services
751	Automotive Rental and Leasing, Without Drivers
753	Automobile Repair Shops
762	Electrical Repair Shops
769	Miscellaneous Repair Shops and Related Services
811	Legal Services

Table 3.14 - Continued

SIC code	Industry Description
871	Engineering, Architectural, and Surveying
872	Accounting, Auditing, and Bookkeeping Services
873	Research, Development, and Testing Services
874	Management and Public Relations Services

Source: United States Department of Labor; `www.osha.gov`

Table 3.15: Industry measures

SIC code	Asset Tangibility (US)	External Finance Dependence (US)	Physical Capital Intensity (UK)	Human Capital Intensity (UK)
104	0.345	1.993	0.0347	0.0325
152	0.019	1.318	0.0137	0.0335
161	0.344	-0.130	0.0205	0.0383
162	0.230	-0.123	0.0124	0.0357
171	0.041	-1.758	0.0073	0.0353
173	0.251	0.329	0.0062	0.0380
174	0.136	0.875	0.0101	0.0345
175	0.379	-0.134	0.0148	0.0323
176	0.087	-2.946	0.0079	0.0332
178	0.335	1.490	0.0152	0.0405
179	0.257	-0.697	0.0210	0.0360
201	0.419	-0.326	0.0292	0.0255
202	0.330	-0.447	0.0473	0.0288
203	0.285	-1.028	0.0378	0.0277
204	0.437	-0.467	0.0592	0.0331
205	0.492	-0.356	0.0225	0.0200
206	0.361	-0.763	0.0463	0.0247
207	0.360	0.106	0.0698	0.0356
208	0.333	-0.333	0.1170	0.0321
209	0.319	-0.199	0.0328	0.0259
211	0.125	-3.438	0.1541	0.0431
221	0.634	-0.105	0.0362	0.0252
222	0.374	-0.574	0.2263	0.0083
225	0.162	-0.084	0.0126	0.0204
226	0.051	1.883	0.0309	0.0261
227	0.317	-0.618	0.0229	0.0270
228	0.510	-0.403	0.0288	0.0251
229	0.392	-0.048	0.0285	0.0266
232	0.193	-0.892	0.0126	0.0236

Table 3.15 - Continued

SIC code	Asset Tangibility	External Financial Dependence	Physical Capital Intensity	Human Capital Intensity
238	0.113	0.258	0.0142	0.0251
239	0.307	0.790	0.0146	0.0227
242	0.107	1.008	0.0315	0.0260
243	0.429	-0.506	0.0178	0.0277
245	0.189	-1.890	0.0268	0.0281
249	0.214	-1.214	0.0262	0.0264
251	0.285	-1.055	0.0162	0.0275
252	0.355	-1.407	0.0189	0.0321
261	0.636	-0.210	0.2391	0.0385
262	0.574	-0.557	0.0725	0.0385
265	0.470	-0.774	0.0446	0.0304
267	0.513	-0.776	0.0401	0.0306
271	0.230	-2.067	0.0476	0.0295
272	0.094	-1.273	0.0231	0.0440
273	0.133	-0.834	0.0197	0.0375
274	0.120	-1.140	0.0269	0.0405
275	0.332	-0.732	0.0459	0.0360
278	0.287	-2.180	0.0356	0.0328
281	0.371	-0.277	0.0972	0.0442
282	0.421	-0.202	0.0516	0.0340
283	0.124	9.304	0.0678	0.0452
284	0.170	-0.728	0.0332	0.0308
285	0.385	-1.319	0.0398	0.0361
286	0.342	0.280	0.1267	0.0453
287	0.270	-0.821	0.1056	0.0361
289	0.224	-0.223	0.0580	0.0387
299	0.147	-1.140	0.0584	0.0396
301	0.375	0.060	0.0387	0.0312
302	0.123	-1.299	0.0139	0.0250
306	0.329	-0.363	0.0288	0.0316
308	0.344	-0.151	0.0336	0.0296
321	0.416	-0.403	0.0329	0.0277
322	0.365	-1.037	0.0380	0.0326
323	0.306	1.072	0.0495	0.0312
324	0.510	-0.803	0.1134	0.0401
325	0.386	-0.222	0.0699	0.0334
326	0.084	-7.519	0.0267	0.0272
327	0.436	-0.152	0.0505	0.0342
328	0.382	-0.106	0.0215	0.0265
329	0.148	3.985	0.0557	0.0326
331	0.459	-0.105	0.0405	0.0328

Table 3.15 - Continued

SIC code	Asset Tangibility	External Financial Dependence	Physical Capital Intensity	Human Capital Intensity
332	0.465	-0.687	0.0273	0.0321
333	0.410	0.647	0.0342	0.0333
334	0.377	-0.115	0.0281	0.0319
336	0.226	-3.981	0.0289	0.0323
341	0.390	-0.709	0.0291	0.0324
342	0.169	-2.041	0.0266	0.0312
343	0.236	1.566	0.0307	0.0359
344	0.317	-0.429	0.0199	0.0339
345	0.399	-2.277	0.0308	0.0287
346	0.420	0.020	0.0310	0.0310
348	0.181	-0.404	0.0477	0.0417
349	0.228	-0.706	0.0250	0.0323
351	0.188	6.268	0.0378	0.0358
352	0.135	-1.177	0.0263	0.0307
353	0.248	-0.341	0.0216	0.0366
354	0.213	-0.740	0.0314	0.0358
355	0.169	0.289	0.0278	0.0381
356	0.222	-0.478	0.0248	0.0376
357	0.107	0.186	0.0209	0.0404
362	0.170	0.018	0.0221	0.0358
363	0.128	-0.769	0.0247	0.0286
364	0.230	-0.230	0.0207	0.0320
365	0.144	0.398	0.0245	0.0362
366	0.124	1.525	0.0206	0.0406
367	0.177	0.198	0.0240	0.0312
369	0.179	2.043	0.0203	0.0328
371	0.273	-0.149	0.0329	0.0340
372	0.152	-1.124	0.0307	0.0400
373	0.282	-0.271	0.0240	0.0347
374	0.270	0.151	0.0175	0.0395
375	0.216	0.910	0.0154	0.0250
379	0.241	-0.452	0.0186	0.0306
381	0.146	-0.934	0.0223	0.0380
382	0.128	0.384	0.0171	0.0392
384	0.122	3.311	0.0317	0.0388
387	0.127	-1.060	0.0155	0.0408
391	0.025	1.523	0.0164	0.0246
393	0.305	-0.627	0.0444	0.0356
394	0.124	0.427	0.0236	0.0292
399	0.247	-0.255	0.0264	0.0300
401	0.698	-0.307	0.0212	0.0423

Table 3.15 - Continued

SIC code	Asset Tangibility	External Financial Dependence	Physical Capital Intensity	Human Capital Intensity
411	0.148	0.526	0.0400	0.0247
421	0.480	0.175	0.0318	0.0316
441	0.742	0.332	0.1566	0.0364
444	0.603	-0.579	0.1107	0.0365
449	0.576	0.457	0.0228	0.0369
451	0.581	0.111	0.0786	0.0399
452	0.535	0.213	0.0533	0.0448
458	0.390	-0.182	0.0463	0.0373
461	0.801	-0.896	1.8359	0.0325
472	0.065	0.568	0.0102	0.0274
474	0.657	0.160	0.5089	0.0369
478	0.606	1.249	0.0143	0.0330
489	0.271	2.184	0.0386	0.0511
495	0.388	0.371	0.0530	0.0300
501	0.175	-0.312	0.0304	0.0276
502	0.040	0.435	0.0210	0.0286
503	0.195	0.521	0.0254	0.0268
504	0.081	0.743	0.0162	0.0419
505	0.276	0.480	0.0348	0.0331
506	0.063	-0.009	0.0168	0.0325
507	0.148	-0.470	0.0158	0.0272
508	0.185	-0.258	0.0194	0.0318
509	0.139	-0.157	0.0584	0.0258
512	0.091	-1.519	0.0210	0.0321
513	0.060	-1.047	0.0190	0.0283
514	0.246	-0.064	0.0233	0.0275
515	0.191	-0.550	0.0346	0.0305
516	0.287	-1.020	0.0203	0.0343
518	0.356	1.085	0.0283	0.0294
519	0.107	-0.469	0.0222	0.0340
523	0.186	-2.755	0.0220	0.0196
531	0.435	0.070	0.0201	0.0181
541	0.494	-0.235	0.0261	0.0130
543	0.280	-0.561	0.0058	0.0116
544	0.476	-0.148	0.0139	0.0148
549	0.451	4.362	0.0222	0.0172
554	0.573	0.000	0.0799	0.0152
565	0.304	-0.897	0.0165	0.0186
566	0.288	-0.359	0.0118	0.0161
571	0.289	-0.208	0.0332	0.0241
572	0.253	0.258	0.0181	0.0243

Table 3.15 - Continued

SIC code	Asset Tangibility	External Financial Dependence	Physical Capital Intensity	Human Capital Intensity
581	0.581	-0.018	0.0301	0.0157
591	0.130	0.497	0.0377	0.0166
593	0.142	-0.378	0.0264	0.0261
594	0.221	-0.105	0.0114	0.0211
596	0.105	1.150	0.0164	0.0273
599	0.116	0.768	0.0214	0.0214
701	0.662	0.189	0.0959	0.0171
702	0.830	0.641	0.0723	0.0170
703	0.819	-0.561	0.1505	0.0172
722	0.433	-0.351	0.0172	0.0337
729	0.091	-1.319	0.0332	0.0205
731	0.058	-0.204	0.0117	0.0457
733	0.090	1.377	0.0266	0.0632
734	0.097	-2.121	0.0010	0.0110
735	0.492	0.232	0.0925	0.0340
736	0.089	-0.753	0.0037	0.0401
737	0.097	3.019	0.0130	0.0568
738	0.100	1.271	0.0172	0.0383
751	0.607	0.513	0.3036	0.0269
753	0.479	0.508	0.0290	0.0290
762	0.200	1.433	0.0065	0.0284
769	0.254	6.203	0.0086	0.0343
811	0.141	-2.196	0.0049	0.0378
871	0.166	-0.177	0.0064	0.0454
872	0.070	-0.672	0.0118	0.0404
873	0.130	8.764	0.0374	0.0473
874	0.091	-0.516	0.0121	0.0495
Average	0.287	-0.035	0.050	0.032
p10	0.091	-1.299	0.0124	0.0204
p25	0.141	-0.728	0.0186	0.0270
p75	0.390	0.371	0.0398	0.0366
p90	0.535	1.377	0.0786	0.0406

Notes: The table shows by sector the calculated measures for asset tangibility (Tang), external financial dependence (FinDep), physical capital intensity (CapInt) and human capital intensity (HumInt) using the methodology described in the main text. p10, p25, p75 and p90 indicate the 10th, 25th, 75th and 90th percentile of the distribution, respectively.

Table 3.16: Pairwise correlations of industry measures

	Tang	FinDep	CapInt	HumInt
Tang	1.00			
FinDep	-0.03 (0.71)	1.00		
CapInt	0.37 (0.00)	-0.03 (0.64)	1.00	
HumInt	-0.20 (0.01)	0.18 (0.01)	0.02 (0.83)	1.00

Notes: The table shows the pairwise correlations between the industry measures: asset tangibility ($Tang$), external financial dependence ($FinDep$), physical capital intensity ($CapInt$) and human capital intensity ($HumInt$). P-values of the t-test with the null hypothesis of no correlation in parentheses.

Table 3.17: Estimated coefficients by industry and estimation method

	OLS			**FE**			**LP**		
SIC code	**capital**	**labor**	**obs.**	**capital**	**labor**	**obs.**	**capital**	**labor**	**obs.**
104	0.28	0.57	411	0.21	0.35	411	0.20	0.78	251
152	0.29	0.62	143533	0.41	0.44	143533	0.18	0.49	122559
161	0.36	0.58	11496	0.60	0.34	11496	0.31	0.41	10801
162	0.23	0.71	24027	0.37	0.52	24027	0.16	0.60	18802
171	0.25	0.72	27591	0.44	0.43	27591	0.17	0.50	25260
173	0.21	0.76	36867	0.33	0.46	36867	0.11	0.60	33195
174	0.21	0.68	12960	0.29	0.48	12960	0.10	0.61	11722
175	0.16	0.71	11843	0.21	0.49	11843	0.11	0.56	10572
176	0.17	0.70	8922	0.17	0.61	8922	0.10	0.59	8151
178	0.32	0.64	1114	0.46	0.37	1114	0.25	0.53	1052
179	0.22	0.69	23522	0.23	0.45	23522	0.15	0.58	20957
201	0.38	0.55	23647	0.60	0.20	23647	0.38	0.39	21931
202	0.42	0.57	10614	0.63	0.22	10614	0.32	0.45	9867
203	0.38	0.54	9098	0.53	0.26	9098	0.31	0.37	7654
204	0.47	0.51	12757	0.71	0.18	12757	0.43	0.37	11564
205	0.58	0.37	18230	0.82	0.13	18230	0.55	0.21	16829

Table 3.17 - Continued

	OLS			FE			LP		
SIC code	**capital**	**labor**	**obs.**	**capital**	**labor**	**obs.**	**capital**	**labor**	**obs.**
206	0.45	0.56	4434	0.62	0.22	4434	0.36	0.41	3971
207	0.44	0.60	2881	0.59	0.21	2881	0.32	0.42	2681
208	0.41	0.60	16255	0.59	0.25	16255	0.35	0.42	14531
209	0.35	0.59	14139	0.41	0.36	14139	0.27	0.46	12247
211	0.45	0.52	746	0.31	0.42	746	0.44	0.41	564
221	0.37	0.53	3034	0.53	0.28	3034	0.31	0.45	2915
222	0.29	0.61	1700	0.50	0.46	1700	0.19	0.55	1671
225	0.38	0.54	10172	0.56	0.21	10172	0.24	0.50	9585
226	0.23	0.63	5769	0.20	0.38	5769	0.11	0.57	5371
227	0.31	0.63	1394	0.42	0.44	1394	0.34	0.58	964
228	0.33	0.56	5864	0.47	0.40	5864	0.23	0.51	4891
229	0.35	0.60	6234	0.50	0.33	6234	0.24	0.50	5597
232	0.46	0.46	19796	0.64	0.13	19796	0.35	0.48	18365
238	0.41	0.47	6146	0.59	0.14	6146	0.31	0.46	5603
239	0.38	0.49	5886	0.62	0.25	5886	0.34	0.43	5227
242	0.50	0.39	12874	0.76	0.09	12874	0.49	0.28	11565
243	0.32	0.63	6303	0.49	0.26	6303	0.20	0.45	5929
245	0.35	0.56	12530	0.58	0.25	12530	0.31	0.40	11505
249	0.36	0.52	5830	0.56	0.21	5830	0.29	0.44	5035
251	0.44	0.50	21666	0.68	0.16	21666	0.38	0.34	19481
252	0.36	0.51	6032	0.56	0.16	6032	0.32	0.34	5276
261	0.36	0.60	417	0.54	0.25	417	0.21	0.30	380
262	0.36	0.59	4447	0.39	0.35	4447	0.19	0.52	3697
265	0.33	0.62	14346	0.39	0.37	14346	0.20	0.47	12218
267	0.36	0.56	10905	0.50	0.20	10905	0.27	0.43	9502
271	0.38	0.55	6058	0.46	0.31	6058	0.28	0.45	4563
272	0.19	0.74	5871	0.12	0.42	5871	0.07	0.61	4107
273	0.27	0.63	6467	0.26	0.28	6467	0.13	0.49	4840
274	0.26	0.59	2639	0.25	0.35	2639	0.18	0.47	1641
275	0.33	0.57	23454	0.47	0.27	23454	0.24	0.38	18596
278	0.30	0.53	1791	0.27	0.20	1791	0.20	0.49	1639
281	0.35	0.59	5114	0.44	0.34	5114	0.38	0.42	3561
282	0.35	0.58	5735	0.37	0.37	5735	0.20	0.48	4415
283	0.28	0.70	8651	0.38	0.35	8651	0.23	0.48	7061
284	0.33	0.63	7647	0.39	0.31	7647	0.21	0.47	6689
285	0.34	0.60	6601	0.53	0.29	6601	0.31	0.37	5860
286	0.34	0.64	1967	0.28	0.41	1967	0.26	0.51	1704
287	0.26	0.72	2576	0.37	0.41	2576	0.22	0.58	2244
289	0.26	0.69	8673	0.32	0.40	8673	0.24	0.52	6958
299	0.44	0.53	2488	0.40	0.25	2488	0.26	0.46	2017
301	0.44	0.51	637	0.75	0.18	637	0.46	0.28	511

Table 3.17 - Continued

	OLS			FE			LP		
SIC code	**capital**	**labor**	**obs.**	**capital**	**labor**	**obs.**	**capital**	**labor**	**obs.**
302	0.38	0.54	15168	0.59	0.26	15168	0.27	0.49	14797
306	0.31	0.63	5857	0.44	0.41	5857	0.18	0.52	5054
308	0.32	0.60	29550	0.45	0.33	29550	0.24	0.44	24971
321	0.38	0.59	4162	0.51	0.29	4162	0.28	0.47	3708
322	0.45	0.51	2627	0.57	0.19	2627	0.29	0.38	2348
323	0.51	0.38	355	0.73	0.47	355	0.58	0.40	280
324	0.46	0.53	1561	0.32	0.33	1561	0.19	0.37	1366
325	0.33	0.66	8246	0.48	0.39	8246	0.24	0.51	7755
326	0.41	0.55	3194	0.62	0.23	3194	0.37	0.43	2748
327	0.31	0.61	20702	0.39	0.37	20702	0.18	0.49	19771
328	0.27	0.63	7029	0.40	0.36	7029	0.17	0.54	6923
329	0.36	0.55	3510	0.44	0.30	3510	0.38	0.46	3037
331	0.30	0.65	9244	0.39	0.41	9244	0.20	0.51	7921
332	0.34	0.59	3622	0.53	0.23	3622	0.25	0.43	3145
333	0.34	0.62	4423	0.36	0.45	4423	0.18	0.50	3309
334	0.26	0.64	1749	0.36	0.27	1749	0.21	0.56	1551
336	0.42	0.48	1799	0.62	0.23	1799	0.25	0.38	1669
341	0.33	0.60	5064	0.50	0.33	5064	0.27	0.45	4685
342	0.26	0.64	7436	0.36	0.32	7436	0.14	0.55	6554
343	0.20	0.74	7731	0.25	0.42	7731	0.11	0.64	7389
344	0.32	0.61	37018	0.53	0.31	37018	0.24	0.50	34060
345	0.35	0.56	4145	0.54	0.22	4145	0.23	0.43	3678
346	0.29	0.63	14167	0.36	0.38	14167	0.20	0.55	13576
348	0.24	0.69	793	0.26	0.38	793	0.33	0.47	681
349	0.24	0.67	59193	0.29	0.40	59193	0.14	0.58	49069
351	0.29	0.64	1522	0.57	0.28	1522	0.28	0.48	1281
352	0.30	0.63	6596	0.44	0.35	6596	0.22	0.49	5981
353	0.24	0.69	14676	0.34	0.40	14676	0.14	0.55	12820
354	0.24	0.67	11718	0.38	0.34	11718	0.14	0.53	10813
355	0.23	0.68	21235	0.29	0.41	21235	0.13	0.56	19122
356	0.21	0.71	32050	0.24	0.39	32050	0.16	0.58	28379
357	0.31	0.63	4884	0.41	0.31	4884	0.22	0.55	3347
362	0.27	0.66	12134	0.42	0.39	12134	0.24	0.51	10915
363	0.31	0.62	4165	0.42	0.28	4165	0.19	0.47	3559
364	0.28	0.64	9192	0.36	0.40	9192	0.22	0.50	8144
365	0.28	0.64	2539	0.34	0.42	2539	0.22	0.42	1936
366	0.28	0.67	4704	0.28	0.45	4704	0.16	0.58	4036
367	0.24	0.66	7324	0.27	0.46	7324	0.25	0.53	6024
369	0.23	0.69	12462	0.22	0.37	12462	0.15	0.55	9542
371	0.31	0.64	19808	0.44	0.44	19808	0.21	0.50	17299
372	0.28	0.69	2308	0.41	0.47	2308	0.41	0.53	1623

