ABSTRACT

Title of dissertation: CAPITAL INFLOWS, FINANCIAL DEVELOPMENT AND CREDIT CONSTRAINTS AT THE FIRM LEVEL: THEORY AND EVIDENCE

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This dissertation is composed of two related essays on the effects of periods of large capital inflows on macroeconomic aggregates and financing constraints at the firm level, and the relationship of the differences in these effects among developed and emerging economies with the degree of financial development.

In the first essay I conduct an empirical exploration of this topic. I show that periods of large capital inflow are associated with more volatile macroeconomic outcomes in economies with a low degree of financial development, relative to economies with more developed financial systems. Employing firm level data for 42 countries, I show that firms in economies with a low level of financial development exhibit a relatively larger loosening in the cost of borrowing and a larger appreciation in equity prices. I show that financing constraints are more prevalent in firms located in countries with a low degree of financial development. Moreover, periods of capital inflow booms relax these financing constraints. This decrease is significant regardless of the composition of capital inflows, stronger when coupled with domestic credit booms, larger for firms in the non-tradable sector and larger for firms that depend more heavily on internal funds to finance their investment opportunities.

In the second essay, using a theoretical model, I explain the larger aggregate response around capital inflow booms, as arising from varying degrees of financial development, and their relation to the pervasiveness of credit constraints at the firm level. I propose a heterogeneous agents model in which the share of borrowing-constrained agents depends on the level of financial development. Agents in an economy characterized by a low degree of financial development can use a lower share of their assets, measured at their market value, as collateral to secure debt. I show that a period of large capital inflow causes an increase in the demand for capital for both unconstrained and constrained firms. At the initial valuation of capital, only unconstrained firms can freely adjust their demand for capital. However, the increase in the aggregate demand for capital increases its valuation and thus generates a loosening in financing constraints for ex-ante constrained firms, and an amplified response at the firm level and on macroeconomic aggregates.

Capital Inflows, Financial Development, and Credit Constraints at the Firm Level: Theory and Evidence

by

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DEDICATION

To my loving wife and my parents for holding me through the rough times.

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Chapter 1

Introduction

This dissertation is composed of two related essays on the effects of periods of large capital inflows on macroeconomic aggregates and financing constraints at the firm level, and the relationship of the differences in these effects among developed and emerging economies with the degree of financial development.

In the first essay I conduct an empirical exploration of this topic. I show that periods of large capital inflow are associated with more volatile macroeconomic outcomes in economies with a low degree of financial development, relative to economies with more developed financial systems. Employing firm level data for 42 countries, I find that firms in economies with a low level of financial development exhibit a relatively larger loosening in the cost of borrowing and a larger appreciation in equity prices. I show that financing constraints are more prevalent in firms located in countries with a low degree of financial development. Moreover, capital inflow booms relax these financing constraints. This decrease is significant regardless of the composition of capital inflows, stronger when coupled with domestic credit booms, larger for firms in the non-tradable sector and larger for firms that depend more heavily on internal funds to finance their investment opportu-

nities. The main contribution of the first essay is to use periods of large capital inflows as an exogenous event, not related to idiosyncratic investment opportunities at the firm level, and show that financing constraints decrease during these periods for firms in countries characterized by a low degree of financial development.

In the second essay, using a theoretical model, I explain the larger aggregate response around capital inflow booms, as arising from varying degrees of financial development, and their relation to the pervasiveness of credit constraints at the firm level. I propose a heterogeneous agents model in which the share of borrowing-constrained agents depends on the level of financial development. Agents in an economy characterized by a low degree of financial development, due to more pervasive agency problems, can use a lower share of their assets measured at their market value as collateral to secure debt. I show that a period of large capital inflows causes an increase in the demand for capital for both unconstrained and constrained firms. At the initial valuation of capital, only unconstrained firms can freely adjust their demand for capital. However, the increase in the aggregate demand for capital increases its aggregate valuation and thus generates a loosening in financing constraints for ex-ante constrained firms, and an amplified response at the firm as well as the aggregate level.

The dynamic response to this aggregate shock affects differently economies in which financing constraints are more pervasive. This amplification in the aggregate response is composed of two effects. Given that firms face an upward sloping supply of capital, a shock that induces unconstrained firms to invest causes increases in the aggregate price of capital. This produces a relaxation of the bor-

rowing constraint for constrained firms. The second effect is related to the amplification in the response of ex-ante constrained firms that are able to adjust capital freely as long as the appreciation in the valuation of capital lasts. The main contribution of the second essay is to focus on the allocational consequences of periods of large capital inflow, highlighting a transmission channel that involves the increase in the market value of capital in the relaxation of financing constraints, and the distortion in aggregate outcomes that arises from the interaction of the response from *ex-ante* constrained and unconstrained firms.

These results are important in the current debate on the design of policies that try to mitigate the incidence of financial crisis. The imposition of capital controls, or limiting the increase in the value of capital in this model, would have an allocational effect that has been neglected so far in the literature. Therefore, a heterogeneous agents environment in which the behavior of both constrained and unconstrained firms is taken into account, is key to understand the implications of these type of policies. The increase in the price of capital allows firms that are constrained to increase their capital stock, and loosen the effect of a low level of financial development, at least while the *pecuniary externality* described persists. Taking this into account, policies that would try to address directly the sources of the low level of financial development, and ultimately of the pervasiveness of financially constrained firms would be superior, to limiting financial flows.

Chapter 2

Literature Review

This dissertation is related to three strands of the macroeconomics literature. The first is the study of the cause and consequences of periods of large capital inflows. The second one is the study of the macroeconomic implications of frictions in the financial sector that amplify and propagate shocks over the business cycle. The third component is the literature that studies the relationship between investment and financial constraints at the firm level. These topics have been widely studied separately in the open macroeconomics literature and what is novel in this dissertation is the approach taken to combine them and provide a response to relevant questions raised on the causes, consequences, and policy responses to periods of large capital inflow. This chapter surveys the main contributions in each of these topics and highlights the value added that this dissertation makes to each of them. However a comprehensive survey of each of the strands of the literature is out of the scope of this chapter and the references within each study cited would give a broader view.

2.1 Capital Flow Bonanzas

A large literature has studied the causes and consequences of periods of large capital inflows. The adverse consequences that these periods exert, most notably in emerging economies, has resulted in many authors trying to explain the "capital inflow problem". Theoretically, if countries are financially integrated, capital should flow from rich, capital abundant countries, to poor countries in which capital is relatively more scarce and the marginal productivity of capital is larger. However this prediction of the open economy model only seems to hold during specific periods of time. Often these periods have ended abruptly, characterized by sudden reversals in the flow of capital, and they have been followed by sharp contractions in output, banking and balance of payments crises.

Reinhart and Reinhart (2009) represent the most recent and complete survey of the literature on this topic. They find that loose global financing conditions, commodity prices and low growth in advanced economies help predict the number of capital inflow episodes. They also find that in emerging economies these periods are characterized by increases in domestic demand and asset prices. Also they are often followed by banking and current account crises.

Cardarelli and others (2007) studies the policy responses to periods of large capital inflows. They show that fiscal restraint decreases the probability of these periods ending up with a current account crises and that if these flows are persistent interventions that limit nominal currency appreciations are ineffective. Also, they develop an algorithm to classify years of capital inflow booms similar to the one proposed in chapter 3. They highlight the importance of the quality of financial

markets to predict the aftermath of these periods and the proper policy responses.

Many studies, recently surveyed in Chapter 14 of Vegh (forthcoming), have tried to determine if external or domestic factors are responsible for periods of large capital inflows. Most of these studies find that external factors are more likely to trigger these periods but that differences in domestic factors are responsible for the macroeconomic consequences of them.

Relating the causes and consequences that these periods have at the individual level, one of the main contributions of this paper, is a topic that has not received much attention. However, Mendoza and Terrones (2008) study the effect on macroeconomic, financial, and firm level data of periods of increases in domestic credit to the private sector. They show that these periods are characterized by larger fluctuations of macroeconomic aggregates and firm level variables in emerging economies. For emerging markets domestic credit booms and capital flow bonanzas are often simultaneous.

2.2 Macroeconomic Implications of Financial Imperfections

A second component of the macroeconomics and international economics literature that this paper is related to, is the one that studies the macroeconomic implications of financial imperfections, as the widely studied financial accelerator mechanism of Bernanke, Gertler, and Gilchrist (1999). It is also related to the research agenda surveyed on Arellano and Mendoza (2002), and more recently represented by Mendoza (2010) that aims to quantify the macroeconomic implications of financial frictions of the Kiyotaki and Moore (1997) type. Jeanne and Korinek (2010)

and Bianchi (2009) study the normative implications of magnification of credit cycles by the interaction between collateralizable debt and asset prices (or the real exchange rate).

Aoki, Benigno, and Kiyotaki (2009) study the responses to periods of current account liberalizations for different degrees of development of the financial system. The definition of the degree of financial development is the same as the one used in chapter 4. However, the transmission channel they highlight is related to the failure of a poor financial system to transfer purchasing power efficiently from savers to investing agents due to agency problems. After a financial liberalization the economy receives capital inflows that are amplified by an asset price appreciation that loosens borrowing constraints, but the aftermath differs depending on the degree of financial development.

Guerrieri and Lorenzoni (2011) use a heterogeneous agents model to study the effects of a credit crunch on consumer demand. They model a closed economy in which the interest rate adjusts to equalize borrowing and lending from households. They show that adding nominal rigidities on the lower bound of the interest rate tend to amplify recessions. Even though they do not use financial frictions, theirs is a first approach to study changes in borrowing constraints in a heterogeneous agents environment. Buera and Moll (2012) employ a heterogenous agents closed economy model with financial frictions to study the implications of an exogenous shock to collateral constraint to highlight that allocational features, that can only be highlighted in heterogeneous agents models, are an important transmission channel in the propagation and amplification of financial shocks. However, their main goal is to understand how important are financial shocks in the explanation of

aggregate fluctuations. Shourideh and Zetlin-Jones (2012) use a heterogeneous agents closed economy model with privately and publicly traded firms that face collateral constraints. They find that in their proposed environment disturbances in financial markets explain a large share of macroeconomic fluctuations. Even though these studies share some features of the model in chapter 4, this dissertation proposes a novel transmission channel by which endogenous changes in asset prices relax borrowing constraints for ex-ante constrained economies generating amplification in macroeconomic responses.

2.3 Firm Level Investment and Financial Constraints

Another strand of the literature that is related to this dissertation is the one studying the relationship between investment and financial constraints. Pioneered by Fazzari and others (1988), this literature interprets a positive and significant correlation between firm level investment and the financial net worth of the firm as a rejection of a perfect financial markets model. Notably, Kaplan and Zingales (1997) challenge these results and a large debate, surveyed on Schiantarelli (1996), has ensued on these findings that give a role to financing constraints in determining investment.

Many authors have disregarded the relationship between financial variables and investment at the firm level as evidence of financing constraints. Using a structural model approach, Cooper and Ejarque (2003) show that this positive relationship can be obtained in a model without financing frictions, and explained by firms with market power. Eberly and Abel (2004) and more recently Eberly, Rebelo, and Vincent (2009) obtain a positive and significant relationship between

investment and financial variables without assuming financing frictions and adjustment costs to investment. Their results rely mainly on decreasing returns to scale, or monopoly power.

Bayraktar, Sakellaris, and Vermeulen (2005) use a model that allows for the existence of convex and non-convex adjustment costs, as well as financing frictions in a representative agent model of a closed economy. They calibrate the model using moments from a sample of manufacturing firms from Germany, and find that both real and financial frictions are important to explain investment dynamics. Lorenzoni and Walentin (2007) propose a model in which financial frictions weaken the response of investment to Tobin's q and creates a relationship between investment and cash flow that fits data from U.S. stock market listed firms from 1978 to 1989.

Empirical explorations similar to the one proposed in chapter 3 have been proposed by some authors. Notably, Love (2003) shows that financial development reduces financial constraints at the firm level by showing how liquidity at the firm level, as a proxy for financing conditions, impacts investment, after controlling for investment opportunities. Love and Zicchino (2006), using a Panel VAR identify orthogonal shocks to financial variables in a sample of developing and emerging economies. They find that the relationship between investment and a shock to financial conditions is significantly stronger for firms in countries with less developed financial systems. The work that is more related to the findings in chapter 3 is Harrison, Love, and Mcmillan (2004). In that paper, they find empirically that direct foreign investment decrease firms financial constraints, and that restrictions in capital account transactions have increased them.

I add to this literature by proposing an structural, general equilibrium, het-

erogeneous agents model that highlights a transmission channel describing how financial constraints are relaxed during periods of large capital inflows, and how the effect of this relaxation depends explicitly on the level of financial development. An empirical contribution of this dissertation is to show that financing constraints decrease regardless of the nature of capital inflows given that the larger increase in the aggregate price of capital loosens borrowing constraints and not only direct foreign investment influences outcomes at the firm level.

Chapter 3

An Empirical Exploration of the Effect of Capital Inflow Booms at the Firm Level

Capital inflow booms affect emerging and developed economies differently. For emerging economies, capital flow *bonanzas* are associated with more volatile macroeconomic outcomes, appreciations in exchange rates and asset prices. They usually precede financial and sovereign debt crises. These empirical regularities have been largely documented and policy measures as capital controls and macroprudential regulation have been proposed to counteract the potential harmful consequences of capital inflows. However the microeconomic causes of this amplified responses and the potential effects at the individual level have not been studied widely.

Using data on macroeconomic aggregates, I show that, given common-sized increases in capital inflows, economies characterized by a low degree of financial development, undergo larger increases in aggregate output, private consumption, and investment, when compared to the reaction evidenced in economies with a higher level of financial development. At the microeconomic level, using a cross-country firm-level panel data set, during large capital inflow periods firms in low

financial development economies show larger decreases in the effective cost of debt, and a larger increase in the market price-to-book ratio of equity.

These findings motivate the study of the behavior of financing constraints around periods of large capital inflows. In this chapter, I show that during these periods firms located in countries with low levels of financial development experience a loosening in financial constraints. The approach that I employ to test the effect of financing constraints on firms' behavior has been widely used, as explained in chapter 2. This approach defines the relation between internal funds and the investment rate at the firm level, as a measure of financing constraints. In a perfect capital market environment firms should be able to freely finance investment opportunities, and the level of internal funds, or other financial variables at the firm level, should not be correlated with the investment rate. Using tests suggested by the q-theory of investment, regression analysis shows that for firms in economies with a low degree of financial development, the conditional correlation between investment and the cash flow of the firm, representing internal funds, is larger than for economies with a higher level of financial development. Moreover, periods of large capital inflow decrease this conditional correlation between cash flow and the investment rate. However, given that many caveats apply to this approach, I conduct some robustness tests and find that the benchmark results are robust to different specifications. Also, employing a Panel VAR methodology that does not rely on functional assumptions to derive estimating equations, I conduct an analysis that shows how financing constraints, measured as the response of investment to shocks in financial variables not correlated to changes in fundamentals, decrease during periods of large capital inflow.

In section 3.1, I develop a canonical investment model to derive the relation between investment, financial variables at the firm level, and investment opportunities –proxied by the market-to-book ratio of the firm (average q)– that motivates the empirical strategy. In section 3.2, I describe the dataset used and the methodology employed to determine periods of large capital inflows and the level of financial development. In section 3.3, I describe the empirical approach and show the results, along with the main robustness tests. The last section of this essay concludes and highlights the main findings.

3.1 A Canonical Model of Investment at the Firm Level: The Q-Theory of Investment

A canonical neoclassical model can be used to show how if capital markets are perfect, investment should react solely to investment opportunities, represented by the marginal benefit of an extra unit of capital (marginal q). Moreover, Hayashi (1982) shows that under certain technological conditions and market structure, the market price-to-book ratio of the firm, an observable variable, is related to marginal q, which is not observable. In this section, I use this canonical model to derive the estimation equation used in the empirical results and to show how financing constraints can distort these results.[1]

Assume there is a large number of firms that are price takers in their output and inputs markets. Their objective is to maximize the stream of dividends d_t, discounted by the factor M_t. They choose investment i_t, demand for labor l_t, de-

[1] In chapter 4 I propose and solve a general equilibrium model with endogenous financing constraints. The model described in this chapter serves the purpose of explaining the empirical strategy.

mand for capital k_t, and can borrow or lend freely at an exogenous gross interest rate R up to an exogenous debt limit $-\Phi$. Denote the level of savings (debt if negative) as b_t. Firms operate a constant returns to scale technology that is linearly homogeneous in k and l, and is subject to productivity shocks denoted by z_t. Also, firms incur capital adjustment costs, with the cost per unit of investment given by $\psi\left(\frac{i_t}{k_t}\right)$. This function is increasing and convex in i and it also satisfies the condition that the total cost $i\psi\left(\frac{i}{k}\right)$ is linearly homogeneous in i and k. Capital depreciates at the rate δ.

The firms' problem is given by:

$$\max_{\{l_t,k_{t+1},i_t,b_{t+1}\}} E_0\left\{\sum_{t=0}^{\infty} M_t\left[d_t + b_t R - b_{t+1}\right] \equiv\right\} \tag{3.1}$$

$$\max_{\{l_t,k_{t+1},i_t,b_{t+1}\}} E_0\left\{\sum_{t=0}^{\infty} M_t\left[z_t F\left(k_t,l_t\right) - w_t l_t - i_t\left(1+\psi\left(\frac{i_t}{k_t}\right)\right) + b_t R - b_{t+1}\right]\right\}$$

$$\text{s.t.} \qquad i_t = k_{t+1} - (1-\delta)\,k_t \qquad (\text{multiplier } q_t) \tag{3.2}$$

$$b_{t+1} \geq -\Phi \qquad (\text{multiplier } \mu_t) \tag{3.3}$$

The first order conditions are given by:

F.O.C :

$$b_{t+1}: E_t\left(\frac{M_{t+1}}{M_t}\right) = \frac{1-\mu_t}{R} \tag{3.4}$$

$$l_t: \qquad z_t F_2\left(k_t,l_t\right) - w_t = 0 \tag{3.5}$$

$$i_t: \qquad q_t - \left(1+\psi\left(\frac{i_t}{k_t}\right) + \acute{\imath}_t\psi'\left(\frac{i_t}{k_t}\right)\right) = 0 \tag{3.6}$$

$$k_{t+1}: \qquad -q_t + E_t\left\{\frac{M_{t+1}}{M_t}\left[\begin{array}{c} z_{t+1}F_1\left(k_{t+1},l_{t+1}\right) + \left(\frac{i_{t+1}}{k_{t+1}}\right)^2\psi'\left(\frac{i_{t+1}}{k_{t+1}}\right) \\ +q_{t+1}\left(1-\delta\right)\end{array}\right]\right\} = 0 \tag{3.7}$$

Multiply both sides of Equation 3.7 by k_{t+1}.

$$q_t k_{t+1} = E_t \left\{ \frac{M_{t+1}}{M_t} \left[z_{t+1} F_1 \left(k_{t+1}, l_{t+1} \right) k_{t+1} + \frac{i_{t+1}^2}{k_{t+1}} \psi' \left(\frac{i_{t+1}}{k_{t+1}} \right) + q_{t+1} k_{t+1} \left(1 - \delta \right) \right] \right\}$$

Given that the production function is linearly homogeneous, $F(k_{t+1,}l_{t+1}) = F_1 \left(k_{t+1}, l_{t+1} \right) k_{t+1} + F_2 \left(k_{t+1}, l_{t+1} \right) l_{t+1}$, and using the optimal demand for labor condition (Equation 3.5) the above expression can be expressed as:

$$q_t k_{t+1} = E_t \left\{ \frac{M_{t+1}}{M_t} \left[z_{t+1} F(k_{t+1,}l_{t+1}) - w_{t+1} l_{t+1} - \frac{\left(i_{t+1} \right)^2}{k_{t+1}} \psi' \left(\frac{i_{t+1}}{k_{t+1}} \right) + q_{t+1} k_{t+1} \left(1 - \delta \right) \right] \right\}$$

Using the capital accumulation condition, $k_{t+1} = \frac{k_{t+2}}{(1-\delta)} - \frac{i_{t+1}}{(1-\delta)}$ yields.

$$\begin{aligned} q_t k_{t+1} &= E_t \left\{ \frac{M_{t+1}}{M_t} \left[\begin{array}{c} z_{t+1} F(k_{t+1,}l_{t+1}) - w_{t+1} l_{t+1} - \frac{\left(i_{t+1} \right)^2}{k_{t+1}} \psi' \left(\frac{i_{t+1}}{k_{t+1}} \right) \\ + q_{t+1} \left[\frac{k_{t+2}}{(1-\delta)} - \frac{i_{t+1}}{(1-\delta)} \right] \left(1 - \delta \right) \end{array} \right] \right\} \\ q_t k_{t+1} &= E_t \left\{ \frac{M_{t+1}}{M_t} \left[\begin{array}{c} z_{t+1} F(k_{t+1,}l_{t+1}) - w_{t+1} l_{t+1} - \frac{\left(i_{t+1} \right)^2}{k_{t+1}} \psi' \left(\frac{i_{t+1}}{k_{t+1}} \right) - i_{t+1} q_{t+1} \\ + q_{t+1} k_{t+2} \end{array} \right] \right\} \end{aligned}$$

Using the FOC with respect to investment, $q_{t+1} = 1 + \frac{i_{t+1}}{k_{t+1}} \psi' \left(\frac{i_{t+1}}{k_{t+1}} \right) + \psi \left(\frac{i_{t+1}}{k_{t+1}} \right)$, and replacing it in the above expression:

$$\begin{aligned} q_t k_{t+1} &= E_t \left\{ \frac{M_{t+1}}{M_t} \left[z_{t+1} F(k_{t+1,}l_{t+1}) - w_{t+1} l_{t+1} - i_{t+1} \left[1 + \psi \left(\frac{i_{t+1}}{k_{t+1}} \right) \right] + q_{t+1} k_{t+2} \right] \right\} \\ q_t k_{t+1} &= E_t \left\{ \frac{M_{t+1}}{M_t} \left[d_{t+1} + q_{t+1} k_{t+2} \right] \right\} \\ q_t k_{t+1} &= E_t \left\{ \frac{M_{t+1}}{M_t} \left[d_{t+1} + \frac{M_{t+2}}{M_{t+1}} \left(d_{t+2} + q_{t+2} k_{t+3} \right) \right] \right\} \end{aligned}$$

Iterating forward this equation up to time T and calculating the limit as $T \to \infty$,

$$q_t k_{t+1} = E_t \left\{ \sum_{s=0}^{\infty} \left(\prod_{j=0}^{s} \frac{M_{t+j+1}}{M_{t+j}} \right) d_{t+s+1} + \lim_{T \to \infty} \left(\prod_{j=0}^{T} \frac{M_{t+j+1}}{M_{t+j}} \right) q_T k_{T+1} \right\}$$

The last term is 0 by the transversality (no bubble) condition. Then,

$$q_t k_{t+1} = E_t \left\{ \sum_{s=0}^{\infty} \left(\prod_{j=0}^{s} \frac{M_{t+j+1}}{M_{t+j}} \right) d_{t+s+1} \right\}$$

Suppose that the firm operates in an environment in which the constraint on the level of debt is never binding, i.e. $\mu_t = 0 \forall t$. Then, the above condition yields:

$$q_t k_{t+1} = E_t \left(\sum_{s=0}^{\infty} \frac{d_{t+s+1}}{R^{s+1}} \right) \equiv V_t$$

This implies that the present discounted value (at the exogenous and constant gross interest rate R) of the stream of dividends of the firm, which is by definition the value of the firm V_t, is equal to $q_t k_{t+1}$. Then,

$$q_t = \frac{V_t}{k_{t+1}} \equiv \text{Average } q$$

By Equation 3.7, q_t is also equal to the marginal benefit of an extra unit of capital, marginal q. Then average q can be used as a proxy for investment opportunities, and it is a sufficient statistic for the investment rate at the firm level under the perfect capital markets hypothesis.

