Financial Development and the Asymmetry of Monetary Policy

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Abstract

In this paper we develop a simple model of the relationship between financial markets and investment by entrepreneurs in the presence of a Central Bank. The model allows us to analyze how the level of financial development affects the way credit spreads –and therefore the volume of credit and output– react to monetary policy actions. We show that in countries where financial markets are poorly developed lending rates may react in an asymmetric manner to monetary expansions and contractions: monetary contractions generate a larger output impact than expansions. Other implications of the model are in line with those in the literature. Cross-country empirical evidence for this asymmetry is provided.

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1 Introduction

The role of monetary policy (MP) is to set short-term interest rates in order to influence prices and/or output. Although there seems to be a consensus in the literature about the existence of these relationships, there is still much debate regarding the fundamental mechanisms behind them, or the main channels through which MP affects real and other nominal variables.

At the theoretical level, the monetary approach stresses the *interest rate* or *liquidity channel*: an increase in monetary supply reduces interest rates, which in turn affects private spending –consumption and investment. An alternative approach stresses a *credit channel* (Bernanke and Blinder, 1988; Bernanke and Gertler, 1989, 1995; Bernanke et al., 1999; Gertler and Gilchrist, 1993). According to this view, the change in monetary conditions affects not only the "price of liquidity" (short-term interest rate), but also the conditions at which credit is allocated among the agents in the economy (external finance premium).

The acknowledgement of this credit channel has generated increased attention in recent years on the interplay between MP and financial intermediaries. This literature has looked both at how MP directly affects financial intermediaries –and, more generally, firms– by impacting their balance-sheets (Chatelain et al., 2003; Gertler and Gilchrist, 1994; Kashyap and Stein, 1995; Kashyap et al., 1993; Oliner and Rudebusch, 1996) and at how financial intermediaries intervene in the transmission channel through credit conditions (Freixas and Holthausen, 2006; Kashyap and Stein, 2000; Bolton and Freixas, 2005; Stein, 1998; Van den Heuvel, 2000).

Given that both the credit and liquidity channels operate through the financial system, the level of financial development should be a crucial factor in explaining MP effectiveness. This last feature has not been properly studied even though the issue has been raised in several forums.[1] Furthermore, as the financial system develops, the relative power of a channel as MP transmitter could change. In fact, it seems to be the case that the credit channel is more relevant in emerging or underdeveloped countries -with poor financial systems-, whereas as the economy develops the liquidity channel takes a more preeminent role in the transmission of MP (see Kamin et al., 1998). Still, the relationship between financial development and the effectiveness of MP has been mostly overlooked in the literature.

In this paper we attempt to give a first step in filling this gap. In particular, we are interested in analyzing how the level of development of the financial sector affects the way monetary policy actions are transmitted to credit conditions. Specifically, we look at the reaction of lending rates to changes in a policy rate, and we relate those changes to the degree of competition in the financial sector.

We develop a simple model that shows how in countries with less developed financial markets lending rates are not only significantly higher, but they also may present an asymmetric behavior. We show that the reaction of lending rates to expansionary and contractionary policies is different –monetary expansions may not reduce lending rates– and consequently output reacts more intensely to monetary contractions than to monetary expansions. The rest of the features of the model are consistent with other findings in the literature. We then

[1] An example is the *Conference on Financial Innovation and Monetary Transmission* held at the Federal Reserve Bank of New York (see the FRBNY Economic Policy Review of May 2002).

show empirical evidence for this asymmetric effect. We use a cross-section of more than fifty countries for which measures of financial development and monetary policy effectiveness can be calculated. The findings are in line with the predictions of the model: monetary policy is more likely to have asymmetric effects the lower the general development of the financial system.

The rest of the paper is organized as follows. In the next section we develop a simple model of banking credit in the line of Besanko and Kanatas (1993), Hölmstrom and Tirole (1997), Repullo and Suárez (1998, 2000) and Bolton and Freixas (2005), that allows us to analyze how lending rates react to changes in the policy interest rate. In section 3 we summarize a broader empirical analysis in which we have looked at the relationship between financial development (hereafter, FD) and monetary policy effectiveness (hereafter, MPE). In that section we briefly explain our measures of FD and MPE, and the main findings that support the implications of the model in Section 2. Finally, section 4 concludes.

2 A Simple Model of Lending by Financial Intermediaries

In this section we present a simple model that analyzes the importance of financial markets on the effectiveness of monetary policy in the short run. The model, in the spirit of those of Besanko and Kanatas (1993), Repullo and Suárez (1998, 2000) or Bolton and Freixas (2005), is a simple extension of Hölmstrom and Tirole (1997) and it is intended to analyze specifically two issues. First, we look at how unexpected liquidity shocks affect firms' borrowing capacity, without considering changes in inflationary expectations, i.e. we will focus on a short-run liquidity effect of monetary policy. Second, we try to understand whether or not the directions in liquidity changes are crucial for the size of output responses, i.e. we investigate if the effects of monetary policy are symmetric or not. We focus on the financial sector as the transmission mechanism of given monetary policy actions and, consequently, do not model the design of monetary policy or the demand side of the economy.

In our model, there are three types of agents: firms, financial intermediaries and the Central Bank. There are two periods. In the first period, financial contracts are signed and investment decisions are made. In the second period, investment returns are realized, claims are settled and output and prices are determined. All agents are risk neutral and limited liability applies.

2.1 Real Sector

We assume that there is a continuum of firms. Firms differ in their level of assets A, but they all have access to the same technology. The initial distribution of assets is given by $G(A)$. Each firm has one indivisible project in which to invest, with cost $I > 0$. If $A < I$, the firm needs $(I - A)$ external financing in order to carry out the project. For simplicity, assume that $G(I - \varepsilon) = 1$ for ε small enough. Thus, all firms need to borrow funds in order to invest. If firms can obtain the funding needed, in the second period the return of the project will be R if the project succeeds and 0 otherwise.

In the absence of proper incentives, firms may reduce the probability of success of the project and enjoy a private benefit. Entrepreneurs therefore can choose between two types of projects:

$$\text{Good project (high expected returns):} \quad \begin{cases} \text{private benefits} = 0 \\ \text{probability of success} = p_h \end{cases}$$

$$\text{Bad project (low expected returns):} \quad \begin{cases} \text{private benefits} = B \\ \text{low probability of success} = p_l \end{cases}$$

such that, $p_h - p_l = \triangle p > 0$ and B is a private benefit for the entrepreneur independent of whether the project is successful or not.

Let γ be the opportunity cost of capital in the interbank market. We assume that:

$$p_h R - \gamma I > 0 > p_l R - \gamma I + B \tag{1}$$

i.e., only the good project is economically viable. The reason for this assumption is the following: as the total expected return of bad projects, including private benefits, is below costs, financial contracts must be written in such a way as to exclude the possibility that a firm chooses to undertake a bad project.[2]

2.2 Financial Sector

There are two main agents in the financial sector: the financial intermediaries and the Central Bank.

2.2.1 Financial Intermediaries

The financial system is composed of many financial intermediaries. The financial market could be deep, with competition, or it could be shallow, with no competition whatsoever –in the limit, a single profit-maximizing monopolist. In the first case, we will assume that the capital of the financial intermediaries, K_I, will adjust to accommodate regulatory requirements as well as a zero profit condition. In the second case, we assume that $K_I = \overline{K_I}$ is fixed –at least in the horizon of the model– and the credit and interest rates will adjust to changes in market conditions or in the regulatory framework.

Financial intermediaries have to comply with two regulatory requirements imposed by the Central Bank:

1. They must pay a fixed cost, C, to be able to verify firms' returns.[3]

2. The amount of capital they own, K_I, must be such that the total amount of credit relative to K_I should satisfy a ratio of $\frac{1}{\delta}$, where δ is the minimum capital requirement.

2.2.2 Central Bank

The Central Bank has two main tasks:

[2] This restriction is similar in spirit and equal in form to the one in Holmström and Tirole (1997).

[3] This cost could be interpreted similarly to the monitoring cost in Hölmstron and Tirole (1997), although we omit the third project they include in order to generate this monitoring cost.

1. To impose prudential regulations on the financial intermediaries.

2. To carry out monetary policy actions in order to keep inflation low and, maybe, affect output.

Regarding the second task, the Central Bank regulates the total amount of money in the economy through operations in the interbank market, using the short-term interest rate γ as instrument. The objective is to keep prices constant taking as given the demand for real balances:

$$\frac{M}{P} = f(Y, \gamma) \tag{2}$$

where M is the total amount of money, P is the price level, and Y is aggregate output. We will assume that the price in period one, $P_1 = 1$ and γ is believed to have been set such that the price in period two, $P_2 = 1$. We then will allow for unexpected monetary shocks, as the Central Bank may try to deviate from its output or price targets. Given no change in inflation expectations, these nominal shocks will have an impact on P and/or on Y in the second period.