Table 3.17 - Continued

	OLS			FE			LP		
SIC code	**capital**	**labor**	**obs.**	**capital**	**labor**	**obs.**	**capital**	**labor**	**obs.**
373	0.24	0.71	6500	0.40	0.39	6500	0.13	0.64	5628
374	0.34	0.57	2553	0.51	0.34	2553	0.24	0.44	2435
375	0.17	0.77	1329	0.19	0.49	1329	0.17	0.65	1199
379	0.14	0.76	801	0.08	0.37	801	0.06	0.52	553
381	0.22	0.72	8422	0.26	0.45	8422	0.13	0.59	6375
382	0.25	0.67	6165	0.42	0.37	6165	0.19	0.53	5655
384	0.27	0.64	7025	0.22	0.41	7025	0.17	0.50	5992
387	0.23	0.61	526	0.22	0.65	526	-0.02	0.59	477
391	0.23	0.62	5337	0.22	0.34	5337	0.13	0.58	4991
393	0.42	0.37	465	0.45	-0.04	465	0.54	0.32	412
394	0.29	0.61	3555	0.35	0.35	3555	0.22	0.48	3064
399	0.26	0.65	10966	0.29	0.43	10966	0.20	0.52	5685
401	0.23	0.69	1469	0.26	0.40	1469	0.43	0.48	761
411	0.24	0.68	16845	0.24	0.32	16845	0.14	0.66	14501
421	0.32	0.62	67320	0.48	0.37	67320	0.23	0.52	47829
441	0.32	0.53	4820	0.26	0.37	4820	0.22	0.48	2414
444	0.36	0.51	913	0.50	0.33	913	0.35	0.43	594
449	0.23	0.66	10292	0.34	0.32	10292	0.16	0.65	7605
451	0.24	0.75	1229	0.16	0.55	1229	0.10	0.73	552
452	0.21	0.80	1136	0.20	0.65	1136	0.20	0.66	680
458	0.22	0.70	1658	0.22	0.47	1658	0.06	0.69	1012
461	0.46	0.28	195	0.82	0.01	195	0.01	0.15	136
472	0.17	0.78	15526	0.20	0.46	15526	0.09	0.66	9216
474	0.45	0.42	1492	0.43	0.32	1492	0.23	0.36	986
478	0.21	0.66	26512	0.23	0.39	26512	0.15	0.63	16651
489	0.35	0.61	6580	0.49	0.34	6580	0.28	0.50	4277
495	0.42	0.48	8327	0.64	0.22	8327	0.33	0.42	7553
501	0.23	0.69	120382	0.28	0.37	120382	0.16	0.48	102545
502	0.23	0.63	45999	0.28	0.35	45999	0.16	0.50	41780
503	0.25	0.60	56546	0.31	0.29	56546	0.16	0.44	51873
504	0.21	0.74	21024	0.24	0.48	21024	0.10	0.63	18608
505	0.27	0.61	31997	0.31	0.32	31997	0.15	0.53	28298
506	0.20	0.72	45595	0.21	0.43	45595	0.12	0.55	41112
507	0.20	0.68	21771	0.20	0.35	21771	0.13	0.48	20101
508	0.22	0.66	104134	0.24	0.37	104134	0.14	0.50	85685
509	0.28	0.56	4892	0.25	0.31	4892	0.17	0.50	4301
512	0.24	0.68	25969	0.29	0.30	25969	0.16	0.50	23209
513	0.20	0.62	32632	0.21	0.42	32632	0.13	0.48	27756
514	0.29	0.54	92195	0.39	0.20	92195	0.22	0.41	83521
515	0.25	0.62	22172	0.31	0.30	22172	0.17	0.53	20642
516	0.21	0.65	26830	0.22	0.35	26830	0.11	0.55	23887

Table 3.17 - Continued

	OLS			FE			LP		
SIC code	**capital**	**labor**	**obs.**	**capital**	**labor**	**obs.**	**capital**	**labor**	**obs.**
518	0.29	0.52	17264	0.41	0.13	17264	0.24	0.35	15581
519	0.28	0.59	14888	0.38	0.25	14888	0.16	0.50	12354
523	0.21	0.65	19971	0.33	0.27	19971	0.16	0.40	19050
531	0.46	0.41	8021	0.69	0.12	8021	0.38	0.22	6380
541	0.39	0.53	61205	0.60	0.16	61205	0.37	0.21	55402
543	0.29	0.55	1220	0.42	0.24	1220	0.24	0.48	1168
544	0.40	0.55	1695	0.61	0.34	1695	0.24	0.46	1597
549	0.31	0.60	3598	0.42	0.42	3598	0.20	0.40	3392
554	0.28	0.66	20872	0.47	0.20	20872	0.21	0.48	19775
565	0.21	0.68	21849	0.26	0.45	21849	0.15	0.42	19650
566	0.25	0.62	5502	0.30	0.33	5502	0.20	0.33	4993
571	0.21	0.67	19533	0.29	0.40	19533	0.16	0.39	18254
572	0.23	0.69	12001	0.41	0.33	12001	0.18	0.44	11017
581	0.27	0.65	36996	0.41	0.31	36996	0.24	0.36	33329
591	0.34	0.52	9218	0.57	0.19	9218	0.26	0.26	8306
593	0.31	0.45	1048	0.41	0.18	1048	0.21	0.46	691
594	0.36	0.52	5244	0.59	0.23	5244	0.24	0.35	4777
596	0.24	0.65	6265	0.25	0.38	6265	0.22	0.52	5420
599	0.24	0.61	39878	0.34	0.33	39878	0.17	0.50	36546
701	0.30	0.62	36129	0.42	0.32	36129	0.22	0.41	30850
702	0.30	0.52	2669	0.43	0.30	2669	0.27	0.38	2192
703	0.34	0.55	2120	0.27	0.19	2120	0.10	0.43	1588
722	0.32	0.51	2002	0.57	0.14	2002	0.27	0.43	1604
729	0.34	0.55	1912	0.28	0.50	1912	0.27	0.46	1543
731	0.22	0.68	22145	0.18	0.48	22145	0.10	0.62	14606
733	0.21	0.67	2371	0.12	0.55	2371	0.16	0.69	1651
734	0.20	0.70	19282	0.18	0.44	19282	0.09	0.64	17193
735	0.39	0.52	12321	0.43	0.51	12321	0.22	0.47	9207
736	0.26	0.55	9008	0.23	0.34	9008	0.16	0.51	2034
737	0.21	0.73	52506	0.20	0.51	52506	0.11	0.71	34004
738	0.24	0.62	40861	0.20	0.46	40861	0.13	0.63	19956
751	0.54	0.39	4373	0.51	0.42	4373	0.31	0.31	2656
753	0.27	0.66	24172	0.44	0.37	24172	0.20	0.60	22155
762	0.27	0.65	1084	0.53	0.36	1084	0.19	0.63	1017
769	0.18	0.72	2019	0.14	0.51	2019	0.09	0.70	1923
811	0.21	0.68	2959	0.12	0.49	2959	0.17	0.59	1050
871	0.23	0.70	36894	0.28	0.53	36894	0.13	0.67	24012
872	0.24	0.67	12121	0.18	0.45	12121	0.15	0.65	5394
873	0.25	0.68	10086	0.50	0.46	10086	0.20	0.62	7008
874	0.23	0.64	27174	0.19	0.41	27174	0.13	0.62	13416

Notes: The table shows estimated coefficients on capital and labor and the number of observations from a Cobb-Douglas production function. Three methods are used: ordinary least squares (OLS), fixed effects within (FE) and Levinsohn and Petrin (LP) estimation.

Table 3.18: Pairwise correlations of firms' TFP measures

	TFP OLS	TFP FE	TFP LP
TFP OLS	1.00		
TFP FE	0.89	1.00	
	(0.00)		
TFP LP	0.92	0.86	1.00
	(0.00)	(0.00)	

Notes: The table shows the pairwise correlations between the three measures of TFP using OLS, FE and LP estimation, described in the main text. P-values of the t-test with the null hypothesis of no correlation in parentheses.

Table 3.19: Descriptive statistics

Variable description	Variable	Obs	Mean	Std. Dev.	Min	Max
Log of TFP (OLS)	TFP_OLS	1 541 597	3.10	0.90	-7.08	11.15
Log of TFP (FE)	TFP_FE	1 541 597	3.43	1.16	-6.55	11.63
Log of TFP (LP)	TFP_LP	1 290 959	3.93	0.94	-5.89	12.24
Private credit by deposit money banks as a share of GDP	FinDev	1 541 597	0.82	0.29	0.06	1.65
Private credit by deposit money banks and other financial institutions as a share of GDP		1 541 597	0.84	0.28	0.06	1.65
External financial dependence (US industry median)	FinDep	1 541 597	0.04	1.28	-7.52	9.30
Asset tangibility (US industry median)	Tang	1 541 597	0.24	0.16	0.02	0.83
Asset tangibility (tangible fixed assets to total assets, UK industry median)	Tang1 (UK)	1 541 597	0.22	0.16	0.05	0.85
Asset tangibility (tangible plus financial fixed assets to total assets, UK industry median)	Tang2 (UK)	1 541 597	0.25	0.16	0.06	0.88
Firm-level asset tangibility (tangible fixed assets as a share of total assets)	Tang1 (firm-level)	1 541 498	0.21	0.20	0	0.999
Firm-level asset tangibility (tangible plus financial fixed assets as a share of total assets)	Tang2 (firm-level)	1 541 501	0.25	0.21	0	0.999
Log of real GDP per capita in PPP	Y/L	1 541 597	10.04	0.34	8.61	11.03
Physical capital intensity (UK industry median)	CapInt	1 541 597	0.03	0.03	0.00	1.84
Tertiary school enrollment (% of gross)	H/L	1 541 597	57.47	10.80	9.50	86.90
Human capital intensity (UK industry median)	HumInt	1 541 597	0.03	0.01	0.01	0.06
Average governance index	Institutions	1 541 597	1.17	0.44	-0.47	1.94
Publicly quoted firm (Dummy variable)		1 541 597	0.01	0.08	0	1
Number of employees		1 541 597	88.70	435.97	1	19729
Log of Sales (in Tsd USD)		1 349 270	8.20	1.39	0	17.66
Log of material costs (in Tsd USD)		1 290 959	7.29	1.79	0	18.04
Log of real value added (in Tsd real USD)		1 541 597	6.81	1.52	-0.71	16.32
Log of real fixed assets (in Tsd real USD)		1 541 597	6.09	2.00	-0.71	17.73
Log of real total assets (in Tsd real USD)	Firm size	1 541 597	7.80	1.58	-0.04	18.32
Debt to total assets ratio	Debt ratio	1 491 922	0.92	0.12	0	0.999
Effectively applied import tariff rate in % (simple industry average)		464 192	2.31	4.70	0	189
Effectively applied import tariff rate in % (weighted industry average)		464 192	2.93	4.38	0	189

Notes: Summary statistics only for the estimation sample period of 1999-2003.

Table 3.20: Pairwise correlations of variables

	TFP OLS	TFP FE	TFP LP	FinDev*FinDep	FinDev*Tang	(Y/L)*CapInt	(H/L)*HumInt	Firm size
TFP OLS	1.00							
TFP FE	0.89	1.00						
TFP LP	0.92	0.86	1.00					
FinDev*FinDep	0.06	0.04	0.01	1.00				
FinDev*Tang	-0.04	-0.11	0.05	-0.09	1.00			
(Y/L)*CapInt	-0.13	-0.15	-0.02	0.01	0.39	1.00		
(H/L)*HumInt	0.37	0.35	0.30	0.26	-0.14	-0.10	1.00	
Firm size	0.31	0.35	0.55	0.05	0.16	0.12	0.14	1.00

Notes: The table shows the pairwise correlations between the main variables used in section 3.5.

Table 3.21: Productivity (OLS) and financial constraints

Dependent Variable:	**TFP_OLS**			
	(1)	(2)	(3)	(4)
FinDev*FinDep	0.017**		0.016**	0.029***
	(0.0068)		*(0.0066)*	*(0.0074)*
FinDev*Tang		-0.14**	-0.13**	-0.24***
		(0.056)	*(0.055)*	*(0.067)*
(Y/L)*CapInt				-0.91
				(1.30)
(H/L)*HumInt				-0.23***
				(0.055)
Firm size	0.13***	0.13***	0.13***	0.13***
	(0.0055)	*(0.0055)*	*(0.0055)*	*(0.0055)*
Country*year dummies	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes
Observations	1541597	1541597	1541597	1541597
Number of firms	461454	461454	461454	461454
Number of clusters	3527	3527	3527	3527
R-squared	0.240	0.240	0.240	0.240

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 3.22: Productivity (FE) and financial constraints

Dependent Variable:	**TFP_FE**			
	(1)	(2)	(3)	(4)
FinDev*FinDep	0.015*		0.014	0.022**
	(0.0087)		*(0.0083)*	*(0.0094)*
FinDev*Tang		-0.24***	-0.24***	-0.31***
		(0.075)	*(0.074)*	*(0.085)*
(Y/L)*CapInt				-1.58
				(1.51)
(H/L)*HumInt				-0.16***
				(0.061)
Firm size	0.15***	0.15***	0.15***	0.15***
	(0.0082)	*(0.0082)*	*(0.0082)*	*(0.0082)*
Country*year dummies	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes
Observations	1541597	1541597	1541597	1541597
Number of firms	461454	461454	461454	461454
Number of clusters	3527	3527	3527	3527
R-squared	0.181	0.181	0.181	0.181

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 3.23: Productivity (OLS) and financial constraints: robustness

Dependent Variable:	**TFP_OLS**							
Financial Development measure	Private credit by deposit money banks (% of GDP)							Private credit by banks and other financial institutions (% of GDP)
Asset Tangibility measure	Tang (US)	Tang1 (UK)	Tang2 (UK)	Tang1 (firm-level)	Tang2 (firm-level)	Tang (US)	Tang (US)	Tang (US)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FinDev*FinDep	0.029***	0.030***	0.030***	0.028***	0.027***	0.028***	0.028***	0.034***
	(0.0074)	*(0.0072)*	*(0.0071)*	*(0.0072)*	*(0.0070)*	*(0.0073)*	*(0.0082)*	*(0.011)*
FinDev*Tang	-0.24***	-0.34***	-0.33***	-0.21***	-0.34***	-0.25***	-0.32***	-0.38***
	(0.067)	*(0.079)*	*(0.077)*	*(0.038)*	*(0.044)*	*(0.063)*	*(0.083)*	*(0.099)*
Institutions*FinDep						-0.010		
						(0.013)		
Institutions*Tang						0.43***		
						(0.15)		
(Y/L)*FinDep							0.0078	
							(0.034)	
(Y/L)*Tang							0.74*	
							(0.44)	
(Y/L)*CapInt	*-0.91*	*-0.29*	*-0.22*	*-1.32*	*-0.87*	*-0.99*	*-2.22*	*-0.78*
	(1.30)	(1.25)	(1.25)	(1.30)	(1.27)	(1.27)	(1.54)	(1.27)
(H/L)*HumInt	*-0.23***	*-0.27***	*-0.26***	*-0.21***	*-0.21***	*-0.22***	*-0.22***	*-0.21***
	(0.055)	(0.056)	(0.055)	(0.054)	(0.053)	(0.055)	(0.053)	(0.057)
Firm size	*0.13***	*0.13***	*0.13***	*0.13***	*0.13***	*0.13***	*0.13***	*0.13***
	(0.0055)	(0.0055)	(0.0055)	(0.0055)	(0.0055)	(0.0055)	(0.0055)	(0.0055)
Country*year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1541597	1541597	1541597	1541498	1541501	1541597	1541597	1541597
Number of firms	461454	461454	461454	461411	461409	461454	461454	461454
Number of clusters	3527	3527	3527	3527	3526	3527	3527	3527
R-squared	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. Asset tangibility measures are defined in Appendix B. Institutions is an index of governance quality and is defined in Appendix B. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 3.24: Productivity (FE) and financial constraints: robustness

Dependent Variable:	TFP_FE							
Financial Development measure	Private credit by deposit money banks (% of GDP)							Private credit by banks and other financial institutions (% of GDP)
Asset Tangibility measure	Tang (US)	Tang1 (UK)	Tang2 (UK)	Tang1 (firm-level)	Tang2 (firm-level)	Tang (US)	Tang (US)	Tang (US)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FinDev*FinDep	0.022**	0.024***	0.024***	0.021**	0.021**	0.022**	0.028***	0.024*
	(0.0094)	*(0.0089)*	*(0.0088)*	*(0.0087)*	*(0.0086)*	*(0.0095)*	*(0.011)*	*(0.014)*
FinDev*Tang	-0.31***	-0.44***	-0.43***	-0.30***	-0.46***	-0.31***	-0.42***	-0.52***
	(0.085)	*(0.095)*	*(0.092)*	*(0.044)*	*(0.053)*	*(0.084)*	*(0.11)*	*(0.14)*
Institutions*FinDep						-0.0093		
						(0.023)		
Institutions*Tang						0.49**		
						(0.24)		
(Y/L)*FinDep							-0.039	
							(0.043)	
(Y/L)*Tang							0.99*	
							(0.58)	
(Y/L)*CapInt	*-1.58*	*-0.72*	*-0.65*	*-2.00*	*-1.44*	*-1.67*	*-3.31**	*-1.34*
	(1.51)	(1.47)	(1.47)	(1.52)	(1.49)	(1.48)	(1.76)	(1.46)
(H/L)*HumInt	*-0.16****	*-0.21****	*-0.20****	*-0.13***	*-0.14***	*-0.15****	*-0.14***	*-0.15***
	(0.061)	(0.062)	(0.061)	(0.059)	(0.058)	(0.060)	(0.056)	(0.063)
Firm size	*0.15****	*0.15****	*0.15****	*0.15****	*0.15****	*0.15****	*0.15****	*0.15****
	(0.0082)	(0.0082)	(0.0082)	(0.0082)	(0.0082)	(0.0082)	(0.0082)	(0.0082)
Country*year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1541597	1541597	1541597	1541498	1541501	1541597	1541597	1541597
Number of firms	461454	461454	461454	461411	461409	461454	461454	461454
Number of clusters	3527	3527	3527	3527	3526	3527	3527	3527
R-squared	0.181	0.182	0.182	0.182	0.182	0.182	0.182	0.182

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. Asset tangibility measures are defined in Appendix B. Institutions is an index of governance quality and is defined in Appendix B. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 3.25: Productivity (OLS) and financial constraints: country sample robustness

Dependent Variable:	TFP_OLS							
Country Sample	**All**	**West**	**East**	**Sample1**	**Sample2**	**exclude IT**	**exclude ES**	**exclude FR**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FinDev*FinDep	0.029***	0.027***	0.049	0.029***	0.029***	0.022***	0.026***	0.029***
	(0.0074)	*(0.0070)*	*(0.061)*	*(0.0074)*	*(0.0074)*	*(0.0053)*	*(0.0082)*	*(0.0075)*
FinDev*Tang	-0.24***	-0.19***	1.06*	-0.24***	-0.24***	-0.14***	-0.20***	-0.25***
	(0.067)	*(0.065)*	*(0.56)*	*(0.067)*	*(0.067)*	*(0.052)*	*(0.069)*	*(0.068)*
(Y/L)*CapInt	-0.91	-4.15**	1.21	-0.96	-0.90	-0.68	0.28	-0.60
	(1.30)	*(1.89)*	*(1.78)*	*(1.31)*	*(1.30)*	*(1.36)*	*(1.28)*	*(1.34)*
(H/L)*HumInt	-0.23***	-0.19***	-0.54***	-0.23***	-0.23***	-0.064	-0.24***	-0.25***
	(0.055)	*(0.057)*	*(0.16)*	*(0.055)*	*(0.055)*	*(0.048)*	*(0.061)*	*(0.056)*
Firm size	0.13***	0.13***	0.14***	0.13***	0.13***	0.13***	0.12***	0.13***
	(0.0055)	*(0.0060)*	*(0.014)*	*(0.0055)*	*(0.0055)*	*(0.0065)*	*(0.0062)*	*(0.0056)*
Country*year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1541597	1410871	130726	1539291	1540975	1179516	1194948	1269269
Number of firms	461454	413279	48175	460227	461139	366283	371250	368520
Number of clusters	3527	2340	1187	3079	3327	3348	3348	3348
R-squared	0.240	0.112	0.595	0.240	0.240	0.283	0.266	0.248

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. "Sample1" excludes the following countries: CY, IE, IS, LU, LV, MK, CH, HU, AT. "Sample2" excludes the following countries: CY, IE, IS, LU, LV, MK. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 3.26: Productivity (FE) and financial constraints: country sample robustness

Dependent Variable:	TFP_FE							
Country Sample	**All**	**West**	**East**	**Sample1**	**Sample2**	**exclude IT**	**exclude ES**	**exclude FR**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FinDev*FinDep	0.022**	0.017**	0.0026	0.022**	0.022**	0.020**	0.022**	0.023**
	(0.0094)	*(0.0085)*	*(0.073)*	*(0.0094)*	*(0.0094)*	*(0.0087)*	*(0.0093)*	*(0.0095)*
FinDev*Tang	-0.31***	-0.22***	0.26	-0.31***	-0.31***	-0.24***	-0.26***	-0.31***
	(0.085)	*(0.081)*	*(0.74)*	*(0.085)*	*(0.085)*	*(0.081)*	*(0.076)*	*(0.085)*
(Y/L)*CapInt	-1.58	-4.75**	0.20	-1.62	-1.57	-1.59	-0.39	-1.20
	(1.51)	*(2.08)*	*(2.15)*	*(1.53)*	*(1.51)*	*(1.63)*	*(1.50)*	*(1.56)*
(H/L)*HumInt	-0.16***	-0.054	-0.93***	-0.16***	-0.16***	-0.074	-0.18***	-0.18***
	(0.061)	*(0.055)*	*(0.20)*	*(0.061)*	*(0.061)*	*(0.072)*	*(0.066)*	*(0.062)*
Firm size	0.15***	0.16***	0.12***	0.15***	0.15***	0.15***	0.15***	0.15***
	(0.0082)	*(0.0091)*	*(0.018)*	*(0.0082)*	*(0.0082)*	*(0.0095)*	*(0.0091)*	*(0.0083)*
Country*year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1541597	1410871	130726	1539291	1540975	1179516	1194948	1269269
Number of firms	461454	413279	48175	460227	461139	366283	371250	368520
Number of clusters	3527	2340	1187	3079	3327	3348	3348	3348
R-squared	0.181	0.108	0.447	0.181	0.181	0.207	0.195	0.185

Notes: Robust standard errors adjusted for clustering on country-industry pairs in parentheses. The table shows fixed-effects within estimates. Country-year dummies and a constant are suppressed. "Sample1" excludes the following countries: CY, IE, IS, LU, LV, MK, CH, HU, AT. "Sample2" excludes the following countries: CY, IE, IS, LU, LV, MK. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 3.27: Descriptive statistics for export status

Variable description	Variable	Obs	Mean	Std. Dev.	Min	Max
Log of TFP (OLS)	TFP_OLS	765 617	3.36	0.74	-4.84	10.79
External financial dependence (US data)	FinDep	765 617	0.05	1.30	-7.52	9.30
Asset tangibility (US data)	Tang	765 617	0.25	0.16	0.02	0.83
Firm-level asset tangibility (tangible fixed assets as a share of total assets)	Tang1 (firm-level)	765 594	0.19	0.19	0	0.999
Log of real GDP per capita in PPP	Y/L	765 617	10.11	0.21	9.06	10.25
Physical capital intensity (UK industry median)	CapInt	765 617	0.03	0.03	0.001	1.84
Tertiary school enrollment (% of gross)	H/L	475 756	55.79	6.87	30.54	67.39
Human capital intensity (UK industry median)	HumInt	765 617	0.03	0.01	0.01	0.06
Log of real total assets (in Tsd real USD)	Firm size	765 565	8.10	1.60	0.81	19.53
Publicly quoted firm (Dummy variable)		765 617	0.01	0.10	0	1
Effectively applied import tariff rate in % (simple industry average)		217 769	1.67	2.06	0	106.97
Effectively applied import tariff rate in % (weighted industry average)		217 769	2.36	2.54	0	171.89

Notes: Summary statistics only for the estimation sample.

