Financial Frictions and Monetary Transmission*

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Abstract
This paper examines the effect of financial frictions on the strength of the credit channel of monetary policy. First, we use a DSGE model characterized by financial frictions as in Bernanke, Gertler, and Gilchrist (1999), and calibrate it using parameter values for countries with different levels of financial frictions. We find that the credit channel is stronger in countries with high levels of financial frictions. The intuition is that in these countries, external finance premiums are more sensitive to firms' financial leverage. By affecting asset prices, therefore, monetary policy has greater impact on external finance premiums and output. Second, we provide empirical evidence for this relationship. We use cross-country data in SVAR models to generate indicators for credit channel strength. We then show that there is a positive relationship between financial frictions, captured by bankruptcy recovery rates, and credit channel strength, confirming the predictions of the model.

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1. Introduction

According to the credit channel theory of the monetary transmission mechanism, frictions in credit markets that generate a wedge between the costs of raising funds externally and internally, the external finance premium, help explain the effect of monetary policy on real variables. For example, the cost of monitoring in credit markets suggests poorly-collateralized borrowers will pay a higher premium for external funds than larger, more-collateralized borrowers. The credit channel of monetary policy is the mechanism through which monetary policy impacts the real economy by altering the external finance premium. In particular, by affecting this wedge countercyclically, monetary policy has an additional impact on real variables beyond its standard effect through the cost of capital.

The credit channel consists of the balance sheet channel, in which monetary policy affects borrowers' net worth and debt collateral, and the bank lending channel, in which policy impacts the level of intermediated credit (c.f. Bernanke and Gertler, 1995, for a review of the credit channel). These channels have been widely incorporated into general equilibrium models through costly state verification to enhance the empirical relevance of these models (see for example the financial accelerator model of Bernanke, Gertler and Gilchrist (1999), hereafter BGG). A key result from these models is that the strength of both channels and therefore the broader credit channel increases with the level of financial frictions. In particular, in financial systems where financial frictions such as the cost of monitoring (state verification cost) are more pronounced, monetary policy has a larger impact on external finance premiums. Cross-country empirical tests of this result, however, are scarce.

In this paper, we investigate the cross-country relationship between financial market frictions and credit channel strength (hereafter CCS). To do so, we first motivate our empirical analysis by calibrating an open-economy extension of the financial accelerator model of BGG (1999) to two countries with relatively low and high levels of financial frictions, Brazil and Canada.[1] The model simulations confirm two implications of the financial accelerator: 1) CCS is inversely related to the level of financial frictions, and 2) as the level of financial frictions increases, the external finance premium is more sensitive to firms' financial leverage.

We then test using cross-country data whether higher levels of financial frictions are consistent with a stronger credit channel. Using cross-country data is preferable to comparing CCS within a specific country at different time periods. The reason is that financial frictions are relatively stable over time, especially compared to monetary policy.[2] One potential issue, however, is that it is difficult to identify monetary policy shocks using the same model specification for countries that are at different stages of development.[3] Nevertheless, we find similar results using various methodologies.

We use bankruptcy recovery rates, the proportion of a firm's value creditors can recover from a defaulting firm, as an indicator of financial frictions. This variable provides a close match to the source of financial frictions in costly state verification models. Our paper therefore represents, to the best of our knowledge, a first attempt at using comprehensive cross-country data (including both developing and developed countries) to test the empirical relevance of these models.

We then generate proxies for CCS in each country. To do this, we use forecast error variance decompositions (FEVD) that are measured by the percentage of the variance of both output and lending spreads' forecast error variance attributable to monetary policy shocks. These

[1] The open-economy model is similar to Gertler, Gilchrist, and Natalucci (2007).
[2] See for example Djankov et al. (2007, 2008) for empirical evidence that support the stability of financial frictions.
[3] See also discussion by Elbourne and de Haan (2006) on the usefulness of estimating structural VARs in comparing the monetary transmission mechanisms across countries.

FEVDs are computed using impulse responses from a structural vector autoregressive (SVAR) model. To identify monetary policy shocks, we use strategies similar to that of Kim (1999) and Hoffman (2007) for G-8 and non-G-8 countries, respectively.