2.3 Financial Contracts

The financial contract must be designed in such a way that firms will always choose the good projects. One optimal contract could be:

1. Firms invest all their funds A, while the financial intermediaries will provide $(I - A)$.

2. Neither party is paid anything if the project fails.

3. If the project succeeds, the firms are paid R_F and the financial intermediaries are paid R_I.

4. Financial intermediaries charge a rate β for each loan.

Therefore, if the project succeeds we have that:

$$R_F + R_I = R \tag{3}$$

The total cost of the loan R_I is then

$$R_I = \beta(I - A) \tag{4}$$

Given that we need that our firms choose the good project, the financial contract must satisfy an incentive constraint (IC)[4]:

$$p_h R_F \geq p_l R_F + B \tag{5}$$

[4] It should be noticed that a participation constraint (PC) is also needed. In particular, we need that:

$$p_h R_F > \gamma A$$

If β is not too large, in particular if $\beta < \dfrac{R}{I}$, it is easy to show that the PC is not binding. That is, firms are always willing to get a loan for investment purposes.

It can be shown that for each value of γ there is a value of firm's assets $A(\beta, \gamma)$ for which the PC becomes binding instead of the IC. However, the values of β and γ for which this phenomenon occurs are outside the relevant range: notice, in particular, that $\beta > \frac{R}{I}$ would imply that investment projects have a lower return than banking finance, which seems to be counterintuitive. Thus, even though for a large β the PC could be binding, we focus our attention only in the case in which the IC dominates the PC.

or, alternatively,

$$R_F \geq \frac{B}{\triangle p} \tag{6}$$

Therefore, we have that:

$$R - \beta(I - A) \geq \frac{B}{\triangle p} \tag{7}$$

Given the fixed return of the project R, it is clear that whether the IC is satisfied depends on the level of assets –and, consequently, on the size of the loan– of the firm. From (7) we can derive, as a function of β, the critical level of assets needed for firms to satisfy the IC and be given access to credit:

$$A(\beta) = I - \frac{1}{\beta}\left(R - \frac{B}{\triangle p}\right) \tag{8}$$

This implies that, given β, only firms with $A > A(\beta)$ will have access to credit. Notice also that:

$$\frac{\partial A(\beta)}{\partial \beta} = \frac{1}{\beta^2}\left(R - \frac{B}{\triangle p}\right) > 0$$

It is clear that an increase in β, the lending interest rate charged by financial intermediaries, leads to an increase in the minimum size necessary to obtain credit and small firms are squeezed out of the credit market. Thus, we need to study the behavior of financial intermediaries –how they set the lending rate β– in order to be able to analyze the effect on the economy of changes in γ and β. This behavior depends on the structure of the financial market and, in particular, on the extent of development, which we associate with the level of competition.

2.3.1 Financial Contracts under Banking Competition (with deep financial markets)

In a deep financial market with perfect competition we should observe zero profits at the banking level. Financial intermediaries have to choose β to solve the following problem:

$$\Pi(\beta;\gamma) = \int_{A(\beta)}^{I} p_h \beta (I - A) dG(A) - C - \gamma \int_{A(\beta)}^{I} (I - A) dG(A) = 0 \tag{9}$$

where $\int_{A(\beta)}^{I}(I - A)dG(A)$ is the total amount of credit in the economy, derived from (8). It must be the case that the capital of the financial intermediaries, K_I, complies with prudential regulations,

$$K_I \geq \delta \int_{A(\beta)}^{I} (I - A) dG(A) \tag{10}$$

Our assumption of deep financial markets includes free entry into the financial intermediaries market. This ensures that the zero profit condition can be achieved, and that K_I will adjust so that equation (10) holds with equality.

Let $\beta = b$ be the solution to the problem defined in (9), i.e. b is such that $\Pi(b;\gamma) = 0$. This value b that solves (9) will depend on the parameter γ. Therefore we have a function $b = b(\gamma)$ for which higher γ implies higher b (see Lemma 1 below).

The existence of at least one equilibrium in this economy will depend crucially on $G(\cdot)$. To characterize the equilibrium, let us define:

$$H(\beta) = \frac{C}{p_h \int_{A(\beta)}^{I} (I - A) dG(A)} + \frac{\gamma}{p_h}$$

An equilibrium for this economy is a fixed-point solution to the above equation such that $\beta = H(\beta)$.

In this equation, the lending rate β has two components. The first one is the expected funding cost given by $\left(\frac{\gamma}{p_h}\right)$. The second is the average intermediation cost that is given by the expression $\left(\frac{C}{p_h \int_{A(\beta)}^{I} (I - A) dG(A)}\right)$.[5]

Now, it can be easily shown that $\lim_{\beta \to \infty} H(\beta) = \infty$ given that $\lim_{\beta \to \infty} A(\beta) = I$. Also, note that $H(\gamma) > \gamma$. Therefore, for a very large value of γ we could have a situation with no equilibrium, such as the one displayed on Figure 1, panel A. Alternatively, for small enough values of γ we could have a solution with more than one equilibrium, such as that in Figure 1, panel B. Obviously, the number of equilibria depends on $G(\cdot)$ and on γ.[6] In Panel B, the equilibrium at point A is stable while the equilibrium at point C is unstable. We focus hereafter on the stable equilibrium.

[FIGURE 1 HERE]

Lemma 1: If there exists a stable equilibrium at $b(\gamma)$, the profit function is increasing in β and $b'(\gamma) > 0$.

Proof: At the stable equilibrium, $\frac{\partial H(b)}{\partial b} < 1$. This implies $\frac{C p_h (I - A(b)) g(A(b)) A'(b)}{p_h^2 \left(\int_{A(b)}^{I} (I - A) dG(A)\right)^2} < 1$ and noting that the equilibrium condition $b = H(b)$ can be expressed as $(p_h b - \gamma) = \frac{C}{\int_{A(b)}^{I} (I - A) dG(A)}$, the condition for the stable equilibrium is that

$$-(p_h b - \gamma)(I - A(b)) g(A(b)) A'(b) + \int_{A(b)}^{I} p_h (I - A) dG(A) > 0 \tag{11}$$

where the left-handside corresponds exactly to the derivative of the profit function with respect to β evaluated at b.

From (9), we have the solution

$$b = \frac{C}{p_h \int_{A(b)}^{I} (I - A) dG(A)} + \frac{\gamma}{p_h} \tag{12}$$

[5] Alternative specifications for the intermediation cost C do not affect the results significantly, so we opted for keeping the simplest possible specification.

[6] There is a maximum value of γ, say $\overline{\gamma}$, for which there is a single equilibrium and, beyond which there is no zero-profit equilibrium (specifically, a no-trade equilibrium). $\overline{\gamma}$ is a function of $G(\cdot)$ that can be found by solving for the zero profit condition at a point where $\frac{\partial H(\beta)}{\partial \beta} = 1$. No explicit expression for $\overline{\gamma}$ can be obtained, though.

By implicitly differentiating with respect to γ and solving out for the derivative we obtain

$$\frac{\partial b}{\partial \gamma}=\frac{\int_{A(b)}^{I}(I-A)dG(A)}{p_h\int_{A(b)}^{I}(I-A)dG(A)-(p_h b-\gamma)(I-A(b))g(A(b))A'(b)}>0 \tag{13}$$

given that the numerator is always positive and the denominator, from the first part of the lemma, is positive at the stable equilibrium.

This last result is quite intuitive. In (12) it can be seen that when γ increases there are two effects on b. First, a higher funding cost for the intermediary (cost channel). Second, as β increases and some entrepreneurs are squeezed out of the credit market, the average intermediation cost increases, pushing b further (a disintermediation channel). This is shown in Figure 2.■

[FIGURE 2 HERE]

2.3.2 Financial Contracts without Banking Competition (without deep financial markets)

In a setting with shallow financial markets, we assume that K_I is fixed and that there is imperfect competition. Then, β must solve the following problem:

$$W(\beta;\gamma,K_I)=\underset{\beta}{Max}\int_{A(\beta)}^{I}p_h\beta(I-A)dG(A)-C-\gamma\int_{A(\beta)}^{I}(I-A)dG(A) \tag{14}$$

$$\text{s. t. } \overline{K_I}\geq\delta\int_{A(\beta)}^{I}(I-A)dG(A) \tag{15}$$

Given no free entry in the short-run and K_I fixed at $\overline{K_I}$ equation (15) may hold with inequality and, furthermore, if it holds with equality then credit cannot possibly increase in the short run.

Assume now that $B\left(\gamma,\overline{K_I}\right)$ solves $W\left(\beta;\gamma,\overline{K_I}\right)$.

Lemma 2: For each γ, $B\left(\gamma,\overline{K_I}\right)\geq b\left(\gamma\right)$.

Proof: As $W\left(b\left(\gamma\right);\gamma,\overline{K_I}\right)=0$ when (15) is not binding we can differentiate the profit function W with respect to β and evaluate it at b, yielding

$$-\left(p_h b-\gamma\right)\left(I-A\left(b\right)\right)g\left(A\left(b\right)\right)A'\left(b\right)+\int_{A(b)}^{I}p_h(I-A)dG(A)$$

which is strictly greater than zero at the stable equilibrium (Lemma 1). Therefore B must be strictly greater than $b\left(\gamma\right)$ at all γ corresponding to stable equilibria. If $\gamma=\overline{\gamma}$, then an immediate extension of Lemma 1 implies that $B\left(\overline{\gamma},\overline{K_I}\right)=b\left(\overline{\gamma}\right)$, with a unique zero-profit equilibrium.