Chapter 4

The Empirics of Securitization by Banks: Determinants and Incentive Effects[1]

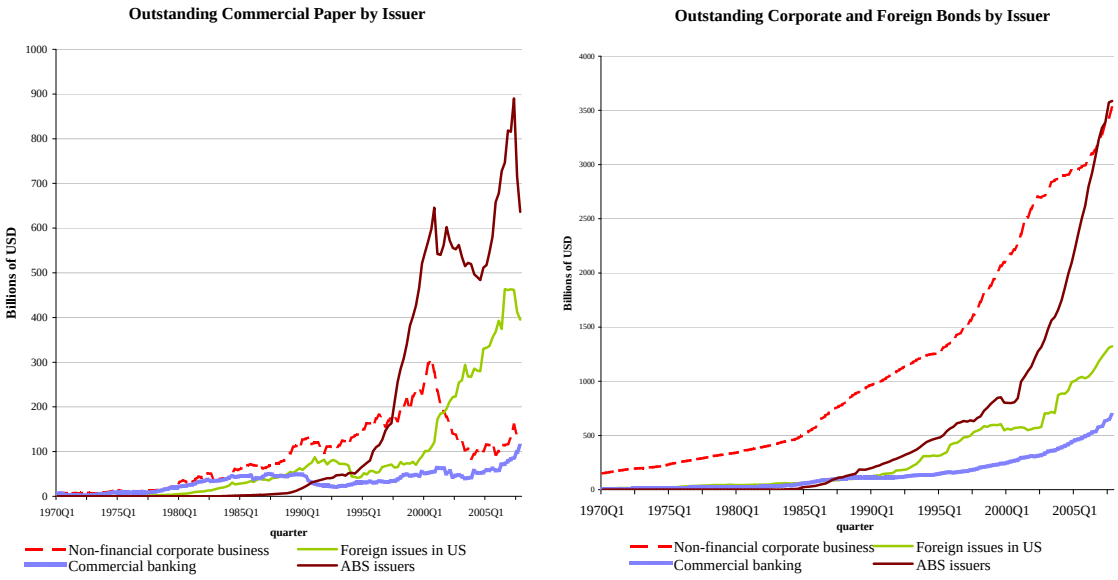
[1]This chapter is based on a joint work with Desislava Andreeva.

4.1 Introduction

Between 2000 and 2007 the market for asset-backed securities was one of the largest and fastest-growing segments in the fixed-income securities market. Despite its size and the vibrant issuance activity, it attracted the attention of policy makers, researchers, and the general public only after the onset of the current crisis. Figure 4.1 depicts the evolution of the outstanding amount of asset-backed securities in the US compared with securities issued by non-financial corporations, commercial banks, and foreign issuers. Between 2000 and 2007 the segment of asset-backed commercial paper was the largest one in short-term debt markets. With regard to longer-term debt, depicted in the right panel, the amount of asset-backed securities outstanding experienced a remarkable growth until mid-2007. By the end of the year it had become larger than the outstanding amount of non-financial corporate bonds.

With the benefit of hindsight, it is apparent that the observed surge in securitization activity had been accompanied by poor underwriting standards and the origination of riskier credit. Defaults on those risky financial claims led to losses accruing to the investors in asset-backed securities and triggered a global financial crisis. Right now asset-backed securities are still called by some "toxic waste" assets. Exploring why securitization takes place, particularly whether it is solely driven by attempts to circumvent capital adequacy regulation and whether it leads to unsound bank lending and excessive risk taking, can help us understand better the observed development. Furthermore, it can help in improving the regulation of capital markets to foster the resilience of the financial system. Therefore, the questions we address in this paper, focusing on the banking sector, are: why do banks securitize loans and does securitization affect the incentives of banks for prudent screening and monitoring of borrowers.

Securitization can be broadly defined as the transformation of illiquid



Notes: Author's calculations using data from the Flow of Funds Statistics for the US.

Figure 4.1: Evolution of the amount outstanding of securitized assets in the US during the period 1970-2007

financial claims into tradable securities; see Greenbaum and Thakor (1987). The central feature of securitization is that it allows assets to be removed from the balance sheet of the institution that originated them onto the balance sheet of a special trust company. For these assets the bank is no longer required to hold regulatory capital. Theory gives us roughly two views on why banks may choose to securitize assets: on the one hand, for instance, Allen and Carletti (2006), Allen and Gale (2007), and Cerasi and Rochet (2008) see securitization as a largely beneficial financial innovation that allows a better allocation of risk, lowers the distress costs for the issuer, and (see Arping (2004) or Chiesa (2008)) leads to better incentives for monitoring. On the other hand, there is a more pessimistic view of securitization as being largely driven by attempts to circumvent capital regulation and impairing incentives; see for instance Gorton and Pennacchi (1995) and Fecht and Wagner (2007).

Our empirical results confirm the latter view. Using panel data on large

US banks we find evidence of the existence of a regulatory arbitrage motive in securitization. The novel feature of our analysis is the introduction of a corrected measure for the tier 1 capital to total assets and total regulatory capital to risk-weighted assets ratios. In most empirical studies regressions of the issuance activity of banks on their leverage and a set of controls are performed; see for instance Minton et al. (2004) and Bannier and Hänsel (2008). Such studies find that the probability of securitizing rather decreases as leverage ratios increase, implying that banks with a high capital basis tend to securitize more often than capital-constrained banks. The finding contradicts the regulatory arbitrage hypothesis, according to which banks with low capital available to back additional lending benefit the most from securitization. They can seize new profitable lending opportunities without having to issue new equity or build it up slowly via retained earnings, thus one would expect that securitization rather becomes more probable as leverage grows. The approach of Minton et al. (2004) is problematic because the observed leverage ratios are endogenous. If banks use securitization to circumvent capital regulation, they will structure the transactions so that the ex-post observable leverage in their balance sheet is lowered.

We propose a different approach: instead of using observable but endogenous capital ratios we construct a proxy for the unobservable counterfactual capital ratio. It allows us to capture the effect of capital on securitization but cuts the reverse influence of securitization on capital adequacy. We argue that by doing so we use the variable actually relevant to the decision to securitize: namely, how high the disclosed ratio would have been if the assets were, instead of being securitized, retained on the balance sheet. Banks with low counterfactual capital ratios benefit from securitization, as they are able to remove assets from their balance sheet and free capital to back new loans. As a result, the standard capital ratios do not appear low any more. Looking at the extensive margin of securitization we find that a low counterfactual

capital ratio, measured either via the tier 1 capital to total assets or the total regulatory capital to risk-weighted assets ratios, increases the probability of securitizing. Further, we focus on the sample of securitizing banks only and shed light on banks' decision on how many assets to securitize. We find evidence that capital arbitrage is an important determinant of the intensive margin of securitization too. Furthermore, our empirical results show that banks facing higher costs of on-balance-sheet debt financing will use securitization techniques on a larger scale. This finding is consistent with the efficient risk-sharing view of securitization.

Next, we investigate how securitization affects the quality of securitized loans. Currently, there is relatively little literature on that topic. We assess the effects of securitization by comparing the ex-post observed delinquencies on loans of the same type during the same quarter originated by the same institution that are securitized with those retained. The observed higher delinquencies we interpret as evidence of adverse effects of securitization on incentives for monitoring or adverse selection of loans by originators. We also analyze how commonly used techniques for overcoming such incentive problems - the retention of a subordinated stake in securitized assets - affect the delinquencies of securitized loans. The results suggest that such techniques are not successful in reducing moral hazard or adverse selection problems in securitization. Rather the amount of bank capital at originating institutions influences significantly positively the quality of originated and securitized loans.

In a way our research indicates that capital adequacy regulation is a double-edged sword: whereas loopholes in the regulatory framework can seduce banks to securitize assets just for the sake of not having to hold regulatory capital, sufficient levels of capital do give banks the right incentives for prudent behavior.

The rest of the paper is organized as follows. Section 4.2 provides a review

of the related theoretical and empirical literature. The subsequent section provides a brief look at our data set. Section 4.4 describes the potential determinants of securitization activity. In sections 4.5 and 4.6 we present our empirical models on the extensive and intensive margins of securitization. The estimation strategy and results are presented too. Section 4.7 looks at the incentive effects of securitization. Finally, section 4.8 concludes.

4.2 Related literature

The theoretical literature on credit risk transfer and securitization can be traced back to Greenbaum and Thakor's "Bank funding modes", published in 1987 in the *Journal of Banking and Finance*. They analyze why banks choose to fund assets via securitization versus the traditional issuance of deposits in an adverse selection framework. Greenbaum and Thakor (1987) emphasize the role of bank regulation and the advancing information processing technology. In the equilibrium of their model banks hold riskier assets and securitize the "good" ones. The subsequent literature can be roughly divided into two main strands. The first one explores the scope for risk sharing between the banking sector and other sectors in the economy as well as its effects on the stability of banks and possible contagion. The second one puts more emphasis on the implications for monitoring of loan applicants and the quality of originated loans. Those two strands are intrinsically linked. Risk sharing via securitization insulates banks from losses, and in a world with asymmetric information and limited liability, alters incentives to prevent defaults. Thus, any beneficial effect from risk transfer from the arguably more vulnerable banking sector to other sectors in the economy will be attenuated by the adverse effect on monitoring incentives. Additionally, incentive problems in securitization can lead to the origination of bad loans and thus can undermine the safety and soundness of banks if part of the risks are retained

by the originator or banks themselves invest in asset-backed securities.

Let us very briefly summarize the most recent theoretical and empirical contributions, starting with the theoretical papers on risk sharing and its effects on the financial system stability. In Allen and Gale (2007) banks securitize assets to circumvent capital regulation. They show that inefficiently high capital adequacy requirements for banks induce credit risk transfer to a hypothetical insurance sector. The link between the two sectors gives rise to systemic risk: problems in the insurance sector can spread to the banking industry. Based on an augmented version of this model, Allen and Carletti (2006) focus on the interaction between idiosyncratic liquidity shocks and credit risk transfer to create contagion. In their model securitization is truly driven by risk-sharing considerations. Risk sharing is desirable because the sectors engage in activities with imperfectly correlated returns. Credit risk transfer, though, induces insurers to hold a long-term security, which otherwise is held by banks only. Contagion arises because bad outcomes for insurance companies force them to sell the long security. This in turn harms banks hit by adverse liquidity shocks as they use the long security to refinance in the interbank market. Depressed prices of the long security do not allow them to collect the necessary resources to pay out depositors and lead to bankruptcies.[2] In all those models banks do not perform screening and monitoring of borrowers; the emphasis lies rather on the implications for the stability of individual banks and arising contagion effects.

One of the first papers to focus on incentives is the work of Gorton and Pennacchi (1995). The authors stress the adverse effect of securitization on the quality of originated loans. Banks selling a proportional claim on loans do not bear the full loss if those loans default and, therefore, their incentives for borrower monitoring are distorted. In a recent paper Fecht and Wagner (2007) show that securitization remedies the hold-up problem between

[2]Wagner and Marsh (2006) follow a very similar line of research.

bank managers and shareholders, which ceteris paribus allows a safer capital structure with a higher equity share. Securitization can therefore potentially improve stability. However, because rents collected by managers are lower, their incentives to monitor borrowers are damaged. On the contrary, Chiesa (2008) shows that securitization can lead to better incentives for monitoring. The result arises in a framework of banks prone to gamble on a good economic outlook instead of stringently screening whom to grant a loan. Securitization alleviates the incentives for gambling and induces banks to exert monitoring effort. Arping (2004) demonstrates that securitization can have a beneficial effect on the incentives of borrowers without impairing the monitoring by lenders. In his framework securitization facilitates the ex-post enforcement of the debt contract between borrower and lender. Finally, Cerasi and Rochet (2008) show that loan sales and credit derivatives can provide optimal insurance to banks without impairing incentives.

The existing theoretical literature, while giving a consistent prediction that securitization leads to contagion effects, is rather inconclusive on both why banks securitize and whether this leads to the origination of bad loans. This is the starting point for our empirical analysis. There are several empirical studies on the determinants of securitization and only a few on the incentive issues.

With regard to the determinants of securitization, most studies cannot find evidence of a capital arbitrage motive. For instance Minton et al. (2004) use data on US financial firms, among others banks, in the period 1993-2002. They show that unregulated finance companies and investment banks are more likely to securitize than regulated commercial banks, which they interpret as evidence against the regulatory capital arbitrage view. Focusing on banks only they find that banks with higher capital ratios are more likely to securitize, which again confirms the previous result. Very similar is the empirical study of Bannier and Hänsel (2008), suggesting that there is lit-

tle or no evidence of capital arbitrage in securitization. They use data on collateralized loan obligations (CLO) issued by large European banks during the period 1997-2004. Throughout most of the specifications the capital ratios seem to have no significant impact on the probability of securitizing. The only exception is a fixed-effects logit specification based on a restricted sample of listed institutions only. Bannier and Hänsel (2008) conclude that securitization is mainly used as an efficient funding tool, especially for banks with high credit risk and low liquidity, which reduces the overall costs of financing. Gorton and Souleles (2006) and Martin-Oliver and Saurina (2007) also do not support capital arbitrage as a driving motive for securitization but rather suggest that liquidity needs or lower debt funding costs are the main drivers. Contrary to most of the literature, Calomiris and Mason (2004) find that circumventing regulation is motivating banks to securitize assets. Focusing on credit card debt securitizations of US commercial banks, they find evidence that the desire to reach lower levels of capital than the regulatory requirement is a driving motive. Finally, Dionne and Harchaoui (2003) study the relationship between bank capital, securitization, and credit risk using Canadian bank data. One result of their analysis is that securitization is negatively related to capital ratios.

The empirical literature on incentive problems in securitization is somehow scarcer. In a recent paper Keys et al. (2010) ask whether securitization impairs the incentives of financial firms to screen borrowers properly based on US data on securitized subprime mortgages. They use the fact that mortgages given to borrowers with a creditworthiness measured by the FICO scores[3] of 620 and above are easily securitized whereas mortgages granted to borrowers with a FICO of 619 or lower remain on the balance sheet of the originator with a very high probability.[4] Originators take this into account

[3]Fair Isaac Credit Score. A greater value of the FICO score indicates lower credit risk.

[4]This threshold arises due to regulation constraints. Ginnie Mae and Fannie Mae generally do not accept such mortgages.

at the time mortgages are granted and, therefore, may screen more carefully loan applicants with a FICO of 619 or lower. Indeed, Keys et al. (2010) find that securitized loans with a FICO of 619 perform ex post better than those with a FICO of 621. Hence, securitization has adverse effects on the screening incentives of loan originators. Dell' Ariccia et al. (2008) and Mian and Sufi (2009) also provide some evidence of poor screening due to securitization using loan-level data for sub-prime mortgages, even though this is not the main focus of their work. Both studies find that denial rates on loan applications are lower in regions in which a bigger fraction of mortgages were securitized and interpret it as evidence that lending standards deteriorate due to securitization.

Our study adds to both strands of the empirical literature. With regard to identifying a capital arbitrage motive in securitization we propose a corrected version of the standard capital ratios used in empirical works that does not suffer from endogeneity. Using the proposed corrected capital ratios we find evidence of capital arbitrage. Additionally to giving evidence of poor incentives for borrower screening, we show how bank characteristics and the amount of provided credit enhancements relate to the quality of securitized loans. Our results suggest that a sufficient level of bank capital rather than the retention of a first-loss piece gives banks the right incentives and leads to the origination of better quality loans.

4.3 Data and summary statistics

The data come from the Uniform Bank Performance Report, collected by the Federal Deposit Insurance Corporation[5], and cover the period starting in the third quarter of 2003 to the second quarter of 2008. It contains the

[5]The data is available at the Federal Financial Institutions Examination Council webpage at `www.ffiec.gov/ubpr.htm`.

income statements and balance sheet statements, data on regulatory capital and risk-weighted assets, securitization activities, past due loans and leases, and off-balance-sheet exposure. In the second quarter of 2008 a total of 7622 banking institutions insured by the FDIC were operating. For our analysis of the determinants of securitization we concentrate on the activities of big commercial banks with assets of more than 1 billion US dollars and the credit card specialty banks in the United States. This leaves us with a cross-sectional dimension of our panel of 506 banks. We are aware that we concentrate on a group of banks that may be systematically different from smaller banks. Nevertheless, we believe that this is the relevant sample for our purposes since securitization activity decreases sharply with the size of institutions. Among the 186 banks with assets of more than $3 billion in the second quarter of 2008 approximately 33% have securitized assets at least once during the period. Looking at the 297 banks with assets between $1 billion and $3 billion, we observe less than 5% active banks. If we consider the peer group of even smaller banks with assets of more than $0.3 billion but less than $1 billion the share of banks that participate in securitization drops even further to around 2.5%. Given that bigger banks also securitize bigger pools of assets, we believe that we cover most of the actual securitization activities of commercial banks in the United States. In our analysis we also include FDIC insured banks specializing in credit card loans. We restrict our attention to private label securitization activities only. We do not analyze securitization transactions settled via the Government Sponsored Enterprises. Our data sample covers approximately 83% of banking assets and 42% of securitized assets backing outstanding private label asset-backed securities[6] in the fourth quarter of 2007.

Regarding the question of whether securitization leads to incentive prob-

[6]Asset-backed securities in the sense of our analysis include all the securities issued in a securitization transaction, which are backed by financial claims to third parties. These include MBS, CDO, CLO, etc.

lems, we have a sample of 110 banks that reported past dues and losses for both their securitized assets and those retained on the balance sheet.

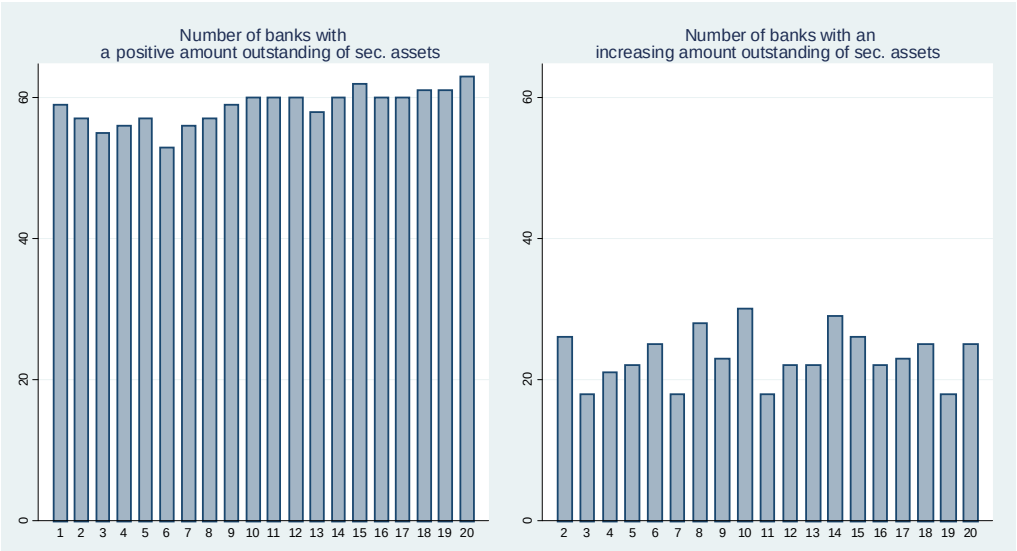
Let us have a first look at the data. Out of the total 506 banks 86 have securitized assets at least once during the period; 83% of the banks in the sample are never-securitizers. The left panel of Figure 4.2 reveals that in every single quarter a relatively constant number of around 60 banks reported a positive amount outstanding of securitized assets. Reporting a positive amount outstanding of securitized assets does not necessarily imply that the bank has been involved in new securitization activities. Assets that have been securitized in previous periods and have not matured yet are part of the reported volume. In the right panel of Figure 4.2 we depict the number of banks whose reported outstanding securitized assets have increased during the quarter. These banks engaged in new securitization activities definitely. However, this measure of issuance activity slightly underestimates the frequency of new securitization activity by banks,[7] as the amount of maturing assets plus the amount charged off due to defaults may be larger than the amount of assets that were securitized during a quarter.