To derive the estimating equation, I assume that $\psi\left(\frac{i_t}{k_t}\right) = \frac{\phi}{2}\left(\frac{i_t}{k_t}\right)$, where $\dot{\phi} > 0$. Using Equation 3.6:

$$\begin{aligned} q_t &= 1 + \phi\left(\frac{i_t}{k_t}\right) \\ \frac{i_t}{k_t} &= -\frac{1}{\phi} + \frac{1}{\phi} q_t \end{aligned} \tag{3.8}$$

This result shows how average q, used as a proxy for investment opportunities, solely determines the investment to fixed capital rate at the firm level under the perfect capital markets hypothesis. However, for a firm that is financially con-

strained, the discount factor applied to the stream of dividends will be modified as well as the relation between investment and average q. For example, for a firm in which the borrowing constraint, $b_{t+1} = -\Phi$ which implies $\mu_t > 0$, and the level of desired investment has to be financed from internal funds.

This is the reason for including a proxy of internal funds of the firm in the specification given in the modification of Equation 3.8 in the empirical strategy. How tight the constraint is for an individual firm is directly related to the degree of financial development at the country level. Moreover, the main hypothesis to be tested using this specification is related to the change of this relationship (as a indicating the presence of financing constraints) during periods of capital inflow booms.

3.2 Data and Definitions

I use annual data from 42 economies for the period 1990 to 2009. The source of macroeconomic data is the International Financial Statistics (*IFS*) published by the International Monetary Fund (*IMF*). I collect data on gross domestic product, private aggregate consumption, gross fixed capital formation, the GDP deflator, the financial account (and its components) for each country. To conduct robustness checks to the benchmark empirical results, I also use domestic credit to the private sector from IFS.

In order to classify countries among low and high financial development groups, I use the dataset on debt enforcement collected by Djankov and others (2008). They document differences in procedures, as well as recovery and efficiency rates in the disposition of assets, in the bankruptcy case of a hypothetical firm for 88 coun-

tries[2]. In this paper I use the efficiency and recovery rate, the estimated cost of the insolvency proceeding, and an index of creditor rights for each of the countries in the sample. Details on each of these variables, as well as macroeconomic aggregates, can be found in Table 3.1. I classify a country as one with high financial development if it ranks in at least three of the mentioned measures above (below for the cost) than the all sample median[3]. Country values for each of these variables are shown in Table 3.2 and Table 3.3.

Table 3.1: Aggregate Variables Definition

Variable	Description and Source
Macroeconomic Aggregates	
Financial Account (Net) in US$	Records credit and debit transactions in financial assets with non-residents. IFS
Financial Account (Gross) in US$	Records sales of financial assets with non-residents of the reporting economy. IFS
Portfolio Financial Flows in US$	Gross financial account excluding foreign direct investment. IFS
Output in US$	Gross domestic product. IFS
Consumption	Aggregate consumption from the private sector. IFS
Investment	Gross fixed capital formation. IFS
Output in local currency	Gross domestic product. IFS
All aggregate data in local currency expressed in real terms using the GDP Deflator from IFS.	
Financial Development (Source: Djankov, Hart, McLiesh and Shleifer (2008))	
Creditor rights	An index aggregating creditor rights, following La Porta et al. (1998).
Cost	The estimated cost of the insolvency proceeding, as a % of the value of the insolvency estate..
Efficiency rate	Present value of the terminal value of the firm after bankruptcy costs.
Recovery rate	Present value of the terminal value for claimant bank.

The literature has often relied on macroeconomic aggregates as private credit to GDP ratio, stock market capitalization, private bond market capitalization, and deposits in the financial system, to denote the level of financial development, as is described in Beck, Demirguc-Kunt, and Levine (2009). However, even after taking historical averages of these macroeconomic variables, all of them are potentially

[2]India and Pakistan are not included in this dataset but I decided to label them as countries with low financial development.

[3]Results are robust to an specification in which countries are separated as Developed and Emerging by their income per-capita.

correlated with periods of large capital inflow and thus would not be an ideal instrument to identify countries with high and low financial development. Using the measures proposed by Djankov and others (2008) that are structural, persistent, related to the actual financing constraints that firms face, and more importantly not related to periods of large capital inflow permits to classify countries in a more transparent way.

The measures of financial development used in this paper are related to the most common measure of financial development used in the literature that is the ratio of credit to the private sector to GDP. In Figure 3.1 the efficiency rate calculated for each country by Djankov and others (2008) is related to the average between 1990 and 2009 of private credit to GDP. There is clearly a positive relationship between these two variables. In Figure 3.2 the relationship between the recovery rate and private credit suggests also a positive relationship between these variables. In Figure 3.3, the cost of the bankruptcy procedure is negatively related to private credit, and Figure 3.4 shows the positive relationship between the index of creditor rights and private credit.

The source of firm level data is Worldscope for the period 1990 to 2009 for the same group of countries. Worldscope collects balance sheet and earnings statement data for publicly traded firms. Its scope ranges from full coverage in some developed economies, to all firms for which there has been investors interests in some emerging economies. I show firm level variables constructed from Worldscope and their definitions in Table 3.6[4]. In the empirical results, I use data for non-financial firms. The list of countries, median number of firms used by year,

[4]The data cleaning procedure is summarized in Appendix A

Figure 3.1: Financial Development (Efficiency Rate and Private Credit)

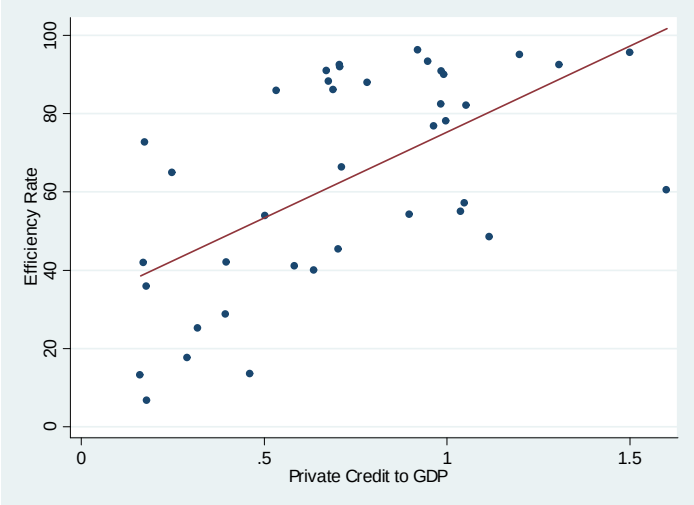


Figure 3.2: Financial Development (Recovery Rate and Private Credit)

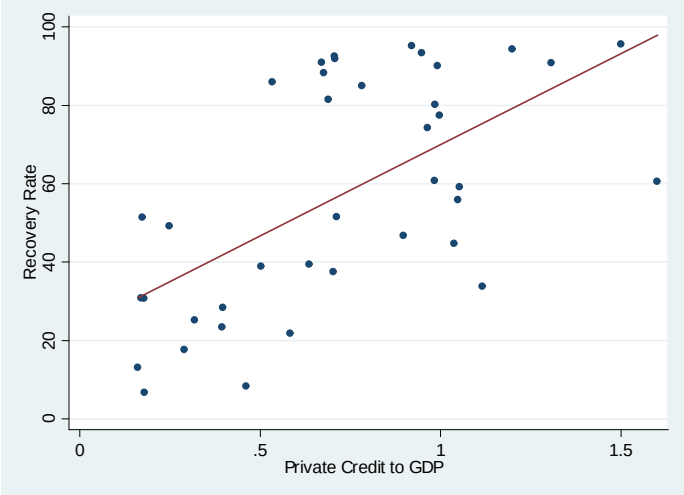


Figure 3.3: Financial Development (Cost of Bankruptcy Procedure and Private Credit)

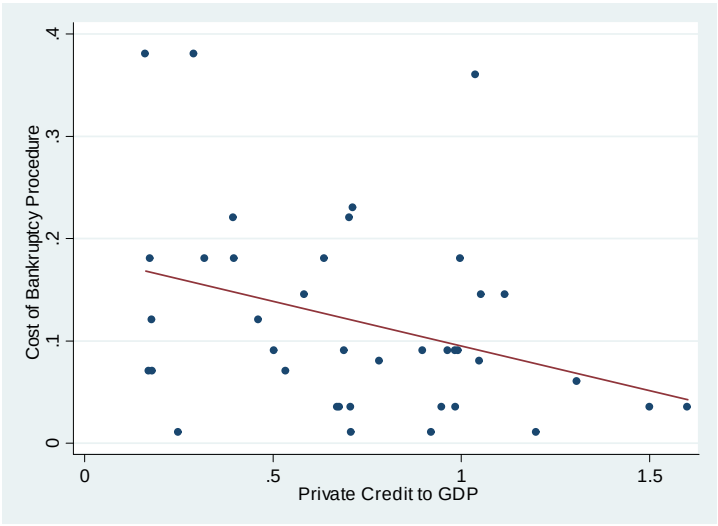
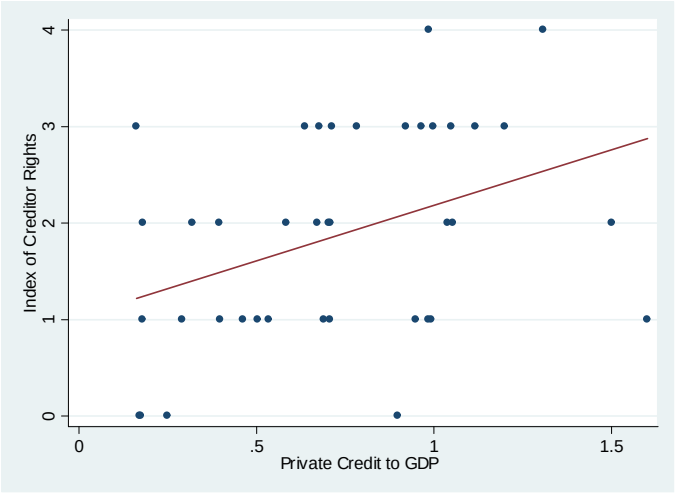


Figure 3.4: Financial Development (Creditor Rights and Private Credit)



and the total number of firm-year observations are shown for high and low degree of financial development countries in Table 3.2 and Table 3.3. In Table 3.4 and Table 3.5, I show the median values of the financial account to GDP ratio, the investment and cash flow to capital ratios, and average Q for all firms in each country for high and low financial development respectively.

Table 3.2: High Financial Development: Firm and Debt Enforcement Data

Data by Country	Median Firm-Year	Total Firm-Year	Efficiency	Recovery	Creditor Rights	Cost
Australia	215	5818	87.80	84.90	3.00	0.08
Austria	38	723	78.00	77.30	3.00	0.18
Belgium	38	731	90.80	90.80	2.00	0.04
Canada	303	7329	93.20	93.20	1.00	0.04
Denmark	61	1123	76.70	74.10	3.00	0.09
Finland	40	744	92.40	92.40	1.00	0.04
France	251	4911	54.10	46.60	0.00	0.09
Germany	236	4967	57.00	55.70	3.00	0.08
Hong Kong, China	251	5469	88.30	86.30	4.00	0.09
Ireland	28	545	89.90	89.90	1.00	0.09
Israel	45	1352	66.20	51.40	3.00	0.23
Japan	1200	21712	95.50	95.50	2.00	0.04
Korea, Rep.	162	5319	88.10	88.10	3.00	0.04
Netherlands	72	1379	94.90	94.20	3.00	0.01
New Zealand	42	798	90.70	80.10	4.00	0.04
Norway	65	1295	91.80	91.80	2.00	0.01
Portugal	4	54	82.30	60.60	1.00	0.09
Singapore	141	3648	96.10	95.10	3.00	0.01
Spain	60	1068	82.00	59.00	2.00	0.14
Sweden	80	1940	86.00	81.30	1.00	0.09
Switzerland	92	1696	60.40	60.40	1.00	0.04
United Kingdom	636	11928	92.30	90.70	4.00	0.06
United States	1490	25662	85.80	85.80	1.00	0.07
Total	79	110211	88.10	85.80	2.00	0.07

Source: Worldscope and Djankov et.al (2008)

Capital inflow booms are defined similarly to Reinhart and Reinhart (2009) as years when the financial account to gross domestic product, that measures the size of capital inflow, is larger than the 80th percentile value for the country specific distribution between 1985 and 2009. To be sure that the algorithm picks up relevant periods of large capital inflows the definition also requires the Financial Account

Table 3.3: Low Financial Development: Firm and Debt Enforcement Data

Data by Country	Median Firm-Year	Total Firm-Year	Efficiency	Recovery	Creditor Rights	Cost
Argentina	25	501	35.80	30.60	1.00	0.12
Brazil	99	1755	13.40	8.20	1.00	0.12
Chile	65	1207	40.90	21.70	2.00	0.14
Colombia	11	214	64.80	49.10	0.00	0.01
Egypt, Arab Rep.	17	355	28.60	23.30	2.00	0.22
Greece	32	994	53.80	38.80	1.00	0.09
India	43	463				
Indonesia	183	6444	25.10	25.10	2.00	0.18
Italy	81	1879	45.30	37.40	2.00	0.22
Malaysia	247	5822	48.40	33.70	3.00	0.14
Mexico	51	925	72.60	51.30	0.00	0.18
Morocco	8	130	41.90	28.30	1.00	0.18
Pakistan	44	995				
Peru	25	550	41.80	30.70	0.00	0.07
Philippines	65	1050	17.50	17.50	1.00	0.38
South Africa	101	2088	39.80	39.30	3.00	0.18
Thailand	134	2964	54.90	44.60	2.00	0.36
Turkey	51	1242	6.60	6.60	2.00	0.07
Venezuela, RB	11	170	13.10	13.00	3.00	0.38
Total	54	29748	40.90	30.60	2.00	0.18

Source: Worldscope and Djankov et.al (2008)

Table 3.4: High Financial Development: Macroeconomic Data

Data by Country	FA GDP	Inv to Cap	Cashflow to Cap	Avg Q
Australia	4.51	4.53	24.55	1.60
Austria	-0.06	5.86	27.43	1.43
Belgium	-3.97	1.94	37.09	1.34
Canada	-1.20	5.52	18.35	1.58
Denmark	-1.24	2.98	27.83	1.18
Finland	-2.99	4.77	24.75	1.26
France	-0.50	0.98	38.89	1.59
Germany	-0.56	3.04	32.09	1.96
Hong Kong, China	-5.49	3.06	15.73	0.95
Ireland	-1.00	3.30	30.60	1.84
Israel	-0.77	2.27	21.46	1.43
Japan	-2.79	1.14	17.84	1.15
Korea, Rep.	-1.16	3.32	20.74	0.76
Netherlands	-3.00	3.85	30.41	1.62
New Zealand	3.29	2.72	21.51	1.45
Norway	-6.27	4.41	17.34	1.48
Portugal	3.47	5.22	12.38	0.82
Singapore	-17.33	2.13	18.73	1.16
Spain	3.11	1.66	20.48	1.43
Sweden	-1.35	3.64	26.38	1.75
Switzerland	-9.79	1.51	25.58	1.35
United Kingdom	1.78	4.40	26.84	1.76
United States	2.63	3.40	35.71	1.89
Total	-1.24	3.17	24.78	1.46

Source: Worldscope and IFS

Table 3.5: Low Financial Development: Macroeconomic Data

Data by Country	FA GDP	Inv to Cap	Cashflow to Cap	Avg Q
Argentina	2.39	3.84	20.12	1.06
Brazil	1.41	3.89	23.16	0.83
Chile	1.35	3.49	19.14	1.38
Colombia	1.79	1.38	16.17	0.85
Egypt, Arab Rep.	0.40	5.13	44.20	1.61
Greece	4.76	2.14	22.82	1.79
India	1.02	14.59	24.39	1.30
Indonesia	-0.17	9.44	25.78	1.40
Italy	0.66	1.98	25.48	1.23
Malaysia	-6.74	1.54	17.02	0.95
Mexico	1.82	2.54	18.07	1.30
Morocco	-1.06	7.66	63.86	2.38
Pakistan	2.43	2.08	19.68	1.09
Peru	2.40	0.90	24.24	1.15
Philippines	0.70	0.27	14.20	0.79
South Africa	0.93	8.82	37.64	1.55
Thailand	-2.21	1.68	24.61	1.08
Turkey	1.01	3.85	40.75	1.52
Venezuela, RB	-4.53	-1.05	13.73	0.58
Total	1.25	3.27	23.14	1.23

Source: Worldscope and IFS

Table 3.6: Firm Level Variables

Variable	Worldscope Definition
Capital Expenditure	Funds used to acquire fixed assets other than those associated with acquisitions
Capital	Gross Property, Plant and Equipment less accumulated reserves for depreciation, depletion and amortization
Average Q	Price to book ratio of equity
Debt	Represents all interest bearing and capitalized lease obligations
Interest expense	Amount of interest paid by the company during the year as shown on the cash flow statement
Common equity	Common shareholders' investment
Price	Closing price of the company's stock
Cash flow	Net cash receipts and disbursements resulting from the operations of the company.
Sales	Represent gross sales and other operating revenue less discounts, returns and allowances

to GDP ratio to be larger that 3%[5]. Only the capital inflow boom episodes between 1990 and 2009 are shown in Figure 3.5. This algorithm defines 111 episodes, 45 and 66 for high and low financial development economies respectively. Figure 3.6 confirms the findings by Reinhart and Reinhart (2009); the likelihood of undergoing a capital inflow bonanza increases with lower global financing conditions with a lag. Years when the federal funds rate has dropped significatively in real terms, as a proxy for global financing conditions, are followed by years when there is a surge in capital flows. Moreover, there is a concentration of these periods in the middle of the 1990's decade as well as the years after 2002. The empirical strategy to be explained below, makes use of these empirical regularities to propose capital inflow booms as events that are exogenous to firms in an economy, and that are triggered by global loose financing conditions[6].

3.3 Empirical Strategy and Results

3.3.1 Event Analysis

The first step in the empirical analysis is to compare the behavior exhibited by macroeconomic aggregates and firm level variables in low and high financial development economies around periods of large capital inflows using an event analysis. For macroeconomic aggregates each variable is defined as the log-deviation

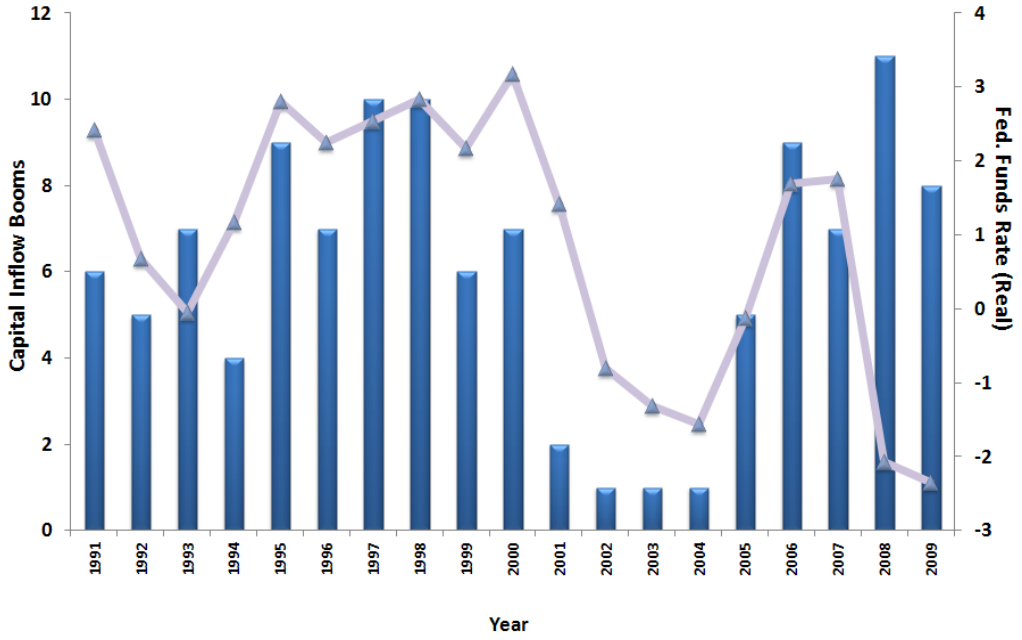
[5]I used different thresholds for the FA/GDP ratio (0%, 4% and 5%) and main results do not change significatively.

[6]The IMF's World Economic Outllook in 2007 (Cardarelli and others (2007)) used a similar definition to study capital inflow episodes for 50 developed and emerging economies between 1987 and 2006. The number of episodes they found was 109 and many of them are also classified by the algorithm in this paper as capital inflow booms and similar empirical regularities in macroeconomic aggregates.

Figure 3.5: Episodes by Country

Country	Capital Inflow Boom Years				
Argentina	1993	1994	1997	1998	1999
Australia	2004	2005	2007		
Austria	1995	1998	1999		
Brazil	1997	1998	1999	2000	2001
Canada	1993	2009			
Chile	1993	1998			
Colombia	1995	1996	1997	1998	
Egypt, Arab Rep.	1998	1999	2008		
Finland	1991	1992	2008		
Greece	2006	2007	2008	2009	
India	2009				
Indonesia	1991	1995	1997		
Ireland	2000	2007	2008		
Israel	1995	1996	1999	2000	
Italy	1991	1992			
Korea, Rep.	1996	1997			
Malaysia	1991	1994	1995	1996	1997
Mexico	1991	1992	1993	1994	1998
Morocco	2008	2009			
New Zealand	1997	2005	2006		
Norway	1998				
Pakistan	1995	1996	2006	2007	2008
Peru	1995	1997			
Philippines	1993	1995	1996	1997	2000
Portugal	2000	2006			
South Africa	1998	2006	2007	2008	2009
Spain	2005	2006	2007	2008	2009
Sweden	1993	2008			
Thailand	1991	1992	1995	1996	
Turkey	2000	2005	2006	2007	2008
United Kingdom	1999	2006	2009		
United States	2000	2002	2003	2005	2006
Venezuela, RB	1992	1993	1998		

Figure 3.6: Capital Inflow Boom Episodes and Global Financing Conditions



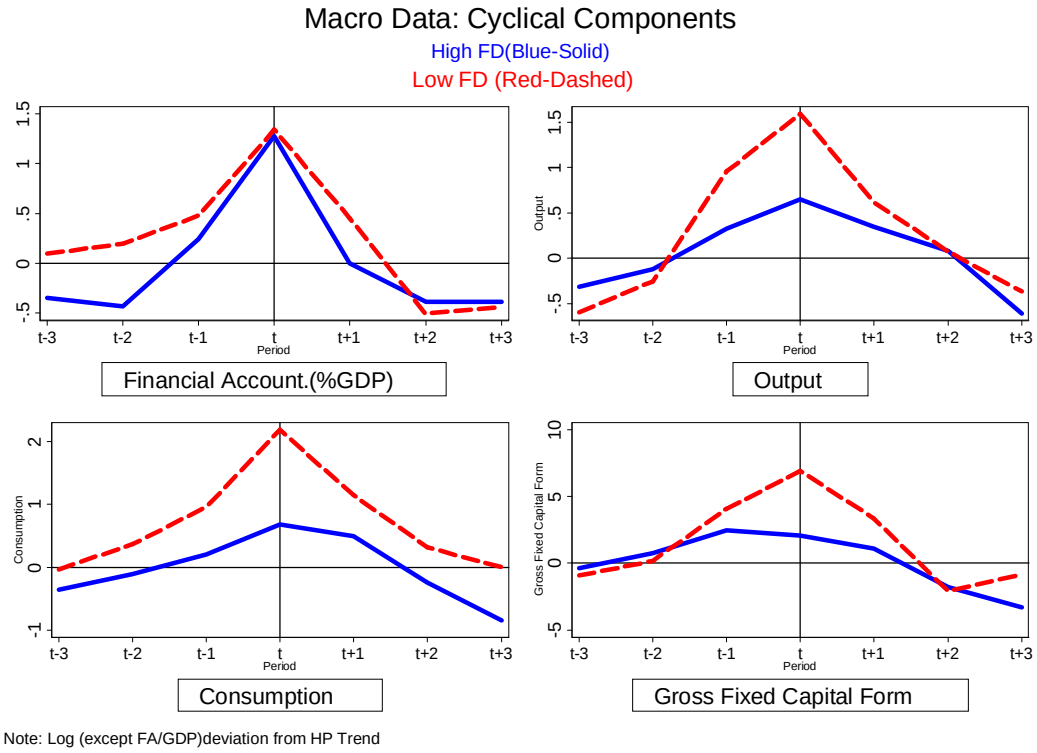
from the Hoddrick-Prescott trend[7]. Then, I construct event windows three years before, during, and three years after the capital inflow boom year. Then, I calculate the median response for each group of countries. The top left panel of Figure 3.7 shows that for high and low financial development economies, the magnitude of capital inflows relative to the size of the economy is similar around boom periods for both groups of countries. However there is a significant difference in the behavior between high and low financial development economies during periods of capital inflow booms for output, private aggregate consumption, and gross aggregate investment.