Next, we use our measure of CCS in a pooled regression of up to 74 countries from 1984 through 2008 to test the effect of recovery rates on the CCS variable. Our results reveal a negative (positive) and statistically significant relationship between recovery rates (financial frictions) and CCS that is robust to alternative specifications. The magnitude of the coefficient, however, varies significantly depending on the sample period or estimation procedure. Specifically, the coefficient of the recovery rate variable (in our benchmark model) implies that a one percentage point increase in recovery rates leads to a 0.31 percentage point drop in the percent of the variation of output explained by the policy rate. A value of 0.31 implies that if Hungary were to increase its recovery rate to the level of the UK's, it would reduce the percent of the variation in output explained by the policy rate from 26.0% to 16.7%. Thus this study provides cross-country evidence on the importance of financial frictions in explaining the transmission mechanism of monetary policy.

As an additional test of this relationship, we generate an alternative measure of financial frictions and determine whether this measure affects CCS. As mentioned above, the financial accelerator model predicts that as the level of financial frictions increases, the external finance premium becomes more sensitive to firm leverage, i.e. leverage sensitivity increases. We can therefore use leverage sensitivity as another proxy for financial frictions. Using financial market data to predict financial frictions is an alternative to measuring financial frictions using survey data and is a contribution of this paper. To capture leverage sensitivity for each country, we estimate, using firm level data, the effect of firm leverage on the external finance premium. We approximate external finance premiums with corporate bond spreads. We use bond deals of non-financial firms and other firm-specific data from 47 countries, over the period 1995 to 2009, provided by the Thomson One Banker database. Using these estimated leverage sensitivities, we reinvestigate the relationship between financial frictions and CCS and again find support for the model's predictions.

A key implication of our results is that lowering the level of financial frictions may weaken the ability of central banks to affect economic activity. While CCS in the United States has been questioned—financial markets in the United States, it has been argued, provide numerous ways for borrowers and lenders to avoid the contractionary effects of monetary policy—the credit channel may be more potent in other countries depending on the characteristics of a country's financial institutions. In countries with greater financial frictions, borrowers may be more sensitive to a shift in the health of their balance sheet, making them sensitive to a rise of the external finance premium. Indeed, a significant number of studies point to a stronger credit channel outside of the U.S.[4]

Our paper complements the relatively few studies that have looked at the effect of financial frictions on CCS specifically. Cecchetti (1999), for example, finds a positive relationship between financial frictions (measured using legal institutional quality) and CCS using data from 11 European countries. In this paper, we substantiate Cecchetti's (1999) general finding by providing broader evidence for the effect of financial market frictions on CCS, using data from 74 countries, including both advanced and developing nations. In contrast, Elbourne and de Haan (2006), who use a similar approach to Cecchetti (1999) and consider the effect of institutional quality on 10 Central and Eastern European countries, conclude that there is little

[4] c.f. Angelopoulou and Gibson (2007), Atta-Mensah and Dib (2008), Braun and Larrain (2005), de Bont (2004), Gallegati (2005), Gambacorta (2005), Hulswig et al. (2006), Mateut, Bougheas and Mizen (2006), Matousek and Sarantis (2008), Mizen and Yalcin (2006), Reinhart and Vazquez (2006), Suzuki (2005).

relationship between differences in financial institutions across countries and the monetary transmission mechanism. Our results suggest institutional quality may, in fact, matter for the transmission mechanism over a broader sample of countries.

Our paper also complements a broader literature on the effect of institutions on the effectiveness of monetary policy. Many studies focus on the effect of central bank independence (CBI) on inflation or the impact of financial market development on CCS. CBI is in general found to be associated with the lower levels of inflation observed in the last couple of decades (c.f. Berger, Eijffinger, and de Haan, 2001; Klomp and de Haan, 2007), while the evidence is mixed for the effect of financial market development on CCS. We incorporate this broader literature by including as controls measures of CBI and financial market development. We find that financial frictions have an independent effect on CCS. Moreover, many studies have pointed to the effect of deregulation in financial markets in the 1980s, in particular, on the potency of the credit channel the United States (see Kuttner and Mosser (2002) for discussion). Our findings are consistent with such an inverse relationship between more efficient financial markets and a weaker credit channel.

The rest of the paper is organized as follows: Section 2 discusses the financial accelerator model that motivates our empirical tests. In Section 3 we generate our indicator of CCS. In Section 4 we estimate the effect of the bankruptcy recovery rate, our main indicator of financial frictions, on CCS. Sections 5 and 6 present robustness tests, including alternative measures of financial frictions. Section 7 concludes.