In the next Figure 4.3 we contrast the size of banks that have never securitized with the size of banks that have securitized assets at least once. Active banks were significantly bigger and were able to increase their size more quickly during the relevant period. The difference in size is remarkable given that we choose to concentrate on big banks only.

Securitizing banks seem to engage in more risky lending activities or operate in more risky segments of the credit market. Figure 4.4 depicts that securitizing banks have been experiencing considerably higher losses on their on-balance-sheet loans and leases throughout the period. Against the higher expected losses they also hold higher loan loss reserves on average.

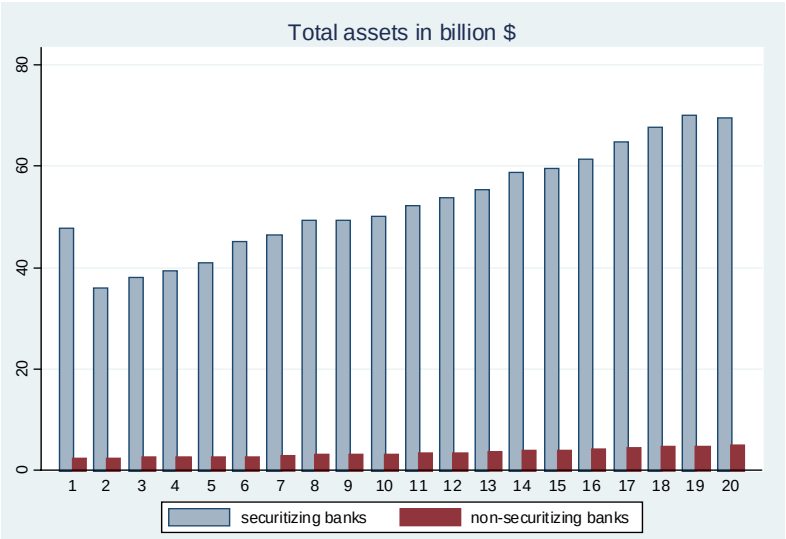
Those riskier lending practices, though, appear to be profitable. The

[7] And certainly the volume of newly securitized assets.



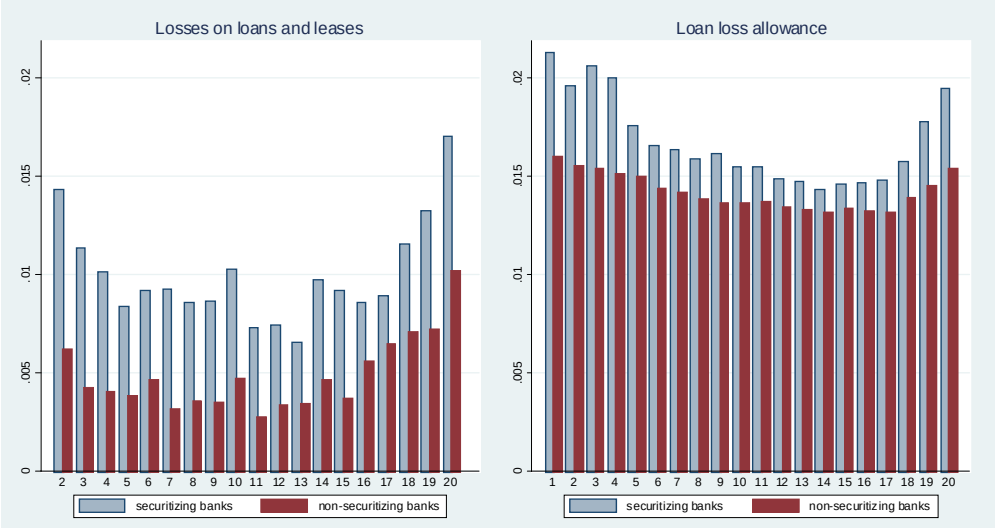
Notes: Quarters denoted on the horizontal axis. 1 is the third quarter of 2003; 20 is the second quarter of 2008.

Figure 4.2: Number of banks reporting securitization activity during the quarters



Notes: Quarters denoted on the horizontal axis. 1 is the third quarter of 2003; 20 is the second quarter of 2008.

Figure 4.3: Bank size



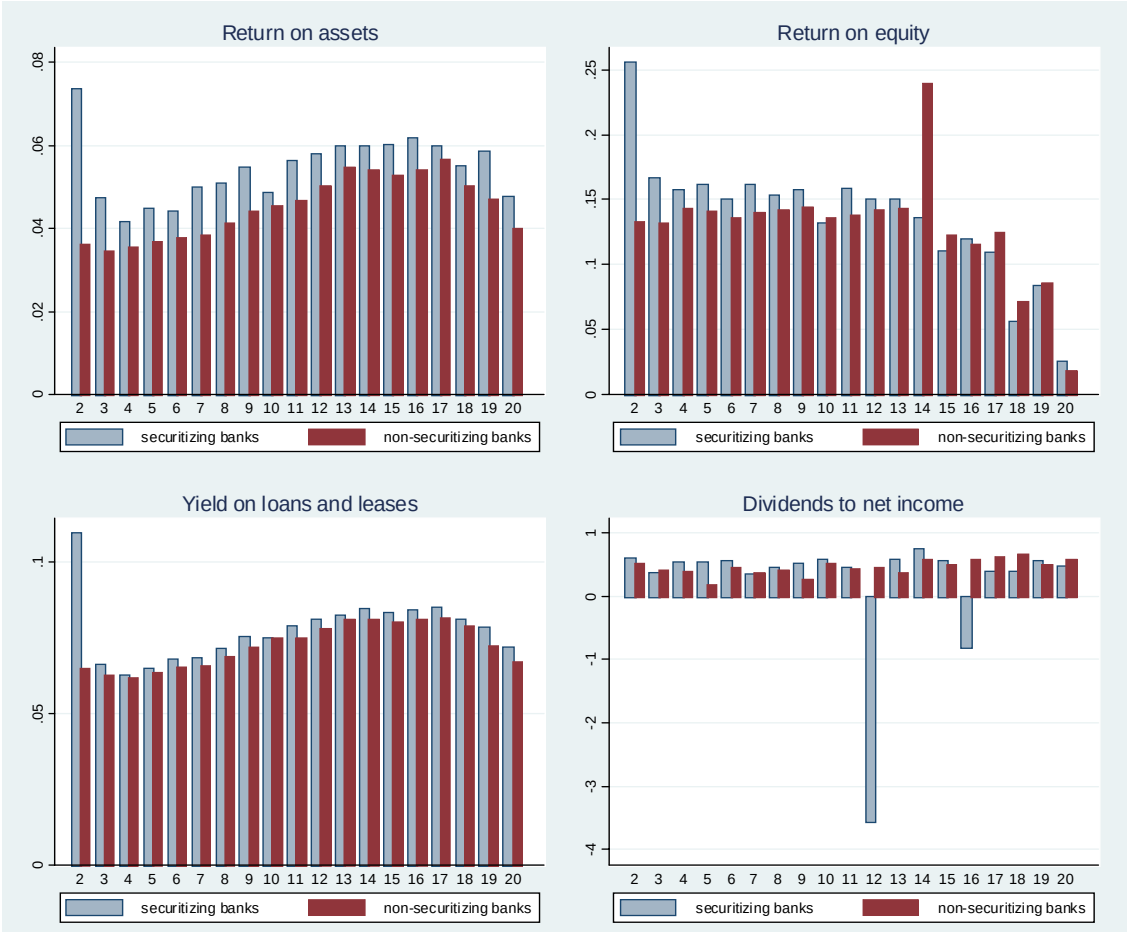
Notes: The figure shows losses and loss allowances as a ratio to total loans and leases. Quarters denoted on the horizontal axis. 1 is the third quarter of 2003; 20 is the second quarter of 2008.

Figure 4.4: Credit risk

lower-left panel of Figure 4.5 shows that the yields on loans and leases realized by securitizing banks are slightly better than those of non-securitizers.

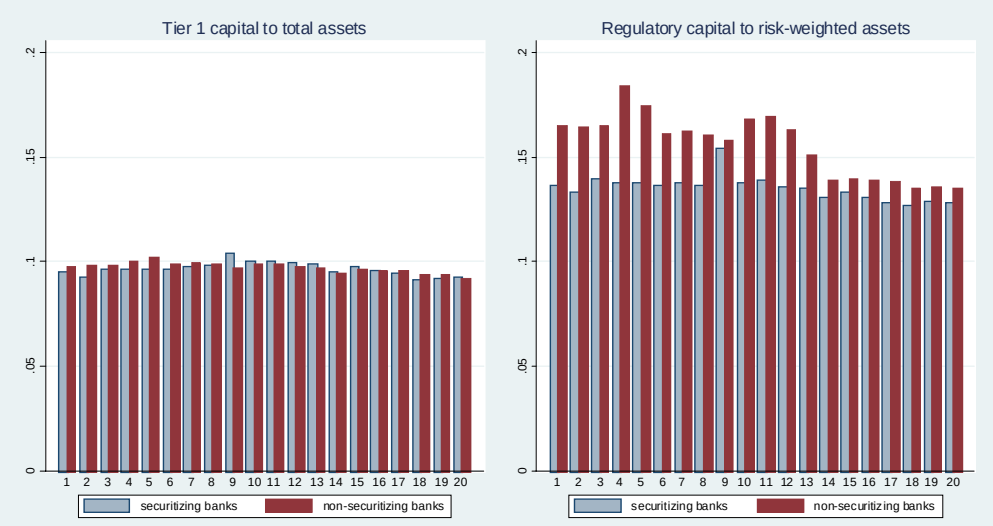
The overall profitability of securitizers is higher too; see the difference in the average return on assets in the upper-left panel of Figure 4.5. It can be largely explained by the higher non-interest income those banks generate, including income from securitization and servicing activities. Comparing the returns on equity, in the upper-right panel, the finding is slightly different. Securitizers do not perform better throughout the whole period; since the last quarter of 2006 the return on equity of non-securitizers has been higher on average.

The lower-right panel of Figure 4.5 shows the ratio of dividends to profits. Up until the third quarter of 2007 securitizing banks paid out a larger fraction of net income. The two big negative outliers in the second quarter of 2006 and the second quarter of 2007 arise because banks that had booked losses nevertheless paid dividends. Since the onset of the crisis this pattern has changed: in three out of the four quarters since mid-2007 non-securitizers



Notes: Quarters denoted on the horizontal axis. 2 is the fourth quarter of 2003; 20 is the second quarter of 2008.

Figure 4.5: Bank profitability



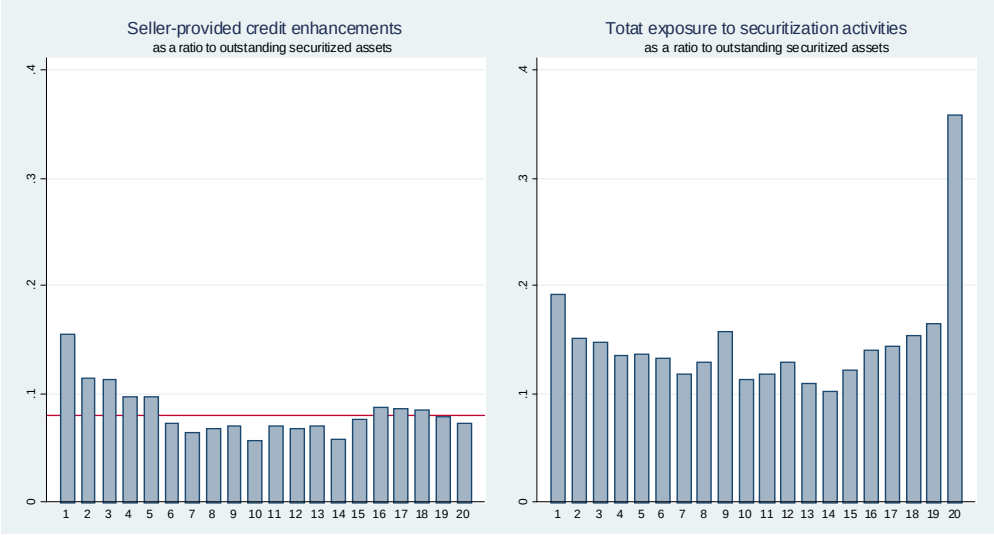
Notes: Quarters denoted on the horizontal axis. 1 is the third quarter of 2003; 20 is the second quarter of 2008.

Figure 4.6: Regulatory capital ratios

payed a higher fraction of net income to shareholders.

In Figure 4.6 we compare the regulatory capital ratios of banks. Banks in the United States are required to hold sufficient capital to maintain both a ratio of tier 1 capital to total assets of at least 4% and a ratio of total risk-based capital to risk-weighted assets of at least 8%. There are no systematical differences in the tier 1 capital ratio shown in the left panel of Figure 4.6. The ratio of regulatory capital to risk-weighted assets, however, is substantially higher for non-securitizing banks up until the end of 2006. During the last 7 quarters of the period, the difference in regulatory capital has become smaller; nevertheless, it remains positive in the data.

The aim of securitization is the transfer of a significant part of the risk associated with the underlying pool of assets. Banks, though, retain some of the risk in the form of a subordinated claim, that serves as a credit enhancement, or as a pro-rata share of the issued asset-backed securities. The left panel of Figure 4.7 shows us how much credit enhancement banks provided to their securitized assets. On average such enhancements amount to around



Notes: Quarters denoted on the horizontal axis. 1 is the third quarter of 2003; 20 is the second quarter of 2008. The horizontal line marks the 8% threshold.

Figure 4.7: Securitization exposure

8 percent of the outstanding securitized assets.[8] In the right panel we depict the total of subordinated claims and retained ownership[9] in securitized assets. The total exposure to securitization as a percentage of the amount outstanding of securitized assets seems to decrease very slowly up to the first quarter of 2007 and increases quite sharply in the course of the crisis. The

[8]Interesting is the significant drop in seller-provided credit enhancements from the third quarter of 2003 to the second quarter of 2004. The regulation regarding the treatment of securitization exposures in calculating the regulatory capital ratios was changed in January 2002, see Federal Register (2001). The new rule obliged banks to hold one dollar of bank capital against each dollar of outstanding retained subordinated claims. The previous regulation had limited the maximal capital charge to the minimum of either the retained subordinated stake or the capital the bank would have had to maintain, had it, instead of securitizing those assets, left them on the balance sheet. Under the old regulation a bank that securitized a pool of f.e. consumer credit of $100 and retained a subordinated claim of size $10 had to hold only $8 of capital against the pool, whereas under the new rule the capital charge increases to $10 - the size of the subordinated claim. This may have made it no longer profitable for banks to retain a large subordinated exposure to securitized assets. The data on seller-provided credit enhancements in 2003 partially capture the structure of older securitizations. The retained credit enhancements starting from the last quarter of 2004 to the second quarter of 2007 amounted to less than 8% of the amount outstanding of securitized assets and thus indeed allowed a lower capital charge.

[9]The so-called retained seller's interest, which does not provide any credit enhancement and carries a pro-rata share of the risk.

extreme peak in the second quarter of 2008 is most probably due to banks providing support to previously securitized assets.[10]

4.4 Determinants of securitization activity

The observed securitization activity is an equilibrium outcome, determined by both demand- and supply-side factors. The main aim of our analysis is to identify the factors affecting the decision of banks to securitize assets. Thus, we focus on the supply of asset-backed securities by credit institutions in the baseline analysis, while controlling for possible changes in demand over time by using quarter dummies. According to theory, there are two main drivers: risk-sharing considerations[11] and the possibility of gaining regulatory capital relief via securitization.[12] Additionally, securitization may allow banks to fund assets at more favorable debt costs. This is the so-called "efficient contracting view". The transfer of the ownership of the underlying assets to a special purpose vehicle removes them from the bankruptcy estate of the originating institution.[13] Thus, investors in asset-backed securities do not bear the risk of bankruptcy of the bank itself, but only risks associated with the performance of the underlying assets.[14] We also account for economy of scale and scope effects and a possible self-selection into securitization of more profitable banks.

To complement our analysis, we also try to identify demand-side effects by including a set of macroeconomic variables capturing investors' risk appetite

[10]We provide disaggregated data on the seller-provided credit enhancements by type of securitized loans in Figure 4.9 of the Appendix C.

[11]See Allen and Carletti (2006) and Wagner and Marsh (2006).

[12]See for instance Allen and Gale (2007).

[13]The securitized assets are not part of the bank's bankruptcy estate and thus investors in ABS continue to receive the interest and principle payments even in the case it becomes bankrupt. Special purpose vehicle are structured in a way that makes it impossible to become insolvent. See Schwarcz (1994).

[14]See for instance Calomiris and Mason (2004) and Gorton and Souleles (2006).

and the monetary policy stance. We follow a purely empirical strategy, as performed in the literature for instance by Minton et al. (2004) and Bannier and Hänsel (2008), among others.

These are our working hypotheses:

- **Regulatory capital relief**: The "regulatory capital arbitrage" hypothesis calls for a negative relationship between capital ratios and securitization activity.[15] Capital constrained banks will use securitization techniques in order to improve their disclosed regulatory capital ratios. There are two challenges for the econometric identification of this causal relationship. First, banks will not wait until the regulatory constraint becomes binding. We believe that they act in a forward-looking manner and use the techniques preemptively. Second, if banks are successful in circumventing capital regulation, the *ex-post* observed capital ratio should not appear low any more. We argue that using such ex-post observed capital ratios in the regression analysis, as performed in the existing literature, is misleading and propose a different approach: we use a proxy of the unobservable counterfactual capital adequacy ratio. Since this is a departure from the existing literature, let us explain our idea in some detail.

  Consider a credit institution, which intends to use securitization for capital relief purposes. Let us assume that it would like to originate new loans, but by doing so it risks becoming capital constrained. To prevent this from happening, it can securitize part of its loans. Suppose that it has risk-weighted assets Y_{t-1} and regulatory capital C_{t-1} and expects to grant new loans $\Delta Y_t > 0$. Without the use of securitization, its regulatory capital ratio in period t would be lower, equal to $\frac{C_{t-1}}{Y_{t-1}+\Delta Y_t}$, and possibly leave no buffer to the regulatory threshold. Let Z_t denote the amount of assets to be securitized and z_t the size of the first-loss

[15] See Duffie and Garleanu (2001) and Calomiris and Mason (2004) among others.

piece. After the assets have been securitized, the capital ratio changes to:[16]

$$\frac{C_{t-1} - z_t}{Y_{t-1} + \Delta Y_t - Z_t} \tag{4.1}$$

If the term z_t/Z_t is lower than $C_{t-1}/(Y_{t-1} + \Delta Y_t)$, securitization activities will *improve* the ratio. This is probably why people find a positive relationship between securitization and capital adequacy. However, this is not the casual link from capital constraints to securitization. We generally do not observe how low capital ratios would have been if securitization had not taken place. The observed capital ratio suffers from endogeneity: a low capital ratio induces banks to securitize assets but once securitization has taken place, capital ratios do not appear low any more. We construct a proxy for the counterfactual capital ratio by putting the securitized assets back on the balance sheet and adding the retained credit enhancements z_t to the regulatory capital. Intuitively, we focus on how low capital levels affect the decision to securitize by suppressing the positive effect of securitization on capital adequacy. In this manner we are able to solve the reverse causality from securitization back to the observed capital ratio.[17]

Since the capital adequacy regulation in the USA imposes two restrictions, we construct the counterfactual proxies for the two minimum capital ratios required: a *Capital/RWA*, defined as the regulatory total risk-based capital as a share of risk-weighted assets, and *Tier1/Total Assets*, defined as the tier 1 capital to total assets.[18]

[16] The regulatory rules, see Federal Register (2001), for securitization state that the first-loss piece must be deducted from capital for regulatory purposes; therefore, the numerator decreases. As the securitized assets Z_t are no longer on the balance sheet of the bank, the denominator decreases too.

[17] A similar approach is followed by Calomiris and Mason (2004). They use a ratio of capital to the sum of on-balance-sheet and securitized assets, but do not take into account the size of the first-loss piece in the numerator.

[18] We have data on the amount outstanding of provided credit enhancement at period t

Table 4.10 in Appendix C reports the mean of the "original" and the "corrected" capital ratios.[19] Since those do not differ for non-participating institutions, we should compare the means calculated for the subsample of securitizers who were active at least once during the sample period. On average the corrected measure is about 1% lower than the standard one.