For firm level data, I define the value for each of the variables in each country as the one exhibited by the median firm per year. To eliminate differences in the behavior coming from country levels and to capture deviations from medium term trend, I define each variable as the difference from the 10 year centered moving average. To calculate the event windows, I compute the median value across countries for each of the groups, similarly than with macroeconomic aggregate data. Results for firm level variables around capital inflow years are consistent with the proposed hypothesis of the relaxation of financial constraints being related to different reactions at the micro and macroeconomic level.

Figure 3.8 shows that the investment to fixed capital rate presents a similar behavior for both groups of countries. However, the effective cost of borrowing, the leverage ratio measured using the fixed capital stock using the market value, and the price-to-book ratio of firms, evidence larger changes around periods of capital

[7]Each of the macroeconomic aggregates is expressed in real terms using the GDP deflator from IFS. For the financial account, the ratio to GDP and not the natural logarithm is used to construct event windows.

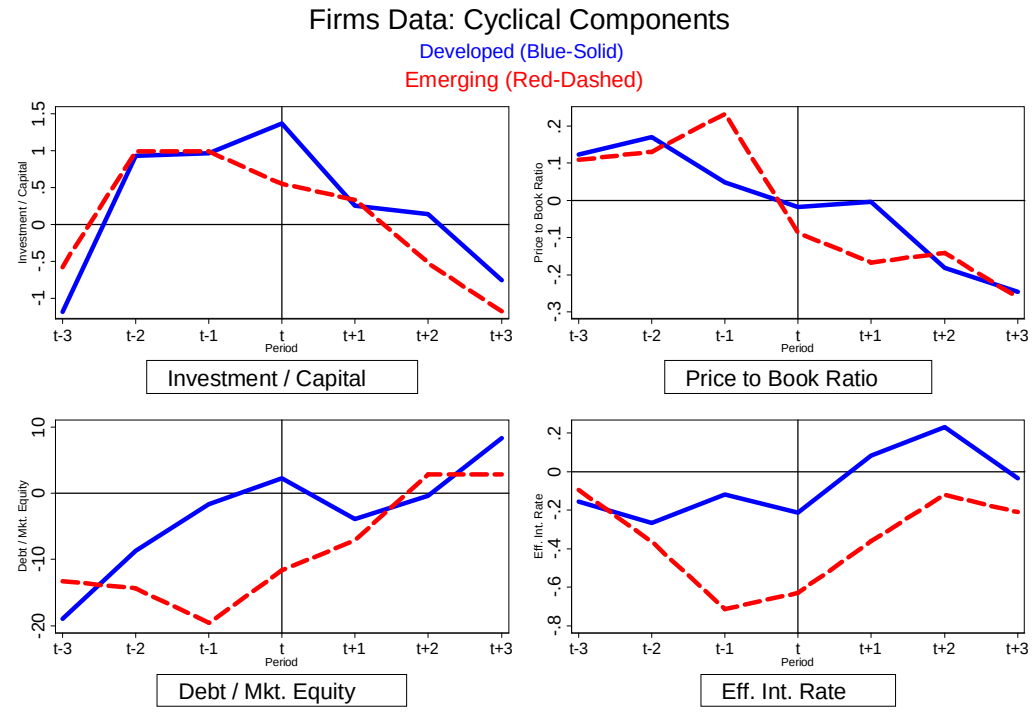
Figure 3.7: Event Analysis: Capital Inflow Booms (1)



Note: Log (except FA/GDP)deviation from HP Trend

inflow boom for economies characterized by a low level of financial development. Table 3.7 and Table 3.8 show the t-stats for each of the variables in the event windows. In general, the estimated coefficients are not statistically significant for the deviation from the trend for firm level variables in countries with a high level of financial development. However, they are significant for firms in economies with a low level of financial development. These findings are consistent with periods of capital inflow boom associated with significant amplified increases in the market value of assets owned by firms, decreasing the leverage ratio, and decreases in the cost of borrowing for firms in low financial development countries.

Figure 3.8: Event Analysis: Capital Inflow Booms (2)



Note: Diff. from 10 year centered MA. In Standard Deviation

Table 3.7: Significance of coefficcient for High FD (t-stat)

	FinAccount	Output	Consumption	Investment	FirmInvest	Price-to-Book	DebtMktequity	EffIntRate
t-3	-1.54	-1.77	-0.97	-0.35	-1.68	0.98	-0.93	-1.58
t-2	-0.80	-1.05	-0.53	-0.26	0.98	1.28	-0.78	-0.48
t-1	1.23	0.42	0.99	2.21	1.01	0.68	0.26	-0.30
t	5.02	1.58	2.19	1.99	2.03	-0.88	0.26	-1.03
t+1	0.43	1.10	1.46	1.26	0.85	-1.65	-0.79	0.26
t+2	-1.59	-0.61	-1.08	-0.76	0.15	-2.06	-0.04	-0.03
t+3	-1.19	-2.62	-4.50	-2.05	-0.64	-2.35	0.59	-0.60

Table 3.8: Significance of the coefficient for Low FD(t-stat)

	FinAccount	Output	Consumption	Investment	FirmInvest	Price-to-Book	DebtMktequity	EffIntRate
t-3	0.41	-2.02	-0.64	-1.33	-0.59	0.49	-2.38	-0.03
t-2	0.56	-0.51	1.30	0.37	1.22	0.95	-2.96	-0.75
t-1	2.87	2.02	2.43	3.29	1.37	1.55	-4.79	-1.98
t	6.99	3.83	7.16	8.45	0.70	-0.75	-3.23	-1.83
t+1	1.21	0.95	1.77	2.59	0.59	-2.90	-1.19	-1.00
t+2	-1.50	0.07	0.47	-1.05	-1.33	-1.54	0.30	-0.43
t+3	-1.12	-1.07	0.00	-0.47	-2.02	-4.41	0.34	-0.96

3.3.2 Reduced Form Results

Q-Investment Regressions

To gain more understanding of firm-level behavior around capital inflow booms I study the reaction of financial constraints during periods of large capital inflows for firms in high and low financial development. I measure financial constraints at the firm level as the response of investment to internal funds, controlling for investment opportunities. A larger conditional correlation between investment and the cash flow (as a proxy for internal funds) of the firm, controlling for the market to book ratio of assets (average Q), as a proxy for investment opportunities, is related to larger financing constraints, as is described in section 3.1. If a period of large capital inflow decreases financing constraints at the firm level, and this period is not related to increases in investment opportunities not captured by average q, the conditional correlation between cash flow and investment should decrease. Moreover, if the level of financial development is related to financing constraints this decrease should be larger for firms in countries with a low degree of financial development.

The identification strategy relates the investment to capital ratio $\left(\frac{i}{k}\right)$ to average q, the cash flow of the firm also scaled by the capital stock ($\frac{Cashflow}{k}$), a country specific dummy variable indicating years of large capital inflows ($KI\ Boom$), a dummy indicating if a country is from a low financial development country $LowFinDev$, and the double and triple interaction term between the last three variables[8]. The estimating equation is described in Equation (3.9).

[8]The $LowFinDev$ clasification, given that it does not variate for a firm in the sample would be included in the firm level fixed effect term.

$$\frac{i_{jt}}{k_{jt}} = \beta_0 + \beta_1 q_{jt} + \beta_2 \left(\frac{Cashflow_{jt}}{k_{jt}}\right) + \beta_3 \left(KI\ Boom_{ct}\right) \tag{3.9}$$
$$+\beta_4 \left(\frac{Cashflow_{jt}}{k_{jt}}\right) \times \left(KI\ Boom_{ct}\right) + \beta_5 \left(\frac{Cashflow_{jt}}{k_{jt}}\right) \times \left(LowFinDev_c\right)$$
$$+\beta_6 \left(LowFinDev_c\right) \times \left(KI\ Boom_{ct}\right) + \beta_7 \left(\frac{Cashflow_{jt}}{k_{jt}}\right) \times \left(LowFinDev_c\right) \times \left(KI\ Boom_{ct}\right)$$
$$+f_j + d_t + \epsilon_{jt}$$

Firm (j) level, and year (t) fixed effects.

ϵ_{jt} is corrected for arbitrary correlation at the country (c)-year (t) level

This proposed specification allows to test for the two main hypothesis: (1) that firms in countries with low financial development are subject to more pervasive financing constraints and, (2) that periods of capital inflow booms decrease these financing constraints more in countries with low financial development. Under the proposed hypothesis, $\beta_2 > 0$, suggests the presence of financing constraints at the firm level, $\beta_5 > 0$ implies that these constraints are more pervasive in countries with a low level of financial development, $\beta_4 < 0$ implies that these constraints decrease during periods of large capital inflows and $\beta_7 < 0$ would imply that this relaxation is larger for firms in countries with low degree of financial development.

I control for constant unobserved heterogeneity among firms by removing time invariant fixed effects at the firm level. To control for the effects of trends on the variables, I include year fixed effects. Finally, standard errors are corrected for an arbitrary correlation structure at the country-year level.

The empirical strategy exploits the fact that for an individual firm, a country wide period of large capital inflows is an exogenous event that should not be re-

lated to firm specific investment opportunities. After controlling for firm and year fixed effects, any change in the reliance of investment on internal funds, can be attributed to a change in financing constraints. There is still a possibility that the capital inflow boom is related to homogeneous changes in investment opportunities not reflected in average q and thus the specification given in Equation 3.9 would not represent changes in financing constraints. I address some of these concerns in the robustness checks.

Results In the first column of Table 3.9 I show the benchmark result of the proposed specification. The coefficient on Average q results positive and significant as is standard in the literature. The positive and significant coefficient on the cash-flow to capital rate and the interaction term confirms the first proposed hypothesis: financing constraints are more pervasive for firms in countries with low financial development. The size of the coefficient in the interaction term between the cash-flow to capital rate and the dummy indicating that a firm operates in a low financial development country is close to 5 times larger than the coefficient on the cash flow rate when this dummy is equal to zero, indicating an economic significatively larger dependence on cash flow to fund investment opportunities in countries with a low level of financial development.

The coefficient on the interaction term between the cash flow to capital rate and the dummy indicating a year when the country was undergoing a capital inflow boom, results negative and significant indicating that capital inflow booms decrease financing constraints. Moreover, the main hypothesis of the specification, that this decrease is more relevant for firms in economies with a low level of financial development is confirmed: the coefficient in the triple interaction term is

negative and significant. This is the main result of this paper and it is confirmed using different robustness tests.

The composition and direction of capital flows may influence the results given that for an economy with an open capital account there may be booms in inflows that are matched by outflows, and using the net flow position would not be informative of the change in the size of inflows. The first robustness test addresses the possibility that for countries with more open financial accounts, the net financial account position may not be a clear indicator of large capital inflows, and of decreases in financing constraints at the firm level. To overcome this possibility, I define periods of large capital inflows using gross capital inflows similarly than with the net financial account. Column (2) Table 3.9 shows that the main results do not change. Capital inflow booms decrease the reliance of investment on cash flow significatively for firms in low financial development countries.

Another possibility is that the decrease in financing constraints is driven only by foreign direct investment (FDI) flows. In Column (3) of Table 3.9 I show that the composition of capital inflows does not matter: if only financial gross inflows are used to determine which years are considered as capital inflow booms, the main results do not change significatively. This result confirms that the transmission channel is not only present when capital inflow booms are related to FDI flows, but also when they are determined by financial flows. The main results explained above still hold for the different definition of capital inflow booms: the interaction term is only significant for firms located in countries classified as having a low level of financial development.

Periods of large capital inflows have also been related to financial liberalization

Table 3.9: Q-Investment Regressions: Benchmark Results and Composition of Capital Inflows

VARIABLES	(1) Net FA	(2) Gross FA	(3) Financial Flows
Average q	0.040***	0.040***	0.040***
	[0.001]	[0.001]	[0.001]
Cashflow	0.008***	0.007***	0.007***
	[0.001]	[0.001]	[0.001]
Cashflow x Low Fin. Dev.	0.042***	0.042***	0.041***
	[0.003]	[0.003]	[0.003]
KI Boom	0.005***	-0.000	0.001
	[0.002]	[0.001]	[0.001]
Cashflow x KI Boom	-0.004***	-0.000	-0.001
	[0.001]	[0.001]	[0.001]
KI Boom x Low Fin. Dev.	0.017***	0.011***	0.013***
	[0.004]	[0.003]	[0.003]
Cashflow x KI Boom x Low Fin. Dev	-0.010**	-0.008**	-0.007*
	[0.004]	[0.004]	[0.004]
Observations	129,948	129,948	129,948
Number of Firms	21,431	21,431	21,431

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

in emerging economies that increase investment opportunities to all firms, and may not be related to increases in firm level fundamentals. To control for these investment opportunities, I do not include as periods of large capital inflows years that were the year before, the year after, or the same year classified as large financial reforms as defined by Abiad, Detragiache, and Tressel (2010). Columns (1) of Table 3.10 shows that the main findings are not affected when these observations are not considered as capital inflow booms[9].

In Column (2) of Table 3.10 I check the possibility that domestic credit booms are responsible for the loosening in credit constraints at the firm level. Even though this hypothesis is closely related to the loosening in financing constraints, if the source of the loosening is domestic, the implication of capital inflow booms relaxing financing constraints could be related to endogenous changes in investment opportunities at the firm level. For example, an increase in domestic credit can be triggered by loose domestic monetary policy or by financial innovations in the domestic credit sector, a result that would not be related to periods of booms in capital inflows. To test this hypothesis I define credit booms as years when domestic credit per capita exceeds by 1.65 standard deviations from the Hoddrick-Prescott country specific trend, a similar definition to the one proposed by Mendoza and Terrones (2008), and replace the dummy variable of capital inflow booms in the specification above with a domestic credit booms dummy. Credit booms are related to larger investment only for firms in low financial development economies, and the triple interaction term is not significant.

Another possibility is that results are not driven by decreases in financing con-

[9]Close to 10% of periods are removed from representing periods of large capital inflows if they are accompanied by large financial reforms.

straints during periods of large capital inflow but that investment opportunities not captured by average q due to specification or measurement error, are responsible for the decrease in financing constraints. To control for this possibility I define output booms, defined similarly than capital inflow booms but using the top 20% in the deviations from the Hoddrick-Prescott trend. Column (3) of Table 3.10 show that the interaction terms are not significant implying that output booms that may be related to increases in investment opportunities are not related to decreases in financing constraints[10].

To check if investment opportunities, measured using average q, change significatively during periods of large capital inflows, and if the decrease in financing constraints is not present when taking this into account, I add to the specification above an interaction term between average q and the capital inflow dummy, an interaction term between average q and the financial development dummy, and the triple interaction term between average q, the capital inflow boom dummy, and the low financial development dummy. Results in Column (1) of Table 3.11 do not change as is described by the coefficient in the triple interaction term between cashflow, capital inflow booms, and the low financial development dummy. More importantly the triple interaction term that includes average q does not result significant.

As another robustness test I use data on the issuance of American Depositary Receipts (ADR)[11] at the firm level, given that firms with access to foreign capital markets do not face the same degree of financing constraints that the ones that

[10]Only 49 out of the 141 capital inflow booms are catalogued as output booms.

[11]American Depository Receipts are shares of foreign companies that can be purchased in the United States, with transactons settled and dividends paid in dollars.

Table 3.10: Financial Reforms, Credit and Output Booms

VARIABLES	(1) No Fin. Reform	(2) Credit Boom	(3) Output Boom
Average q	0.040***	0.040***	0.040***
	[0.001]	[0.001]	[0.001]
Cashflow	0.008***	0.007***	0.007***
	[0.001]	[0.001]	[0.001]
Cashflow x Low Fin. Dev.	0.042***	0.039***	0.039***
	[0.003]	[0.003]	[0.003]
KI Boom	0.006***		
	[0.002]		
Cashflow x KI Boom	-0.004***		
	[0.001]		
KI Boom x Low Fin. Dev.	0.017***		
	[0.004]		
Cashflow x KI Boom x Low Fin. Dev	-0.010**		
	[0.005]		
Cashflow x Credit Boom		0.008***	
		[0.002]	
Credit Boom		-0.017***	
		[0.004]	
Credit Boom x Low Fin. Dev		0.029***	
		[0.007]	
Cashflow x Cred. Boom x Low Fin Dev		0.007	
		[0.008]	
Cashflow x Output Boom			-0.000
			[0.001]
Output Boom			0.014***
			[0.002]
Cashflow x Output Boom X Low Fin. Dev			0.002
			[0.004]
Observations	129,948	129,948	129,948
Number of Firms	21,431	21,431	21,431

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

can not. In columns (2) and (3) of Table 3.11, I show that firms in countries with a low level of financial development and that do not have access to foreign capital markets through the issuance of ADR are the ones whose financing constraints are relaxed during periods of large capital inflows as the negative and significant coefficient in the triple interaction term in column (3) shows.

Table 3.11: Investment Opportunities and Access to Foreign Cap. Market

VARIABLES	(1) Investment Opp.	(2) ADR	(3) No ADR
Average q	0.040***	0.048***	0.039***
	[0.001]	[0.004]	[0.001]
Cashflow	0.008***	-0.008***	0.009***
	[0.001]	[0.003]	[0.001]
Cashflow x Low Fin. Dev.	0.043***	0.035***	0.045***
	[0.003]	[0.007]	[0.003]
KI Boom	0.002	0.021**	0.004**
	[0.003]	[0.009]	[0.002]
Cashflow x KI Boom	-0.004***	-0.011***	-0.003***
	[0.001]	[0.004]	[0.001]
Avg. q x KI Boom	0.006**		
	[0.003]		
Avg. q x Low Fin. Dev	-0.004		
	[0.003]		
KI Boom x Low Fin. Dev.	0.021***	-0.000	0.019***
	[0.005]	[0.012]	[0.005]
Avg. q x KI Boom x Low Fin. Dev	-0.004		
	[0.005]		
Cashflow x KI Boom x Low Fin. Dev	-0.011**	0.013	-0.014***
	[0.005]	[0.010]	[0.005]
Observations	129,948	8,181	121,763
Number of Firms	21,431	797	20,631

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Another way to check the robustness of the results is to use industry characteristics and find if the decrease in financing constraints during periods of large capital inflow is larger in industries in which financing constraints are assumed to be more pervasive. Tornell and Westermann (2003) describe how there exists an asymmetry in financing opportunities across tradeable and non-tradeables sectors, given that the former have access to world capital markets and can use their production as collateral to obtain funds, a possibility that the latter do not enjoy. Rajan and Zingales (1998) propose an industry wide index that has been frequently used to measure the differences in the need of external finance. A priory, industries that have a low dependence on external finance should experience a larger relaxation of financial constraints during periods of large capital inflows. In this paper, I calculate this index that is defined as the amount of desired investment that cannot be financed through internal cash flows generated by the same firm. I follow their approach and aggregate data on firms for the United States for each of the different industries, as defined by Worldscope. The reason to use data from the United States is that it is a good proxy for the demand for external funds in other countries, given the large degree of financial development. I classify an industry as been part of the high need for external finance if it lies above the median for the calculated index. In Table 3.12, I show the industries used and the classification among tradability and dependence on external finance groups.

In Table 3.13, the hypothesis that firms in non-tradable sectors experience a higher decrease in financing constraints is confirmed. The interaction term between cashflow and the capital inflow dummy is only negative and significant for this group of firms in countries with a low level of financial development. The

Table 3.12: Firms' Sectors

Industry	**Tradability**	**RZ-Index**
Aerospace	Tradable	Low-Dependance
Apparel	Tradable	High-Dependance
Automotive	Tradable	Low-Dependance
Beverages	Tradable	Low-Dependance
Chemicals	Tradable	High-Dependance
Construction	Non-Tradable	Low-Dependance
Diversified	Tradable	Low-Dependance
Drugs, Cosmetics And Health Care	Tradable	High-Dependance
Electrical	Tradable	High-Dependance
Electronics	Tradable	High-Dependance
Food	Tradable	High-Dependance
Machinery And Equipment	Tradable	High-Dependance
Metal Producers	Tradable	High-Dependance
Metal Product Manufacturers	Tradable	Low-Dependance
Oil, Gas, Coal And Related Services	Tradable	High-Dependance
Paper	Tradable	Low-Dependance
Printing And Publishing	Non-Tradable	Low-Dependance
Recreation	Non-Tradable	High-Dependance
Retailers	Non-Tradable	Low-Dependance
Textiles	Tradable	High-Dependance
Tobacco	Tradable	Low-Dependance
Transportation	Non-Tradable	Low-Dependance
Utilities	Non-Tradable	Low-Dependance
Miscellaneous	Non-Tradable	High-Dependance

results also show that the decreases in financing constraints are focalized in countries with a low degree of financial development and that produce in industries with a low dependence on external finance. These results confirm the hypothesis that capital inflow booms in low financial development economies are related to decreases in financing constraints.

Table 3.13: Tradability and Access to External Finance

VARIABLES	(1) Tradables	(2) Non-Tradables	(3) High RZ Index	(4) Low RZ Index
Avg. q	0.041***	0.038***	0.042***	0.034***
	[0.002]	[0.002]	[0.001]	[0.002]
Cashflow	0.008***	0.008***	0.007***	0.011***
	[0.001]	[0.001]	[0.001]	[0.001]
Cashflow x Low Fin. Dev.	0.037***	0.050***	0.039***	0.048***
	[0.004]	[0.005]	[0.004]	[0.005]
KI Boom	0.006**	0.004	0.005**	0.005
	[0.003]	[0.003]	[0.002]	[0.004]
Cashf x KI Boom	-0.004***	-0.004**	-0.005***	0.003
	[0.002]	[0.002]	[0.001]	[0.003]
KI Boom x Low Fin. Dev.	0.008	0.029***	0.010*	0.031***
	[0.006]	[0.006]	[0.006]	[0.007]
Cash x KI Boom x Lo FinDev	-0.005	-0.018***	-0.004	-0.025***
	[0.006]	[0.007]	[0.006]	[0.007]
Observations	70,812	59,136	91,129	38,819
Number of Firms	12,016	9,415	15,256	6,175

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

An Instrumental Variable Approach The results provided assume that capital inflow booms are independent of any idiosyncratic (firm level), time varying unobservables at the firm level. The main assumption is that periods of large capital

inflows can be used as a "natural experiment" in which the only firm level source of variation that is not accounted for are the changes in financing conditions. However, this assumption can be challenged given that time varying unobservables can be related to the capital inflow dummy. To correct for this possible endogeneity I conduct an instrumental variable estimation.