2. Theoretical Framework

Following the breakthrough studies on asymmetric information, led by Akerlof (1970), a large number of researchers have relaxed the assumption of the Modigliani-Miller theorem and investigated the role that financial frictions play in the amplification of shocks to economies. Some of these studies (BGG, 1989, 1999; Carlstrom and Fuerst, 1997; Prescott and Townsend, 1984; Townsend, 1979) introduce these frictions in the form of asymmetric information costs banks face when they agree on a loan contract. These costs are generally referred to as monitoring costs and represent the percentage of the value of a loan that banks cannot recover when there is default. BGG (1999) solve a model (dubbed the financial accelerator model) characterized by these asymmetric information costs and derive an expression for external finance premium that firms face when they borrow from banks:

$$\frac{E\left[R^{k}\right]}{R}=v\left(\frac{QK}{N},\mu\right) \qquad v'\left(\frac{QK}{N}\right)>0 \quad , \quad v'(\mu)>0 \tag{1}$$

where $E\left[R^{k}\right]$, R, Q, K, N, μ represent the borrowers' expected returns to capital, risk free rate, price of capital, capital stock, borrower's net worth, and the monitoring cost coefficient respectively. The implication of equation (1) is that the external finance premium, $E\left[R^{k}\right]/R$ is positively correlated with a borrower's leverage, given by QK/N, and the monitoring cost coefficient. In this paper we focus on the bankruptcy recovery rate 1- μ, which is inversely related to the monitoring cost coefficient, μ.

The second equation that the authors add to an otherwise standard new Keynesian model is the evolution of net worth given by:

$$N_{it+1}=f\left(N_{t},Q_{t},K_{t},R_{t}\right) \qquad f'(\mu)>0 \tag{2}$$

Equation (2) shows that as the monitoring cost coefficient increases, the effect of a shock on net worth, through its effects on returns to capital, asset prices and capital stock, increases as well. The high amplitude of net worth, in turn, implies larger responses of leverage and external premium. Firms decrease investment in response and generate a fall in asset prices and thereby a further fall in net worth. The fall in net worth causes a further increase in the external premium and a larger drop in output.

Given this setup, if a central bank changes its policy rates, it can affect the economy in two ways: First, lending spreads are affected directly. Second, by altering asset prices, central banks can have an effect on firms' leverage and therefore affect the level of borrowing. In each case, the effect of central bank's policy on borrowing spreads is positively related to the level of financial frictions (monitoring cost coefficient) in the economy. In line with this argument, researchers (c.f. BGG; Gertler Gilchrist and Natalucci, 2007) find that the impulse responses to shocks in models with positive monitoring costs are substantially higher than those from models without these costs.

In this paper, we test whether variation in monitoring costs across countries results in varying ability of central banks to affect the economy. Our main investigation strategy is the empirical methodology outlined in Sections 3 to 5. However, the financial accelerator model of BGG (1999) constitutes a convenient setup to investigate this hypothesis. As a first test, therefore, we calibrate an open economy extension of the BGG (1999) model to two countries with relatively low and high levels of financial frictions, Brazil and Canada.[5] A complete description of the model and the calibration strategy are provided in Appendix A and B respectively. We then measure impulse responses to monetary policy shocks in these economies.

Figure 1 displays the responses to a 100 annualized basis point interest rate shock that persists at the rate of 0.95 per quarter. The top panel shows that output responses to an interest rate shock are amplified as the monitoring cost coefficient increases in both economies. There

[5] These economies were chosen since they have similar size but have dissimilar levels of financial frictions. GDP for Canada and Brazil were 849.6 and 803.1 Billion SDRs in 2008 respectively. GDPs of these countries have also been similar in the 1998-2008 period. World Bank's Doing Business Survey reports that lenders' recovery rates when there is bankruptcy are on average 89.4% and 7.4% for Canada and Brazil respectively in the 2004-2009 period. The other bankruptcy cost measure in the survey, cost as a percentage of estate shows a similar pattern (10.5% for Brazil and 4% for Canada). There were other country pairs with similar size but dissimilar financial frictions. Brazil and Canada were chosen mainly due to data availability.

are two reasons for this effect. First, the costs of bankruptcy in the aggregate resource constraint are proportional to the monitoring coefficient. Second, the drop in net worth is higher when the monitoring cost coefficient is larger, as shown in equation (2). The larger fall in net worth implies a higher leverage, external premium and output responses. Indeed, the responses of external finance premiums, shown in the bottom panel, reveal a positive correlation with these premiums and monitoring costs in both economies. Furthermore, when the monitoring cost coefficients are calibrated to match the lending spreads in these economies, we see that the responses of output and external premiums are much higher in the country with the higher monitoring cost coefficient (Brazil).