- **Risk sharing**: If securitization is used to transfer risk from the bank to outside investors, we would expect higher risk to be associated with a higher probability of securitizing. To capture this idea we use the variable *loss allowances*. The variable controls for credit risk as perceived by the bank. It is measured as the ratio of the allowances for future loan and lease losses to total loans and lease-financing receivables.

- **Financing costs**: Securitization can be used as an efficient tool for lowering the debt financing costs. The interest and principal payments to investors in asset-backed securities are not affected in the event of the bankruptcy of the originator. Consequently, the financing costs by issuing asset-backed securities do not include a premium for this risk. We use the *average costs of bank debt* (including subordinated notes and debentures) as a measure of financing costs. The more costly debt financing is for individual institutions, the higher the probability of securitizing should be.

- **Economies of scope**: Securitization comprises activities similar to in-

and the amount outstanding of securitized assets by type. We calculate the counterfactual Tier1/Total Assets ratio by adding the amount of credit enhancements to tier 1 capital and the amount of securitized assets to total assets; for the Capital/RWA ratio we again add the provided credit enhancements to the total capital for regulatory purposes and add the risk-weighted securitized assets to the risk-weighted assets. For weights we use 0.50 for mortgages and home equity loans and 1 for other loans, as required for assets held on the balance sheet of banks.

[19] In addition Table 4.8 in Appendix C provides a pairwise correlation matrix for these capital ratios.

vestment banking. The key steps in the securitization process - pooling the underlying assets, underwriting the securities, and placing them on the market - require expertise that is very similar to the one acquired in investment banking. Therefore, potential synergy effects arise. To capture this idea we use the variable *investment banking* measured as investment banking income to total income. We expect that the more strongly involved a bank is in investment banking, the higher the probability of securitizing.

- **Economies of scale**: Since there are substantial fixed costs for setting up a special purpose vehicle, we expect bigger banks that securitize bigger loan pools to experience lower average costs of securitization. We capture this idea by using the *total assets* as the measure of bank size and expect a positive relationship.

- **Profitability**: Securitization may be more easily feasible for more profitable banks, as they possibly can afford to pay the high up-front fixed costs[20] of issuing asset-backed securities. Hence, there might be some sort of "selection" of more profitable banks into securitization. To capture this idea we use the *yield on loans and leases* as our measure of profitability. More profitable banks become more likely securitizers.[21]

- **Average tax rate**: Financing through ABS has the disadvantage of non-deductibility of costs from the pre-tax income compared with on-balance-sheet debt finance.[22] Thus, we expect banks with high effective tax rates to be less likely to securitize assets. The variable *average tax*

[20]These are for example administrative and legal costs for setting up a SPV as well as rating agency fees.

[21]Previous studies use return on equity as a measure of profitability. However, this measure is likely to be endogenous, because securitization itself directly influences the return on equity via increased non-interest income.

[22]See Minton et al. (2004).

rate is defined as applicable income taxes as a share of the pre-tax net operating income.

We now turn to the possible demand factors. Two macroeconomic variables are included:

- **Fed funds rate**: A low level of interest rates and high money supply might induce investors to search for more profitable investment opportunities, among others in asset-backed securities. For that reason we expect a negative sign here.

- **Baa risk premium**: We want to capture the overall risk appetite of investors. The Baa risk premium is calculated as the difference between the yield on corporate bonds with a Baa rating and the yield on 10-year government bonds.[23] We expect a lower risk premium to be associated with a higher demand for asset-backed securities.

We concentrate on two main questions. The first one asks why do (or do not) banks securitize assets? Here we try to identify systematic differences between the groups of securitizers and non-securitizers, which relate to this decision. We call this the *extensive margin* of securitization. The second question we ask is why some banks securitize more than other banks. Here we identify differences between banks within the group of securitizers relating to the scale of securitization activity, calling it the *intensive margin*. Let us first turn our attention to the extensive margin.

4.5 The extensive margin of securitization

We start with the standard binary choice model, which can be derived from the following latent variable model. Let $\Delta\pi$ denote the unobservable change

[23] We obtain the data from the web page of the Board of the Governors of the Federal Reserve System, `http://www.federalreserve.gov`.

in expected discounted profits if a bank chooses to securitize assets.[24] We assume that it is a linear function of observables:

$$\Delta\pi = \boldsymbol{x}\boldsymbol{\beta} + \epsilon \tag{4.2}$$

where $\boldsymbol{x}$ represents the row vector of determinants of securitization (including a constant), $\boldsymbol{\beta}$ is the column vector of coefficients, and ϵ is a random error term. Let s be a binary choice variable, equaling 1 if the bank securitizes assets during the quarter and 0 otherwise.

A profit-maximizing bank participates in securitization if $\Delta\pi > 0$. Hence, the probability of securitizing is given by:[25]

$$\begin{aligned} P(s=1|\boldsymbol{x}) = P(\Delta\pi > 0|\boldsymbol{x}) = P(\boldsymbol{x}\boldsymbol{\beta} + \epsilon > 0|\boldsymbol{x}) = \\ = P(\epsilon > -\boldsymbol{x}\boldsymbol{\beta}|\boldsymbol{x}) = 1 - G(-\boldsymbol{x}\boldsymbol{\beta}) = G(\boldsymbol{x}\boldsymbol{\beta}) \end{aligned} \tag{4.3}$$

where $G(.)$ is the cumulative distribution function of ϵ. We further assume that $G(.)$ is the standard normal cumulative distribution function, which leads to the probit model.

We estimate the model by maximum likelihood. The log likelihood function for a sample of N banks observed over T periods is given by:

$$L(\boldsymbol{\beta}) = \sum_{i=1}^{N}\sum_{t=1}^{T}\{s_{it} ln\left[G(\boldsymbol{x}_{it}\boldsymbol{\beta})\right] + (1 - s_{it}) ln\left[1 - G(\boldsymbol{x}_{it}\boldsymbol{\beta})\right]\} \tag{4.4}$$

To account for a possible serial correlation within panel units and heteroskedasticity across panels, we use a cluster-robust variance-covariance es-

[24] We use the term profits even though this could stand for any benefits to stakeholders, managers, or other decision makers that cannot be expressed monetarily.

[25] Here we assume that the distribution of ϵ is symmetric, with a mean of zero.

timator, with banks as cluster units.[26]

Before outlining the estimation results, let us briefly explain how we generate the left-hand side variable. The most natural way to proceed would be to define an active bank, $s_{it} = 1$, if we observe new issuance of asset-backed securities by bank i in quarter t, as performed for instance by Minton et al. (2004) or Bannier and Hänsel (2008). Unfortunately, we have data on the amount outstanding of securitized assets only. Given the available data we can choose among three strategies:

- treat banks as participating in every period if we observe a positive amount outstanding of securitized assets at least once. This strategy is suitable for identifying determinants that do not depend on the particular time period, like the relative size difference of securitizers vs. non-securitizers as visible in Figure 4.3. However, it does not allow us to find factors accounting for the dynamics of the decision of banks to securitize over time, as their status as securitizer would not depend on issuance in any particular period.

- treat banks as participating in period t if we observe a positive amount outstanding of securitized assets. This approach has a drawback: observing a positive outstanding amount does not necessarily imply that new issuance has occurred. Bank loans typically have a maturity of more than one quarter, therefore, a positive amount outstanding can be observed even though no new assets were securitized. Thus, some

[26]The alternative strategy would have been to use a random effects probit estimator. This specification deals with serial autocorrelation in the composite error term due to the presence of an unobserved random effect. More specifically, it assumes that the autocorrelation of the error terms is equal at all lags. We decided to use a pooled probit estimator with corrected standard errors because Monte Carlo studies, for instance Guilkey and Murphy (1993), suggest that it performs as well as the computationally intensive random effects probit estimator. It is further recommended as, first, one does not have to assume equicorrelated error terms and, second, if there is another form of clustering on the bank level in our data, inference based on the random effects estimates would be misleading.

institutions, which were not active at time t, will be misclassified as securitizers.

- treat banks as participating at time t only if we observe an increasing amount outstanding of securitized assets. Even though this approach captures new issuance more accurately, it has a similar drawback to the previous strategy. Whereas observing an increase implies that new issuance has occurred, it is possible that the amount outstanding of securitized assets decreases despite the issuance of asset-backed securities during the period if the newly issued amount is lower than the amount of previously securitized loans maturing during the quarter. Thus, some institutions, that issued new ABS will be misclassified as non-participating.

Since we would like to capture the possible dynamics in banks' securitization activity, we consider the second and third options. Both strategies lead to a non-classical measurement error in the left-hand side variable. We believe that the misclassification is only minor if we use the latter one and treat banks as participating at time t if we observe an increase in the amount outstanding of the securitized assets. The misclassification biases coefficients downward in absolute value but preserves their signs.[27] Thus, we interpret the absolute value of the estimated coefficients rather as lower bounds of the true relationship and focus on the direction of the relation.

Throughout all the specifications we exclude the last two quarters in our sample, as at that time the crisis had already intensified, asset-backed securities were considered "toxic" and securitization was for practical purposes not feasible. We report the estimation results using the counterfactual total regulatory capital to risk-weighted assets ratio in Table 4.1 and alternatively using the tier 1 capital to total assets ratio in Table 4.2. In all the spec-

[27] See Hausman et al. (1998).

Table 4.1: The extensive margin of securitization: using Capital/RWA Corrected

Dependent Variable:	**Securitization Dummy**						
Estimation:	**Pooled Probit**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Capital/RWA Corrected	-6.20*	-5.60*	-5.60*	-7.21*	-5.63*	-5.73*	-6.57*
	(3.26)	*(3.18)*	*(3.13)*	*(3.87)*	*(3.10)*	*(3.11)*	*(3.68)*
Log of Total Assets	0.39***	0.41***	0.39***	0.40***	0.37***	0.39***	0.39***
	(0.043)	*(0.043)*	*(0.044)*	*(0.042)*	*(0.046)*	*(0.044)*	*(0.045)*
Credit Card Bank	1.82***	1.38***	1.73***	1.44***	1.80***	1.78***	1.32***
	(0.26)	*(0.27)*	*(0.31)*	*(0.43)*	*(0.27)*	*(0.27)*	*(0.39)*
Yield Loans and Leases		5.30**					2.65
		(2.68)					*(4.32)*
Financing Costs			2.52				2.36
			(11.1)				*(12.1)*
Credit Risk (Loss Allowances)				10.7			8.89
				(8.49)			*(10.4)*
Investment Banking					5.77*		5.81*
					(3.48)		*(3.51)*
Tax Rate						-0.010	-0.011*
						(0.0063)	*(0.0062)*
Fed Funds Rate							-0.16
							(0.13)
Baa Risk Premium							-1.48*
							(0.89)
Quarter dummies	yes	yes	yes	yes	yes	yes	yes
Observations	8445	7875	7941	8372	7941	7939	7873
Number of bank clusters	506	503	506	503	506	506	503
Wald statistic	224	223	240	270	212	214	298
Pseudo R-squared	0.36	0.35	0.35	0.37	0.36	0.36	0.37

Notes: Robust standard errors adjusted for clustering on the bank level in parentheses. Constant and quarter dummies are suppressed. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

ifications we use the first lags of the explanatory variables[28] to reduce the problems due to omitted variables or reverse causality, as lags are naturally correlated with the contemporaneous values and at the same time they are less likely to be correlated with the error term.[29] We control for possible changes in securitization activity over time for instance due to changes in investor demand by using time dummies. Only in the last specification in column (7) we control directly for the stance of monetary policy and the risk appetite of investors.[30] Furthermore, we include a dummy variable that equals 1 if the institution is a credit card specialty bank in addition to the variables described in the previous section, as banks specialized in credit card loans use credit risk transfer instruments more often than other commercial banks. We finally estimate the model using the standard capital ratios and compare the results to check to what extent endogeneity is a problem. These results are reported in Tables 4.12 and 4.13 in Appendix C.

Let us first have a look at Table 4.1. Reported are the coefficients[31] of a pooled probit estimation of the probability of securitizing on the corrected total capital to risk-weighted assets ratio, the logarithm of total assets, the debt financing costs, the yield on loans and leases, loan loss allowances, investment banking activities, average tax rate, and a credit card bank dummy.

Banks indeed seem to use securitization techniques to circumvent capital regulation. Throughout all the specifications the coefficient for the counterfactual capital to risk-weighted assets ratio is negative and significant at the 10% level. As expected, banks whose corrected capital ratio is low securi-

[28]Table 4.10 in Appendix C provides descriptive statistics for all explanatory variables. Furthermore, Table 4.11 in Appendix C shows their pairwise correlations.

[29]Non-linear estimation techniques, like maximum likelihood, are particularly sensitive to small endogeneity problems, which can cause a bias in the set of all the estimated coefficients.

[30]We continue to control for other time fixed effects by keeping a set of time dummies. Compared with the specifications without the two macro variables, we reduce the number of included time dummies by two.

[31]Note that in non-linear models the coefficients do not match the marginal effects, thus one cannot interpret their magnitude in the usual way but only their sign.

tize with a higher probability. We interpret the result as evidence of capital arbitrage in securitization.

Using the standard capital to risk-weighted assets ratio, the results are quite different; see Table 4.12 in Appendix C. The coefficient is positive, though insignificant, suggesting, contrary to the capital arbitrage hypothesis, that capital-constrained banks tend to securitize with a lower probability. Again, as already pointed out, the standard capital ratio is endogenous and the estimated coefficient biased upwards. The endogeneity problem seems to be severe enough to alter the sign of the coefficient.

The size of the credit institution also matters for the securitization decision. The coefficient for the logarithm of total assets is positive and significant in all the specifications in Table 4.1, implying that larger institutions securitize assets with a higher probability. Our intuition for the result is that high fixed costs associated with securitization act as a barrier to market entry for smaller banks. The average securitization cost for these institutions would be higher, as they would generally want to securitize smaller pools of assets and the fixed costs cannot be spread across a large pool of loans. Furthermore, as expected banks specializing in credit card lending also securitize with a higher probability due to their special business model.[32]

To test whether profitability influences the probability of securitizing, we include the yield on loans and leases in columns (2) and (7). The coefficient reported in column (2) is significant and positive, which at first sight supports the idea of profitable banks more easily affording the high up-front costs of securitization. Once we also control for all the other determinants, though, the coefficient becomes insignificant; see column (7). The estimate in column (2) possibly suffers from an omitted variable bias. The origination of riskier credit is associated with higher yields. Therefore, if higher credit

[32]Gorton and Souleles (2006) point out that credit card securitization is the second largest segment after mortgage backed securities issuance.

risk increases the probability of securitizing, the yield on loans and leases may capture some of its effect. Not controlling for credit risk induces an upward bias in the coefficient in specification (2). Once we control for it in column (7), the bias disappears and the coefficient on yield on loans and leases becomes insignificant.

We are not able to find evidence in support of banks engaging in securitization either as a means to share credit risk or as a way to fund loans at more favorable debt financing costs. Both coefficients have the expected positive sign,[33] but are insignificant. Thus, our empirical results do not confirm the hypothesis of securitization mainly used as a tool for transfering credit risk from the banking industry to sectors more capable or willing to bear them. Capital arbitrage rather seems to be the driving motive for the extensive margin.

The degree to which banks engage in investment banking activities influences as expected their decision to securitize positively. The coefficient for investment banking activities is positive and significant in both columns (5) and (7). Additionally to economies of scope, tax considerations seem to be important. Banks with higher tax rates benefit more from tax deductibility, therefore, we expect that higher tax rates correlate negatively with the probability of securitizing. The coefficient is indeed negative, but significant only in the last specification.

Even though the main focus of our empirical analysis lies in identifying supply-side factors in securitization, we include the federal funds rate and the Baa risk premium in the last specification (7). Both regressors capture variations in investor demand for asset-backed securitites. The respective coefficients have the expected negative sign. Loose monetary policy, captured by low levels of the fed funds rate, generally leads to higher investor

[33]Both when included individually in columns (3) and (4), respectively, and when controlling for all the possible determinants in column (7).

Table 4.2: The extensive margin of securitization: using Tier 1/Total Assets Corrected

Dependent Variable:	**Securitization Dummy**						
Estimation:	**Pooled Probit**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tier 1/Total Assets Corrected	-5.28**	-5.00*	-4.82*	-6.63**	-4.94*	-4.76*	-5.98*
	(2.60)	*(2.77)*	*(2.57)*	*(3.22)*	*(2.61)*	*(2.52)*	*(3.28)*
Log of Total Assets	0.38***	0.40***	0.38***	0.39***	0.36***	0.38***	0.38***
	(0.044)	*(0.044)*	*(0.045)*	*(0.045)*	*(0.047)*	*(0.045)*	*(0.047)*
Credit Card Bank	1.95***	1.49***	1.85***	1.65***	1.92***	1.90***	1.46***
	(0.29)	*(0.28)*	*(0.34)*	*(0.44)*	*(0.30)*	*(0.30)*	*(0.39)*
Yield Loans and Leases		5.52**					3.38
		(2.67)					*(4.18)*
Financing Costs			2.63				1.54
			(10.8)				*(12.0)*
Credit Risk (Loss Allowances)				9.85			7.54
				(8.52)			*(10.3)*
Investment Banking					5.18		5.18
					(3.30)		*(3.28)*
Tax Rate						-0.0089	-0.0095
						(0.0062)	*(0.0062)*
Fed Funds Rate							-0.14
							(0.12)
Baa Risk Premium							-1.36
							(0.87)
Quarter dummies	yes	yes	yes	yes	yes	yes	yes
Observations	8445	7875	7941	8372	7941	7939	7873
Number of bank clusters	506	503	506	503	506	506	503
Wald statistic	196	195	220	242	186	187	274
Pseudo R-squared	0.35	0.35	0.34	0.36	0.35	0.35	0.36

Notes: Robust standard errors adjusted for clustering on the bank level in parentheses. Constant and quarter dummies are suppressed. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

demand for more risky but higher yielding investment opportunities, among others also in asset-backed securities. In turn, it should increase the probability of securitizing for all the institutions in the sample. Similarly, low levels of the Baa risk premium relate to a high appetite for risk of investors and are expected to lead to a higher probability of securitizing. Only the coefficient for the Baa risk premium is significant, though. The results are sensitive to changes in the set of included time dummies and should not be overemphasized.

Table 4.2 summarizes the results of the same analysis, using the corrected tier 1 to total assets ratio instead of the corrected ratio of capital to risk-weighted assets. All the coefficients are very similar in magnitude to those reported in Table 4.1. Capital arbitrage considerations, economies of scale, and being a credit card bank significantly influence the probability of securitizing of banks in our sample. The previously significant effects of taxes and investment banking activities are no longer so.[34]

Worthwhile is again the comparison of estimation results with those using the standard tier 1 ratio instead of the corrected one. Table 4.13 in Appendix C reveals that the coefficient of the standard ratio is positive and significant at the 5% level throughout all the specifications. Recall that when using the standard capital to risk-weighted assets ratio the positive coefficient was not significant. We believe that the endogeneity problem for the standard tier 1 ratio is more severe, as securitization for regulatory capital purposes leads to a higher increase in the Tier 1/Total Assets ratio than in the Capital/RWA ratio. The reason is quite straightforward: whereas securitization leads to a similar reduction in the numerator of both ratios because the provided credit enhancements have to be deducted, the denominator of the tier 1 ratio decreases typically more strongly as the assets are not weighted and on average the risk weighting is lower than 1. Again, endogeneity is indeed a

[34]The p-values rise to 12-13%.

problem, and if not considered biases the results significantly.

4.6 The intensive margin of securitization

After having analyzed the participation decision of banks, we turn our attention to the question of why some banks use securitization on a larger scale and/or more often. We label it the *intensive* margin of securitization. Among the securitizing banks in our sample, the median bank securitizes in 4 out of 19 quarters, with around 44% of the banks being active only once or twice during the sample period. The securitized assets of the median bank amount to only around 3.7% of its on-balance-sheet assets, whereas banks at the 75th percentile of the distribution have around 23% securitized to retained assets. A natural question, thus, is which factors account for these observed differences *within* the group of securitizing banks.

In this section we use a more structural model of securitization activities. Instead of grouping the banks into securitizers and non-securitizers, based on the change in the amount outstanding of securitized assets, we try to model the evolution of the stock of those assets and "difference out" the new issuance of asset-backed securities.[35]

We start with the following identity, which shows the evolution of the amount outstanding of securitized assets:

$$S_{it} = S_{i,t-1} + newissuance_{it} - repayment_{it} - chargeoffs_{it} \tag{4.5}$$

where S_{it} denotes the amount outstanding of assets securitized by bank i

[35]Prior literature using stock data, e.g. Gorton and Souleles (2006) among others, pursues a different empirical modeling strategy. Researchers typically use models that ignore the dynamics of the outstanding securitized assets. However, given the observed dependence of the stock data over time, this is an unnatural assumption.

in period t. The identity simply says that the stock of securitized assets increases with the issuance of new asset-backed securities and decreases with loan repayments as well as loan charge-offs. Since we observe the charge-offs on the securitized assets in each period we can rewrite the equation as:

$$S_{it} + chargeoffs_{it} = S_{it}^{gross} = S_{i,t-1} + newissuance_{it} - repayment_{it} \quad (4.6)$$

In the next step we model the unobserved "repayment" term as a function of observables. The amount of repayments depends positively on the outstanding amount of assets. Further determinants are macroeconomic factors like the interest rates or the business cycle, because for example a low unemployment rate raises the probability that loans will be payed back on time and low interest rates lead to prepayments and refinancing of loans at more favorable terms. Finally, we add time-invariant, bank-specific factors to account for unobserved characteristics that potentially influence the repayment series for each bank in our sample. We end up with the following linear structure on $repayment_{it}$:

$$repayment_{it} = \alpha S_{i,t-1} + \omega_t + \psi_i + \xi_{it} \quad (4.7)$$

where ω_t captures all the relevant time-varying factors (e.g. interest rates, unemployment rate, GDP growth), ψ_i stands for time-invariant determinants, and ξ_{it} is a well-behaved random error term.