The main idea is to relate the capital inflow boom dummy to a variable that is exogenous to the rest of the dependent variables at the firm level for each country. As in Reinhart and Reinhart (2009) and the evidence presented in Figure 3.6, global financing conditions (proxied by the real federal funds rate) affect the number of capital inflow boom episodes. In Table 3.14 I relate the capital inflow boom dummy to the real federal funds rate (and up to three lags) and one lag of the real deviation from long run trend of output[12]. Column (1) shows that the first lag of real output deviation from long run trend increases the probability of a capital inflow episode. However, lags one and two of the real federal funds rate are not significant. Columns (2) and (3) show that an specification with only the first or the second lag of the real interest rate are not significant either. As explained above, the effect of the real interest rate in the probability of undergoing a capital inflow boom is significant with a lag, in this case of three years. I use the specification given in Column (4) of Table 3.14 to estimate the predicted value of the probability of undergoing a capital inflow boom. Figure 3.9 shows the distribution of the predicted values by the linear probability model specified.

To correct for possible endogeneity biasing the results, I replace the KI Boom dummy in the specification in Equation 3.9 with the predicted values from the

[12]The instrumental variables estimation exclude the United States.

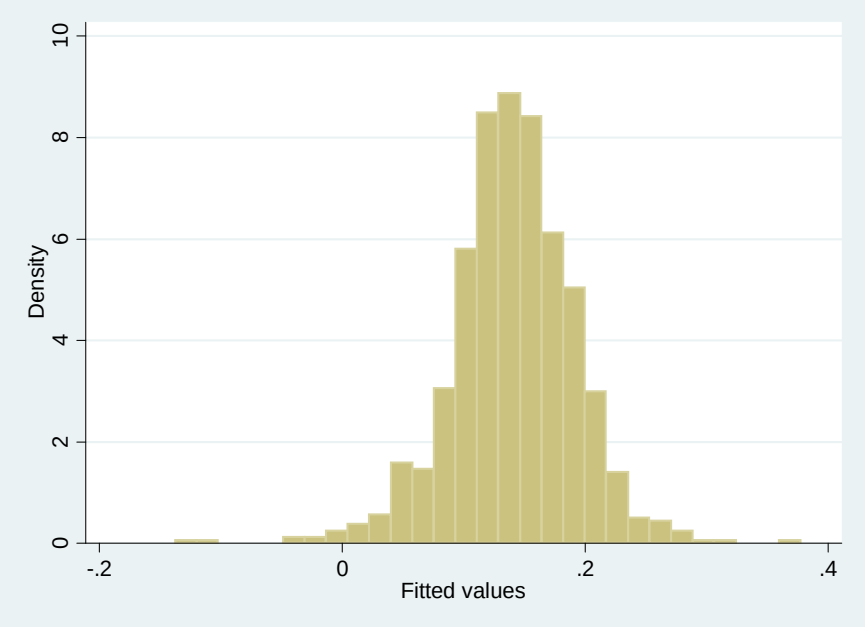
Table 3.14: Instrumental Variables Approach: Auxiliary Regression

VARIABLES	(1) KI Boom	(2) KI Boom	(3) KI Boom	(4) KI Boom
Real Fed. Funds Rate (-1)	0.005	0.003		
	[0.009]	[0.005]		
Real Fed. Funds Rate (-2)	0.012		-0.005	
	[0.015]		[0.006]	
Real Fed. Funds Rate (-3)	-0.023**			-0.012*
	[0.011]			[0.007]
Log-Real GDP Deviation from Trend (-1)	1.898***	1.971***	2.091***	2.104***
	[0.504]	[0.466]	[0.481]	[0.498]
Constant	0.152***	0.131***	0.144***	0.160***
	[0.018]	[0.014]	[0.017]	[0.018]
Observations	861	943	902	861
R^2	0.025	0.016	0.017	0.022

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Figure 3.9: Fitted Values of Linear Probability Model



model. Column (1) of Table 3.15 shows the results of replacing the continuous fitted values for the capital inflow dummy. These findings show that even after correcting for possible endogeneity, the main results still hold: an increase in the probability of the instruments predicting a capital inflow boom decreases financing constraints for firms in low financial development countries.

Table 3.15: Instrumental Variables Approach

VARIABLES	(1) LPM-Predict	(2) Top 15%	(3) Boom Region
Avg. q	0.040***	0.040***	0.040***
	[0.001]	[0.001]	[0.001]
Cashflow	-0.002	0.005***	0.007***
	[0.003]	[0.001]	[0.001]
KI Boom	0.119***	0.005	-0.011***
	[0.026]	[0.004]	[0.002]
Cashflow x Low Fin. Dev.	0.054***	0.044***	0.042***
	[0.007]	[0.003]	[0.003]
Cash x KI Boom	0.045**	0.007***	0.002
	[0.017]	[0.002]	[0.001]
KI Boom x Low Fin. Dev.	0.038	0.022***	0.038***
	[0.031]	[0.006]	[0.005]
Cash x KI Boom x Low Fin. Dev	-0.080*	-0.017***	-0.012**
	[0.043]	[0.005]	[0.005]
Observations	104,808	104,808	129,948
Number of Firms	17,654	17,654	21,431

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

However, the interpretation of this coefficient is not comparable with the findings presented above. To correct for this possibility, using the fitted estimates obtained in the auxiliary regression I define a capital inflow dummy as the observations for which the predicted values are in the top 15% of the predicted values.

I select this cutoff percentile to have a similar percentage of fitted episodes than in the baseline estimations. Column (2) shows that the triple interaction term is still negative and significant. These results confirm that during periods of large capital inflow booms, predicted by lagged global financing conditions and the real growth rate of output, decrease financing constraints for firms in economies with low financial development.

Finally another way to check if results are biased by changes in investment opportunities at the firm level not captured by average q, I restrict capital inflow episodes to periods in which more than 40% of the countries in the region are also undergoing a capital inflow boom, regardless if the country in the specific year was also undergoing a capital inflow boom. Using this definition there are a total of 72 capital inflow boom periods and 46 of them are also categorized with the benchmark classification. This change in the definition permits to isolate changes in investment opportunities from overall changes in financing conditions. In other words it allow to define capital inflow booms as only related to "push" rather than "pull" factors. Column (3) of Table 3.15 shows that the main results do not change when using this alternative specification.

More Robustness Tests If the difference in the degree of financial development is responsible for the larger response in the decrease of financing constraints, redefining the sample to include less countries as classified as low financial development should produce a larger coefficient in the triple interaction term and the findings in the rest of robustness tests should not change. By redefining the high financial development countries as those that have at least one (instead of at least two as was defined above in the baseline results), four countries cross the threshold and

are labeled as high financial development countries. These countries are Greece, Mexico, Thailand, and Turkey.

Table 3.16 shows that the expected findings do not change after redefining the countries between high and low financial development. The coefficient in the triple interaction term is larger (-0.013 vs. -0.010) for the baseline definition of capital inflow booms, using the net financial account to GDP ratio. The coefficients for Column (2) and Column (3) do not change but the significance for the dummy of capital inflow boom for the gross financial account increases.

Table 3.16: Robustness Check: Benchmark Results

VARIABLES	(1) Net FA	(2) Gross FA	(3) Financial Flows
Avg. q	0.040***	0.040***	0.040***
	[0.001]	[0.001]	[0.001]
Cashflow	0.008***	0.007***	0.008***
	[0.001]	[0.001]	[0.001]
Cashflow x Low Fin. Dev.	0.047***	0.046***	0.046***
	[0.003]	[0.003]	[0.003]
KI Boom	0.006***	0.001	0.002
	[0.002]	[0.001]	[0.001]
Cashflow x KI Boom	-0.004***	-0.000	-0.001
	[0.001]	[0.001]	[0.001]
KI Boom x Low Fin. Dev.	0.017***	0.008**	0.011***
	[0.005]	[0.003]	[0.003]
Cashflow x KI Boom x Low Fin. Dev	-0.013***	-0.008**	-0.007*
	[0.005]	[0.004]	[0.004]
Observations	129,948	129,948	129,948
Number of Firms	21,431	21,431	21,431

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

In the Column (1) of Table 3.17, excluding capital inflow booms that were not

accompanied by financial reforms does not change the main results for the new categorization between low and high financial development. In Column (2) the triple interaction term using domestic credit booms to identify changes in financing conditions at the firm level does not result significant. Column (3) shows that output booms do not change financing conditions either, as obtained in the benchmark results.

Table 3.17: Robustness Check: Financial Reforms, Credit and Output Booms

VARIABLES	(1) No Fin. Reform
Avg. q	0.040***
	[0.001]
Cashflow	0.008***
	[0.001]
Cashflow x Low Fin. Dev.	0.042***
	[0.003]
KI Boom	0.006***
	[0.002]
Cashflow x KI Boom	-0.004***
	[0.001]
KI Boom x Low Fin. Dev.	0.017***
	[0.004]
Cashflow x KI Boom x Low Fin. Dev	-0.010**
	[0.005]
Observations	129,948
Number of Firms	21,431

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Column (1) of Table 3.18 shows that controlling for changes in investment opportunities proxied by average q, does not change the coefficient in the triple interaction term, implying that investment opportunities do not change significatively

for low financial development economies during periods of large capital inflows. Column (2) and Column (3) of Table 3.18 show that the triple interaction term is only significant for firms that do not have access to American Depositary Receipts, that are the ones with more financing constraints.

In Table 3.19 I show that the coefficients in the triple interaction increase, as expected, for firms in the non-tradable sector and in industries with a low dependence on external finance. As in the benchmark classification, for tradeables and for firms located in industries with high dependence on external finance the triple interaction term does not result significant.

Even though institutional features that determine the degree of financial development are persistent, economies may evolve to a higher level over time. This change is not represented in the time invariant measure used in this chapter. To account for this possibility I use a measure of financial development proposed by Beck, Demirguc-Kunt, and Levine (2009). Their financial development index combines measures of the importance of credit to the private sector, deposits in the financial sector, stock market capitalization, and the value of stocks traded. To use this measure of financial development, I change the dummy variable that represents if a country is from a low financial development country with this continuous and time varying measure.In Table 3.20 I show the marginal response of investment to a change in the cash flow to capital rate for the 25th and 75th percentiles in the degree of financial development. The first column shows the response for normal years and the second column for years of financial development. Results show that for firms located in countries with a a lower level of financial development, the response to the cash flow to capital is larger in both normal years as well

Table 3.18: Robustness Check: Investment Opportunities and Access to External Finance

VARIABLES	(1) Invest. Opp.	(2) ADR	(3) No ADR
Avg. q	0.041***	0.048***	0.039***
	[0.001]	[0.004]	[0.001]
Cashflow	0.008***	-0.008***	0.009***
	[0.001]	[0.003]	[0.001]
Cashflow x Low Fin. Dev.	0.048***	0.043***	0.049***
	[0.003]	[0.009]	[0.004]
KI Boom	0.004*	0.025***	0.005***
	[0.002]	[0.008]	[0.002]
Cashf x KI Boom	-0.004***	-0.011***	-0.003***
	[0.001]	[0.004]	[0.001]
Avg. q x KI Boom	0.004		
	[0.003]		
Avg. q x Low Fin. Dev	-0.006**		
	[0.003]		
KI Boom x Low Fin. Dev.	0.019***	-0.009	0.020***
	[0.005]	[0.013]	[0.005]
Avg. q x KI Boom x Low Fin. Dev	0.002		
	[0.006]		
Cashf x KI Boom x Low Fin. Dev	-0.014***	0.012	-0.017***
	[0.005]	[0.011]	[0.005]
Observations	129,948	8,181	121,763
Number of Firms	21,431	797	20,631

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 3.19: Robustness Check: Tradability and Access to External Finance

VARIABLES	(1) Tradables	(2) Non-Tradables	(3) High RZ Index	(4) Low RZ Index
Avg. q	0.042***	0.038***	0.042***	0.034***
	[0.002]	[0.002]	[0.001]	[0.002]
Cashflow	0.008***	0.008***	0.007***	0.012***
	[0.001]	[0.001]	[0.001]	[0.001]
Cashflow x Low Fin. Dev.	0.040***	0.058***	0.043***	0.056***
	[0.005]	[0.005]	[0.004]	[0.006]
KI Boom	0.007***	0.005**	0.006**	0.007*
	[0.003]	[0.003]	[0.002]	[0.004]
Cashf x KI Boom	-0.004**	-0.004**	-0.005***	0.002
	[0.002]	[0.002]	[0.001]	[0.003]
KI Boom x Low Fin. Dev.	0.007	0.030***	0.008	0.034***
	[0.007]	[0.007]	[0.006]	[0.007]
Cash x KI Boom x Lo FinDev	-0.007	-0.021***	-0.006	-0.031***
	[0.006]	[0.008]	[0.007]	[0.008]
Observations	70,812	59,136	91,129	38,819
Number of Firms	12,016	9,415	15,256	6,175

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

as during capital inflow booms.The response of investment to the cash flow to capital rate does not result significant during a capital inflow boom for neither of the percentile in the degree of financial development.

Table 3.20: Response of Investment to Cash flow to Capital for different Levels of Financial Development

	No KI Boom	**KI Boom**
25%	.0087677	-.0008532
[t-stat]	10.54***	-0.40
75%	.008996	.0014172
[t-stat]	12.44***	0.86
*** denotes 99% significance		

Panel VAR methodology

Another way to disentangle the effect of financing constraints from changes in fundamentals at the firm level is a methodology that does not rely on a model specific assumption but that relates the response of investment to different determinants using a Structural Panel VAR, as described by Love and Zicchino (2006)[13]. This methodology combines the traditional VAR approach with the control for the unobserved heterogeneity at the firm level that allows to impose the restriction that the structure for each cross-sectional unit is the same. Obtaining orthogonalized responses to shocks in each of the variables in the system, this methodology permits to separate the effects of the marginal profitability of investment from the availability of internal funds that influence investment behavior. To control for

[13]In the Panel VAR calculation, the package by Love and Zicchino (2006) is used. In that paper, the authors also relate the larger response of investment to financial variables at the firm level to the degree of financial development. The value added of the results in this paper is to show that during periods of large capital inflow, this robust relationship virtually dissapears.

unobserved heterogeneity the procedure removes firm specific fixed effects by re-defining each variable as the deviation from the forward mean. Another advantage of this methodology is given by the fact that no strong structural assumptions, other than the order in which variables at the firm level affect each other, is needed. These strong assumptions are needed in other empirical approaches as the q theory of investment. In other words, using this technique all variables in the system are treated as endogenous.

In this paper, I use this methodology to capture the effect of financial variables in investment, and to check if this relationship changes during periods of large capital inflow. I propose the specification given in Equation 3.10 where Y_{it} is composed by average q as a measure of investment fundamentals (tobqdet), the cash flow to capital ratio (cfkdet), as a proxy of internal funds, and the investment to capital rate (invkdet).

$$Y_{it} = \Gamma_0 + \Gamma_1 Y_{it-1} + f_i + d_{ct} + e_t \tag{3.10}$$

i denotes Firm, c denotes country, and t year.

The structural assumption to obtain the orthogonalized responses is that average q only responds to the other variables in the system with a lag; cash flow responds contemporaneously to average q, but to the investment to capital ratio with a lag; and the investment to capital ratio responds contemporaneously to the rest of the variables in the system but does not affect any variable contemporaneously. In other words, the system ordering implies that average q is the most exogenous of the variables in the system, and the investment to capital is the most

endogenous. The specification includes one lag of each of the variables.

To control for firm level heterogeneity, this methodology removes the forward mean for each firm, thus removing fixed effects at the firm level and allowing to use lags of each of the variables as instruments in estimating the system by Generalized Method of Moments. The country-year specific effect d_{ct} is removed by substracting the country-year mean value of each variable for each firm.

Results In Table 3.21 I show the result of the estimation for the model using the complete sample for high and low levels of financial development. I focus on the response of investment to the cash flow to capital rate[14]. In the Figure below, in the top panels I show the response of investment to a one standard deviation innovation in the cash flow to capital rate for firms in high and low financial development economies along with the 5-95% confidence intervals of the point estimates obtained using 1000 Montecarlo simulations from the empirical distribution of the coefficients. These findings confirm that an increase in the cash flow to capital ratio, that is not correlated to an increase in the marginal productivity of investment, increases investment both for firms in economies with high and low levels of financial development. The response for firms in economies with a low level of financial development is larger on impact but it is not significatively different among the groups of countries for lags one to six.

In Table 3.22 I show the estimates of the Panel VAR conditioning the sample to the periods of capital inflow booms. I test the hypothesis that the relationship between an orthogonalized response to cash flow and investment changes dur-

[14]The complete set of results of the Panel VAR can be found in Appendix B. The impulse responses obtained result significant and with the expected sign.

Table 3.21: Estimation Results Panel VAR Model: All Sample

	High FD			Low FD		
	$\mathbf{tobq}_t$	$\mathbf{cfk}_t$	$\mathbf{inv}_t$	$\mathbf{tobq}_t$	$\mathbf{cfk}_t$	$\mathbf{inv}_t$
$\mathbf{tobq}_{t-1}$	.519 (93.9)	.045 (3.69)	.041 (17.52)	.473 (42.75)	.029 (3.34)	.025 (6.71)
$\mathbf{cfk}_{t-1}$	.0097 (2.39)	.262 (7.62)	.015 (5.93)	.088 (5.38)	.497 (8.08)	.038 (4.81)
$\mathbf{inv}_{t-1}$	-.039 (-3.65)	-.051 (-1.81)	.217 (30.29)	-.039 (-1.62)	-.173 (-4.45)	.22 (19.57)
Obs.	66,900			15,851		

Note: t-stats in parenthesis. GMM estimation. Country-time and firm fixed effects are controlled for prior to estimation. .

Table 3.22: Estimation Results Panel VAR Model: KI Boom

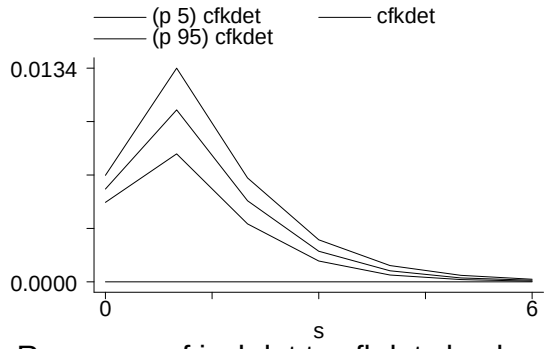
	High FD			Low FD		
	$\mathbf{tobq}_t$	$\mathbf{cfk}_t$	$\mathbf{inv}_t$	$\mathbf{tobq}_t$	$\mathbf{cfk}_t$	$\mathbf{inv}_t$
$\mathbf{tobq}_{t-1}$	.43 (14.95)	.051(0.74)	.061 (4.76)	.53 (9.17)	-.041 (-0.712)	.038 (1.82)
$\mathbf{cfk}_{t-1}$	.003 (0.17)	.206(2.12)	.028 (1.76)	.047 (1.75)	.296 (2.95)	-.025 (-1.85)
$\mathbf{inv}_{t-1}$	-.004(-0.11)	.016(0.15)	.251 (7.37)	-.081(-.83)	.136(1.21)	.406 (8.70)
Obs.	3,014			839		

Note: t-stats in parenthesis. GMM estimation. Country-time and firm fixed effects are controlled for prior to estimation.

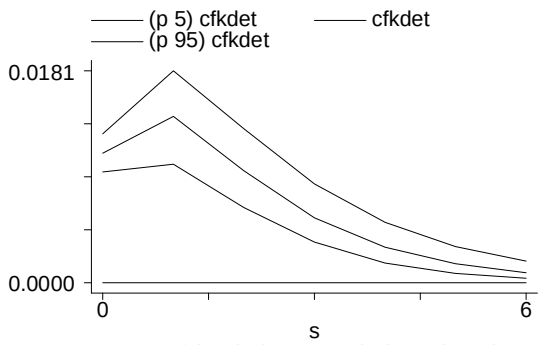
ing periods of large capital inflow. In the bottom panels of the Figure, I show the impulse response of this specification: the positive and significant relationship between investment and firms' internal funds is not significant for countries with a low level of financial development[15]. These results suggests that the effect of capital inflow booms is to decrease the reliance on internal funds, and thus relax borrowing constraints. I conduct the same experiment but using in the specification the sales-to-capital ratio as a proxy for investment opportunities and results do not change.

[15]These results are corroborated using ths sales to capital ratio as the proxy of investment opportunities (instead of Tobin's Q) and shown in the Figure below.

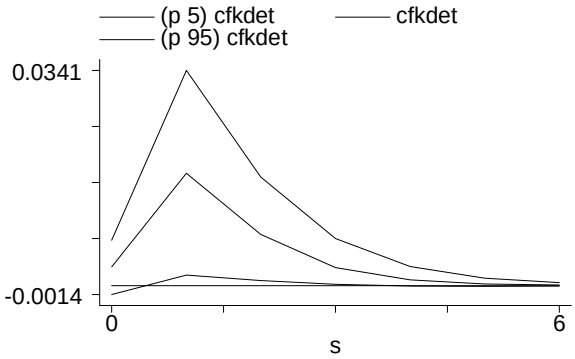
Figure: Impulse Response of
Investment to Cash Flow (Tobin's q)



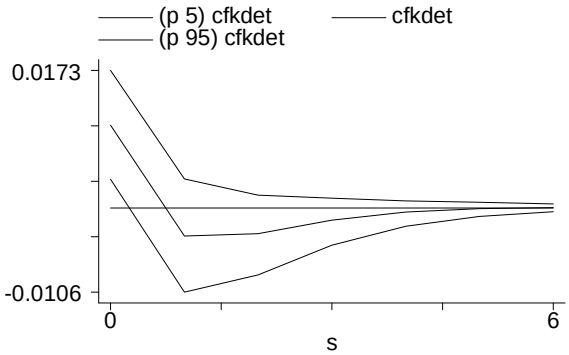
High FD (All Sample)



Low FD (All Sample)

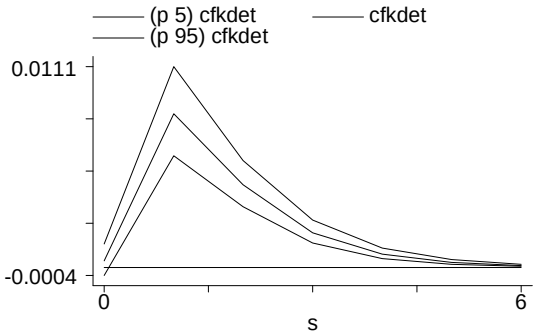


High FD (KI Booms)

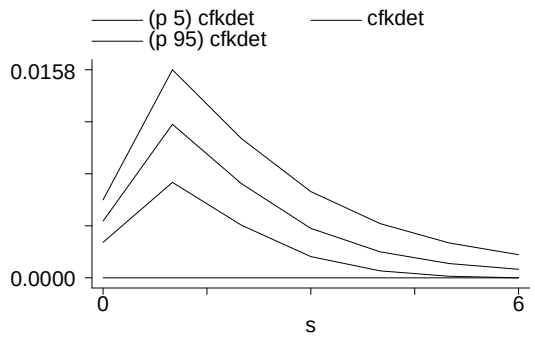


Low FD (KI Booms)

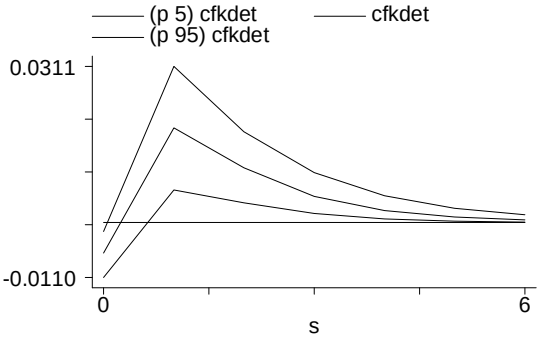
Figure: Impulse Response of
Investment to Cash Flow (Sales-to-Capital)



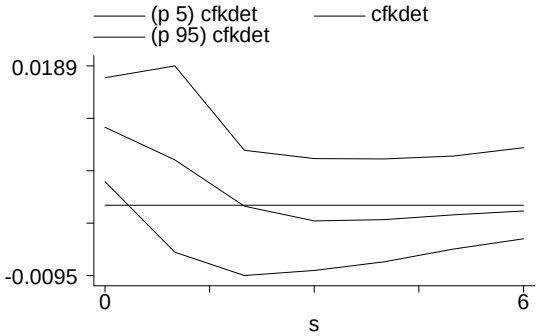
High FD (All Sample)



Low FD (All Sample)



High FD (KI Boom)



Low FD (KI Boom)

3.4 Summary of Empirical Results

In this chapter, I study the relationship between country level financial development, financial constraints at the firm level, and large capital inflow periods. The empirical findings show that macroeconomic and firm level behavior during capital inflow periods are more volatile in economies with a low level of financial development, relative to countries with a high level of financial development. Periods of large capital inflow are used as an exogenous change in financing condi-

tions, that are not related homogeneously to changes in investment opportunities, to unveil the relationship between financial development and aggregate and firm level responses. This experiment is motivated by the exogenous nature that capital inflow booms represent for a single firm.