It is straightforward to extend this analysis to more than two countries and test our main hypothesis. However, there are several drawbacks to such an analysis. First, the debate between Neoclassicals and New Keynesians on the usefulness of New Keynesian models (such as the financial accelerator model) for policy analysis is far from settled.[6] Second, with the calibration strategy used above it is difficult to asses the robustness of the model to the choice of parameter values. This is especially a concern for comparing across countries that are at similar stages of development.[7]

Therefore, in the rest of the paper, we investigate empirically the relationship between financial frictions and CCS using cross-country data.

3. Approximating CCS

We begin our empirical analysis by approximating CCS in different countries. In the following sections, we will study how this proxy is related to the different measures of financial

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[6] See Chari, Kehoe and McGrattan (2008) for a discussion of the drawbacks to using New Keynesian models for policy analysis.

[7] As an alternative to calibration, we used a Bayesian technique to estimate the parameters of the model using data from various countries. We found conflicting results from the simulations of this model mainly due to the high sensitivity of the model parameters' posterior distributions to the prior distributions of these parameters.

frictions. It is important to note here that our goal in this section is to generate a proxy for CCS that is comparable across countries. This task is difficult, however, since variables that represent the stance of monetary policy or the external finance premium are likely to vary across countries. Nevertheless, we use the same definitions for monetary policy (the discount rate) and external finance premium (the lending rate – deposit rate) for each country to facilitate the comparison of CCS across countries.

Previous attempts to quantify CCS have usually estimated VAR models to measure the responses to an unanticipated tightening of monetary policy and then used FEVD obtained from this model for inference. CCS in these studies (c.f. Brüggemann, 2003; Dedola and Lippi, 2005; Ehrmann, 2000; Holtemoller, 2003; Italiano, 2001; Kim, 1999; Kim and Roubini, 2000; Lutkepohl and Wolters, 2003; Mojon and Peersman, 2001) is then measured by the percentage of variations in output explained by monetary policy.[8]

We follow this practice and approximate CCS with FEVDs obtained from a SVAR model.

SVAR

To derive our FEVDs, we estimate a five-variable SVAR model for each country. Each country specification includes the following variables: industrial production index, ip_t, consumer price index (CPI), cpi_t, the spread between lending and deposit rates, ls_t, the central bank rate (discount rate), r_t and the world export price index (measured in local currency) $wxpi_t$. This SVAR model can be represented by the following vector: $y_t = \{ip_t, cpi_t, ls_t, r_t, wxpi_t\}$.

Aside from the lending spread variable, these variables are widely-used in the open economy literature. The industrial production index and the CPI measure overall economic

[8] Other studies (c.f. Cechetti, 1999) use the maximum response to a monetary policy shock instead of FEVDs. We only report the results obtained by using FEVDs since we did not find substantial differences when we used maximum responses.

activity and prices respectively. Interest rate variable captures the monetary authority's reaction to the other variables in the model. The world export price index is included to account for the monetary responses to external price shocks and to external developments that affect the exchange rate. This variable helps us identify monetary policy shocks that are not induced by external developments. We include the lending spread variable to generate an alternative proxy for CCS. Indeed, the model described in Section 2 predicts that if the credit channel is strong, lending spread response (in addition to output response) to monetary policy shocks would be larger.

The industrial production index, CPI, lending spread, discount rate and world commodity price data are monthly and span the 1984:1-2008:5 period.[9] The data were obtained from the International Financial Statistics (IFS) database. The lending spread is measured as the difference between the average lending and deposit rates. Due to data availability, the external finance premium is measured by the lending spreads variable. Using this variable allows us to maximize the number of countries in the cross-country analysis.[10] While the composition of reliance on bank loans and direct borrowing from capital markets is not uniform across countries, we control for these characteristics in the cross-country regression. Alternatively, we used the risk premium on lending data provided by the World Development Indicators and found similar results.[11] This data is collected for the 74 countries listed in Appendix C. This appendix also reproduces the IFS definitions of the macroeconomic variables used in our analysis.

Identification

[9] The industrial production index was available for a majority of the countries in our data set. When this data was not available, we used other indicators for monthly economic activity. These indicators (by country) are displayed in Appendix C.
[10] We also used T-Bill rates instead of deposit rates and reached similar conclusions. The number of observations in our second stage regression, however, decreased significantly.
[11] Risk premium on lending is the interest rate charged by banks on loans to prime private sector customers minus the "risk free" treasury bill interest rate at which short-term government securities are issued or traded in the market. In some countries this spread may be negative, indicating that the market considers its best corporate clients to be lower risk than the government.