When (15) is binding a similar reasoning applies.■

At the point of maximum profit B satisfies the optimality condition

$$\int_{A(B)}^{I} p_h(I-A)dG(A) = (p_h B - \gamma)(I - A(B))\, g(A(B))\, A'(B)$$

where the intuition is that that the loss of the net financial income $(p_h B - \gamma)$ of the fraction of firms that are squeezed out of the credit markets must be equal to the increase in income due to changes in B.

Note that $B\left(\gamma, \overline{K_I}\right) \geq b(\gamma)$ implies that $A(B) \geq A(b)$. Thus, when financial markets are shallow, credit spreads (spread between lending and interbank interest rates) are larger, affecting credit-constrained firms and in turn leading to a lower level of output and a lower capacity for output growth.[7] Additionally, notice that our setup suggests that financial development will occur endogenously in an economy such as ours where there are productive projects that are not being carried out because of the high profits –large spreads– of the financial system.

We have seen that financial cost tends to be higher when there is little competition in financial markets. But, how do lending interest rates respond to changes in market liquidity? Although the answer to this question will depend on the distribution of assets $G(\cdot)$, it should be the case that when there is no competition, the response of lending rates will present a point of asymmetry relative to the response when there is market competition.

Define $\underline{\gamma}$ as the largest value of γ for which $B\left(\underline{\gamma}, \overline{K_I}\right)$ is such that $\overline{K_I} = \delta \int_{A\left(B\left(\underline{\gamma}, \overline{K_I}\right)\right)}^{I} (I - A)dG(A)$.

Lemma 3: $B\left(\gamma, \overline{K_I}\right)$ presents a nondifferentiability at $\underline{\gamma}$. Therefore $\dfrac{\partial B\left(\gamma, \overline{K_I}\right)}{\partial \gamma}$ is "asymmetric" at $\underline{\gamma}$.[8]

Proof: When $\gamma = \underline{\gamma}$ and (15) holds with equality, a decrease in γ can not be followed by a decrease in $B\left(\gamma, \overline{K_I}\right)$ as credit is at its maximum level. Therefore, the decrease in γ can only generate an increase in the profits of the banking firms through a higher intermediation margin $(p_h \beta - \gamma)$. However, an increase in γ when $\gamma = \underline{\gamma}$ will immediately be followed by an increase in $B\left(\gamma, \overline{K_I}\right)$ and a reduction of total credit.■

We show in Figures 3 the form of the $b(\gamma)$ and $B\left(\gamma, \overline{K_I}\right)$ functions. Lemma 2 proves that these two functions must meet at $\overline{\gamma}$, the last possible value of γ for which there is a zero-profit equilibrium. $B\left(\gamma, \overline{K_I}\right)$ could continue beyond $\overline{\gamma}$ (negative profits) or it could be argued that only situations with positive profits are reasonable. In Figure 4 we plot the derivatives $\dfrac{\partial b(\gamma)}{\partial \gamma}$ and $\dfrac{\partial B\left(\gamma, \overline{K_I}\right)}{\partial \gamma}$, which show more specifically how lending rates react to changes in the monetary policy rate. This result is quite intuitive, but it is also quite relevant:

[7] This relationship between economic growth and financial market development has already been extensively discussed in the literature (Bencivenga and Smith, 1991; Greenwood and Jovanovic, 1990; King and Levine, 1993; Levine, 1997; Levine et al., 2000; Levine and Zervos, 1998; Rajan and Zingales, 1998).

[8] More formally, $\dfrac{\partial B\left(\gamma, \overline{K_I}\right)}{\partial \gamma}$ does not exist, given that $\lim\limits_{h \to 0^-} \dfrac{B\left(\gamma + h, \overline{K_I}\right) - B\left(\gamma + h, \overline{K_I}\right)}{h} = 0$ and $\lim\limits_{h \to 0^+} \dfrac{B\left(\gamma + h, \overline{K_I}\right) - B\left(\gamma + h, \overline{K_I}\right)}{h} > 0$. It is precisely this different slope given a positive or negative change in γ that we call asymmetry.

lending rates will not react to monetary policy actions when credit is constrained by the lack of depth –low levels of banking capital and no free-entry– of the financial markets.[9]

[FIGURES 3 AND 4 HERE]

2.4 Monetary Policy

Given Lemma 3, we can now study how an expansionary monetary policy affects output. In our model, unexpected monetary policy actions will have real effects through their impact on the availability of credit, and these effects will depend on the extent of competition in the financial market. As we have already mentioned, we are only interested in changes in market liquidity in the context of financial system competition, without taking into account changes in inflation or output expectations. As this model focuses on the short-run, changes in the nominal interest rate will translate into changes in the real interest rate in the short-run given fixed inflation expectations. Of course, a more dynamic version of this model should account for inflation expectations and explicitly model the Central Bank's actions.

Defining output as

$$Y = \int_{A(\beta)}^{I} p_h R dG(A) \tag{16}$$

it is clear that unexpected changes in γ will affect P or output Y in period 2 via an expansion of credit and the demand for real balances (2). If the Central Bank increases M unexpectedly so as to decrease γ, in the second period we will have that:

$$\hat{P} = \hat{M} - \frac{1}{f}\left[f_1 \frac{\partial Y}{\partial \beta}\frac{\partial \beta}{\partial \gamma} + f_2\right]\frac{\partial \gamma}{\partial M} \tag{17}$$

Definition 1. *Asymmetry of monetary policy.* Monetary policy is asymmetric if the effect on output –and prices– of a contractionary policy (a reduction in M or an increase in γ) is different from that of a monetary expansions (increase in M intended to decrease γ).

Proposition 1. *Asymmetric effectiveness of monetary policy.* In a shallow financial market without banking competition there is a value of γ at which monetary policy is asymmetric.

Proof: The proof follows from lemma 3. As $\dfrac{\partial \beta}{\partial \gamma}$ will be zero when (15) is binding and γ decreases from $\underline{\gamma}$, then $\hat{Y} = \frac{\partial Y}{\partial \beta}\frac{\partial \beta}{\partial \gamma} = 0$. That is, when there is no banking competition, there is a point $\underline{\gamma}$ where expansionary monetary policy has no effect on output and therefore produces only inflation; given that $\dfrac{\partial \beta}{\partial \gamma}$ is positive when $\gamma = \underline{\gamma}$ and γ increases, then contractionary monetary policy will reduce output and its effect on prices will depend on the demand for real balances.■

We do not comment on $\frac{\partial Y}{\partial \beta}$, which depends on the structure of the economy (the distribution of assets $G(\cdot)$) that we left unspecified. The main focus of our analysis was the impact

[9] The functions in the figures have been plotted making the specific assumption that the distribution of firm's assets is Gaussian. All our formal results, however, are independent of this assumption.

of changes in M and γ on the determination of lending rates, and therefore on credit and the possible asymmetry of this impact. An analysis of $G(\cdot)$ could give further insights on the effectiveness of monetary policy to expand output through expansion of credit, but we leave that issue for future research.

2.5 Some comparative Statics

We provide some comparative statics similar to those given in Hölmstrom and Tirole (1997), although we only show the final results on the lending rates functions $b(\gamma)$ and $B\left(\gamma, \overline{K_I}\right)$ in Figure 5.

1) A credit crunch, or a reduction in K_I, is only meaningful in our model when the financial markets are shallow. In deep financial markets, free entry guarantees that firms will always have credit available through the banking system or through alternative intermediaries. In the case of shallow markets, Figure 5, panel A, shows the immediate effects: the point of asymmetry $\underline{\gamma}_1$ increases to $\underline{\gamma}_2$, and in the range $[0, \underline{\gamma}_2]$ lending rates $b(\gamma)$ increase. Credit is reduced because of the higher restriction implied by prudential regulations and, consequently, output also decreases.

2) A collateral squeeze. We model a collateral squeeze as a shift to the left in the distribution of firms' assets $G(A)$. The results in this context are quite interesting. In shallow financial markets a collateral squeeze reduces the lending rates for all values of γ. The intuition here is that there is more mass of firms with low net worth –and therefore asking for large loans– and a reduction in the lending rate allows to expand the total amount of credit, given that it is the small firms that are net-worth constrained. It is unclear whether output will increase, however, since this effect depends on whether the final number of firms with access to credit is larger, or not, and this depends on the change in the distribution $G(A)$. In the case of deep financial markets, $b(\gamma)$ rotates, so that for low values of γ $b(\gamma)$ decreases whereas it increases at the higher range of γ. The intuition here is that firms are concentrated on the lower range of the size distribution. Thus, when γ is small, large firms already have credit, but there is a high mass of small credit-less firms which can be captured by lowering the lending rate $b(\gamma)$. When γ, is large, an increase in $b(\gamma)$ generates little loss of credit volume but generates a compensating increase in intermediation margin.