I show that firms in countries with a low level of financial development exhibit a loosening in the cost of borrowing, coupled with an appreciation in asset prices, and a decrease in financial constraints during periods of large capital inflow. Using q-investment regressions and a firm level Panel VAR the hypothesis that financial development is related to the extent to which financial constraints affect firm level behavior is corroborated. Moreover, I show how financial constraints at the firm level are loosened during periods of capital inflows for firms in low financial development countries. This decrease in financing constraints is larger for firms in the non-tradable sector of the economy, for firms operating in industries with a larger reliance in internal finance, and not present during periods of domestic credit booms, which confirms that the findings are related to the relationship between financing conditions and not because of other unobserved factors. These findings are robust to multiple specifications and robustness tests.

Chapter 4

Financial Development and Credit Frictions at the Firm Level: An Analytical Framework

The main goal of this chapter is to relate the larger response evidenced in macroeconomic aggregates and at the firm level in emerging economies during periods of large capital inflow, described in chapter 3, to the degree of financial development and the pervasiveness of financial constraints. I define the degree of financial development as the extent to which debtors, due to limited commitment, can use their assets measured at their market value to secure debt. In the model, in an economy with a low level of financial development, a larger share of borrowers are restricted by creditors to use a lower fraction of their assets to raise debt, relative to an economy with a higher degree of financial development. The response to a changing economic environment is distorted for firms that are ex-ante constrained. I highlight a transmission channel in which endogenous increases in the aggregate price of capital relaxes borrowing constraints for constrained firms during these periods.

The empirical regularities around periods of large capital inflow, described in

chapter 3 motivate the use of a dynamic, stochastic, heterogeneous agents' model of a Small Open Economy (SOE) with a financial friction, to highlight the interaction between financial development, firm investment decisions, and borrowing constraints. In particular, the degree of financial development determines the share of constrained firms in equilibrium, and thus the reaction to changes in the economic environment, both at the firm level and on macroeconomic aggregates. Countries in which there is a higher degree of financial development experience smaller reactions to equivalent changes in global financing conditions. On the other hand countries where there are more financially constrained agents show larger increases in investment due to the possibility of increasing debt given by the relaxation of borrowing constraints after an endogenous increase in aggregate asset prices.

In the proposed experiment I compare the transition between steady states of economies with varying degrees of financial development, after an exogenous change in the foreign determined interest rate. Periods of large capital inflow are related to looser global financial conditions[1]. Thus, a decrease in the foreign-determined interest rate (and because agents use foreign debt to finance consumption and investment) leads to an aggregate capital inflow and increases in the aggregate capital stock. Through this mechanism, large capital inflow periods are related to increases in firm level and macroeconomic aggregates that differ as the degree of financial development changes.

The analytical framework I propose to describe the role of financial develop-

[1]Reinhart and Reinhart (2009) find a *lagged* response in the probability of a capital flow bonanza to the U.S. real short-term interest rate, as well as low GDP growth in large economies, and increases in commodity prices.

ment around capital inflow booms, uses features from the heterogeneous agent, and incomplete markets literature developed by Aiyagari (1993) and Huggett (1993), with the addition of a borrowing constraint of the Kiyotaki and Moore (1997) type. These characteristics imply that in the proposed setting markets are not only incomplete but also imperfect. The model differs from the Aiyagari-Huggett framework because the return to savings is given by the world determined interest rate, a common assumption when studying Small Open Economies (SOE). The presence of convex capital adjustment costs gives rise to a price of capital different to unity. The specification proposed uses several features from the one used by Mendoza (2010), albeit that one is used to describe a representative agent SOE.

The purpose of using this framework is to compare the behavior of two economies that only differ in the degree of financial development to an aggregate shock that endogenously produces a surge in capital inflows. To obtain this dynamic, in the model I solve for the transition between steady states of an heterogeneous agents economy, characterized by borrowing constrained and unconstrained firms, after an unexpected change in the exogenous real interest rate. In the next section I describe the theoretical model and describe the main transmission channels by which the period of large capital inflows decrease financing constraints at the firm level. Also I define the stationary and the transition recursive equilibrium that characterize the aggregates and firm levels dynamics. In section 4.2 I describe the parameterization procedure, baseline results, and robustness tests to the main results. The last section concludes.

4.1 The Firm-Household Problem

The economy is populated by a continuum of infinitely lived, self-employed, firm-households of mass one[2]. Preferences are defined over consumption (c_t) of one tradable good and the supply of labor (l_t). The specification uses Epstein (1983) Stationary Cardinal Utility (SCU), that permits the model to be characterized by a unique, invariant distribution of foreign assets under incomplete markets by featuring an endogenous rate of time preference[3]. Preferences for each agent are given by[4]:

$$E_0(U) \equiv E_0\left[\sum_{t=0}^{\infty} \exp\left\{-\sum_{\tau=0}^{t-1} v\left(c_\tau - \frac{l_\tau^\omega}{\omega}\right)\right\} u\left(c_t - \frac{l_t^\omega}{\omega}\right)\right] \tag{4.1}$$

where $u(.)$ is a standard concave, and twice differentiable period utility function and $v(.)$ is an increasing, concave and twice differentiable time preference function. In order to eliminate the wealth effect on labor supply, the specification uses the functional form proposed by Greenwood, Hercowitz, and Huffman (1988). This assumption implies that the marginal rate of substitution between consumption and labor is independent of consumption. The parameter $\omega > 1$ determines the elasticity of labor supply.

Production of the tradable good by each of the agents is defined by a constant returns to scale production function that takes as inputs fixed capital (k_t) and labor (l_t), and is subject to idiosyncratic productivity shocks. These shocks, labeled z_t are

[2]A decentralization of the model, specifying consumer and firm's behavior, in which the former own equity of the latter, yields the same results that using the proposed setting.

[3]In subsection 4.2.6 I explain with more detail the reasons for using the Stational Cardinal Utility (SCU) and implications of using an exogenous discount rate.

[4]Lucas and Stokey (1984) state: "The hypothesis of increasing marginal impatience, appears to be an essential component that any theory within the class considered in this paper must posess if it is to generate dynamics under which wealth distributions converge to determinate, stationary equilibria in which all agents have positive wealth and consumption levels".

the only source of uncertainty of the model economy, are i.i.d. across agents, and follow an auto-regressive process for each agent. The production function $F(k,l)$ has the usual properties:

$$F'_k > 0, F'_l > 0, F'_{kk} < 0, F'_{ll} < 0$$

Investment is subject to adjustment costs determined by a linearly homogeneous function $\Psi(i_t, k_t)$ where $\Psi(.)' > 0$. Each firm-household chooses sequences of consumption (c_t), labor supply (l_t), capital (k_{t+1}), investment (i_t) and holdings of one period, non-contingent, bonds (b_{t+1}), taking as given the exogenous gross return on bonds R, and the endogenous market price of capital (q_t).

The period budget constraint and the capital accumulation equations are given by:

$$c_t + i_t(1 + \Psi(i_t, k_t)) + b_{t+1} = e^{z_t} F(k_t, l_t) + b_t R \tag{4.2}$$

$$i_t = k_{t+1} - (1-\delta) k_t \tag{4.3}$$

The credit market is imperfect because foreign lenders require the firm-household to guarantee the debt by offering fixed capital, measured at its market value as collateral. The collateral constraint implies that debt cannot exceed a fraction, denoted by κ, of the market value of fixed capital. As in Kiyotaki and Moore (1997), creditors protect themselves from the possibility of the borrower's repudiation of the debt contract and never allow the size of debt to exceed a share of the market value of collateral. In the setting presented in this model, the differences in the fraction of collateralizable debt will denote differences in the enforcement ca-

pability of lenders to recuperate the collateral and thus is related to the degree of financial development. In short, a higher value of κ implies a more developed financial system, in the sense that agents can use a higher proportion of their assets to obtain loans. The fraction $(1-\kappa)$ represents the amount of fixed capital that the household firm would be able to retain after repudiating the debt contract, and therefore κ is a proxy of the level of financial development. The borrowing constraint is given by:

$$b_{t+1} \geq -\kappa q_t k_{t+1} \tag{4.4}$$

The optimality conditions with respect to consumption, labor, bond holdings, the demand for capital, investment and the complementarity slackness condition are given by:

$$\begin{gathered}
\lambda_t = U_{c_t} \\
l_t^{\omega-1} = F_l\left(k_t, l_t\right) \\
\lambda_t - \eta_t = RE_t\left(\lambda_{t+1}\right) \\
\chi_t - \kappa\eta_t q_t = E_t\left\{\lambda_{t+1}\left[e^{z_{t+1}}F_1\left(k_{t+1}, l_{t+1}\right) - i_{t+1}\Psi_k\left(i_{t+1}, k_{t+1}\right)\right] + \chi_{t+1}\left(1-\delta\right)\right\} \\
\chi_t = \lambda_t\left(1 + \Psi\left(i_t, k_t\right) + i_t\Psi_i'\left(i_t, k_t\right)\right) \\
\eta_t\left[b_{t+1} + \kappa q_t k_{t+1}\right] = 0
\end{gathered}$$

where λ_t is the marginal utility of an extra unit of lifetime consumption, η_t is the multiplier attached to the borrowing constraint (Equation 4.4), and χ_t denotes the shadow value of an extra unit of investment.

If $F\left(.,.\right)$ and $\psi\left(.,.\right)$ are linearly homogeneous and the firm is a price taker in its output market, the shadow value of a marginal unit of capital is equal to the market value of existing capital to its replacement cost, a result shown by Hayashi (1982). This implies, $\tilde{\chi}_t \equiv \frac{\chi_t}{\lambda_t} = q_t$.

The optimality condition with respect to capital, can be written as:

$$q_t = E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t \left(1 - \kappa \eta_t\right)} \left[e^{z_{t+1}} F_1 \left(k_{t+1}, l_{t+1}\right) - i_{t+1} \Psi_k \left(i_{t+1}, k_{t+1}\right) + q_{t+1} \left(1 - \delta\right) \right] \right\} \tag{4.5}$$

The firm-household's discount factor is distorted, for constrained agents, by the presence of the collateral constraint. The mass of constrained agents is then a function of the financial development variable, κ a result that I show quantitatively.

Proposition 1 *The distortion to the pricing kernel of firm's demand for capital amplifies shocks to each agent's demand.*

Proof. In order for the pricing kernel to amplify shocks $(1 - \kappa\tilde{\eta}_t)$ should be less than one and greater than zero.

From the first order conditions,

$$1 - \tilde{\eta}_t = RE_t \left(\frac{\lambda_{t+1}}{\lambda_t} \right) > 0$$

$$1 - \tilde{\eta}_t \leq 1 - \kappa\tilde{\eta}_t$$

$$\text{given that, } \; 0 \leq \kappa \leq 1$$

$$\begin{aligned} \text{Also} \quad (1 - \kappa\tilde{\eta}_t) &\leq 1 \text{ given that } \tilde{\eta}_t \equiv \frac{\mu_t}{\lambda_t} \geq 0 \\ \text{and } \kappa &\geq 0 \end{aligned}$$

■

Defining $\Omega_{t+i+1} \equiv \frac{\lambda_{t+i+1}}{\lambda_{t+i}\left(1 - \tilde{\eta}_{t+i}\kappa\right)}$, and using transversality condition, the for-

ward solution of the capital pricing function yields:

$$q_t = E_t \left[\sum_{j=0}^{\infty} \left[\prod_{i=0}^{j} \left(\Omega_{t+i+1} \right) \right] d_{t+j+1} \right]$$

where d_{t+j+1} denotes dividends of the firms. This implies that the expectation that the constraint could bind in the future, also distort the demand for capital in equilibrium.

The supply of capital for each agent can be obtained using the first order condition with respect to investment. After aggregating each agent's supply of capital for a given price, the aggregate market supply of capital, taken as given by each of the agents, is denoted by:

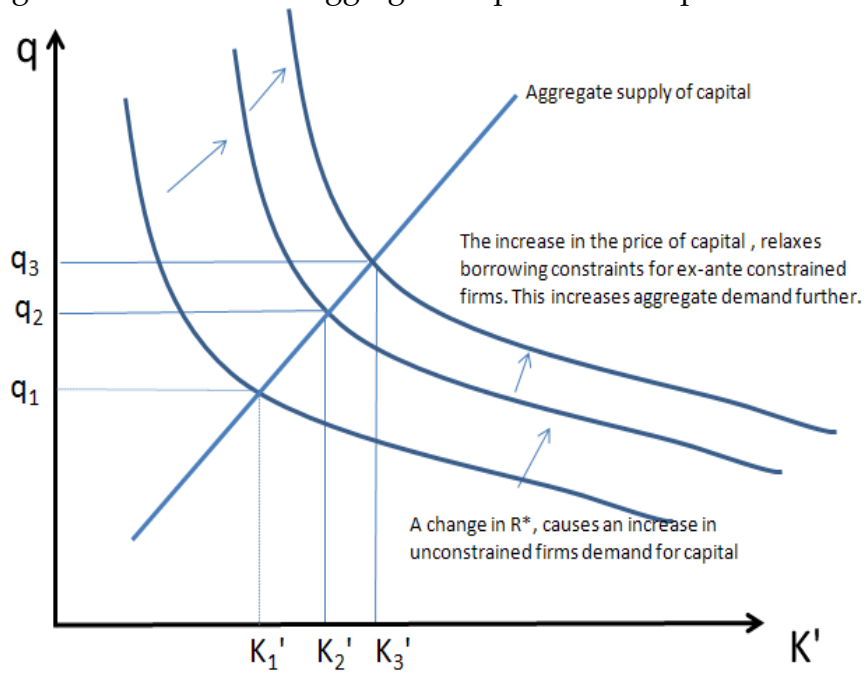
$$q_t = 1 + \Psi(I_t, K_t) + I_t \Psi_i'(I_t, K_t) \tag{4.6}$$

where $I_t = K_{t+1} - (1-\delta) K_t$, and $K_t = \int k_t \ \mu_t \left(k_t, b_t, z_t \right) \ \forall t$. The distribution of agents, denoted by $\mu_t \left(k_t, b_t, z_t \right)$ determines the aggregate state that is relevant in the formation of the price of capital. In the setting proposed agents need to keep track of the aggregate level of the capital stock, because when solving their problem they take the price of fixed capital q_t as given.

4.1.1 Transmission Channel

After an exogenous shock that lowers the opportunity cost of capital, agents that are borrowing constrained at the initial level of asset prices q_t, are not able to increase their debt level to finance the desired increase in capital. However, firms that are not constrained can freely increase their demand for capital. Because the supply of capital is upward sloping, the aggregate price of capital q_t increases, re-

Figure 4.1: Market for Aggregate Capital and Amplification Effect



laxing the borrowing constraint for ex-ante constrained firms and causing these agents to increase the aggregate demand for capital further. This transmission channel is summarized in Figure 4.1.

The lack of a closed form solution to this model, featuring a non-linear transmission mechanism, the interaction between constrained and unconstrained agents, in which the size of constrained and unconstrained agents are endogenously determined, requires the solution of the model using a numerical approximation to the competitive equilibrium.

4.1.2 Recursive Representation

The proposed model can be expressed in recursive form using the following specification. Denote $a \equiv \{b, k\}$ as the agent specific set of endogenous states and z represent the idiosyncratic shock. The problem can then be written as the solution

to the value function for an agent characterized by state (a, z):

$$V(a,z) = \max\left\{u\left(c - \frac{l^{\omega}}{\omega}\right) + \exp\left[-v\left(c - \frac{l^{\omega}}{\omega}\right)\right] E\left[V\left(a', z'\right)\right]\right\} \tag{4.7}$$

subject to the following constraints,

$$s.t. \quad c = e^{z} F(k,l) - i(1 + \Psi(i,k)) + bR - b' \ (a,z) \tag{4.8}$$

$$i = k'(a,z) - (1-\delta)k \tag{4.9}$$

$$b'(a,z) \geq -\kappa q\left(K', K\right) k' \tag{4.10}$$

taking as given the market supply of capital and the evolution of aggregate capital:

$$q = 1 + \Psi'\left(\frac{K' - (1-\delta)K}{K}\right)\left(K' - (1-\delta)K\right) + \Psi\left(\frac{K' - (1-\delta)K}{K}\right) \tag{4.11}$$

$$K' = \int_{a,z} k'(a,z)\,\mu'(a,z)$$

Definition 1 *A stationary competitive equilibrium consists of policy functions $b'(a,z;R,K)$, and $k'(a,z;R,K)$, value function $V(a,z)$, an invariant probability distribution $\mu(a,z)$, the price of capital $q(K',K)$, such that given the gross interest rate R, the level of financial development κ, and a Markov process for the exogenous shock with transition probability matrix $\Pi(z,z')$:*

1. *The decision rules $b'(a,z;R,K)$, $k'(a,z;R,K)$, and the value function $V(a,z;R,K)$ solve the programming problem given by Equation 4.7 subject to the constraints given by Equations 4.8, 4.9, and 4.10, taking as given $q(K',K)$, R, and the Markov*

process.

2. *The decision rules and the shock process induce a stationary law of motion for the distribution of agents:*

$$\mu'\left(a',z'\right)=\int_{a,z}\mu\left(a,z\right)\Pi\left(z,z'\right)$$

3. *The average value of K' and K implied by the average of the firm-households decisions satisfies (capital market clears):*

$$K'=\int_{z,a}\mu'\left(a',z'\right)k'\left(a,z\right)=K$$

4. *The price of capital, $q\left(K',K\right)$ satisfies Equation 4.11 and coincides with the price taken as given by individual agents.*

5. *Goods market clears.*

Given that $K'=K$ in the stationary recursive steady state, the price of capital is constant. The stationary equilibrium provides useful information about how the degree of financial development distorts the policy functions and the distribution of agents. The model determines endogenously the proportion of agents that will be borrowing constrained given the exogenous process for the shock, the financial development variable κ and the gross interest rate. However, a more interesting question that can be solved using this model is, how does the (changing) market price of capital influences the borrowing constraint and in turn the policy functions across an equilibrium path. This can be obtained by solving the transitional dynamics between steady states for two different values of the gross interest rate.

In the transition between steady states, an agent's problem is given by:

$$V_t(a_t, z_t) = \max\left\{u\left(c_t - \frac{l_t^{\omega}}{\omega}\right) + \exp\left[-v\left(c_t - \frac{l_t^{\omega}}{\omega}\right)\right] E_t\left[V_{t+1}(a_{t+1}, z_{t+1})\right]\right\} \tag{4.12}$$

subject to the following constraints,

$$s.t. \quad c_t = e^{z_t} F(k_t, L_t) - i_t(1 + \Psi(i_t, k_t)) + b_t R - b_{t+1} \tag{4.13}$$

$$i_t = k_{t+1}(a_t, z_t) - (1 - \delta) k_t \tag{4.14}$$

$$b_{t+1}(a_t, z_t) \geq -\kappa q_t(K_{t+1}, K_t) k_{t+1} \tag{4.15}$$

taking as given:

$$q_t = 1 + \Psi(I_t, K_t) + I_t \Psi'(I_t, K_t) \tag{4.16}$$

$$I_t = K_{t+1} - (1 - \delta) K_t$$

Definition 2 *A competitive equilibrium transition path consists of decision rules* $b_t'(a_t, z_t; R, K_t)$, $k_t'(a_t, z_t; R, K_t)$, *and value functions* $V_t(a, z)$, *probability distributions* $\mu_t(a_t, z_t)$, *pricing function* $q_t(K_{t+1})$, *for* $t = 0, .., \infty$ *such that given the gross interest rate* R, *the level of financial development* κ, *and a Markov process for the exogenous shock with transition probability matrix* $\Pi(z_t, z_{t+1})$*:*

1. *The decision rules and value functions solve the agents' problem Equations 4.12, 4.13, 4.14 , 4.15 given an initial distribution* $\mu^0\left(a_0, z_0; R^0, K^0\right)$ *and the evolution of the price of capital Equation 4.16.*

2. *The sequence of distributions is consistent with the decision rules and the transition matrix:*

$$\mu_{t+1}(a_{t+1}, z_{t+1}) = \int_{a,z} \mu_t(a_t, z_t) \Pi(z_t, z_{t+1})$$

3. *The aggregate value of K_{t+1} implied by the aggregate of the firm-household demand for capital satisfies:*

$$K_{t+1} = \int_{a,z} \mu_{t+1}\left(a_{t+1}, z_{t+1}\right) k_{t+1}\left(a_t, z_t\right)$$

4. *The price of capital satisfies Equation 4.16 and coincides with the price taken as given by individual agents.*

5. *Goods market clears.*

The equilibrium policy functions and distributions in steady state, and during the transition, can be used to calculate the dynamics of market aggregates between steady states characterized by different levels of the exogenous interest rates.[5]

4.2 Results

4.2.1 Functional Forms and Calibration

The functional forms adopted for the utility function follows Epstein's Stationary Cardinal Utility, where $u(.)$, the period utility function and $v(.)$, the endogenous rate of time preference are given by:

$$u\left(c - \frac{l^{\omega}}{\omega}\right) = \frac{\left(c - \frac{l^{\omega}}{\omega}\right)^{1-\sigma} - 1}{1-\sigma}$$
$$v\left(c - \frac{l^{\omega}}{\omega}\right) = \beta \ln\left(1 + c - \frac{l^{\omega}}{\omega}\right)$$

The elasticity of the endogenous rate of time preference with respect to the

[5]The solution procedure to solve for the recursive equilibrium for the stationary and transitional equilibrium is described in Appendix C.

consumption-labor supply aggregate in steady state is given by the relation:

$$\beta = \frac{\log(R)}{\log\left(1 + \bar{c} - \frac{\bar{l}^{\omega}}{\omega}\right)}$$

where $\bar{c}$ and $\bar{l}$ are given by the average deterministic average of consumption and labor supply[6]. This implies a steady state gross discount rate equal to the inverse of the gross interest rate. The value of consumption in steady state is calibrated to obtain the mean value of bond holdings that matches the mean value of the leverage ratio obtained for firm level data from chapter 3. This implies that average debt holdings in steady state are equal to close to 43% of the market value of assets.