Plugging equation (4.7) into (4.6) delivers:

$$S_{it}^{gross} = (1-\alpha)S_{i,t-1} + newissuance_{it} - \omega_t - \psi_i - \xi_{it} \quad (4.8)$$

Next, we use the determinants of new issuance described in the previous section to complete the estimable equation. Assuming further that there

are time-specific, but bank-invariant and time-constant, bank-specific factors that influence the decision to securitize new assets, we end up with our final specification:[36]

$$S_{it}^{gross} = (1-\alpha)S_{i,t-1} + \boldsymbol{x}_{it}\boldsymbol{\gamma} + \omega_t^* + \psi_i^* + \xi_{it}^* \tag{4.9}$$

The main advantage of this specification as opposed to the previous probit model is that here we can partially account for the heterogeneity between banks using bank fixed effects. Moreover, this dynamic model will allow us to test whether our main regressors are exogenous and hence whether our predictions are valid.

Estimating the above relationship via simple OLS and treating $\psi_i^* + \xi_{it}^*$ as the composite error term is problematic in several ways.[37] First, ψ_i^* and $S_{i,t-1}$ are mathematically related and this will lead to biased estimates. A solution is to eliminate the bank fixed effects by substracting the time mean for each bank.[38] However, a problem still remains, because the transformed lagged dependent variable (LDV) is correlated with the transformed error term. Nickell (1981) showed that this introduces a bias into the estimates, that disappears only for $T \to \infty$.[39] We use a technique, first proposed by Anderson and Hsiao (1982) to solve the problem. In order to eliminate the fixed effects first differences are taken from both sides of equation (4.9):

[36] ω_t^* , ψ_i^*, and ξ_{it}^* are the composite terms. $\boldsymbol{x}_{it}$ is the vector of determinants of securitization as described in the previous section.

[37] Equation (4.9) is close to the one with a lagged dependent variable because S_{it}^{gross} and S_{it} are highly correlated. The sample correlation coefficient is $corr(S_{it}^{gross}, S_{it}) = 0.999$. Charge-offs are small relative to the outstanding amounts; hence the variation in the dependent variable is driven by the variation in S_{it}. Including charge-offs on the right-hand side (as the regressor) instead of on the left-hand side, which leads to a standard model with a lagged dependent variable, delivers the same results.

[38] The within-group transformation.

[39] Further, Judson and Owen (1999) find that this bias is important (around 20%) even for $T = 30$.

$$S_{it}^{gross} - S_{i,t-1}^{gross} = (1-\alpha)(S_{i,t-1} - S_{i,t-2}) + (\boldsymbol{x}_{it} - \boldsymbol{x}_{i,t-1})\boldsymbol{\gamma} + \\ +(\omega_t^* - \omega_{t-1}^*) + (\xi_{it}^* - \xi_{i,t-1}^*) \qquad (4.10)$$

Again there is a correlation between the $S_{i,t-1} - S_{i,t-2}$ term and the transformed error term $\xi_{it}^* - \xi_{i,t-1}^*$. To solve the endogeneity problem, one uses an instrumental variable estimator. Anderson and Hsiao (1982) propose the lagged level $S_{i,t-2}$ or the lagged difference $S_{i,t-2} - S_{i,t-3}$ as natural instruments, because they are correlated with $S_{i,t-1} - S_{i,t-2}$, but not with the error term.[40] The instruments are valid if $\xi_{it}^* - \xi_{i,t-1}^*$ is not first-order autocorrelated or equivalently the level ξ_{it}^* doesn't follow a second-order autoregressive process.[41]

Holtz-Eakin, Newey, and Rosen (1988) and Arellano and Bond (1991) propose a generalized method of moments (GMM) estimation of equation (4.10), which is more efficient than that of Anderson and Hsiao (1982). As we go further in time more lagged values can serve as instruments, and more moment conditions can be used to improve efficiency. The GMM framework allows us in addition to test for the exogeneity of the instrument set.[42]

The following moment conditions can be used in the estimation:

[40] Instrumenting in this manner does not work with the within-group transformation.

[41] The first-difference representation introduces serial correlation of the transformed errors (assuming no autocorrelation in levels), but this can be easily treated by using GLS or by using robust variance-covariance estimators.

[42] Arellano and Bover (1995) and Blundell and Bond (1998) point out that "difference" GMM may perform poorly when the time series are very persistent. In this case lagged levels are poor instruments of first differences, which produce the "weak instrument problem". They propose the so-called "system" GMM estimator, where an equation in levels is added to the system of differenced equations. Here the intuition is to instrument levels with differences. However, a crucial and non-trivial assumption requires that the covariance $E[S_{it}\psi_i^*]$ is constant over time (stationary) so that $E[(S_{it} - S_{i,t-1})\psi_i^*] = 0$. The condition is required for **all** the instruments. We believe that the initial stationarity of the time series for the securitized assets is not satisfied because there is a clear upward trend in the stock of asset backed securities between 2003 and 2007. Therefore, system GMM is not appropriate.

$$E[S_{i,t-l}(\xi^*_{it} - \xi^*_{i,t-1})] = 0 \quad \text{for each } t \geq 3 \text{ and } l \geq 2 \tag{4.11}$$

We decide to exploit the "collapsed" version following Roodman (2009b) to reduce the problem of "too many instruments".[43] Thus, we use the following moment conditions:

$$E[S_{i,t-l}(\xi^*_{it} - \xi^*_{i,t-1})] = 0 \quad \text{for each } l \geq 2 \tag{4.12}$$

The additional usual moment conditions are of the form:

$$E[(\boldsymbol{x}_{it} - \boldsymbol{x}_{i,t-1})'(\xi^*_{it} - \xi^*_{i,t-1})] = \mathbf{0} \quad \text{for } t \geq 2 \tag{4.13}$$

where the row vector $\boldsymbol{x}$ contains all the strictly exogenous explanatory variables. If some of the covariates are potentially predetermined or endogenous we use suitable lagged levels to instrument the difference $x_{it} - x_{i,t-1}$.[44]

We address several issues in our estimation. First, we use the amount outstanding of securitized assets as a share of the total managed assets of the bank instead of the level of S_{it}.[45] The total managed assets are defined as the sum of the total on-balance-sheet assets and the total securitized assets. This helps us to avoid problems due to non-stationarity of the series.[46] Second, we perform the "one-step" GMM estimation and produce test statistics by applying the cluster-robust estimator of the variance-covariance matrix

[43] This problem arises because as we go further in time, there are more lags of the dependent variable, which can potentially serve as instruments.

[44] We start by treating these variables as strictly exogenous and perform Difference-in-Hansen tests of exogeneity of instrument subsets. If these reject the null hypothesis of exogeneity we use appropriate lagged levels instead.

[45] The average bank has about 15% and the median bank about 3.5% securitized in all managed assets.

[46] Furthermore, the approach has the following advantage over using on-balance-sheet assets only in the denominator. If a bank securitizes assets, without expanding its on-balance-sheet lending, we will observe higher S_{it} as well as lower retained assets. The share of securitized to retained assets will increase sharply, since both the nominator increases and the denominator decreases.

of residuals, which allows for arbitrary correlation within banks and heteroskedasticity across banks.[47] Third, we test for AR(1) and AR(2) in the first-differenced errors using the Arellano-Bond test for autocorrelation to check whether our instruments are valid. In theory there is a negative first-order autocorrelation in first differences, but there should be no second or higher order autocorrelation. Fourth, we conduct a Hansen (1982) test of overidentifying restrictions to test for the exogeneity of the instrument set as a whole. In addition, to test whether our "corrected" capital ratio measure is exogenous, we perform a Difference-in-Hansen test. We test further whether all the other strictly exogenous explanatory variables are indeed orthogonal to the residuals, but we do not present them in the tables for sake of clarity. Finally, we address the problem of "too many instruments". Since we have a relatively small sample "overfitting" endogenous variables by using too many moment conditions may be a problem.[48] Therefore, we decide to restrict the lag length to using only up to the first five available lags. In addition we "collapse" them into a smaller instrument set. As a consequence, our system of equations has two or three overidentifying restrictions.

Table 4.3 shows the estimation results using the Capital/RWA Corrected ratio, whereas Table 4.4 uses the Tier1/ Total Assets Corrected ratio.[49] The results are qualitatively comparable; therefore, we focus on the results reported in Table 4.3. We use two samples in our analysis. The narrow sample in columns (3) and (4) consists of all the securitizers from the sample used

[47] In theory "two-step" GMM estimation produces a heteroskedasticity- and autocorrelation-robust variance-covariance matrix and is more efficient than the one-step approach. However, as Arellano and Bond (1991) and Roodman (2009a) point out, standard errors can be severely downward biased in small samples. In this case standard errors can then be adjusted using the finite-sample correction of Windmeijer (2005), but since this is only an approximation we decide to stick to our one-step results.

[48] Roodman (2009b) emphasizes that the available instruments may rise quadratically with the number of time periods. For our sample with 18 quarters the maximum potentially available moment conditions amount to $(18-2)(18-1)/2 = 136$.

[49] We use the *xtabond2* command in Stata provided by Roodman (2009a) to obtain our results.

Table 4.3: Dynamic difference GMM estimation results using Capital/RWA Corrected

Dependent Variable:	**Securitized to Total Managed Assets (gross)**			
Sample:	**broad**		**narrow**	
Instruments:	**L2-L4.S**	**L2-L5.S**	**L2-L4.S**	**L2-L5.S**
	(1)	(2)	(3)	(4)
L1.(Securitized to Total Managed Assets)	0.59*	0.55**	0.81**	0.80**
	(0.31)	*(0.28)*	*(0.41)*	*(0.37)*
Capital/RWA Corrected	-1.13**	-1.15**	-1.20*	-1.21*
	(0.54)	*(0.54)*	*(0.61)*	*(0.62)*
Log of Total Assets	-0.15***	-0.15***	-0.15***	-0.15***
	(0.049)	*(0.048)*	*(0.048)*	*(0.048)*
Yield Loans and Leases	0.13	0.13	0.12	0.12
	(0.097)	*(0.095)*	*(0.11)*	*(0.11)*
Financing Costs	1.70***	1.69***	1.93***	1.93***
	(0.64)	*(0.63)*	*(0.72)*	*(0.70)*
Credit Risk (Loss Allowances)	0.037	0.071	0.096	0.11
	(0.59)	*(0.56)*	*(0.61)*	*(0.58)*
Investment Banking	-0.034	-0.034	-0.047	-0.047
	(0.066)	*(0.065)*	*(0.073)*	*(0.072)*
Tax Rate	-0.000063	-0.000063	-0.000070	-0.000071
	(0.00012)	*(0.00012)*	*(0.00015)*	*(0.00015)*
Fed Funds Rate	-0.047	-0.042	-0.20	-0.19
	(0.37)	*(0.36)*	*(0.53)*	*(0.52)*
Baa Risk Premium	-0.039	-0.034	-0.19	-0.19
	(0.39)	*(0.38)*	*(0.55)*	*(0.55)*
Quarter dummies	yes	yes	yes	yes
Observations	1141	1141	955	955
Number of bank clusters	103	103	77	77
Number of instruments	26	27	26	27
F statistic	2.62	2.67	2.33	2.37
F-Test (p-value)	0.0004	0.0003	0.003	0.002
AR(1) Test	-1.68	-1.70	-1.83	-1.95
AR(1) Test (p-value)	0.09	0.09	0.07	0.05
AR(2) Test	-0.79	-0.75	-1.16	-1.15
AR(2) Test (p-value)	0.43	0.45	0.25	0.25
Hansen-J statistic	0.72	1.20	0.056	0.12
Hansen-J (degrees of freedom)	2	3	2	3
Hansen-J (p-value)	0.70	0.75	0.97	0.99
Diff-in-Hansen statistic for Capital/RWA Corrected	0.36	0.03	0.03	0.01
Diff-in-Hansen (p-value)	0.55	0.87	0.86	0.94

Notes: Robust standard errors adjusted for clustering on the bank level in parentheses. Estimates are one-step difference GMM. The table shows the Arellano-Bond test for first- and second-order autocorrelation of the first-differenced residuals. The null hypothesis is no autocorrelation. A heteroskedasticity-robust test of overidentifying restrictions (Hansen J-test) is performed. The null hypothesis is that the instrument set as a group is exogenous. A Difference-in-Hansen test for exogeneity of the instrument subset (here of the capital ratio) is performed. Under the null the instrument excluded is exogenous. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 4.4: Dynamic difference GMM estimation results using Tier1/Total Assets Corrected

Dependent Variable:	**Securitized to Total Managed Assets (gross)**			
Sample:	**broad**		**narrow**	
Instruments:	**L2-L4.S**	**L2-L5.S**	**L2-L4.S**	**L2-L5.S**
	(1)	(2)	(3)	(4)
L1.(Securitized to Total Managed Assets)	0.70**	0.64**	0.92**	0.87**
	(0.33)	*(0.30)*	*(0.44)*	*(0.40)*
Tier1/Total Assets Corrected	-1.44*	-1.48*	-1.63*	-1.65*
	(0.79)	*(0.80)*	*(0.84)*	*(0.84)*
Log of Total Assets	-0.16***	-0.16***	-0.16***	-0.16***
	(0.054)	*(0.053)*	*(0.052)*	*(0.052)*
Yield Loans and Leases	0.12	0.11	0.099	0.097
	(0.11)	*(0.10)*	*(0.11)*	*(0.11)*
Financing Costs	1.96***	1.95***	2.27***	2.26***
	(0.74)	*(0.73)*	*(0.82)*	*(0.80)*
Credit Risk (Loss Allowances)	0.13	0.19	0.30	0.34
	(0.57)	*(0.54)*	*(0.58)*	*(0.54)*
Investment Banking	-0.028	-0.029	-0.041	-0.041
	(0.065)	*(0.064)*	*(0.072)*	*(0.070)*
Tax Rate	-0.000064	-0.000064	-0.000049	-0.000049
	(0.00014)	*(0.00014)*	*(0.00016)*	*(0.00016)*
Fed Funds Rate	-0.22	-0.22	-0.55	-0.55
	(0.39)	*(0.38)*	*(0.56)*	*(0.55)*
Baa Risk Premium	-0.22	-0.22	-0.57	-0.57
	(0.41)	*(0.40)*	*(0.59)*	*(0.57)*
Quarter dummies	yes	yes	yes	yes
Observations	1141	1141	955	955
Number of bank clusters	103	103	77	77
Number of instruments	26	27	26	27
F statistic	2.26	2.34	2.08	2.15
F-Test (p-value)	0.003	0.002	0.008	0.006
AR(1) Test	-1.96	-1.95	-2.00	-2.06
AR(1) Test (p-value)	0.050	0.051	0.046	0.040
AR(2) Test	-1.36	-1.39	-1.39	-1.44
AR(2) Test (p-value)	0.17	0.16	0.16	0.15
Hansen-J statistic	0.73	1.80	0.48	0.81
Hansen-J (degrees of freedom)	2	3	2	3
Hansen-J (p-value)	0.69	0.61	0.79	0.85
Diff-in-Hansen statistic for Tier1/Total Assets Corrected	0.02	0.13	0.06	0.07
Diff-in-Hansen (p-value)	0.89	0.72	0.81	0.79

Notes: Robust standard errors adjusted for clustering on the bank level in parentheses. Estimates are one-step difference GMM. The table shows the Arellano-Bond test for first- and second-order autocorrelation of the first-differenced residuals. The null hypothesis is no autocorrelation. A heteroskedasticity-robust test of overidentifying restrictions (Hansen J-test) is performed. The null hypothesis is that the instrument set as a group is exogenous. A Difference-in-Hansen test for exogeneity of the instrument subset (here of the capital ratio) is performed. Under the null the instrument excluded is exogenous. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

in our binary choice model. In addition, we collected data on all the securitizers with assets between 300 million and 1 billion dollars in the second quarter of 2008. There are 30 banks reporting securitization activities in this sub-group. By adding these banks to our narrow sample we obtain the broad sample used in columns (1) and (2). Beyond the advantage of using more observations this allows us to see whether the inclusion of other banks alters our results. We further present results using two different instrument sets: the first includes the second, third, and fourth lags of S_{it} in column (1) whereas the second includes in addition the fifth lag in column (2).

Throughout all the specifications the Arellano-Bond test suggests the existence of negative first-order serial correlation in the first-differenced residuals at the 10% significance level, that is expected by construction. The test cannot reject the null hypothesis of the absence of AR(2) in the first-differenced residuals, indicating that the lagged levels of the dependent variable are valid instruments. Furthermore, the p-value of the Hansen J-test ranges between 0.70 and 0.99. The null hypothesis of exogeneity of the instrument set as a whole cannot be rejected. Therefore, endogeneity is not driving our results.

A brief look at the table reveals that the results are in general not sensitive to different samples or to the use of different instrument sets. Therefore, we interpret only the results in column (1). Banks with a lower capital ratio securitize more. The estimated coefficient is significantly different from zero at the 5% level. To quantify the effect we compare a bank at the 75th percentile of the distribution of the capital ratio with a bank at the 25th percentile. The latter has an approximately 2 percentage points lower ratio of capital to risk-weighted assets. The coefficient of -1.13 implies that this bank will have 2.26 percentage points higher securitized in total managed assets. However, since we have a dynamic model, the coefficient represents only the contemporaneous effect. The long-run impact is given by $\gamma/(1-(1-$

α)).[50] Given the estimate for $(1-\alpha)$ of 0.59, the long-run effect amounts to $2.26/(1-0.59) = 5.51$ percentage points. The result suggests that the capital arbitrage is important for *both* the extensive *and* the intensive margin of securitization. The performed Difference-in-Hansen test cannot reject the null hypothesis of the exogeneity of Capital/RWA Corrected.[51]

A second important finding is that the financing costs seem to be a further important determinant of the scale of securitization activity. This result supports the efficient contracting view of securitization and is in line with other empirical papers. Looking at column (1) of the table, the coefficient on this variable is positive and statistically significant at the 1% level. An originating bank in the 75th percentile of the distribution faces 1.5 percentage points higher debt financing costs compared with a bank at the 25th percentile. This bank will therefore have around a $1.7 * 1.5 = 2.55$ percentage points higher share of securitized in the total managed assets. In the long run the impact is even higher - 6.22 percentage points.[52]

Another interesting result is the negative, significant at the 1% level coefficient on the total assets variable. Bigger banks seem to have a lower share of securitized in the total managed assets.

Finally, the variables tax rate and investment banking activities do not have a significant impact on the decision on the scale of securitization. These factors seem to determine only the participation decision. If expertise in investment banking influence only the amount of up-front fixed costs of entering the market, like setting up a special purpose vehicle and placing the securities on the market, then this variable will influence indeed only the participation of banks. Bank profitability and credit risk exposure have the expected positive sign, but are again not significant.

Finally, we want to emphasize the appropriateness of our estimation pro-

[50] This is approximately true, because S_{it}^{gross} and S_{it} have almost equal values.
[51] The test statistic is $\chi^2(1)$ distributed. The computed p-value is 0.55.
[52] $6.22 = 2.55/(1-0.59)$.

cedure and the importance of bank fixed effects. Therefore, we estimate the model in equation (4.9) using the fixed-effects (FE) as well as the random-effects (RE) estimator. Table 4.14 in Appendix C shows the estimation results.

First, to indicate the importance of fixed effects, we compare the estimates in column (1) for the random-effects case with column (2) for the fixed-effects case, in both of which use the capital/RWA corrected as the measure for the capital adequacy of a bank.[53] There are significant differences. Comparing the coefficient on the lagged dependent variable, we see in the RE case that it is biased upwards. The result is reasonable, because we expect a positive correlation between the lagged dependent variable and the unobserved fixed effect ψ_i^*. Further, we see an upward bias towards zero for the coefficient on the capital ratio, which is plausible for a positive correlation between it and the unobserved fixed effect ψ_i^*. The table shows in addition the estimated variance due to the fixed effects relative to the overall variance. The *Rho* statistic for the fixed-effects within-estimation is near 1, which confirms the importance of including bank fixed effects.