The main shortcoming of using SVAR methods to study monetary policy is the difficulty in identifying policy shocks. Indeed, the literature seems to be far from a consensus on this subject. Moreover, comparing the effects of monetary policy across countries (as we do in this paper) amplifies the level of difficulty. Therefore, our results should be interpreted modestly.

Nevertheless, we follow three strategies to increase the soundness of our analysis. First, we choose an identification strategy similar to Kim (1999) for G-8 countries and Hoffmann (2007) for others. The appeal of these strategies has been their ability to find responses to monetary policy shocks that are fairly similar to the predictions of theory. Furthermore, using different identification strategies enhances our ability to capture the effects of monetary policy in economies that are dissimilar. The drawback to this approach, however, is that differences across countries may be generated artificially by the differences in model specification. Therefore, as a robustness test, we use the same strategy (Kim, 1999) for industrialized and developing countries to identify monetary policy shocks. Finally, we use the local projections as an alternative method to obtain impulse responses. This method minimizes the consequences of mis-specification that may arise when calculating FEVDs. Local projections and our alternative identification strategies are discussed in the robustness section. We proceed by discussing our benchmark identification strategies.

G-8 countries

To measure monetary policy shocks (that are not correlated with shocks to the other variables in the model), we assume that the monetary policy variable does not respond to output and prices contemporaneously and only responds to these variables with a lag mainly due to lags in announcement. We also assume that output and prices are not affected contemporaneously by financial variables due to adjustment costs associated with these variables. The world export price index is affected by shocks to every other variable. Although, individual countries are not large enough to affect world commodity price index, domestic developments can affect exchange rates and thereby determine the price of exports in local currency units. Notice that, the non standard variable that we include in the VAR is the lending spread. We assume that this variable is affected by every other variable contemporaneously, however, does not affect output and prices nor enters the monetary policy reaction function contemporaneously. This assumption is consistent with Gertler and Gilchrist (1993). These identifying restrictions on the contemporaneous structural parameters are summarized in the equation below.

$$\begin{bmatrix} e_{ip} \\ e_{cpi} \\ e_{ls} \\ e_{r} \\ e_{wxpi} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ P_{21} & 1 & 0 & 0 & 0 \\ P_{31} & P_{32} & 1 & P_{34} & P_{35} \\ 0 & 0 & 0 & 1 & P_{45} \\ P_{51} & P_{52} & P_{53} & P_{54} & 1 \end{bmatrix} \begin{bmatrix} u_{ip} \\ u_{cpi} \\ u_{ls} \\ u_{r} \\ u_{wxpi} \end{bmatrix}$$

where e_{ip} , e_{cpi} , e_{ls} , e_{r} , e_{wxpi} are the structural disturbances and u_{ip} , u_{cpi} , u_{ls} , u_{r} , u_{wxpi} are the residuals obtained from the reduced form equations.

Non G-8:

The restrictions used to identify shocks above have done reasonably well in replicating the response of the economy to monetary shocks in G-8 countries. Although one can argue that these restrictions would be valid for smaller economies as well, the literature (c.f. Hoffmann, 2007) has in general relied on different strategies to identify monetary shocks in developing countries. In particular, these studies assume (reasonably) that advance economy variables such as output prices and interest rates are exogenous to the model that describes a developing economy. In this section, we follow this approach and estimate the following for countries other than those in the G-8.

$$Y_{it} = B(L)Y_{it} + C_0 X_{it} + C(L)X_{it} + e_{it} \quad (4)$$

where Y_{it} is the endogenous domestic variable vector given by: $Y_{it} = [ip, cpi, ls, r]'$. X_{it} is the exogenous foreign variable vector given by $X_{it} = [y*, r*]'$. This vector is comprised of the foreign industrial production index and the discount rate. To obtain impulse responses we use a Cholesky decomposition. The variables in Y_{it} are ordered: *ip, cpi, ls, r.* We use the U.S. industrial production index and discount rate for *y** and *r** respectively.[12]

For a majority of the countries in our sample, Augmented Dickey-Fuller (ADF) tests suggested non-stationarity of the industrial production, consumer price and the world export price indices. However, we do not impose any cointegrating restrictions and estimate an unrestricted VAR in levels since this is a convenient setup for measuring the effects of monetary policy in the short run.[13] A lag length for estimating each VAR is chosen by the corrected-AIC (which is a modified version of the AIC---see Hurvich and Tsai, 1989).