The main goal of the quantitative exercise is to observe how different levels of financing constraints match the behavior observed in macroeconomic aggregates around periods of large capital inflow. Therefore I use functional forms and parameter values for the technological parameters used in the small open economy literature for the quantitative exercises. The functional form for the firm's production function is Cobb-Douglas and the share of capital in total production is denoted by α. The adjustment costs function takes the following form:

$$\Psi(i_t, k_t) = \frac{\phi}{2}\left(\frac{i_t - \delta k_t}{k_t}\right)$$

The productivity shock process is modeled as a first order Markov chain:

$$z_{t+1} = \rho z_t + \epsilon_t$$

$$\epsilon \sim N\left(0, \sigma_z^2\right)$$

[6]In Steady State, $\bar{c} = e^{\bar{z}} F\left(\bar{k}, l\left(\bar{k}\right)\right) - \delta\bar{k} + \bar{b}(R-1)$ where l and k are the steady state solutions of the first order conditions.

The last two parameters to be determined are the real foreign determined interest rate R and the share of the value of assets that can be collateralized, given by κ. The initial steady state value for the interest rate is 4%, and the proposed experiment is a reduction of 25 basis points, that matches the surge in capital inflow from the event analysis in chapter 3. Given that one of the main the objectives of the paper is to compare equilibriums for different degrees of financial development, different values for the parameter κ are used. For the transition, the experiment proposed is one where the value of the interest rate changes, causing the economy to move from one steady state to another highlighting how this dynamics may differ for economies characterized by different values of κ.

Table (4.1) summarizes the benchmark calibration of the model. As noted above these parameter values are standard in the SOE literature.

Table 4.1: Parameterization

Preferences			**Technology**				
σ	ω	β	α	ϕ	ρ	σ_z	δ
2	1.445	0.1118	0.32	2	0.42	0.0129	0.10

4.2.2 Stationary Equilibrium

The lack of closed form solution requires the model to be solved using numerical methods. In particular, the model is solved using a discretization of the state space in evenly spaced grids for the state variables, and solving for the optimal policy functions using value function iteration. The stationary distribution is solved for using the policy functions and the transition matrix for the shock process. Figure 4.2 shows the unconditional stationary distribution of agents over bond holdings for an economy in which firms are not subject to the collateral constraint (per-

fect credit markets). The unconditional distribution of capital is shown in Figure 4.3.

The aim of the proposed experiment is to compare how economies with different degrees of financial development react to a shock in the returns to the aggregate cost of debt. One of the core hypothesis is that for an economy with sufficiently high level of financial development, in the stationary steady state, no agents should be borrowing constrained, and the percentage of constrained agents, depicted in the Figure as the spike in the left side of the distribution over bond holdings, should increase as financial development decreases. Figure 4.4 illustrates this result, and shows the stationary unconditional distribution of bond holdings for different levels of financial development.

As the value of κ diminishes from 0.7 to 0.35, the benchmark values used for high and low level of financial development respectively, the percentage of constrained agents, increases to close to 15% of agents. These distributions illustrate that the endogenous discount factor supports a distribution of agents around the average value of bond holdings in which *ad hoc* limits in assets do not play any role. However with a constant discount rate strictly greater than the interest rate, a condition needed to support a well defined stationary distribution, the share of constrained agents would not depend solely on the degree of financial development but also on the exogenous debt limit and on the difference between the discount rate and the exogenous interest rate. subsection 4.2.6 presents the results using exogenous discounting and clarifies further why the stationary cardinal uility specification is desirable to explain the transmission channel described in the model.

Figure 4.2: Unconditional Distribution over Bond Holdings (Perfect Credit Market)

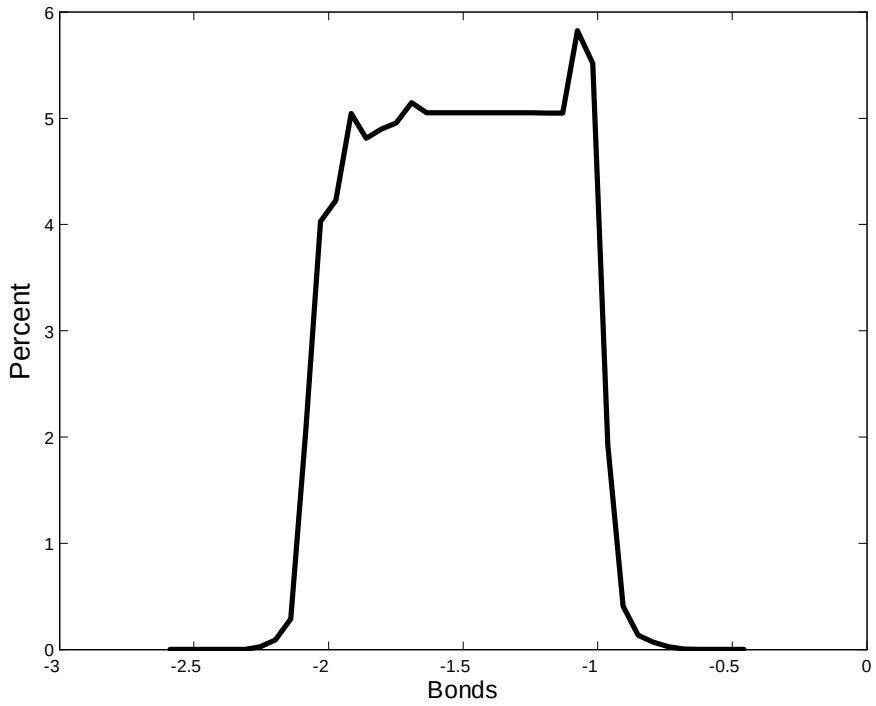


Figure 4.3: Unconditional Distribution over Capital (Perfect Credit Market)

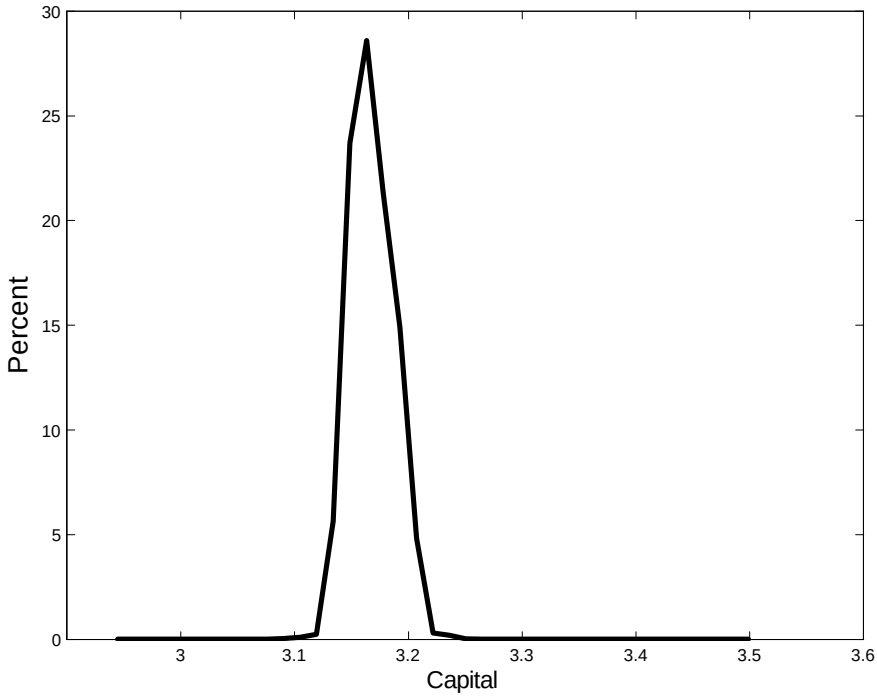
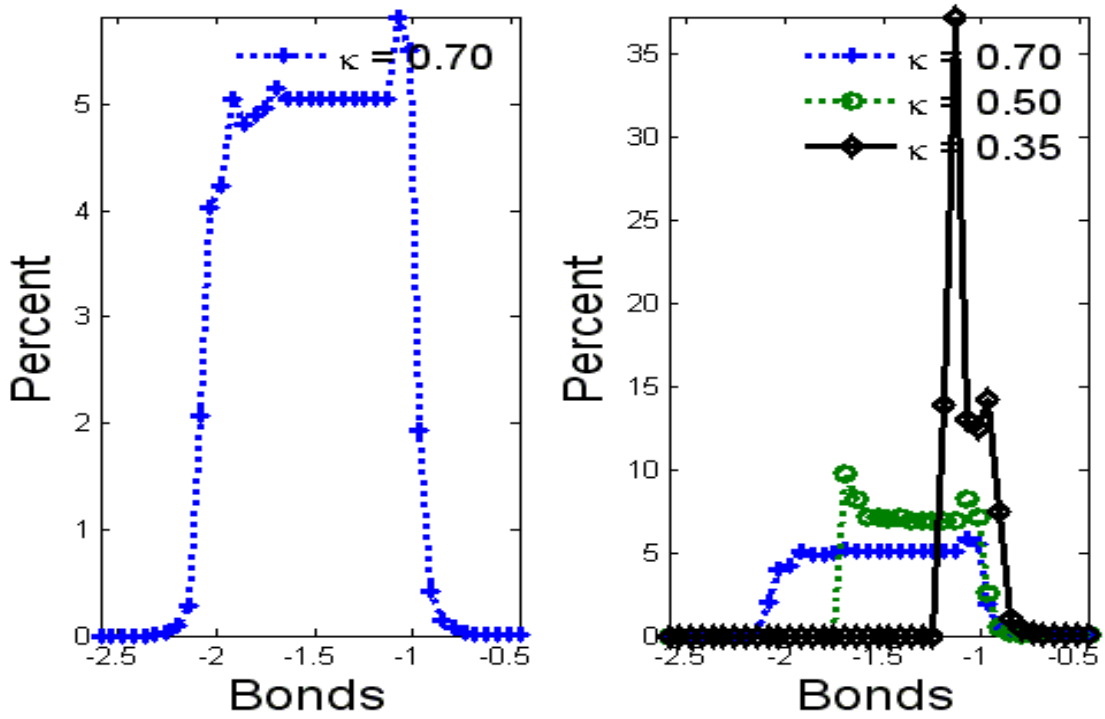
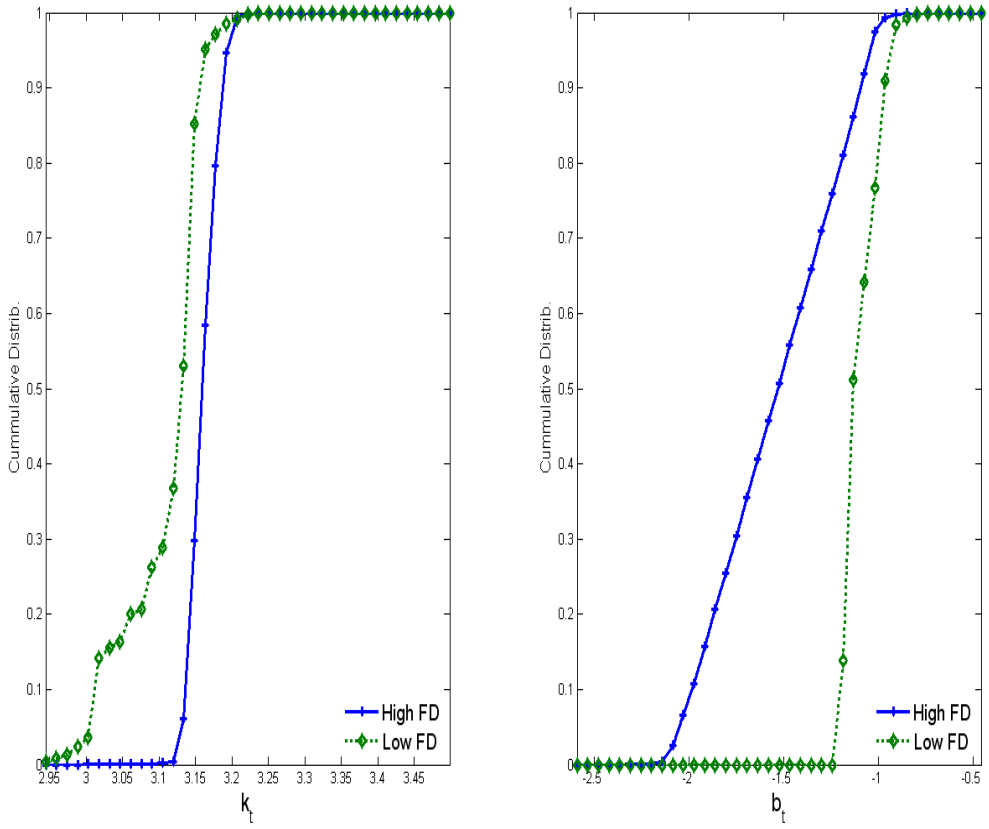


Figure 4.4: Bond Holding Distribution for different degrees of Financial Development



The left panel of Figure 4.5 shows the cumulative stationary distribution of capital holdings as a function of current capital holdings. The Figure shows that for firms in a low financial development environment, a larger share of agents hold a lower level of capital in steady state, an effect of a more restrictive financial constraint. In the right panel of Figure 4.5, the cumulative distribution around the level of debt for an economy with a high level of financial development is distributed uniformly around the average level of debt holdings as there are no constrained agents. However, the cumulative distribution of bond holdings for an economy with a low level of financial development shows that for a significant share of the state space for bonds the percentage of agents is zero and at the point at which the constraint does not bind, the share of agents is more than 10%. The behavior of these agents, that are not able to adjust freely their desired level of

Figure 4.5: Capital and Bond Demand Functions for High and Low FD



bonds and capital plays a key role in the proposed transmission channel.

The financing constraint plays a role in determining average holdings of capital and bonds from firms. I show the average level of capital and debt, as a percentage of the average for perfect credit markets, and the leverage ratio in Table 4.2. The difference in aggregate value of capital is close to 2% less for the lowest value of κ. As the degree of financial development increases, the average value of capital approaches the perfect credit market value. The demand for bonds shows a larger difference for different levels of financing constraints. For the lowest level of financial development, average demand for bonds is close to 62% and it gets close to the perfect capital market value for values of $\kappa = 0.6$. In the third column, the

average level of leverage for the lowest level of financial development is close to the constraint, but as the level of financial development increases, less agents are constrained, implying that there is a larger difference between the value of κ and the average level of leverage.

Table 4.2: Steady State Capital, Bonds, and Leverage

	Capital	**Bonds**	**Leverage**
κ **= 0.30**	0.978	0.623	0.275
κ **= 0.35**	0.984	0.711	0.312
κ **= 0.40**	0.989	0.785	0.343
κ **= 0.45**	0.992	0.843	0.368
κ **= 0.50**	0.994	0.896	0.390
κ **= 0.55**	0.998	0.950	0.412
κ **= 0.60**	1.000	0.991	0.428
κ **= 0.65**	1.000	0.999	0.432
κ **= 0.70**	1.000	1.000	0.432

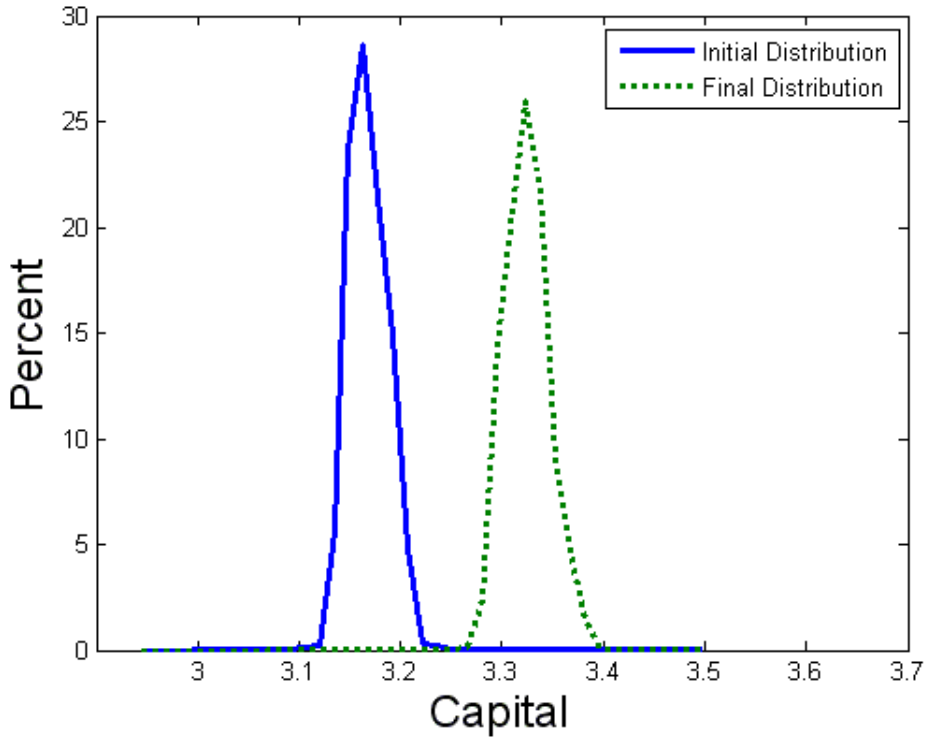
4.2.3 Dynamic Responses

The experiment proposed assumes that there is a 25 basis points decrease in the foreign interest rate. In the experiment, I assume that for each of the agents the productivity shock remains at its steady state value through the transition, even though the distribution of agents is still determined by the specified shock process. This assumption allows to separate the decrease in costs of borrowing from differences in investment opportunities at the firm level.

After an unexpected and permanent fall in the foreign interest rate, there is an increase in the demand for capital for all firms. This increase causes the unconditional distribution of capital to shift to the right in the new final steady state, as Figure 4.6 illustrates[7]. The shape of the distribution over the capital stock does

[7]The benchmark degree of financial development will be $\kappa = 0.35$ to denote low financial de-

Figure 4.6: Initial and Final Distribution over Capital Holdings

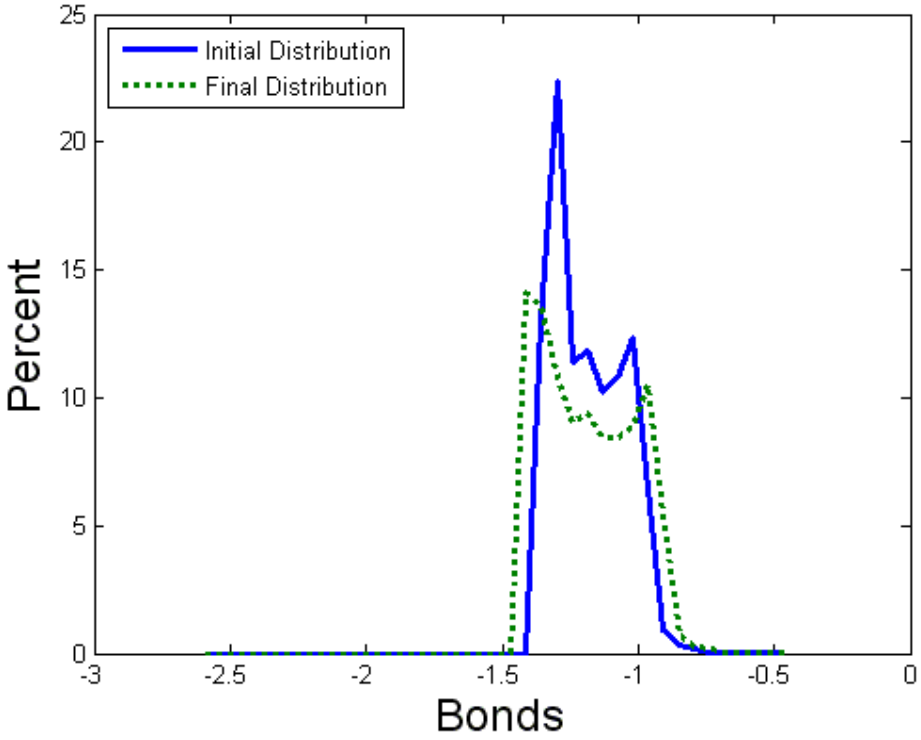


not change significatively. The initial and final distribution over bond holdings is depicted in Figure 4.7. In the final distribution, there are less constrained agents in equilibrium, due to the increase in the level of capital that increases the possibility to raise debt.

The exogenous decrease in the interest rate causes a different effect on the transition for an economy with high and low financial development. Before examining the response in macroeconomic aggregates, it is interesting to illustrate the evolution of the distribution of bond holdings after the shock. In Figure 4.8, the cumulative distribution over bond holdings is depicted for the initial steady state, the period of the shock and up to two periods after the shock. This Figure shows

velopment, and $\kappa = 0.7$ for high financial development. For the initial and final distributions over bond holdings and capital the distribution for the low level of financial development is depicted.

Figure 4.7: Initial and Final Distribution over Bond Holdings



how the relaxation in financing constraints allows firms to demand a higher level of debt after the shock, as the shift to the left in the cumulative distribution for each of the periods shows. This effect gradually disappears and the distribution of bonds in the new steady state is similar to the initial distribution for low levels of debt. As was explained above, the capital accumulation in the transition to the new steady state by firms with a low level of debt permits to sustain a larger level of debt holdings in the new steady state equilibrium.