[FIGURE 5 HERE]

These results are generally in line with those in Hölmstrom and Tirole (1997), that find the same effects on the lending rates –except for this last qualification in the case of a collateral squeeze.

3 Empirical Evidence on the Asymmetry of Monetary Policy

In order to offer some empirical evidence regarding the implications of our model and, more specifically, the possible asymmetry of monetary policy actions we use data on a large cross-section of countries. Data availability has been the main determinant of the final set of countries analyzed and of the methodologies employed. The features of the data and a more thorough empirical analysis, that looks at additional issues, are carefully described in Carranza et al. (2005). We concentrate on the issue of asymmetries, although we first provide a discussion on how we have measured both FD and MPE.

3.1 Measuring Financial Development and Asymmetry in Monetary Policy Effectiveness

A detailed discussion on the literature on measuring FD and MPE can be found in Carranza et al. (2005). We concentrate here on the measures that we have employed in the analysis specific to this paper.

3.1.1 Financial Development Factors

Several variables have been traditionally used to measure the degree of FD. These measures are based on the size of the financial intermediation sector -relative to the size of the economy or to the size of the Central Bank-, the development of the stock market, market structure characteristics and the availability of financial products. For our analysis, we have used the database in Beck et al. (2000) –that contains yearly information on twenty-two indicators for a comprehensive set of countries– even though we had to discard some variables that were not available for a sufficient number of countries.[10] In Table 1 we describe the variables contained in the database.[11] We use for our analysis the average values of the different indicators from 1989:2001, adjusting for missing observations.

[TABLE 1 HERE]

Even after the deletion of some variables, we keep fifteen final indicators of FD. This would make our analysis and discussion unmanageable. Since some of the variables refer to similar concepts, we have attempted to reduce the number of indicators by finding a more compact set of measures.

Principal components and factor analysis have been traditionally used in this type of settings.[12] The methodology of principal components finds combinations of a set of variables that explain most of the variance/covariance of the original variables. These *components* are found from the characteristic vectors of the covariance matrix, and are orthogonal to one another. There are as many components as original variables, but by taking the characteristic vectors associated with the highest eigenvalues one may be able to capture, with only a few measures, most of the variation present in the data. Since these components may not have a clear interpretation, exploratory factor analysis can be used to give a theoretical interpretation to the new variables. Factor analysis rotates the identified components –by changing the coordinates of the initial variables in the space of the components– in order to associate more closely the original variables to each component. Thus, the rotated

[10] This is a standard problem when dealing with developing economies.

[11] A more detailed description of variables and data sources can be found in Beck et al. (2000).

[12] Manuals on multivariate analysis contain more thorough descriptions of the methodologies. See, for example, Rencher (2002) or Srivastava (2002).

components -factors- can be interpreted in terms of which original variables are highly related to each of them.[13]

We have performed an exploratory factor analysis on the fifteen indicators for which sufficient information was available for 59 countries. We found the principal components of the correlation matrix of the fifteen indicators, and decided to keep the first three components, which accounted for 53, 11 and 8 per cent of the total variation respectively (i.e. 72 per cent of the total variation). The remaining twelve components had a much lower explanatory power. We then rotated the components through a VARIMAX rotation and found the loadings that each variable had in the three factors. Table 2 shows the loadings of the fifteen observed indicators. Those with high absolute value have been highlighted in bold. The table also shows the commonality and specificity of each variable.

[TABLE 2 HERE]

The results suggest a nice interpretation of the three factors. The first factor might be interpreted as the "overall size and depth of the *financial intermediaries* sector". Notice that the variables with high loadings reflect the relative size of financial assets to GDP or measure costs of the functioning of the financial intermediaries. The signs are relevant: variables with negative loadings are positively related to the size and efficiency of the financial sector whereas the two variables with positive loading are negatively related. The second factor can be thought as reflecting the "level of *activity/volatility in the stock market.*" The third factor is associated with the *relative size of the Central Bank*. All three factors are intuitive and appealing from the point of view of finding a few relevant composite measures of FD. We believe that the identification of these three factors, and the simplification of the problem of measuring financial depth, are by themselves nice contributions of this preliminary analysis.

3.1.2 Effectiveness of Monetary Policy and Asymmetric Effects

The literature has been dealing with the issue of MPE mostly through the use of VAR analysis (see Bagliano and Favero, 1998; Bagliano et al., 1999; and Christiano et al., 1999, 2005) or through more structural macroeconometric models (e.g. Fair, 2005).We construct several measures that are based on how long it takes for MP to be effective and on the intensity of the impact. These measures are based on VAR models 'a la Christiano et al.'

[13]The usual factor analysis setup represents the observed variables y_j, $j = 1...K$ for individuals $i = 1...N$ as being generated from linear combinations of the J common unobserved factors F_{ji} and K specific factors s_{ki}:

$$\begin{aligned} y_{1i} &= \alpha_{11}F_{1i} + ... + \alpha_{J1}F_{Ji} + s_{1i} \\ &... \\ y_{Ki} &= \alpha_{1K}F_{1i} + ... + \alpha_{JK}F_{Ji} + s_{Ki} \end{aligned}$$

The coefficients α_j are called the *factor loadings*. These loadings are normalized, so ideally we would like to have coefficients close to one and close to zero which would allow for interpretation of the factors. The amount of variance of the variable y_j explained by the common factors F_1 to F_J is called the *commonality* and the amount of variance unexplained -and therefore explained by the specific factor s_j- is called the *specificity*.

(1999, 2005). Most of the literature focused on a few developed economies, mainly because of data limitations. So far we are not aware of studies that have attempted to compare the performance of MP across-countries and to relate MPE to other economic variables.[14]

In order to measure MPE, we follow the setup in Christiano et al. (1999, 2005). We first define a reduced-form VAR

$$Y_t = \Gamma Y_{t-1} + e_t \tag{18}$$

where Y_t is divided into three blocks with a specific ordering:[15] $Y_t = \begin{pmatrix} Y_{1t} \\ mpi_t \\ Y_{2t} \end{pmatrix}$. The first block, Y_{1t}, is the set of variables that have influence in the decisions of the Central Bank (CB) but are not contemporaneously affected by the MP instrument (MPI). The second block, mpi_t, is the specific MP instrument used by the CB, which responds to current values of the variables in Y_{1t}. Finally, Y_{2t} is a set of variables that are contemporaneously affected by the MPI and that enter the CB's decision only with a lag. Therefore, we assume that the CB follows a MP rule such as

$$mpi_t = f(Y_{1t}) + g(mpi_{t-1} + ... + mpi_{t-4} + Y_{1t-1} + ... + Y_{1t-4} + Y_{2t-1} + ... + Y_{2t-4}) + e_{mpi,t} \tag{19}$$

where $f(\cdot)$ and $g(\cdot)$ are (linear) functions and where we have already specified the number of lags (four, as in Christiano et al. 2005). Variables in Y_{1t} only respond to their own lags and to lags of mpi_t and Y_{2t}. Variables in Y_{2t} respond to contemporaneous Y_{1t} and mpi_t, and to lags of all variables.

In their papers, Christiano et al. (1999, 2005) use a number of variables in both Y_{1t} and Y_{2t}.[16] Because of data limitations, we have included an output gap measure –HP-detrended (log)real GDP or (log)IIP–, the consumer price index (CPI)-based inflation rate and the long-term interest rate in Y_{1t}. For the MPI, we have tried two alternative specifications. Given the lack of uniform interest rate measures, we have decided to use money-based variables. In our first specification, we use the growth in a monetary aggregate, thus focusing only on the direct impact of growth in money on output, inflation and interest rates. In a second, more complete specification, we use growth in narrow money (the reserves measure available in the *International Financial Statistics*, IFS, database of the IMF database) as the monetary policy instrument (MPI) and include the growth in the monetary aggregate as a variable in Y_{2t}.

After OLS estimation of the reduced-form VAR $Y_t = \Gamma Y_{t-1} + e_t$, the ordering above can be used to identify the structural shocks in a "block-Cholesky" ordering.[17] Once the structural shocks have been identified, the impulse response functions of the different variables to shocks in the MPI are calculated. This is precisely what Christiano et al. (2005) use

[14] García-Herrero and del Río (2003) carry out a related analysis of monetary policy design across countries.

[15] The order is irrelevant for the estimation of the VAR coefficients, but it is key for the subsequent identification of the structural shocks.

[16] Specifically, Y_{1t} contains real GDP, real consumption, the GDP deflator, real investment, real wages and a measure of labor productivity. The second block, Y_{2t}, contains real profits, growth in a monetary aggregate and a measure of the real prices of stocks. Finally, mpi_t is a short-term interest rate, even though they alternatively use, as we do, a measure of reserves.

[17] See Hamilton (1994) for a review of this identification scheme.

to characterize the response to MP. We follow a similar approach by using the Cholesky-ordering of variables –assuming that inflation does not respond contemporaneously to the output gap– and calculating the impulse response functions to the MPI.