Second, we can compare the Arellano-Bond estimates in column (3) of Table 4.3 with the fixed-effects estimates in column (2) of Table 4.14. Both use the same narrow sample. Although both estimators account for fixed effects, the latter suffers from the "Nickell" bias. The coefficient on the capital ratio is clearly biased towards 0. The bias is significant and amounts to around 33%[54] of the coefficient. Furthermore, the coefficient on the financing costs variable is around 17%[55] biased downward. In line with the econometric literature, this suggests that the within-group estimator is not suitable

[53] A clearer way to test the appropriateness of both estimators would be to perform a Hausman specification test. A necessary assumption for the test is that the fixed-effects estimator is consistent. However, in the presence of a lagged dependent variable this assumption is not fulfilled.

[54] $0.33 = (1.20 - 0.80)/1.20$.

[55] $0.17 = (1.93 - 1.61)/1.93$

for our small T sample.

Overall when considering the intensive margin, we find support for both the capital arbitrage view and the efficient contracting view of securitization.

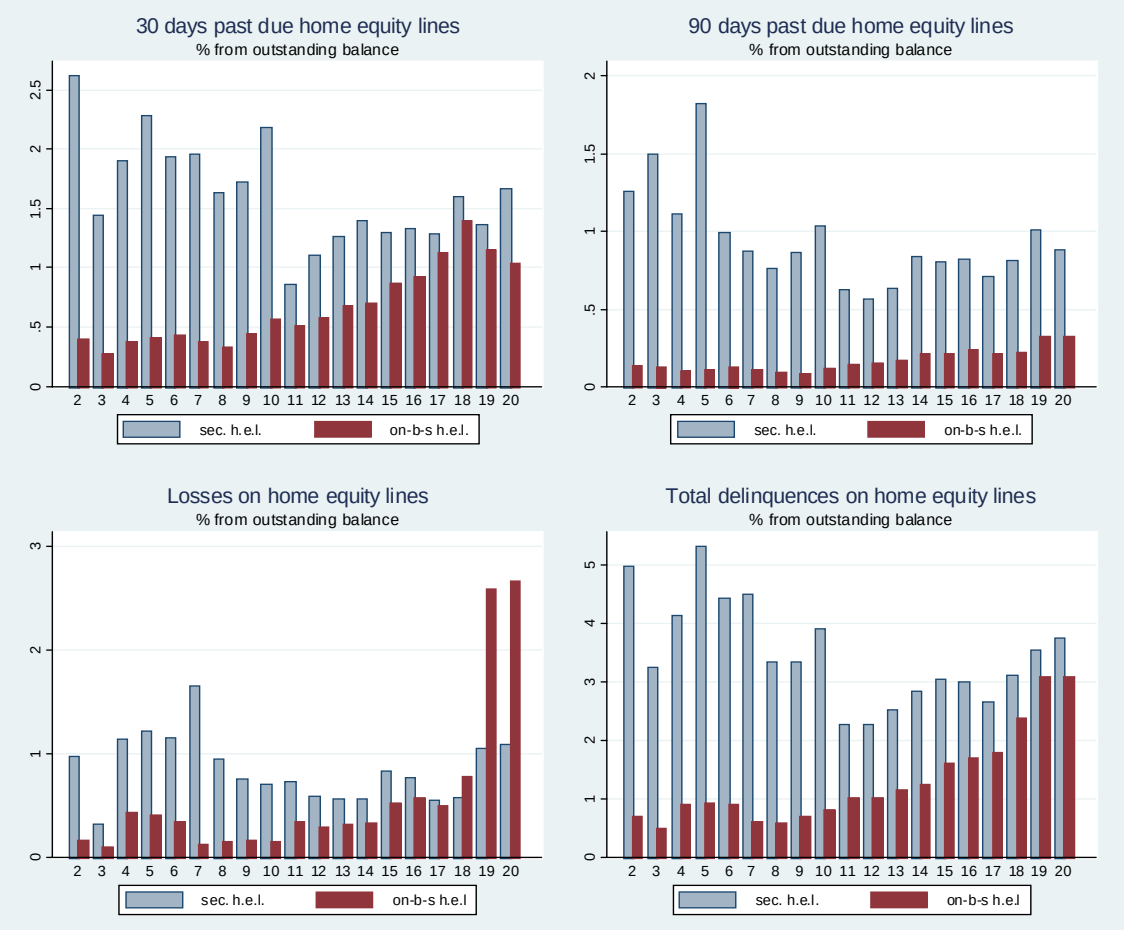
4.7 Incentive effects of securitization

After having provided evidence that capital arbitrage drives asset securitization by banks, we turn to the question of whether and how securitization affects the quality of originated loans. First, we compare the ex-post performance of securitized and retained loans and interpret the observed disparity as evidence of incentive problems. Second, we identify which contractual features and bank characteristics can remedy such problems.

In this section we focus *only* on the sub-sample of securitizing banks. We argue that pooling securitizers with non-securitizers will be misleading and probably overstate the true impact of securitization on the quality of originated loans. The intuition is straightforward. Suppose for a moment that securitization does not lead to bad incentives so that loans originated by the same bank exhibit the same delinquency rates, irrespective of whether they are securitized or not. However, securitizing banks may be systematically involved in a riskier lending.[56] There will be a different performance of securitized loan pools vs. on-balance sheet loan pools simply due to a *selection* of securitizers into such riskier business. However, the disparity would not relate to bad incentives. By focusing on the sub-sample of securitizing banks we rule out such a selection. In a way our empirical strategy boils down to comparing the ex-post observed performance of loans originated by the *same* institution, of the *same* type,[57] observed at the *same* time, which are securitized to those retained on the balance sheet.

[56] Figure 4.4 indicates this.

[57] For example, credit card debt or residential mortgages.



Notes: Quarters denoted on the horizontal axis. 2 is the fourth quarter of 2003; 20 is the second quarter of 2008.

Figure 4.8: Delinquencies on securitized and retained home equity lines

Figure 4.8 summarizes the delinquency rates of home equity loans for the time period between the fourth quarter of 2003 and the second quarter of 2008. The blue bars denote the average delinquencies of retained loans and the red bar the delinquencies of loans originated and securitized by the same group of banks. The two upper panels summarize data on loans more than 30 days past due. Throughout the time period securitized home equity loans had a higher fraction of borrowers failing to meet the due payments than home equity loans originated by the same group of banks and retained by the originator. The lower-left panel features data on the charge-offs. Up until the last quarter of 2007 the development resembles the upper panels. In the last 3 quarters during which the current crisis emerged and intensified, however, the losses on retained loans were substantially higher. Anecdotal evidence suggests that securitization in that particular period was practically impossible and banks were forced to retain loans they planned to securitize. Additionally, banks had to put recently securitized assets, that had quickly become sour, back on their balance sheets in an act of implicit support for reputational purposes. Thus, some of the defaults denoted in the graph as defaults on retained loans could actually reflect losses on either loans that were originally securitized but had to be put back on the balance sheet or loans that were planned to be securitized.

The lower-right panel sums up all the non-performing loans - between 30 and 89 days past due, more than 90 days past due, and those charged off - as the total delinquency rate on home equity loans. This is how we measure "quality". The measure has some caveats. First of all it is an ex-post measure so the poor performance of securitized assets might be the result of "bad luck". A more serious caveat is that the measure does not capture the true profitability. Even though securitized loans are riskier and default more often, the interest rates charged for such loans may be sufficiently high to make them a profitable investment. We do not have any data on interest

Table 4.5: Mean comparison of total delinquencies on securitized vs. retained loans

	Mean of Total Delinquencies		Diff(mean) > 0 p-value
type of loan	securitized loans	retained loans	
Residential Mortgages*	0.18	0.17	0.370
Home Equity Loans	3.41	1.29	< 0.001
Credit Card Debt	7.87	6.23	0.046
Commercial Loans	3.05	2.34	0.006
Other Loans	3.02	0.85	< 0.001

Notes: * The total delinquencies of residential mortgages contain booked losses only. The last column reports the p-value of a paired t-test with the null hypothesis that the mean for the securitized loans is equal to the mean for the retained loans vs. the alternative that the mean for the securitized loans is higher than the mean for the retained loans.

income for securitized loans, thus, we cannot take it into account in our analysis.

We observe the same pattern for other types of loans too. Table 4.5 summarizes the total delinquencies for home equity loans, credit card loans, commercial loans, and other loans.[58] For residential mortgages we do not have data on past dues, so instead of total delinquencies we report booked losses only. The t-test reported in Table 4.5 reveals that total delinquencies on securitized loans are significantly higher for every loan category apart from residential mortgages. We interpret this as evidence that moral hazard and/or adverse selection are a problem in securitization. Obviously banks tend to originate and securitize substantially riskier loans compared with the ones they retain and for which they are liable with their own equity.

Complementary to Table 4.5 we perform a regression-based mean com-

[58] We provide additional details on the quality characteristics of retained and securitized loans in Table 4.15 in Appendix C.

parison:

$$delinq_{jit} = \mu_0 + c_i + c_t + \mu_1 * dummy_{ji} + \mu_2 * controls_{jit} + \omega_{jit} \quad (4.14)$$

where the subscript j denotes the securitized vs. the retained pool of loans for each bank i at time t.

We pool the overall delinquency rates for retained loans and for securitized loans for each securitizing bank i and want to know whether the securitized loans ($dummy_{ji} = 1$) have higher overall delinquencies than the retained ones ($dummy_{ji} = 0$), controlling for bank fixed effects, time fixed effects, and the composition of both pools.[59] Compared with the previous by-type-of-loan comparison, the regression-based analysis using the overall delinquency rates allows us to exploit a larger fraction of the data.[60]

Equation 4.14 is estimated using the within-bank-group transformation. Inference is based on cluster-robust correction of the standard errors. We again exclude observations after the fourth quarter of 2007.

Table 4.6 shows the results. The estimated coefficient μ_1 is positive and significant at the 5% level, indicating that indeed securitized loans are more risky than retained loans. On average the overall delinquency rate of securitized assets in our sample is 1.47 percentage points higher. Given that the overall delinquency rate on retained loans is 1.29%, this is a large number. Further, the coefficients on the composition of both portfolios are jointly

[59] Controlling for the composition of the portfolios here is crucial as certain types of loan exhibit higher delinquencies. Compare for instance the delinquency rates on home equity loans with those on credit card debt in Table 4.5. Differences in the average overall delinquency rate for securitized vs. retained assets in this specification, thus, may arise ceteris paribus if institutions for example securitize all of their credit card loans and retain all of their originated mortgages. To rule out biases due to systematical differences in the composition of the securitized and retained loan pools we explicitly control for their structure.

[60] The reason is that even though banks report the overall delinquency rate for retained and securitized loans some of them do not provide disaggregated delinquency rates by type of loan.

Table 4.6: Regression-based comparison of total delinquencies on securitized vs. retained loans

Dependent Variable:	Total Delinquencies
$Dummy_{ji}$	1.47**
	(0.35)
Composition of securitized portfolio	yes
Composition of retained portfolio	yes
Quarter dummies	yes
Bank fixed effects	yes
Observations	2026
Number of bank clusters	100
R-squared	0.2

Notes: Robust standard errors adjusted for clustering on the bank level in parentheses. The table shows fixed-effects within estimates. Controls for the composition of securitized and retained portfolios, quarter dummies, and a constant are suppressed. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

significant (F-test not reported), which supports our approach.

Once we have stated that indeed securitized loans exhibit much higher delinquency rates, a natural question to ask is: why? In a next step we identify and test whether the poor performance of securitized loans arises due to bad incentives for screening and monitoring.

The quality of securitized assets should depend on the segment of credit markets in which the bank operates, the screening and monitoring effort exerted by bank staff, and unobserved bank characteristics, for instance how accurate the screening technology is, the managerial culture, etc.

We expect that the total delinquencies of securitized loans are higher for banks operating in riskier segments of the credit market, proxied by the total delinquencies of retained loans. This measure also captures the efficiency of the scoring technology available to individual banks for the assessment of borrower creditworthiness. Intuitively, banks that use a less precise scoring program and specialize in riskier lending will exhibit higher delinquencies on both their retained and securitized assets. Any systematical difference in the

delinquencies of securitized and retained loans of the same type granted by the same bank is related to the *willingness* of bank insiders to use the available technology to screen and monitor borrowers and to possible changes in the bank's tolerance to risk for loans to be securitized as opposed to old-fashioned retained loans. Once we have controlled for the screening technology and the segment of credit markets, we can attribute any variation in the ex-post performance of securitized loans to incentives.

Theory suggests that screening and monitoring incentives could be undermined for securitized loans because the originator sells the assets to a third party and transfers most of the risk associated with them to the buyer. The bank is liable with its own equity for any future defaults only up to the stake it retains in the securitization transaction. This may induce banks to originate and securitize riskier loans and monitor borrowers less stringently once a loan is granted. The higher the fraction of the risk in a securitization transaction the originating bank retains, the less severe such moral hazard and adverse selection problems are, according to theory. We have data on credit enhancements and pro-rata stakes in securitizations retained by the originating banks and use them to test these predictions.

In addition to such contractually specified and disclosed retained risk, banks may also provide "implicit recourse", i.e. the bank implicitly promises to support its securitizations beyond its contractual obligations and thus bears additional risks. Banks may do this out of reputational concerns.[61] Such implicit, non-observable, and non-verifiable to outsiders guarantees must be self-enforcing in order to be effective. In this sense the amount of bank equity capital relative to assets influences incentives in two ways. First, provided that banks care about their reputation and promise implicitly to support securitizations, they are liable with their available equity only. The more capital relative to its assets a bank has, the better are its incen-

[61] See Basel Committee on Banking Supervision (2006), p. 235.

tives to screen and monitor implicitly guaranteed securitized loans. Second, implicit recourse is only self-enforcing for banks with a large capital base relative to their assets. To put it in a nutshell, if a bank is on the brink of bankruptcy it would not care much about its future reputation, as the probability that it has a future is small anyway. Therefore, capital adequacy ensures self-enforceability.

For our regression analysis we use the overall delinquency rate of securitized assets ($delinq_{it}^{sec}$) as a measure of the quality of these assets. As a proxy for the quality of retained assets we use the overall delinquencies on retained loans ($delinq_{it}^{ret}$). To make sure differences in the average delinquencies do not arise because for example riskier types of loans constitute a higher fraction of the securitized portfolio, we control for the composition of the retained and securitized loan pools.[62]

As measures of the retained stake in its securitized assets ($retexp_{it}$) we use the size of the credit enhancements provided by the originating bank as well as the retained pro-rata ownership, both as a percentage of the securitized pool. We expect that both a bigger first-loss piece and a higher retained pro-rata share of ownership help overcome incentive problems and thus lead to a better quality of securitized loans. We further expect that the marginal effect of credit enhancements is stronger. The intuition is straightforward: whereas an increase in the first-loss piece of 1 percentage point is associated with an increase in the retained fraction of the overall risk of more than 1%,[63]

[62] Ultimately we are interested in the differences in delinquencies for loans of the same type. Any comparison of the average delinquencies for all types of loans that does not take into account that certain types of loans exhibit higher delinquencies, e.g. credit card loans versus mortgages, could distort the results if banks for example securitize mortgages more easily than credit card debt and thus the composition of its balance sheet is different from the composition of its securitized assets. As not all the banks in our sample report delinquencies for retained and securitized loans by type of loans, we have to use the average delinquency rate of loans originated by a bank observed during a quarter and control for possible differences in the composition of retained and securitized loan pools.

[63] The first losses on the securitized portfolio are born solely by the holder of the first loss piece.

increasing the retained pro-rata ownership by the same magnitude increases the risk by exactly 1%. The higher the retained portion of risk is, according to theory, the more risk prevention is undertaken.

To test whether reputational concerns play a role we use four different measures of the capital adequacy of banks ($capratio_{it}$): a simple tier 1 leverage ratio, a ratio of risk-based capital to risk-weighted assets, and the corrected version of the two ratios used previously. In the current setting the corrected capital ratios measure the consolidated capital base that is there to back the risk inherent in both the retained and securitized assets of bank i. We expect that the better capitalized a bank is, the better the quality of its securitized assets, all other things held equal.

To control for unobservable bank-specific factors we use bank fixed effects. For example, a different maturity structure of the securitized portfolio relative to the retained portfolio can account for differences in the delinquencies. If these are correlated with our main explanatory variables, they would lead to inconsistent estimates.[64] We also include quarter dummies to capture aggregate time-specific effects. Finally, we control for bank size. The control for size is important, as size and leverage are correlated and thus omitting size may induce a bias into our estimates.

Our empirical model is given by the following linear relationship:

$$delinq_{it}^{sec} = \beta_0 + c_i + c_t + \beta_1 * delinq_{it}^{ret} + \beta_2 * capratio_{it} + \\ + \beta_3 * retexp_{it} + \beta_4 * controls_{it} + u_{it} \qquad (4.15)$$

We first perform a fixed-effects estimation of equation 4.15 and report the results from our baseline model in Table 4.7.[65] The data sample covers 100

[64] The only assumption we need is that these factors are constant over our sample period.

[65] Table 4.9 in Appendix C provides pairwise correlations of the explanatory variables.

banks and 1013 bank-year observations. Throughout all the specifications we control for the composition of the retained and securitized portfolios as well as time- and bank-specific effects. Clustered standard errors that account for conditional heteroskedasticity between bank clusters and serial correlation of the residuals u_{it} within bank clusters are reported in parentheses.

Column (1) in the table reports the results of a regression of the total delinquencies on securitized assets on the delinquencies of retained assets. Not surprisingly, the estimated coefficient $\hat{\beta}_1$ is positive and significant at the 1% level. The point estimate of 1.58 indicates that indeed the delinquencies of securitized assets depend closely on those on the retained portfolio.

Next, we include the size of the first-loss piece in column (2). Contrary to what we expected, the coefficient is positive and significant at the 5% level. This implies that the higher the fraction of risk is retained, the worse the securitized assets perform. Subsequently we include the retained pro-rata ownership instead of the first-loss piece and report the results in column (3). The coefficient has the expected negative sign but is insignificant at the 10% level. In column (4) we also use both measures for retained risk by the originator simultaneously. The sign and significance of the coefficients do not change. We suspect that there may be a problem of reverse causality with regard to the variable first-loss piece. Banks that securitize assets with a less good quality must provide higher credit enhancements so that nevertheless ABS structured out of such collateral are granted a good rating and can be placed on the market. As the amount of retained pro-rata ownership does not provide any protection to investors against defaults and, thus, should not influence the rating of asset-backed securities, there is no reverse causality in this case. As a result we obtain the expected negative sign but the estimated coefficient is not statistically significant. In the further regressions we stick to using the first-loss piece as a control for the retained stake.

In columns (5) to (8) we subsequently use the four bank capital measures

Table 4.7: Total delinquencies of securitized loans: FE estimates

Dependent Variable:	**Total Delinquencies of Securitized Loans**							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total Delinquencies of Retained Loans	1.58***	1.57***	1.59***	1.58***	1.42***	1.43***	1.46***	1.45***
	(0.43)	*(0.42)*	*(0.43)*	*(0.42)*	*(0.31)*	*(0.31)*	*(0.35)*	*(0.34)*
First Loss Piece		2.89**		3.06**	3.02***	3.25***	2.93**	3.15***
		(1.31)		*(1.23)*	*(1.13)*	*(1.21)*	*(1.17)*	*(1.19)*
Retained Securitization Ownership			-0.48	-0.87				
			(0.56)	*(0.74)*				
Capital/RWA					-30.3***			
					(9.90)			
Capital/RWA Corrected						-33.2**		
						(13.4)		
Tier1/Total Assets							-31.5***	
							(9.61)	
Tier1/Total Assets Corrected								-42.3**
								(16.8)
Log of Total Assets					-1.16	-0.82	-1.40*	-1.22
					(0.83)	*(0.77)*	*(0.84)*	*(0.87)*
Composition of securitized portfolio	yes	yes	yes	yes	yes	yes	yes	yes
Composition of retained portfolio	yes	yes	yes	yes	yes	yes	yes	yes
Quarter dummies	yes	yes	yes	yes	yes	yes	yes	yes
Bank fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1013	1013	1013	1013	1013	1013	1013	1013
Number of bank clusters	100	100	100	100	100	100	100	100
R-squared	0.538	0.546	0.538	0.547	0.569	0.568	0.561	0.563

Notes: Robust standard errors adjusted for clustering on bank-level in parentheses. The table shows fixed-effects within estimates. Controls for the composition of the securitized and the retained portfolios, quarter dummies and a constant are suppressed. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

and control additionally for the size of banks. In all four cases the reported coefficients have the expected sign and are significant at the 5% level, suggesting that reputational concerns are indeed present. The more capital the originating banks have, the lower are the delinquencies of assets securitized by them. The effect of capital is quantitatively meaningful: increasing the ratio of capital to risk-weighted assets by 1 percentage point reduces ceteris paribus the delinquencies on securitized assets by approximately 0.3 percentage points. This makes up one-fifth of the observed discrepancy in delinquencies between securitized and retained loans. The effect of the other three capital ratios is even slightly higher. In a sense our results suggest that a sufficient level of capital rather than the originator's retained exposure is an effective tool for assuring careful bank lending. This result stresses the importance of the equity capital for incentives.

As a sensitivity analysis we also perform a random-effects estimation and report the results in Appendix C, Table 4.16. This estimator is more efficient than the fixed-effects estimator, but it is consistent only under the assumption that c_i is not correlated with the covariates. Throughout all the specifications the estimated coefficients of interest differ from those shown in Table 4.7. Therefore, we perform a Hausman's specification test, which allows the use of cluster-robust standard errors.[66] It indicates that fixed effects should be used since the null hypothesis that the random effects estimator is consistent is rejected.