The differential effect in macroeconomic aggregates is illustrated in Figure 4.9. For an economy with a low level of financial development, there is a stronger reaction in macroeconomic aggregates. The proposed transmission channel causes that firms that are ex-ante constrained, can increase their demand for capital closer to the desired level. Moreover, given the distortion in the marginal productivity

Figure 4.8: Cumulative Bond Holding Distribution after Shock

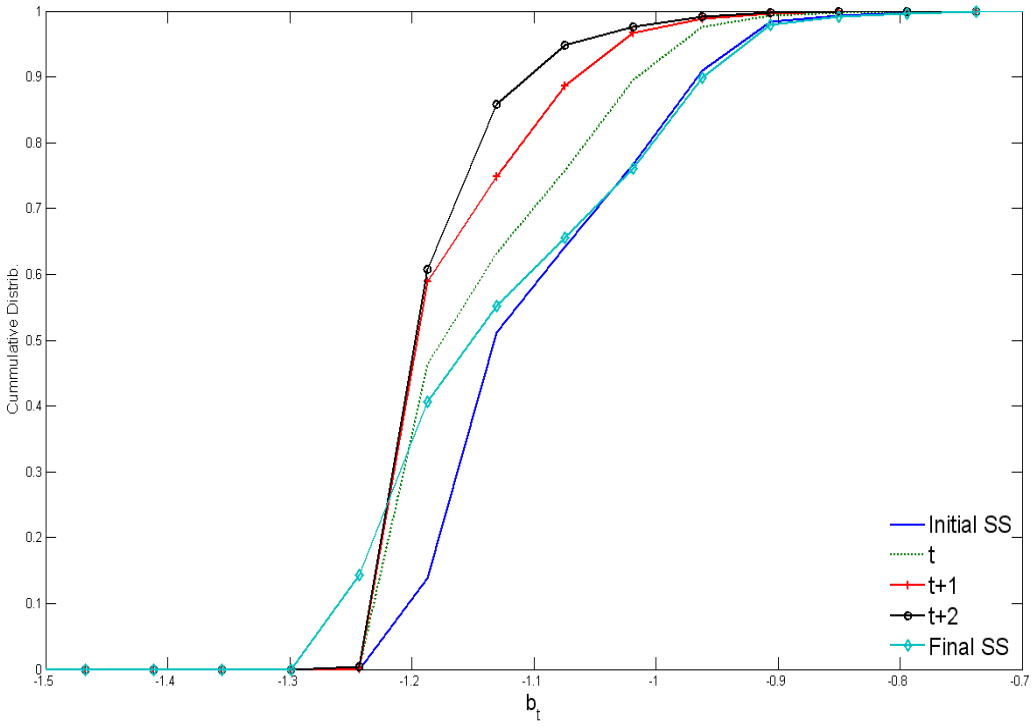
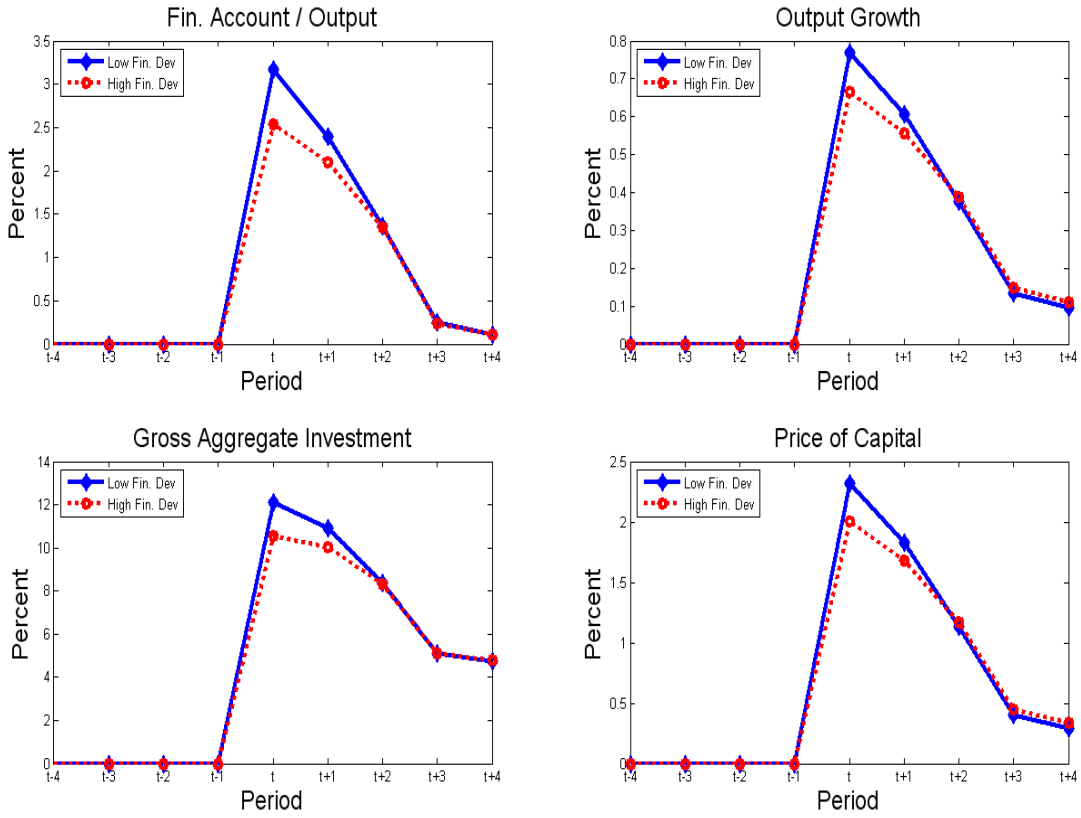
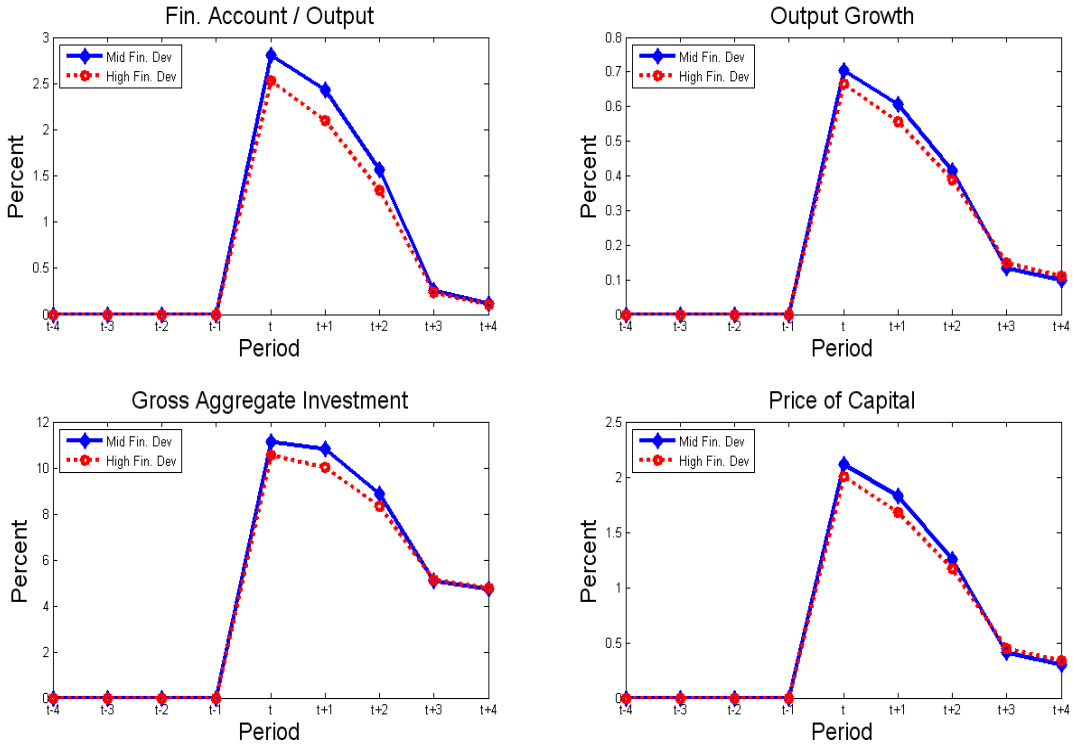


Figure 4.9: Response of Macroeconomic Aggregates for Low and High Degree of Financial Development



of an extra unit of investment, the response of constrained agents is amplified. In the aggregate, these effects are evidenced in a larger reaction in the price of capital, output, gross aggregate investment, and a surge in capital inflows, evidenced as an increase in the financial account. The difference in the latter, as a percent of output is close to one percent, even with output increasing more in an economy with lower financial development. There is also a larger increase in gross aggregate investment (close to 2% larger), and in the price of aggregate capital after the shock (half a percent larger). These findings shows how a model with varying degrees of financial development can explain the difference in aggregate response to periods of large capital inflows evidenced in emerging economies.

Figure 4.10: Response of Macroeconomic Aggregates for Mid and High Degree of Financial Development

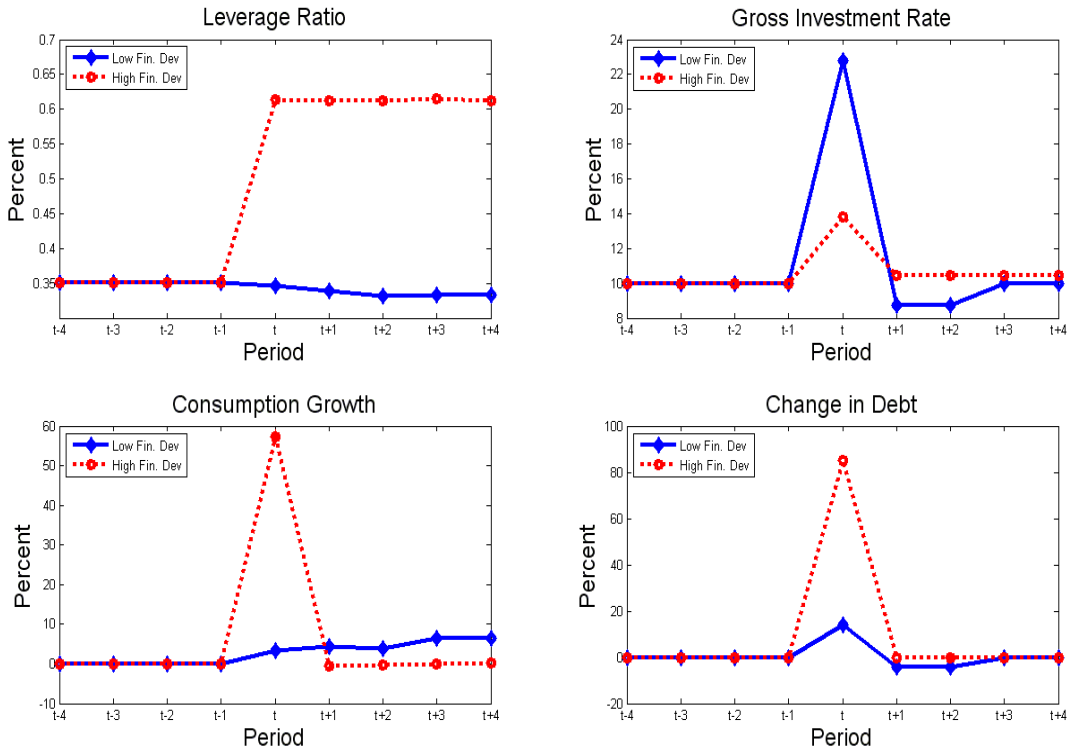


As the level of financial development increases, the amplification effect is less pronounced. In Figure 4.10, I show how increasing the parameter that denotes the level of financial development to $\kappa = 0.55$, the difference in the response of macroeconomic aggregates is not as stark as the one described above. For the financial account, this difference in response changes from close to one percent of output, to less than half a percent. The behavior of output, gross aggregate investment, and the price of capital is also similar. These results confirm that the amplification evidenced in economies with varying degrees of financial development can be attributed to the behavior of financially constrained agents reacting to a relaxation in these constraints.

The amplified response for constrained firms can be explained showing the

difference in behavior for a firm starting from the same leverage ratio in an environment of high and low financial development. I show the response of a firm with a leverage ratio close to 0.35 in an economy in which this is the value of the parameter κ (low financial development), and for one in which this parameter is equal to 0.7 (high financial development) in Figure 4.11. A firm operating in the high financial development environment can increase the leverage ratio without the constraint being binding. This produces that there is an increase in firm's investment due to the increase in it's demand for capital, an increase in consumption, given by the permanent decrease in the foreign interest rate, that is freely financed with an increase in debt. However, for a firm operating in an environment with low financial development, as it tries to increase it's capital stock through increasing debt, the constraint binds. The amplified response in the demand for capital is presented in the top right panel. Given that the firm is ex-ante constrained, the increase in the aggregate price of capital allows the firm to invest on impact and to get closer to the level of capital that would prevail if the constraint were absent. As the constraint becomes binding for a higher level of capital and debt, the investment rate falls abruptly presenting a higher variation. The optimal decision rule for a constrained firm shows how consumption decisions are also distorted and constrained agents cannot adjust it as if they were in an unconstrained environment. The bottom right panel shows that these differences are explained by the possibility that agents in an environment with high financial development have to adjust debt freely, whereas for a firm with low financial development, this is not possible.

Figure 4.11: Response of Firm Level variables for different degrees of Financial Development

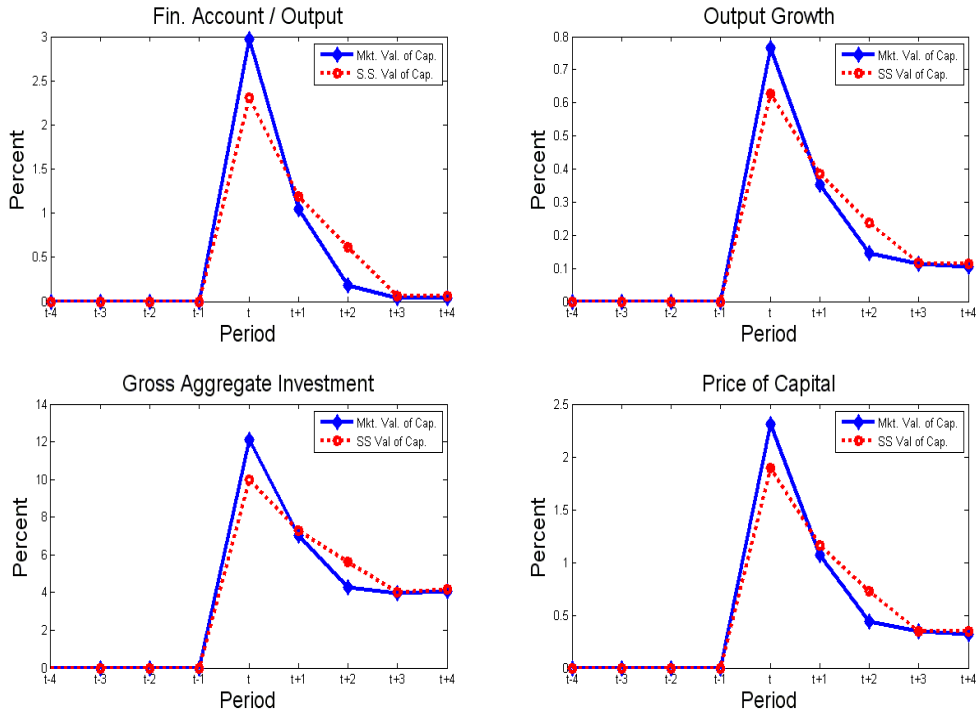


4.2.4 Aggregate Amplification Effect

To measure the aggregate amplification effect that affects firms that are ex-ante constrained, and due to the increase in the aggregate price of capital experience a relaxation in their financial constraint, I conduct an experiment in which the steady state price of capital is the one used to measure the value of the capital stock, and thus to collateralize debt. In Figure 4.12, I show the macroeconomic responses for an economy with low financial development and in which the relevant price for the financial constraint is the market determined, to one in which the relevant price is the steady state price. In other words, I analyze the different behavior due to the characteristic that capital is *marked-to-market* in determining the value of collateral to secure debt. As the Figure shows, the aggregate amplification effect is important in determining the response of economies with low financial development. The *pecuniary externality* described in the transmission channel in Figure 4.1, produces a significative difference in the response of macroeconomic aggregates.

However, this amplification effect due to the externality decreases as the level of financial development increases, given that the share of constrained agents in equilibrium that are affected by the increase in the aggregate price of capital decreases as the share of collateralizable assets decreases, as I show in Figure 4.13. The initial increase in aggregate investment is up to 1.50% larger for an economy in which the value of collateral is measured using the market value, than with the steady state price of capital. For economies with a high level of financial development, characterized by a lower proportion of constrained agents, the difference becomes negligible.

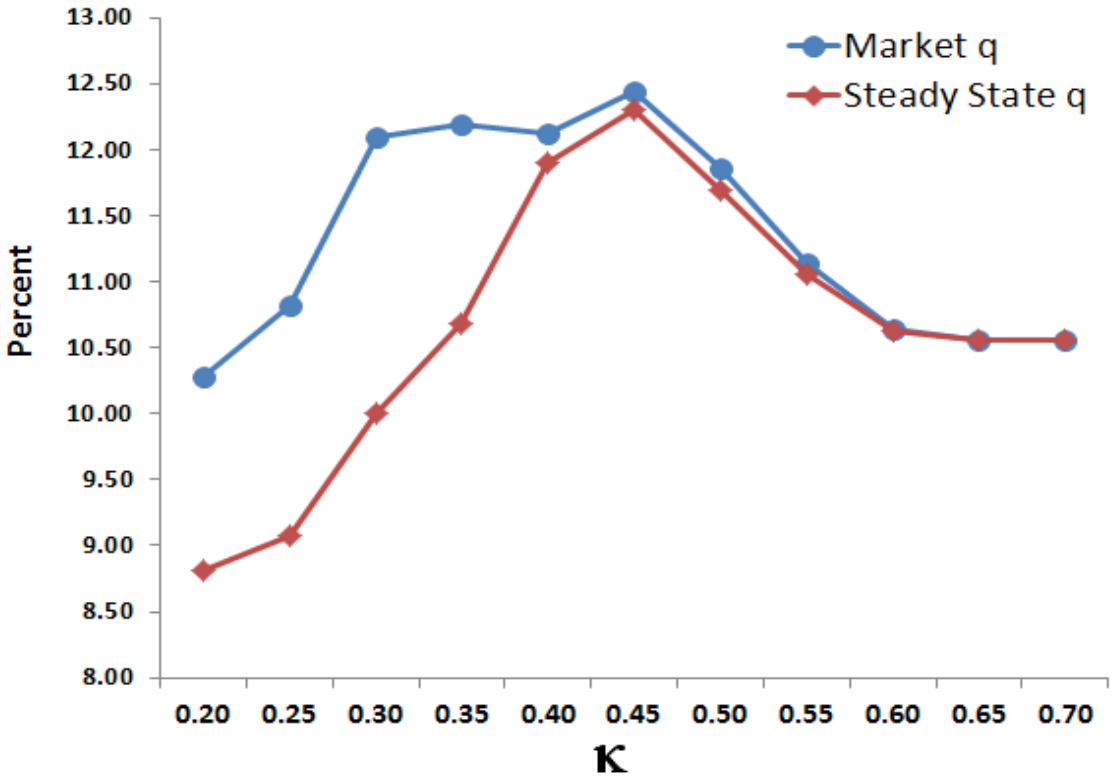
Figure 4.12: Response of Macroeconomic Aggregates (Amplification Effect)



4.2.5 Robustness Checks

A key parameter, that determines the price elasticity of the supply of capital, and thus the reaction in aggregate investment, is related to the adjustment costs that firms face. From Equation 4.16 and using the proposed functional form for the capital adjustment costs, this elasticity is given $\frac{1}{\phi}$. A lower value of ϕ implies a larger response in aggregate investment after the initial shock, and there would be less adjustment in the price of aggregate capital, for the same increase in the aggregate demand for capital. These findings can be confirmed by comparing the initial percentage deviations from steady states values in aggregate investment and the aggregate price of capital in Table 4.3 and 4.4. After the initial shock, the increase in investment is larger for lower values of the adjustment costs parameter, and

Figure 4.13: Initial Increase in Aggregate Investment



there is a higher adjustment of the increase in the aggregate demand for capital through the price level. This result is consistent for different degrees of financial development as the different rows in the Tables show.

Table 4.3: Initial increase in Investment: Robustness Check

	ϕ = 1.5	ϕ = 1.75	ϕ = 1.90	ϕ = 2.00	ϕ = 2.10	ϕ = 2.25	ϕ = 2.50
κ = 0.3	11.34	11.38	11.48	12.09	10.99	11.58	10.08
κ = 0.4	13.64	12.57	12.00	12.12	12.58	12.55	10.98
κ = 0.5	13.40	12.41	11.79	11.86	11.74	11.79	11.84
κ = 0.6	11.35	10.83	10.90	10.64	10.52	10.38	10.11
κ = 0.7	11.24	10.78	10.74	10.56	10.40	10.19	9.71

Table 4.4: Initial increase in Price of Capital: Robustness Check

	ϕ = 1.5	ϕ = 1.75	ϕ = 1.90	ϕ = 2.00	ϕ = 2.10	ϕ = 2.25	ϕ = 2.50
κ = 0.3	1.66	1.92	2.09	2.31	2.18	2.45	2.33
κ = 0.4	2.02	2.13	2.19	2.32	2.52	2.67	2.55
κ = 0.5	1.98	2.10	2.15	2.26	2.34	2.50	2.76
κ = 0.6	1.66	1.82	1.98	2.02	2.09	2.19	2.34
κ = 0.7	1.65	1.81	1.95	2.01	2.06	2.15	2.24

4.2.6 Exogenous Discounting

In this section, I compare the results obtained with a version of the model that does not feature endogenous discounting. The approach with exogenous discounting requires a constant rate of time preference higher than the foreign interest rate to obtain a well defined stationary equilibrium. In particular, Equation 4.1 in this version of the model is expressed as:

$$E_0\left(U\right) \equiv E_0\left[\sum_{t=0}^{\infty} \beta^t u\left(c_t - \frac{l_t^{\omega}}{\omega}\right)\right] \tag{4.17}$$

where $\beta \equiv \frac{1}{1+\theta}$, and $\theta > r$ denotes the rate of time preference[8]. The distribution of wealth in the stationary equilibrium in this case is affected by the endogenous

[8]With $\frac{1+r}{1+\theta} \geq 1$, assets diverge to infinity in stationary steady state because marginal utility converges to zero, and with CRRA preferences this implies that consumption, and therefore assets, diverge to infinity.

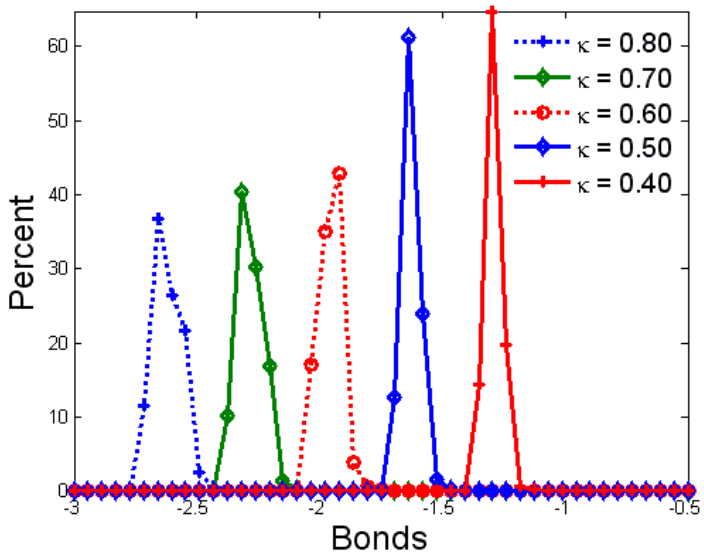
borrowing limit. Given that agents would not want to accumulate debt up to a point in which they have a large probability of the constraint to bind, precautionary savings affect the entire wealth distribution, and not only the proportion of agents that hit the constraint. On the contrary, stationary cardinal utility allows for the endogenous borrowing constraint to remain binding in the stationary equilibrium and only the share of agents that are borrowing constrained is affected by the proportion of the market value of assets that can be collateralized.

The distribution of bond holdings for different values of κ is depicted in Figure 4.14. These findings show that the entire stationary distribution of agents over bond holdings changes for different values of κ[9]. The precautionary savings motive shifts the distribution to the right as the value of κ decreases. This result implies a different response not only from constrained agents, but also from unconstrained agents as stationary holdings of assets is distorted in equilibrium. This is the main reason why the stationary cardinal utility specification is preferred for the analysis proposed.

In Table 4.5 the results from the above Figure can be confirmed. The average leverage ratio (measuring capital at its market value) changes with the value of the parameter κ. This is not the case for the SCU specification as is described in Table 4.2. The difference in the entire wealth distribution causes a change in one of the main findings obtained with SCU. In particular, the response in macroeconomic aggregates is larger for an economy with a higher degree of financial development as is depicted in Figure 4.15. However these findings are expected given

[9]In order to be able to make a comparison the main parameters are set at their baseline values. The exogenous discount rate β is set at 0.958 to obtain a median value of assets comparable with the SCU case.