In order to look at possible asymmetries, we include in the VAR a set of lagged terms that measure monetary contractions. The equation for any variable k in the final VAR looks like:

$$\begin{aligned} y_{kt} &= a_0 + \boldsymbol{\gamma}_k' \left[Y_{t-1}' \;\; Y_{t-2}' \;\; Y_{t-3}' \;\; Y_{t-4}' \right]' + ... \\ &\quad ... + \gamma_{k1}^{mc} \left[\Delta mpi_{t-1} \right]^- + \gamma_{k2}^{mc} \left[\Delta mpi_{t-2} \right]^- + \gamma_{k3}^{mc} \left[\Delta mpi_{t-3} \right]^- + \gamma_{k4}^{mc} \left[\Delta mpi_{t-4} \right]^- + e_{kt} \end{aligned} \tag{20}$$

where $\boldsymbol{\gamma}_k$ is the $(4K \times 1)$ vector of coefficients of the regular lagged terms of the K variables in the VAR and $[\Delta mpi_{t-i}]^-$ are lagged terms that are zero for monetary expansions and take the value of the change in the mpi for monetary contractions. Therefore the coefficients γ_k^{mc} measure the differential effects of lagged changes in the mpi when these changes correspond to a contractionary MP.

This VAR can still be estimated by simple OLS, given that the explanatory variables are the same in all K equations. Once the equations have been estimated, we find the impulse response functions to structural shocks. We do that by simulating the response to reduced-form shocks using the estimated parameters –accounting for the sign of the lagged mpi terms in the simulation– and then we use a Cholesky decomposition of the covariance matrix of the reduced-form errors to identify the structural shocks in a recursive framework, with the variables ordered in the same manner as above. We calculate two IRF's, one for a positive shock to the mpi and one for a negative shock to the mpi. If there are significant asymmetric effects, the two impulse response functions should be different, and the measures of MPE will differ depending on the sign of the shock.

The measures of MPE that we employ are listed in Table 3. They refer to the lag with which the MPI affects output, the size of the direct impact of the MPI (the coefficient on the first significant MPI term in the output equation $y_t = a_0 + ... + a_{11}\Delta m_{t-1} + a_{12}\Delta m_{t-2} + a_{13}\Delta m_{t-3} + a_{14}\Delta m_{t-4} + e_{2t}$) and the accumulated effect after a number of periods of the structural shock (cumulated impulse response function to a monetary shock). One difficulty with the selected measures has to be noted. If for a certain country none of the coefficients of the four lags of the MPI in the output equation is significantly different from zero, the first two measures cannot be calculated. This is why a number of countries have to be dropped from the analysis when the *lag* and *coefficient* variables are included. For the analysis of asymmetries, we distinguish the lag, the size of the direct impact and the accumulated effects of structural shocks for monetary contractions (negative growth in money or reserves). Additionally, we construct four dummy variables, that account for whether there is a significant asymmetric effect, and whether it is stronger: if the coefficient on the negative lagged MPI is significantly positive, that means that the effect of a monetary contraction is larger than that of a monetary expansion.

[TABLE 3 HERE]

We have collected data for as large a set of countries as possible. We placed special effort on ensuring that the final set of countries overlapped with those for which we could effectively measure FD. In order to make the comparisons more immediate, we opted not to combine different data sources, and used the data available in the IFS database. We obtained data for a total of 73 countries, although nine of them presented gaps and/or breaks in the data that impeded the MPE analysis. For each country we collected quarterly data on five variables: an output measure (either GDP volume or an industrial production index), a measure of prices (CPI), the interest rate that was available in the database (long term if possible), a monetary aggregate (M2) and a measure of narrow money. Table 4 shows the list of countries, number of available observations for the final analysis -the period for which the different series overlap- and the measures used for output and the interest rate.[18]

[TABLE 4 HERE]

For the purposes of control and in order to obtain further results, data on other macroeconomic variables were also collected. We show these variables and sources in Table 5, although in the present paper we keep the comments to a minimum.

[TABLE 5 HERE]

3.2 Is Asymmetry related to Financial Development Factors?

The full results in Carranza et al. (2005) contain the coefficients of the two sets of VARs with and without asymmetric terms and an extensive discussion of the correlations of the macroeconomic variables with the FD and MPE measures. We focus now on the results of a final set of cross-country regressions where we relate the MPE measures to FD factors and a limited set of macroeconomic variables. These are regular OLS regressions and we have included four additional probit analyses, where the dependent variables are the four dummy variables described in Table 3. Table 6 shows a summary of the results, where we only include information on the significance and sign of the relationships.

[TABLE 6 HERE]

The relationships of MPE with macroeconomic variables are consistent with intuition. There is no clear picture with respect to the overall MPE measures, although there is some evidence that the level of FD might be negatively associated with MPE, a result that is worth further attention since it is not in line with our model's predictions.

With regards to our main interest, the table shows that the effect of monetary contractions is significantly different in countries with less developed financial systems: the probit analysis of both neg_terms_mon (row 14) and neg_terms_res (row 29) show that the less developed the financial system, the higher the likelihood that monetary contractions will have significantly different effects. Additionally, the size of the Central Bank is related to the probability that asymmetric effects are present and that these asymmetric effects are in the direction predicted by our model: contractionary shocks have a higher impact than expansionary ones. Rows 14-15 show that when the financial sector is relatively larger with respect to the Central Bank, it is more likely that asymmetric effects will appear, thus hinting at a credit-induced explanation of these asymmetries. Finally, the size of the Central

[18] Where no long-term interest rate was available, we tried with both a market interest rate and the discount rate to check for robustness of results. Never did the choice of the interest rate affect the results on MPE, so we used the interest rate with the highest number of observations.

Bank is related to the lag in effectiveness of changes in reserves: the smaller the Central Bank compared to the rest of the financial sector, the longer it takes for reserve changes to be effective (row 16).

4 Conclusion

We are aware of the limitations of both the theoretical analysis –mainly, the static nature of the model and the passive and naive role played by the Central Bank– and empirical analysis –low number of observations (40-50 in the regressions/correlations) and the fact that both the FD factors and the MPE measures are cross-sectional variables generated after a time series analysis.

However, we believe that the conclusions of the model are quite intuitive and in line with those of the existing literature while adding an interesting insight. The appearance of asymmetric effects of economic policies is a phenomenon that has been overlooked by the literature, and we provide a first contribution that should spur more in-depth analyses. The empirical results should be taken as preliminary –and rough– evidence in favor of these asymmetric effects of MP. We believe that most of these results make intuitive sense and support the predictions of the model: credit is an important channel for the transmission of MP actions, and the level of development of the financial sector has implications for the strength of this transmission. In particular, monetary contractions may be more effective than monetary expansions in credit-constrained economies. This should give guidance to policymakers when implementing MP actions in countries with shallow financial markets.

Our paper opens several fruitful avenues for research and should be seen as a first step towards furthering our understanding of the workings of monetary policy and its interplay with financial intermediaries.

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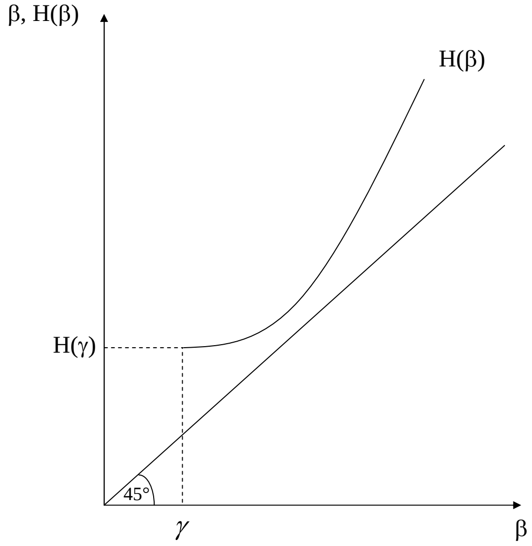
Figure 1: Equilibrium with deep financial markets