[66]The standard Hausman test assumes that the random-effects estimator is fully efficient. In the case that c_i and u_{it} are not i.i.d. this test is not valid. In our case this is indicated by the fact that after random-effects estimation the default standard errors differ considerably from the cluster-robust ones. Cameron and Trivedi (2009), pp. 261-262, and Wooldridge (2002), pp. 290-291, describe how one can conduct this test using a cluster-robust variance-covariance matrix.

4.8 Conclusion

Financial institutions in the USA have increasingly used securitization techniques since the beginning of the nineties. Prior to the financial crisis, the general wisdom on securitization was that it is an efficient tool that allows a better allocation of risks and enhances the resilience of the financial system. The onset of the current crisis has proved this view wrong and revealed some serious misalignments in securitization markets.

Using panel data on big US commercial banks we find robust evidence of banks using securitization techniques to relax regulatory capital constraints. In order to identify this effect empirically we solve the issue of reverse causality by using a corrected capital ratio measure. We further put emphasis on the different behavior of the extensive and intensive margins of securitization. While capital arbitrage drives both margins, lowering the debt financing costs via securitization seems to be only important for the scale of securitization activities.

Subsequently we focus on the incentives for prudent screening and monitoring of securitized loans by originating banks. Controlling for the heterogeneity of originators, loan portfolios, and other characteristics, we find evidence of significantly poorer performance of securitized loans compared with on-balance-sheet loans. Moreover, tools for overcoming incentive problems, like the retention of some of the risk in the securitized portfolio, seem to be ineffective. Finally, our empirical results support minimum capital adequacy regulation as a way to discipline originators to evaluate risk stringently. However, our research also suggests that loopholes in the current regulatory framework may have seduced banks to securitize assets only for the sake of avoiding holding regulatory capital. Such behavior can undermine the safety and soundness of the financial system.

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C Appendix to Chapter 4

Table 4.8: Pairwise correlations of capital ratios

	Capital/RWA	**Capital/RWA Corrected**	**Tier1/Total Assets**	**Tier1/Total Assets Corrected**
Capital/RWA	1.00			
Capital/RWA Corrected	0.97	1.00		
Tier1/Total Assets	0.81	0.74	1.00	
Tier1/Total Assets Corrected	0.80	0.82	0.93	1.00

Table 4.9: Pairwise correlations

	Total Delinquencies of Retained Loans	**90 Days Past Due Retained Loans**	**First-Loss Piece**	**Retained Securitization Ownership**
Total Delinquencies of Retained Loans	1.00			
90 Days Past Due Retained Loans	0.85	1.00		
First-Loss Piece	0.05	0.01	1.00	
Retained Securitization Ownership	0.01	0.23	0.01	1.00

Table 4.10: Descriptive statistics

Variable	Obs	Mean	Std Dev.	Min	Max
Sample All banks					
Securitization Dummy	10553	0.06	0.23	0	1
Capital/RWA	10553	0.140	0.088	0	0.79
Capital/RWA Corrected	10549	0.138	0.087	0	0.79
Tier1/Total Assets	10553	0.095	0.061	0	0.52
Tier1/Total Assets Corrected	10549	0.092	0.055	0	0.49
Log of Total Assets	10557	14.58	1.49	8.35	21.07
Yield Loans and Leases	9978	0.07	0.02	0.04	0.22
Financing Costs	10053	0.02	0.01	0.005	0.05
Credit Risk (Loss Allowances)	10475	0.01	0.01	0	0.26
Investment Banking	10053	0.01	0.01	0	0.44
Tax Rate (in %)	10051	32.39	11.31	-5.16	60.83
Credit Card Bank	10740	0.04	0.20	0	1
Fed Funds Rate	10740	3.33	1.61	1	5.25
Baa Risk Premium	10740	2.07	0.47	1.56	3.38
Sample Securitizers (once during sample period)					
Securitized to Total Assets (gross)	1487	0.38	0.88	0	5.70
Securitized to Total Assets	1487	0.36	0.84	0	5.37
Total Delinquencies of Securitized Loans (in %)	1344	3.67	4.57	-0.01	45.59
Total Delinquencies of Retained Loans (in %)	1294	0.67	2.93	-17.44	20.89
90 Days and less Past Due Retained Loans (in %)	1340	1.59	1.57	0	27.86
First Loss Piece (share of outstanding amount)	1340	0.08	0.18	0	1
Retained Securitization Ownership (share of outstanding amount)	1340	0.05	0.14	0	1
Capital/RWA	2265	0.134	0.058	0	0.79
Capital/RWA Corrected	2261	0.124	0.048	0	0.79
Tier 1/Total Assets	2265	0.096	0.065	0	0.52
Tier1/Total Assets Corrected	2261	0.086	0.042	0	0.49
Sample Securitizers (new issuance only)					
Capital/RWA	610	0.142	0.064	0	0.68
Capital/RWA Corrected	610	0.116	0.044	0	0.49
Tier1/Total Assets	610	0.108	0.082	0	0.52
Tier1/Total Assets Corrected	610	0.082	0.039	0	0.43

Table 4.11: Pairwise correlations of explanatory variables

	Log of Total Assets	Yield Loans and Leases	Financing Costs	Credit Risk	Investment Banking	Tax Rate	Fed Funds Rate	Baa Risk Premium
Log of Total Assets	1							
Yield Loans and Leases	-0.20	1						
Financing Costs	0.04	0.45	1					
Credit Risk	-0.11	0.52	0.07	1				
Investment Banking	0.29	-0.15	-0.16	-0.05	1			
Tax Rate	0.10	-0.03	-0.06	0.05	0.04	1		
Fed Funds Rate	0.10	0.24	0.61	-0.09	-0.04	-0.01	1	
Baa Risk Premium	0.03	-0.06	-0.04	0.06	0.03	-0.02	-0.56	1

Table 4.12: The extensive margin of securitization: using Capital/RWA

Dependent Variable:	**Securitization Dummy**						
Estimation:	**Pooled Probit**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Capital/RWA	0.11	0.37	0.26	0.10	0.18	0.22	0.24
	(0.74)	*(0.79)*	*(0.78)*	*(0.79)*	*(0.77)*	*(0.73)*	*(0.83)*
Log of Total Assets	0.41***	0.42***	0.40***	0.41***	0.39***	0.41***	0.41***
	(0.043)	*(0.043)*	*(0.043)*	*(0.043)*	*(0.044)*	*(0.043)*	*(0.043)*
Credit Card Bank	1.72***	1.28***	1.61***	1.47***	1.68***	1.67***	1.28***
	(0.26)	*(0.24)*	*(0.32)*	*(0.43)*	*(0.27)*	*(0.27)*	*(0.37)*
Yield Loans and Leases		4.98**					3.68
		(2.39)					*(3.89)*
Financing Costs			3.32				1.19
			(10.2)				*(11.3)*
Credit Risk (Loss Allowances)				6.66			4.36
				(8.18)			*(9.81)*
Investment Banking					4.70		4.65
					(3.45)		*(3.48)*
Tax Rate						-0.0089	-0.0092
						(0.0060)	*(0.0061)*
Fed Funds Rate							-0.13
							(0.12)
Baa Risk Premium							-1.20
							(0.85)
Quarter dummies	yes	yes	yes	yes	yes	yes	yes
Observations	8445	7875	7941	8372	7941	7939	7873
Number of bank clusters	506	503	506	503	506	506	503
Wald statistic	213	214	226	229	203	206	272
Pseudo R-squared	0.34	0.34	0.34	0.35	0.34	0.34	0.35

Notes: Robust standard errors adjusted for clustering on the bank level in parentheses. Constant and quarter dummies are suppressed. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 4.13: The extensive margin of securitization: using Tier1/Total Assets

Dependent Variable:	**Securitization Dummy**						
Estimation:	**Pooled Probit**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tier1/Total Assets	2.31**	2.42**	2.44**	2.41**	2.38**	2.37**	2.38**
	(0.99)	*(1.04)*	*(1.04)*	*(1.00)*	*(1.03)*	*(1.02)*	*(1.10)*
Log of Total Assets	0.43***	0.44***	0.43***	0.44***	0.41***	0.43***	0.43***
	(0.041)	*(0.042)*	*(0.042)*	*(0.042)*	*(0.043)*	*(0.042)*	*(0.043)*
Credit Card Bank	1.47***	1.09***	1.34***	1.22***	1.42***	1.42***	1.07***
	(0.27)	*(0.26)*	*(0.31)*	*(0.41)*	*(0.28)*	*(0.28)*	*(0.38)*
Yield Loans and Leases		4.28*					2.72
		(2.34)					*(3.72)*
Financing Costs			4.95				3.25
			(8.64)				*(10.0)*
Credit Risk (Loss Allowances)				6.25			4.64
				(7.66)			*(9.24)*
Investment Banking					4.48		4.51
					(3.54)		*(3.61)*
Tax Rate						-0.0088	-0.0088
						(0.0062)	*(0.0062)*
Fed Funds Rate							-0.13
							(0.12)
Baa Risk Premium							-1.19
							(0.86)
Quarter dummies	yes	yes	yes	yes	yes	yes	yes
Observations	8445	7875	7941	8372	7941	7939	7873
Number of bank clusters	506	503	506	503	506	506	503
Wald statistic	250	260	246	268	242	244	316
Pseudo R-squared	0.35	0.35	0.34	0.35	0.35	0.35	0.35

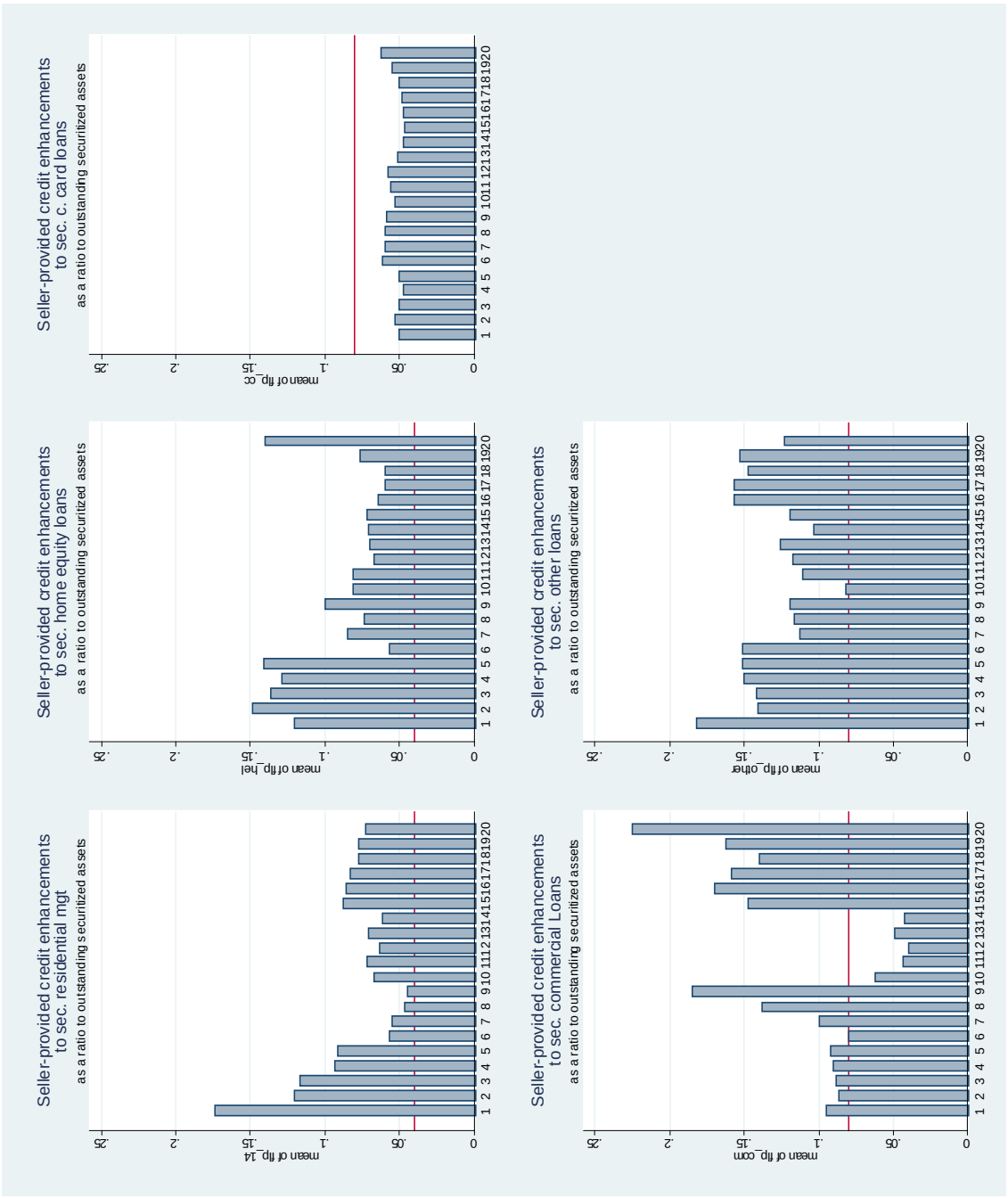
Notes: Robust standard errors adjusted for clustering on the bank level in parentheses. Constant and quarter dummies are suppressed. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 4.14: The intensive margin of securitization: random- vs. fixed-effects estimates

Dependent Variable:	**Securitized to Total Managed Assets (gross)**			
Capital Ratio:	**Capital/RWA Corrected**		**Tier1/Total Assets Corrected**	
Estimation:	**RE**	**FE**	**RE**	**FE**
	(1)	(2)	(3)	(4)
L1.(Securitized to Total Managed Assets)	0.96***	0.71***	0.96***	0.73***
	(0.029)	*(0.088)*	*(0.026)*	*(0.082)*
Capital Ratio	-0.17	-0.80	-0.13	-0.99
	(0.15)	*(0.52)*	*(0.16)*	*(0.66)*
Log of Total Assets	-0.0014	-0.073**	-0.0014	-0.081**
	(0.0013)	*(0.032)*	*(0.0014)*	*(0.036)*
Yield Loans and Leases	0.23	0.21	0.25	0.20
	(0.16)	*(0.16)*	*(0.17)*	*(0.16)*
Financing Costs	1.18**	1.61***	1.18**	1.81***
	(0.53)	*(0.55)*	*(0.53)*	*(0.63)*
Credit Risk (Loss Allowances)	0.36	-0.13	0.33	-0.069
	(0.26)	*(0.46)*	*(0.27)*	*(0.42)*
Investment Banking	0.065	0.00068	0.037	0.047
	(0.067)	*(0.038)*	*(0.044)*	*(0.051)*
Tax Rate	-0.00014	-0.000063	-0.00012	-0.000021
	(0.00017)	*(0.00018)*	*(0.00016)*	*(0.00016)*
Fed Funds Rate	-0.019*	-0.014	-0.018*	-0.012
	(0.010)	*(0.0093)*	*(0.0098)*	*(0.0078)*
Baa Risk Premium	-0.066	-0.067	-0.061	-0.056
	(0.055)	*(0.057)*	*(0.054)*	*(0.050)*
Credit Card Bank	0.0054		0.0056	
	(0.019)		*(0.018)*	
Quarter dummies	yes	yes	yes	yes
Bank fixed effects	no	yes	no	yes
Observations	1043	1043	1043	1043
Number of bank clusters	88	88	88	88
R-squared	0.98	0.69	0.98	0.70
Rho		0.97		0.97

Notes: Robust standard errors adjusted for clustering on the bank level in parentheses. The table shows random-effects (RE) and fixed-effects (FE) within estimates. Constant and quarter dummies are suppressed. Rho is the fraction of variance due to the fixed effects. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Figure 4.9: Seller-provided credit enhancements



Notes: Quarters denoted on the horizontal axis. 1 is the third quarter of 2003; 20 is the second quarter of 2008. The horizontal lines mark the 4% or the 8% thresholds.

Table 4.15: Mean comparison of delinquencies by type of loan and time past due

Residential first lien mortgages

	30 days past due		90 days past due		Booked losses		Total delinquencies	
	securitized	retained	securitized	retained	securitized	retained	securitized	retained
mean	.	.	.	.	0.18	0.17	.	.
sd	.	.	.	.	0.85	0.50	.	.
N*	0	0	0	0	709	709	0	0
min	.	.	.	.	-3.12	-0.21	.	.
max	.	.	.	.	12.01	6.39	.	.

Home equity loans

	30 days past due		90 days past due		Booked losses		Total delinquencies	
	securitized	retained	securitized	retained	securitized	retained	securitized	retained
mean	1.67	0.66	0.96	0.16	0.99	0.46	3.61	1.28
sd	2.66	0.67	1.57	0.18	1.87	0.92	5.55	1.53
N*	170	170	170	170	170	170	170	170
min	0.00	0.01	0.00	0.00	-3.43	-0.07	0.00	0.04
max	14.52	3.52	8.40	0.90	6.91	7.15	22.33	9.98

Credit card debt

	30 days past due		90 days past due		Booked losses		Total delinquencies	
	securitized	retained	securitized	retained	securitized	retained	securitized	retained
mean	1.85	1.95	1.49	1.55	4.71	4.21	8.06	7.70
sd	0.90	0.86	0.80	0.86	2.35	2.24	3.72	3.65
N*	304	304	304	304	304	304	304	304
min	0.00	0.00	0.00	0.00	0.00	-3.35	0.00	0.00
max	6.50	4.41	4.15	4.00	10.85	9.81	17.36	17.20

Commercial loans

	30 days past due		90 days past due		Booked losses		Total delinquencies	
	securitized	retained	securitized	retained	securitized	retained	securitized	retained
mean	1.01	0.79	0.88	0.42	1.17	1.14	3.07	2.35
sd	1.65	0.95	2.16	0.76	2.72	2.28	4.57	3.44
N*	153	153	153	153	153	153	153	153
min	0.00	0.00	0.00	0.00	-3.11	-0.41	-3.11	-0.16
max	8.56	8.52	18.36	5.19	9.73	10.35	18.36	15.36

Other loans

	30 days past due		90 days past due		Booked losses		Total delinquencies	
	securitized	retained	securitized	retained	securitized	retained	securitized	retained
mean	1.24	0.55	1.00	0.13	0.80	0.18	3.04	0.86
sd	1.70	0.51	1.50	0.19	2.29	0.31	4.37	0.72
N*	266	266	266	266	266	266	266	266
min	0.00	0.00	0.00	0.00	-1.24	-0.14	0.00	0.00
max	8.47	4.32	9.78	1.32	18.98	2.38	21.66	4.32

Total

	30 days past due		90 days past due		Booked losses		Total delinquencies	
	securitized	retained	securitized	retained	securitized	retained	securitized	retained
mean	1.39	0.96	0.81	0.30	0.51	0.17	2.71	1.42
sd	2.11	0.68	1.83	0.55	1.35	0.58	3.93	1.24
N*	1067	1067	1067	1067	1067	1067	1067	1067
min	0.00	0.00	0.00	0.00	-3.43	-3.29	0.00	0.00
max	19.97	4.89	25.87	10.43	12.01	5.50	39.86	14.31

Notes: N* denotes the number of time*bank observations. Sample statistics are computed for the sample that is not missing for any of the four variables within each type of loan.

Table 4.16: Total delinquencies of securitized loans: RE estimates

Dependent Variable:	**Total Delinquencies of Securitized Loans**							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total Delinquencies of Retained Loans	1.66***	1.65***	1.66***	1.65***	1.59***	1.57***	1.62***	1.61***
	(0.48)	*(0.48)*	*(0.48)*	*(0.48)*	*(0.41)*	*(0.40)*	*(0.44)*	*(0.44)*
First Loss Piece		2.19**		2.31**	2.21**	2.94***	2.08**	2.66**
		(1.08)		*(1.10)*	*(0.97)*	*(1.13)*	*(0.99)*	*(1.05)*
Retained Securitization Ownership			-0.51	-0.82				
			(0.57)	*(0.70)*				
Capital/RWA					-19.9**			
					(9.47)			
Capital/RWA Corrected						-23.7**		
						(10.6)		
Tier1/Total Assets							-18.0***	
							(5.15)	
Tier1/Total Assets Corrected								-24.6***
								(8.93)
Log of Total Assets					0.19	0.16	0.19	0.15
					(0.18)	*(0.18)*	*(0.17)*	*(0.19)*
Composition of securitized portfolio	yes	yes	yes	yes	yes	yes	yes	yes
Composition of retained portfolio	yes	yes	yes	yes	yes	yes	yes	yes
Quarter dummies	yes	yes	yes	yes	yes	yes	yes	yes
Bank fixed effects	no	no	no	no	no	no	no	no
Observations	1013	1013	1013	1013	1013	1013	1013	1013
Number of bank clusters	100	100	100	100	100	100	100	100
R-squared	0.27	0.26	0.26	0.26	0.27	0.28	0.28	0.27

Notes: Robust standard errors adjusted for clustering on the bank level in parentheses. The table shows random-effects GLS estimates. Controls for the composition of the securitized and the retained portfolio, quarter dummies and a constant are suppressed. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Curriculum Vitae

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