Figure 4.14: Steady States for different degrees of Financial Development (Exogenous Discounting)



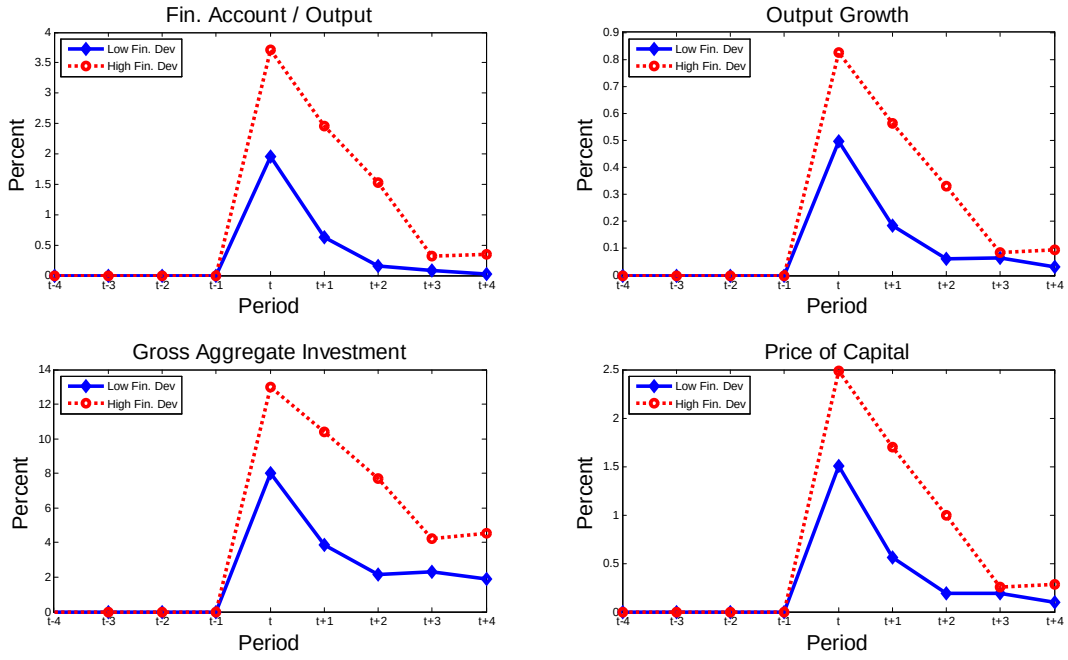
that the difference between the distributions cause that a higher degree of financial development causes an increase in debt holdings and the elasticity of the asset position to changes in interest rates are higher when debt is levels are larger.

Table 4.5: Steady State Capital, Bonds, and Leverage with Exogenous Discounting

	Capital	**Bonds**	**Leverage**
κ **= 0.30**	3.161	-1.004	0.289
κ **= 0.40**	3.183	-1.350	0.385
κ **= 0.50**	3.206	-1.698	0.482
κ **= 0.60**	3.231	-2.055	0.578
κ **= 0.70**	3.246	-2.399	0.672
κ **= 0.80**	3.264	-2.759	0.768

The main transmission channel proposed, by which the increase in the market price of capital permits a share of agents to increase their debt holdings and finance a larger level of investment, is not affected changing the specification to exogenous discounting. Figure 4.16 and Figure 4.17 show that when the borrowing constraint is measured using the steady state value of assets, the increase in

Figure 4.15: Response of Macroeconomic Aggregates for High and Low level of Financial Development (Exogenous Discounting)



macroeconomic aggregates is less than when the market value of assets is used in the borrowing constraints. These results confirm that the transmission channel is present regardless of the specification of the discount rate.

4.3 Conclusions

The theoretical analysis shows how the level of financial development, represented in the model using the share of assets that can be collateralized, influences the share of agents that are borrowing constrained in equilibrium. The proposed experiment examines the transition equilibrium of a heterogeneous agents economy given a permanent and unexpected change in the foreign determined interest rate.

The dynamic response to this aggregate shock affects differently economies in which financing constraints are more pervasive. This amplification in the aggre-

Figure 4.16: Aggregate Amplification Effect Low Financial Development (Exogenous Discounting)

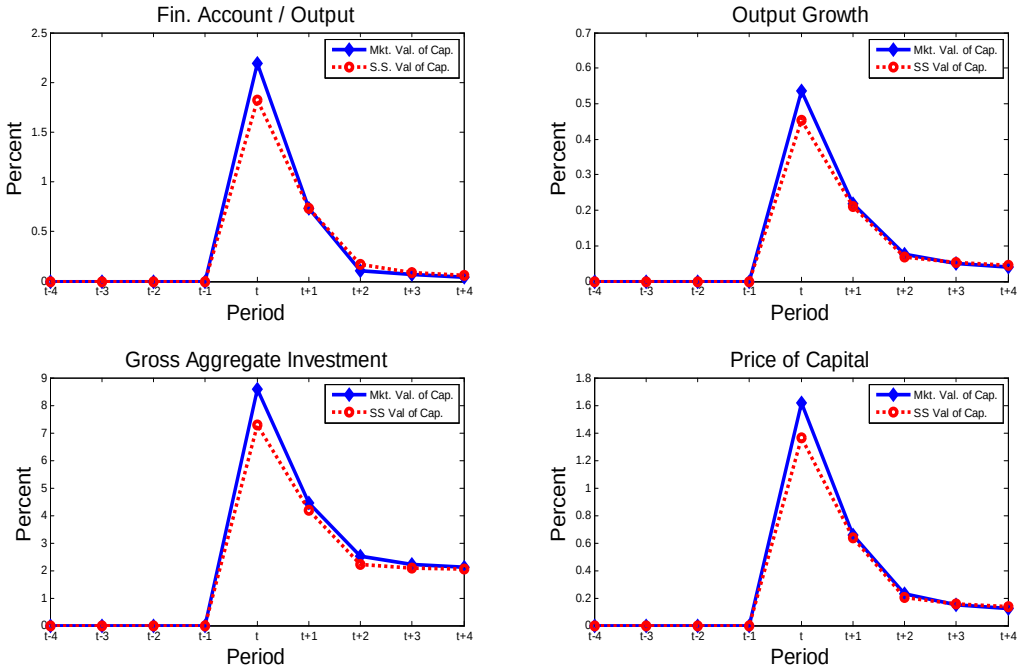
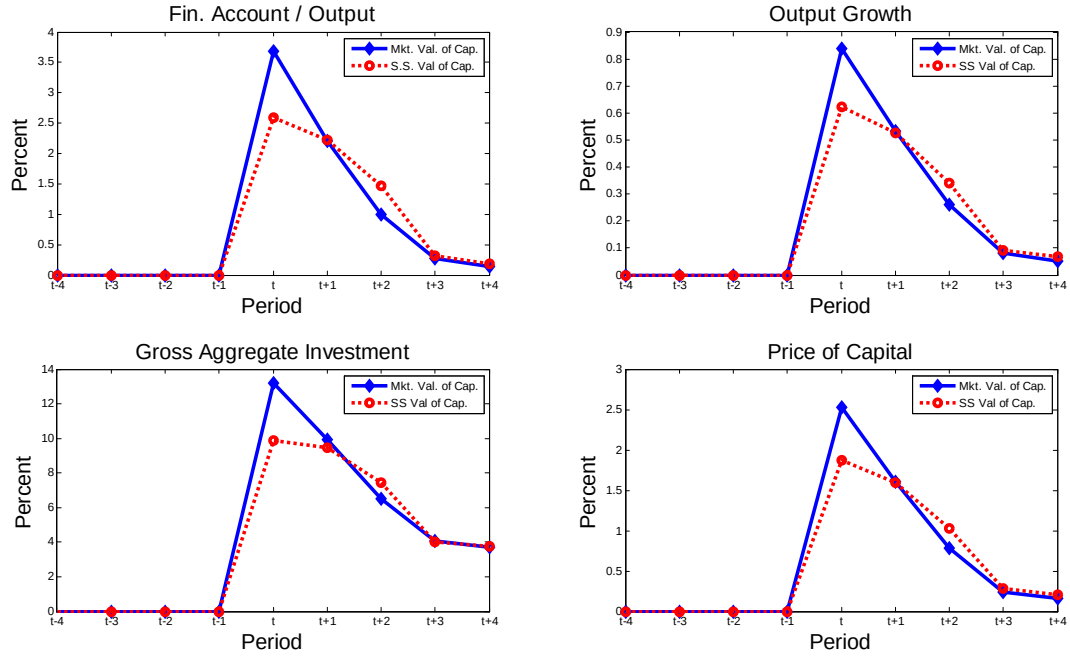


Figure 4.17: Dynamic Amplification Effect High Financial Development (Exogenous Discounting)



gate response is composed of two effects. Given that firms face an upward sloping supply of capital, a shock that induces unconstrained firms to invest causes increases in the aggregate price of capital. This produces a relaxation of the borrowing constraint for constrained firms. The second effect is related to the amplification in the response of an ex-ante constrained firm. Further ongoing research calculates the welfare gains that these periods have, for both constrained and unconstrained firms.

These findings are important in the current debate on the design of policies that try to mitigate the incidence of financial crisis. The imposition of capital controls, or limiting the increase in the value of capital in this model, would have an allocational effect that had been neglected so far in the literature. Therefore, a heterogeneous agents environment in which the behavior of both constrained and unconstrained firms is taken into account, is key to understand the implications of this type of policies. The increase in the price of capital allows firms that are constrained to increase their capital stock, and in some manner undoing the effect of a low level of financial development, at least while the *pecuniary externality* persists. Taking this into account, policies that would try to address directly the sources of the low level of financial development, and ultimately of the pervasiveness of financially constrained firms would be superior, to limiting financial flows.

Appendix A

Data Cleaning Procedure

All balance sheet data from firms is deflated using the CPI from IFS with 2005 as the base year.

The first step of the cleaning procedure is to exclude observations from balance sheet data that is not consistent. Observations with negative values for balance sheet components are excluded from the analysis.

The second step is to exclude firms with a negative Price to Book ratio or one that is larger than 100.

The third step is to calculate variables and ratios of interest and exclude outliers using the country specific distribution. The list of variables of interest is given in the Data Summary tables. The procedure excludes firm-year observations that lie above (below) the 95th percentile (5th percentile) for the country specific distribution of the variable of analysis.

Country-year aggregates from firm level data, means and medians are calculated using total assets as individual weights for observations. Country-year observations with less than 5 firms are excluded from the analysis.

Appendix B

Panel VAR Results

In this Appendix, I present the complete impulse responses for the different specifications of the Panel VAR.

Figure B.1: Impulse Response: High FD (All Sample)

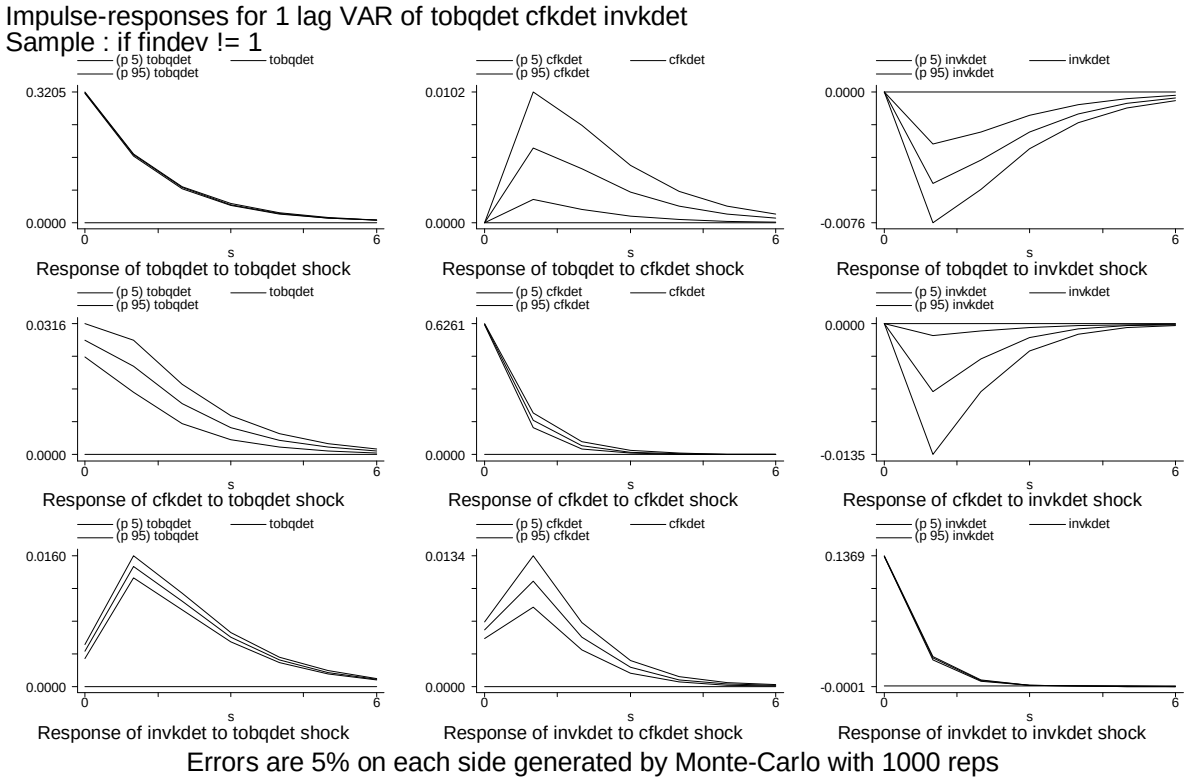


Figure B.2: Impulse Response: Low FD (All Sample)

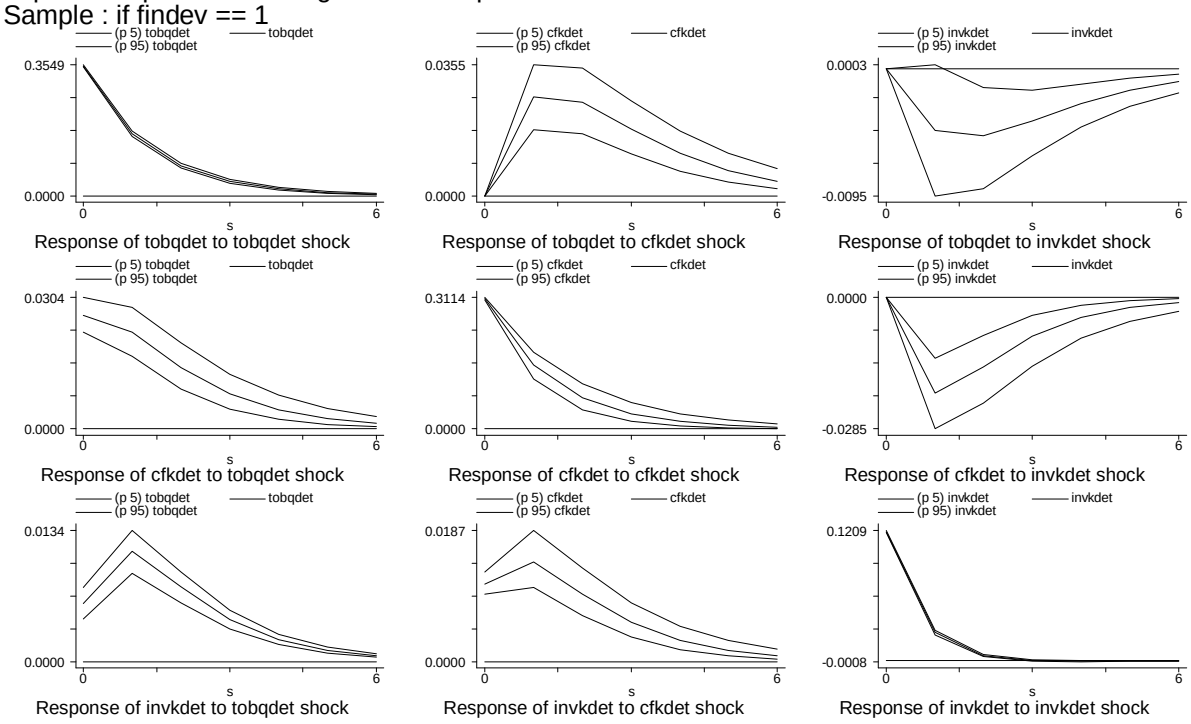


Figure B.3: Impulse Response: High FD (KI Boom)

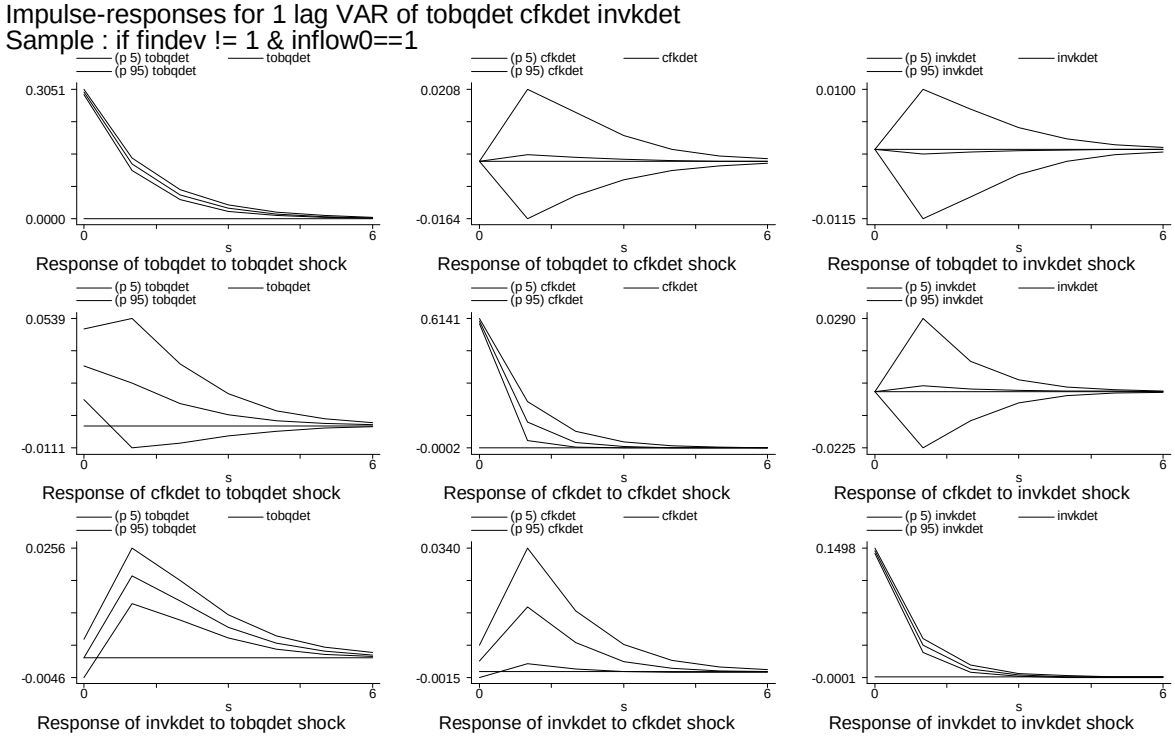
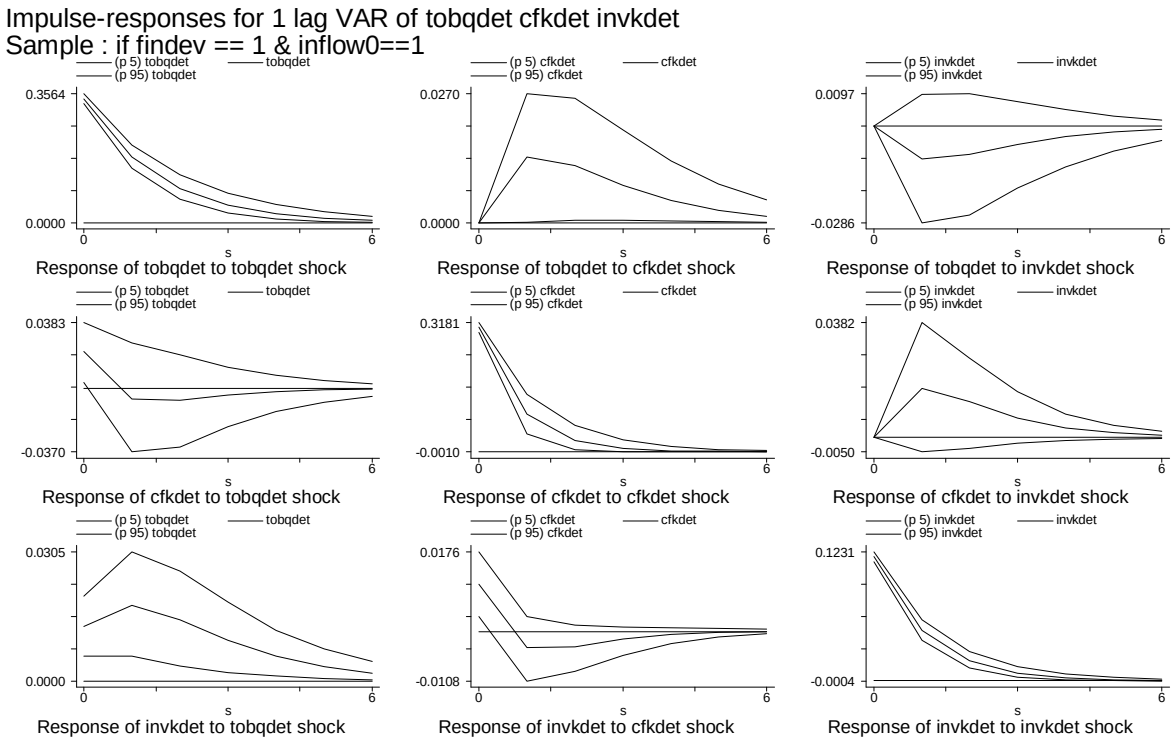


Figure B.4: Impulse Response: Low FD (KI Boom)



Appendix C

Solution Method

The solution method uses Value Function Iteration over a discretized grid for the endogenous and the exogenous state variables. The idiosyncratic shock process is approximated using the method of Tauchen (1986). By construction, the price of capital in the stationary steady state is constant, and agents expectations of the market price of capital do not play a role. Using the equilibrium policy functions and the exogenous shock transition probability matrix, the stationary distribution for a given interest rate and level of financial development can be derived.

The solution of the transition between steady states involves more steps, given that the price of capital, and thus the proportion of agents that are borrowing constrained evolves. The algorithm used to solve for this equilibrium is given by:

1. Solve for the initial and final steady state distributions, characterized by the solution to the stationary model, for two levels of the gross interest rate R^0 and R^1.

2. The economy at $t = 0$ is in the stationary steady state, characterized by the distribution $\mu^0\left(a, z; R^0, K^0\right)$. At the end of period $t = 0$, the interest rate R changes from $t = 1$ and stays permanently at the new level.

3. After T periods, with T arbitrarily set but finite, the economy will settle to the steady state consistent with the new interest rate R^1. This assumption is helpful because it permits to guess a finite sequence of the price of capital and to use backward induction to solve the firm-household problem. The final steady state value function will be given denoted by V_T.

4. Compute the sequence of the price of capital $\{q_t\}_{t=0}^{\infty}$, from a conjectured path of the aggregate capital $\{K\}_{t=1}^{\infty}$, given K^0.

5. Starting at $t = T - 1$, and using backward recursion and the conjectured path of the price of capital, find the policy and value functions that solve the problem given by Equations 4.12 to 4.15.

6. Given the sequence of policy functions, and starting from period 1 with the initial distribution, the sequence of distributions $\{\mu_t\}_{t=0}^{\infty}$, the level of aggregate capital and thus the market price of capital can be computed.

7. Check if the implied price of capital for $t = 0, ..., T$ is consistent with the pricing function conjectured by agents.

8. If not, update the sequence of aggregate capital and return to step 4.

9. Check if T is large enough by checking if the new steady state was attained for a $t < T$.

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