Panel A: No equilibrium



Panel B: Two equilibria - A: stable C: unstable

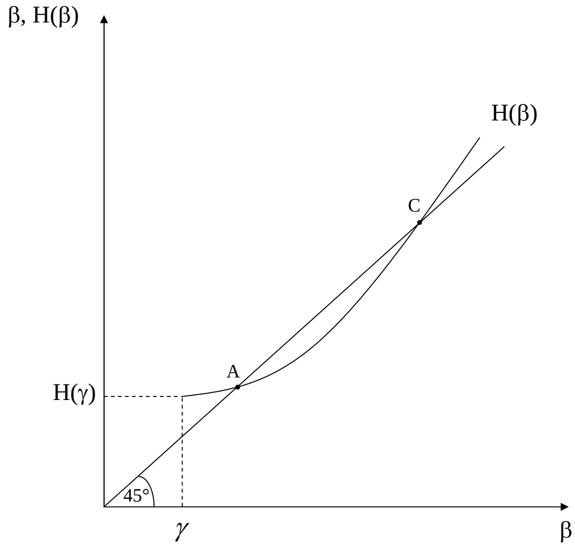


Figure 2: Equilibrium with deep financial markets

A change in γ

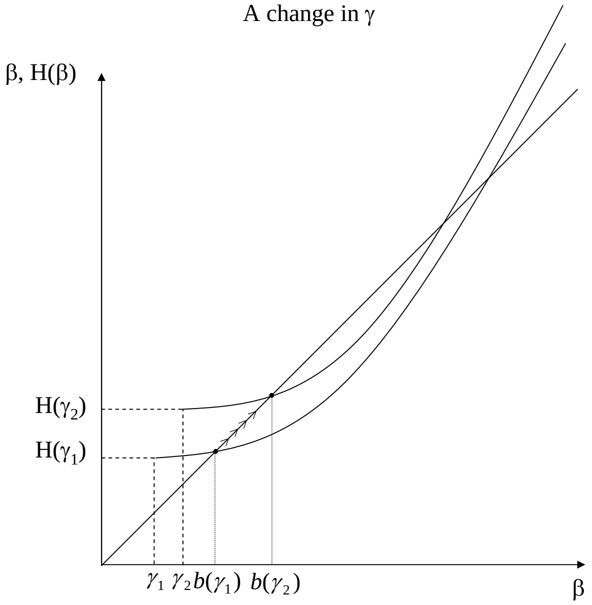


Figure 3

b(γ) and B(γ;K_I) functions

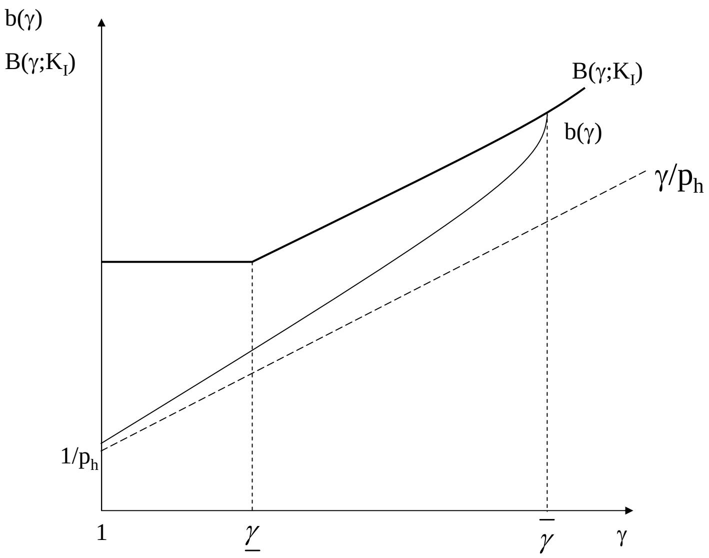


Figure 4

db(γ)/dγ and dB(γ;K_I)/dγ functions

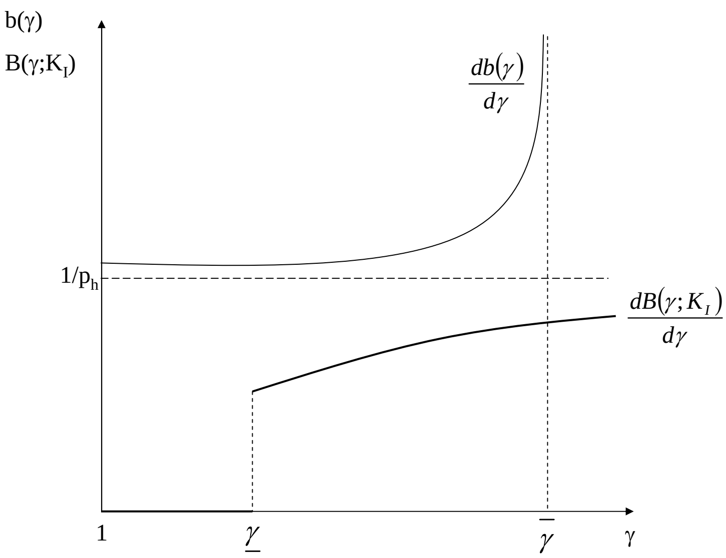
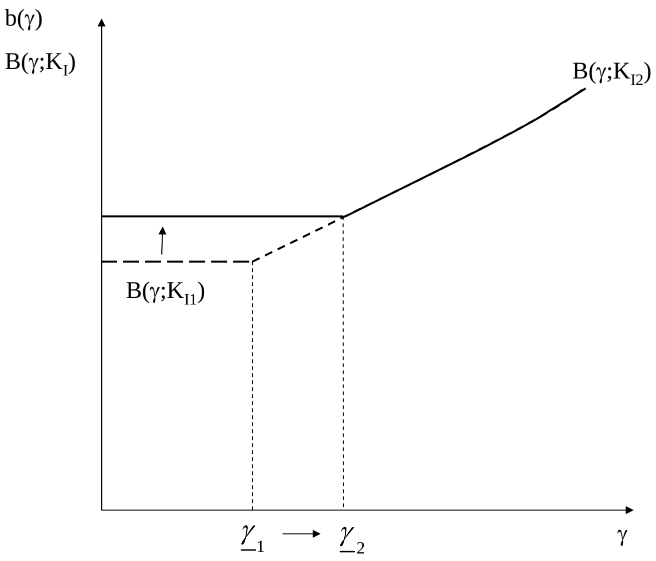


Figure 5: Some comparative statics

Panel A: a credit crunch (reduction of K_I)



Panel B: a collateral squeeze (shift in the distribution of A: reduction in A)

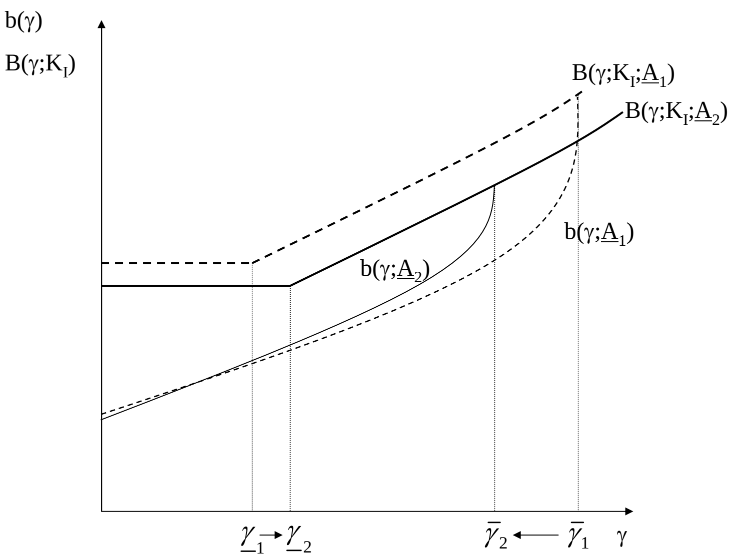


Table 1: Measures of Financial Development (Beck et al., 2004)

Variable name	Description	Source	Time period
Central Bank assets to total financial assets*	Ratio of Central Bank claims on domestic nonfinancial real sector (IFS lines 12, a through d) to total financial claims on nonfinancial real sector (sum of IFS lines 12, 22, and 42, a through d and 42h).	Raw data are from the electronic version of the IMF's *IFS* (IFS lines 12, 22, and 42).	1960-2001
Deposit Money Bank Assets to total financial assets*	Ratio of deposit money bank claims on domestic nonfinancial real sector (IFS lines 22 , a through d) to total financial claims on nonfinancial real sector (sum of IFS lines 12, 22, and 42, a through d and 42h).	Raw data are from the electronic version of the IMF's *IFS* (IFS lines 12, 22, and 42).	1960-2001
Other Financial Institutions Assets to total financial assets*	Ratio of other financial institutions' claims on domestic nonfinancial real sector (IFS lines 42, a through d and h) to total financial assets (sum of IFS lines 12, 22, and 42, a trhough d and 42h).	Raw data are from the electronic version of the IMF's *IFS* (IFS lines 12, 22, and 42).	1960-2001
Deposit money bank vs. central bank assets	Ratio of deposit money bank claims on domestic nonfinancial real sector (as defined above) to the sum of deposit money bank and Central Bank claims on domestic nonfinancial real sector (as defined above)	Raw data are from the electronic version of the IMF's *IFS* (IFS lines 12 and 22, a-d).	1960-2001
Liquid liabilities to GDP	Liquid liabilities to GDP, calculated using the follwing deflation method: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is liquid liablities, P_e is end-of period CPI, and P_a is average annual CPI	Raw data are from the electronic version of the IMF's *IFS* (IFS lines 55L..ZF or, if not available, line 35..ZF). Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF), end-of period CPI (line 64M..ZF or , if not available, 64Q..ZF), and annual CPI (line 64..ZF) are from the electronic version of the IFS.	1960-2001
Central Bank Assets to GDP	Claims on domestic real nonfinancial sector by the Central Bank as a share of GDP, calculated using the following deflation method: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is Central bank claims, P_e is end-of period CPI, and P_a is average annual CPI	Raw data are from the electronic version of the IMF's *IFS* (IFS lines 12, a-d). Data on the deflators is from the electronic version of the IFS (line 64M..ZF or, if not available, line 64Q..ZF) and annual CPI (line 64..ZF). Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF)	1960-2001
Deposit Money Bank Assets to GDP	Claims on domestic real nonfinancial sector by deposit money banks as a share of GDP, calculated using the following deflation method: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is deposit money bank claims, P_e is end-of period CPI, and P_a is average annual CPI.	Raw data are from the electronic version of the IMF's IFS (IFS lines 22, a-d). Data on the deflators is from the electronic version of the IFS (line 64M..ZF or, if not available, line 64Q..ZF) and annual CPI (line 64..ZF). Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF)	1960-2001
Other Financial Institutions Assets to GDP*	Claims on domestic real nonfinancial sector by other financial institutions as a share of GDP, calculated using the following deflation method: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is other financial institutions' claims, P_e is end-of period CPI, and P_a is average annual CPI.	Raw data are from the electronic version of the IMF's IFS (IFS lines 42, a-d and h). Data on the deflators is from the electronic version of the IFS (line 64M..ZF or, if not available, line 64Q..ZF) and annual CPI (line 64..ZF). Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF)	1960-2001
Private credit by deposit money banks to GDP	Private credit by deposit money banks to GDP, calculated using the following deflation method: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is credit to the private sector, P_e is end-of period CPI, and P_a is average annual CPI	Raw data are from the electronic version of the IMF's IFS (IFS lines 22d). Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF), end-of period CPI (line 64M..ZF or , if not available, 64Q..ZF), and annual CPI (line 64..ZF) are from the electronic version of the IFS.	1960-2001
Private credit by deposit money banks and other financial institutions to GDP	Private credit by deposit money banks and other financial institutions to GDP, calculated using the following deflation method: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is credit to the private sector, P_e is end-of period CPI, and P_a is average annual CPI	Raw data are from the electronic version of the IMF's IFS (IFS lines 22d and 42d). Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF), end-of period CPI (line 64M..ZF or , if not available, 64Q..ZF), and annual CPI (line 64..ZF) are from the electronic version of the IFS.	1960-2001
Bank deposits	Demand, time and saving deposits in deposit money banks as a share of GDP, calculated using the following deflation method: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is demand and time and saving deposits, P_e is end-of period CPI, and P_a is average annual CPI	Raw data are from the electronic version of the IMF's IFS (IFS lines 24 and 25). Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF), end-of period CPI (line 64M..ZF or , if not available, 64Q..ZF), and annual CPI (line 64..ZF) are from the electronic version of the IFS.	1960-2001
Financial system deposits	Demand, time and saving deposits in deposit money banks and other financial institutions as a share of GDP, calculated using the following deflation method: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is demand and time and saving deposits, P_e is end-of period CPI and P_a is average annual CPI	Raw data are from the electronic version of the IMF's IFS (IFS lines 24, 25, and 45). Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF), end-of period CPI (line 64M..ZF or , if not available, 64Q..ZF), and annual CPI (line 64..ZF) are from the electronic version of the IFS.	1960-2001
Concentration	Assets of three largest banks as a share of assets of all commercial banks in the system. Note: Data before 1994 are taken from a previous version of Bankscope	Fitch's Bankscope database	1990-2001
Overhead costs	Accounting value of a bank's overhead costs as a share of its total assets. Note: Data before 1994 are from a previous version of Bankscope.	Fitch's Bankscope database	1990-2001
Net interest margin	Accounting value of bank's net interest revenue as a share of its interest-bearing (total earning) assets	Fitch's Bankscope database	1994-2001
Life insurance penetration	Life insurance premium volume as a share of GDP	Premium data is taken from various issues of Sigma. Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF),	1960-2001

* Eliminated from the analysis due to the number of missing observations

Table 1: Measures of Financial Development (Beck et al., 2004)

Variable name	Description	Source	Time period
Non-life insurance penetration	Nonlife insurance premium volume as a share of GDP	Premium data is taken from various issues of Sigma. Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF),	1987-2001
Stock market capitalization to GDP	Value of listed shares to GDP, calculated using the following deflation method: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is stock market capitalization, P_e is end-of period CPI, and P_a is average annual CPI	Standard and Poor's Emerging Market Database (and Emerging Stock Markets Factbook). Data on GDP in US dollars is from the electronic version of the World Development Indicators. Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF) and the deflators (line 64M..ZF or , if not available, 64Q..ZFand annual CPI (line 64..ZF)) are taken from the electronic version of the IFS.	1976-2001
Stock market total value traded to GDP	Total shares traded on the stock market exchange to GDP.	Standard and Poor's Emerging Market Database (and Emerging Stock Markets Factbook). Data on GDP in US dollars is from the electronic version of the World Development Indicators. deflators (line 64..ZF) are taken from the electronic version of the IFS. Data on GDP in local currency (lines 99B..ZF or, if not available, line 99B.CZF)	1975-2001
Stockmarket turnover ratio	Ratio of the value of total shares traded and average real market capitalization, the denominator is deflated using the following method: $Tt/P\_{at}/\{(0.5)*[M_t/P\_e_t + M_{t-1}/P\_e_{t-1}]$ where T is total value traded, M is stock market capitalization, P_e is end-of period CPI P_a is average annual CPI	Standard and Poor's Emerging Market Database (and Emerging Stock Markets Factbook). Data on the deflators (line 64M..ZF or , if not available, 64Q..ZFand annual CPI (line 64..ZF)) are taken from the electronic version of the IFS.	1976-2001
Private bond market capitalization to GDP*	Private domestic debt securities issued by financial institutions and corporations as a share of GDP, calculated as follows: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is amount outstanding of private domestic debt securities, P_e is end-of period CPI, and P_a is average annual CPI	Bond data is taken from the electronic version of the Bank of International Settlements' *Quarterly Review: International Banking and Financial Market Developments* by sector and country of issuer. Data on GDP in US dollars is from the electronic version of the World Development Indicators. Data on the deflators (line 64M..ZF or , if not available, 64Q..ZFand annual CPI (line 64..ZF)) are taken from the electronic version of the IFS.	1990-2001
Public bond market capitalization to GDP*	Public domestic debt securities issued by government as a share of GDP, calculated as follows: $\{(0.5)*[F_t/P\_e_t + F_{t-1}/P\_e_{t-1}]\}/[GDP_t/P\_a_t]$ where F is amount outstanding of public domestic debt securities, P_e is end-of period CPI, and P_a is average annual CPI	Bond data is taken from the electronic version of the Bank of International Settlements' *Quarterly Review: International Banking and Financial Market Developments* by sector and country of issuer. Data on GDP in US dollars is from the electronic version of the World Development Indicators. Data on the deflators (line 64M..ZF or , if not available, 64Q..ZFand annual CPI (line 64..ZF)) are taken from the electronic version of the IFS.	1990-2001

* Eliminated from the analysis due to the number of missing observations

Table 2: Factor loadings and percentage of variance explained
First three components VARIMAX Rotation

Indicator of Financial Development	Factor loadings			Variance Explained	
	1st factor	2nd factor	3rd factor	Common	Specific
Deposit money bank vs. central bank assets	-0.337	-0.178	**0.876**	0.999	0.001
Central Bank Assets to GDP	0.041	0.12	**-0.964**	0.999	0.001
Deposit Money Bank Assets to GDP	**-0.738**	-0.214	0.263	0.66	0.34
Private credit by deposit money banks to GDP	**-0.786**	-0.145	0.28	0.717	0.283
Private credit by deposit money banks and other financial institutions to GDP	**-0.773**	-0.271	0.253	0.735	0.265
Bank deposits	**-0.792**	0.398	0.227	0.999	0.001
Financial system deposits	**-0.814**	0.359	0.229	0.999	0.001
Concentration	0.161	0.021	-0.055	0.029	0.971
Overhead Costs	**0.795**	0.169	-0.016	0.999	0.001
Net Interest Margin	**0.781**	0.087	-0.064	0.999	0.001
Life insurance penetration	**-0.687**	-0.056	0.314	0.574	0.426
Non-life insurance penetration	-0.156	0.039	0.253	0.09	0.91
Stock market capitalization to GDP	**-0.768**	-0.119	0.196	0.999	0.001
Stock market total value traded to GDP	-0.509	**-0.696**	0.149	0.999	0.001
Stockmarket turnover ratio	-0.009	**-0.786**	0.08	0.999	0.001

Table 3: Measures of Monetary Policy Effectiveness - Asymmetric terms included

VAR Specification	Measure	Measure Description
4-variable VAR Money Growth as MPI	lag_mon	First significant lag of money growth in output equation
	coef_mon	Coefficient of the first significant lag of money growth in output equation
	sum_mon	Sum of the coefficients of the four lags of money growth in output equation
	abs_mon	Absolute value of sum_mon
	cum4_mon	Impulse response function: cumulative effect of structural shock to MPI on output after 4 quarters
	cum8_mon	Impulse response function: cumulative effect of structural shock to MPI on output after 8 quarters
	cum12_mon	Impulse response function: cumulative effect of structural shock to MPI on output after 12 quarters
	lagneg_mon	**First significant lag of negative money growth term in output equation**
	coefneg_mon	**Coefficient of the first significant lag of negative money growth in output equation**
	sumneg_mon	**Sum of the coefficients of the four lags of negative money growth in output equation**
	cum4neg_mon	**Impulse response function: cumulative effect of negative structural shock to MPI on output after 8 quarters**
	cum8neg_mon	**Impulse response function: cumulative effect of negative structural shock to MPI on output after 4 quarters**
	cum12neg_mon	**Impulse response function: cumulative effect of negative structural shock to MPI on output after 8 quarters**
	neg_terms_mon	**1 if any of the terms of negative money growth is statistically significant in VAR, 0 otherwise**
	sign_neg_mon	**1 if the significant term has a positive sign, 0 otherwise**
5-variable VAR Reserves Growth as MPI	lag_res	First significant lag of reserves growth in output equation
	coef_res	Coefficient of the first significant lag of reserves growth in output equation
	sum_res	Sum of the coefficients of the four lags of reserves growth in output equation
	abs_res	Absolute value of sum_res
	cum4_res	Impulse response function: cumulative effect of structural shock to MPI on output after 4 quarters
	cum8_res	Impulse response function: cumulative effect of structural shock to MPI on output after 8 quarters
	cum12_res	Impulse response function: cumulative effect of structural shock to MPI on output after 12 quarters
	lagneg_res	**First significant lag of negative reserves growth in output equation**
	coefneg_res	**Coefficient of the first significant lag of negative reserves growth in output equation**
	sumneg_res	**Sum of the coefficients of the four lags of negative reserves growth in output equation**
	cum4neg_res	**Impulse response function: cumulative effect of negative structural shock to MPI on output after 4 quarters**
	cum8neg_res	**Impulse response function: cumulative effect of negative structural shock to MPI on output after 8 quarters**
	cum12neg_res	**Impulse response function: cumulative effect of negative structural shock to MPI on output after 12 quarters**
	neg_terms_res	**1 if any of the terms of negative reserves growth is statistically significant in VAR, 0 otherwise**
	sign_neg_res	**1 if the significant term has a positive sign, 0 otherwise**

Table 4: Data used in the Monetary Policy VARs

Country	COMMENTS	N. Obs.	Rate Used	Output Measure
Argentina		33	Lending	GDP Volume
Australia		89	Long	GDP Volume
Austria		75	Long	GDP Volume
Bangladesh		27	Discount	IIP
Barbados		91	Lending	IIP
Belarus	No CPI DATA			
Belgium		75	Long	GDP Volume
Brazil		39	Deposit	IIP
Canada		95	Long	IIP
Chile		96	Lending	IIP
Colombia		47	Discount	IIP
Costa Rica		36	Discount	GDP Volume
Cote d'Ivorie	Sample ends in 1986 because of breaks in data	62	Discount	IIP
Croatia		34	Discount	IIP
Cyprus		63	Discount	IIP
Czech Republic		40	Discount	IIP
Denmark		55	Discount	GDP Volume
Ecuador		46	Discount	GDP Volume
Estonia		42	Deposit	GDP Volume
Fiji	Sample ends in 1997	73	Discount	IIP
Finland		75	Discount	GDP Volume
France		74	Long	GDP Volume
Germany		76	Discount	GDP Volume
Greece		120	Discount	IIP
Hong Kong		88	Lending	GDP Volume
Hungary		34	Discount	GDP Volume
India		95	Discount	IIP
Indonesia		44	Lending	GDP Volume
Ireland		64	Deposit	IIP
Israel		95	Lending	GDP Volume
Italy		72	Discount	GDP Volume
Jamaica	Not enough observations of output measure			
Japan		93	Long	GDP Volume
Jordan		95	Discount	IIP
Kenya	No output measure			

Country	COMMENTS	N. Obs.	Rate Used	Output Measure
Korea		95	Long	GDP Volume
Latvia		37	Lending	GDP Volume
Lithuania		39	Lending	GDP Volume
Luxembourg	No measure of money			
Macedonia		30	Deposit	IIP
Malawi		88	Discount	IIP
Malaysia		63	Deposit	GDP Volume
Malta		28	Discount	GDP Volume
Mexico		94	Deposit	GDP Volume
Morocco		39	Discount	IIP
Netherlands		84	Long	GDP Volume
New Zealand		86	Long	GDP Volume
Nigeria		93	Lending	IIP
Norway		95	Long	GDP Volume
Pakistan		81	Long	IIP
Panama		34	Lending	IIP
Peru		46	Discount	GDP Volume
Philippines		62	Discount	GDP Volume
Poland		30	Discount	GDP Volume
Portugal		75	Discount	GDP Volume
Romania	No interest rate data			
Singapore		89	Lending	IIP
Slovakia		34	Lending	GDP Volume
Slovenia		38	Lending	GDP Volume
South Africa		110	Long	GDP Volume
Spain		83	Long	GDP Volume
Sri Lanka	Not enough Output data			
Sweden		87	Lending	GDP Volume
Switzerland		90	Long	GDP Volume
Tanzania	Not enough Output data			
Thailand		38	Discount	GDP Volume
Tunisia	Break in output data			
Turkey		62	Discount	GDP Volume
United Kingdom		115	Long	GDP Volume
Uruguay		87	Discount	IIP
USA		131	Long	GDP Volume
Zambia	Not enough overlap in data			
Zimbabwe		32	Deposit	IIP

Table 5: Other Macroeconomic Variables

	Measure	Source	Code in WDI database
Income level	1 to 4 score[a]	From World Bank classification	
Debt level	1 to 3 score[b]	From World Bank classification	
South Asia	0/1 indicator	From World Bank classification	
Europe & Central Asia	0/1 indicator	From World Bank classification	
East Asia & Pacific	0/1 indicator	From World Bank classification	
Latin America & Caribbean	0/1 indicator	From World Bank classification	
Middle East & North Africa	0/1 indicator	From World Bank classification	
Western Europe & North America	0/1 indicator	From World Bank classification	
Sub-Saharan Africa	0/1 indicator	From World Bank classification	
Central government debt	% of GDP	World Bank WDI Database	GB.DOD.TOTL.GD.ZS
GDP growth (annual %)	Average %	World Bank WDI Database	NY.GDP.MKTP.KD.ZG
	Std. Dev.	World Bank WDI Database	
GNI per capita, Atlas method	US$	World Bank WDI Database	NY.GNP.PCAP.CD
Gross fixed capital formation (GFCF)	% of GDP	World Bank WDI Database	NE.GDI.FTOT.ZS
GFCF (annual % growth)	Average %	World Bank WDI Database	NE.GDI.FTOT.KD.ZG
	Std. Dev.	World Bank WDI Database	
Inflation, GDP deflator (annual %)	Average %	World Bank WDI Database	NY.GDP.DEFL.KD.ZG
	Std. Dev.	World Bank WDI Database	
Services, etc., value added	% of GDP	World Bank WDI Database	NV.SRV.TETC.ZS
Short-term debt	% of total external debt	World Bank WDI Database	DT.DOD.DSTC.ZS
Degree of dollarization	0 to 25 score	Reinhart et al. (2004)	

All averages and standard deviations the period 1989:1999

[a] Low income=1; Lower middle income=2; Upper middle income=3; High income=4
[b] Less indebted=1; Moderately indebted=2; Severely indebted=3

Table 6: Significance of independent variables in simple regressions with MPE measures as DV's

	Dep. Variable	Independent Variables: GDP growth – Average	GDP growth – Std. Dev.	GFCF growth – Average	GFCF growth – Std. Dev.	Inflation – Std. Dev.	Financial Development – General	Financial Development – Stock Market	Financial Development – Central Bank	Adjusted R2 / Pseudo R2
1	lag_mon		+			–				-0.048
2	coef_mon	–	+	+	–		+			0.218
3	sum_mon	–	+	+	–		+			0.199
4	abs_mon			+			+			0.073
5	cum4_mon	–		+						0.208
6	cum8_mon	–	+	+	–		+	+		0.308
7	cum12_mon						+	+		0.076
8	**lagneg_mon**	+	+		–					0.093
9	**coefneg_mon**	–	–		+			–		0.152
10	**sumneg_mon**		–							0.022
11	**cum4neg_mon**		+			–		+		0.103
12	**cum8neg_mon**					–		+		0.21
13	**cum12neg_mon**					–		+		0.058
14	**neg_terms_mon**	+	+				+		+	0.416
15	**sign_neg_mon**	+							+	0.242
16	lag_res								+	0.114
17	coef_res									0.172
18	sum_res									-0.273
19	abs_res									-0.243
20	cum4_res	–		+						-0.055
21	cum8_res	–		+						0.069
22	cum12_res	–		+						0.175
23	**lagneg_res**									-0.197
24	**coefneg_res**									-0.346
25	**sumneg_res**	+	–			+				0.417
26	**cum4neg_res**	–				–				0.066
27	**cum8neg_res**	–	+	+					–	0.393
28	**cum12neg_res**	–	+	+	–					0.185
29	**neg_terms_res**						+			0.258
30	**sign_neg_res**	+								0.264

The cells include the sign of the relationship, when significant at the 15% level