FEVDs are calculated using historical distributions and a forecast horizon of 48 months. FEVDs are measured by the percentage of accumulated output or lending spread responses to current and past shocks (up to 48 months) that are explained by discount rate shocks.[14]

The first two rows of Table 2 display summary statistics for CCS. It is important to note at this point that our measures for CCS are (with the exception of a few cases) within the ranges

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[12] Replacing the U.S. with Germany for countries in the European Union did not change our results significantly. For countries in the European Monetary Union (EMU), we estimated the VAR model prior to EMU membership.

[13] Alternatively, we measured variables in logs and detrended them using a quadratic time trend and obtained similar results.

[14] A majority of the studies measure FEVDs for single forecast horizons. In contrast to our analysis, these studies are in general are for a single country. Since policy lags are different across countries, measuring FEVD by the accumulated responses of output and lending spreads to monetary policy shocks was a reasonable approach. Alternatively, we approximated CCS by a simple average of the FEVDs at different forecast horizons, and by the FEVDs at single forecast horizons. Our second stage results were considerably similar and therefore are not reported.

of values found by other studies, as shown in Table 1. The measures are similar despite the different identification schemes, forecast horizons, frequencies and measures for output and monetary policy stance.

4. Financial frictions and CCS

In this section, we investigate the relationship between CCS and financial frictions. We use the FEVDs generated in the previous section as proxies for CCS. We focus on the FEVD of output as an indicator of CCS, but also look at the FEVD of the lending spread. We capture the level of financial frictions by the percentage of the value of a loan recovered by lenders (the recovery rate) when there is default. In particular, the higher the recovery rate, the lower the level of financial frictions. Of course the recovery rate is only one aspect of financial frictions. We choose to focus on this variable, however, because it provides a close match to the source of financial frictions (the monitoring cost coefficient) discussed in Section 2 and therefore allows us to more accurately test the predictions of the financial accelerator model.

Let RR_i and CCS_i denote the recovery rate and CCS for country *i*, and let x_i denote the vector of country specific control variables. The bottom panel of Table 2 shows that the simple correlation between these two variables is -0.36. In this section we determine whether this negative relationship holds after controlling for other factors. We estimate the following model:

$$CCS_i = \alpha_0 + \alpha_1 RR_i + \beta x_i + \varepsilon_i \tag{3}$$

As control variables we include the log of real GDP per capita and a more general institutional quality variable, GOVQ, that averages measures of law and order, corruption, and bureaucratic quality, obtained from ICRG. Real GDP is converted to U.S. dollars to maintain a common unit of measure. The inclusion of these variables ensures that RR_i is not picking up the effects of the overall level of development or other measures of institutional quality. We also include stock market capitalization (% of GDP) to control for financial market development. By doing so, we are able to account for the dampening effect that a developed financial market would have on CCS by providing alternative sources of finance during contractions. It is also reasonable to assume that a more independent central bank can have a greater impact on the real economy. Therefore, we control for CBI. Finally, we also include real interest rates since high real interest rates could indicate that monetary policy is more influenced by fiscal sustainability and the neutralization of capital inflows and outflows (especially in small open economies).

For the measure of CBI, we consider the CBI indices in Cukierman et al. (1992), which are based on legal aspects of independence (*LEGAL*) and the turnover rate of central bank governors (*TURNOVER*).[15] The indices are generally available until 1989 for both advanced and developing economies and assume one value per decade. They range from 0 to 1, with higher values indicating greater CBI for the legal index and lower CBI for the turnover index. The legal index was extended through 2002 for 24 Latin American and Caribbean countries by Jácome and Vázquez (2005), who also added a few new countries to the sample, and through 1999 for advanced countries by Siklos (2008). The turnover index was supplemented with data after 1990 from Crowe and Meade (2007) and Dreher, et al. (2008).

The sample includes 74 countries for which all necessary data were available. We use annual data averaged over the years 1984 to 2008 for the right hand side variables to match the sample period used to generate the dependent variable.[16] Thus there is only one observation per country. We estimate equation (3) using OLS with robust standard errors.

Data on financial frictions: the bankruptcy recovery rate

[15] *TURNOVER* is the average number of changes in the central bank governor per year in each decade. For example, If *TURNOVER* = 0.2, there are 2 changes per decade for an average tenure of 5 years.
[16] Central bank independence index was only available for the 1989-2000 period.

The key parameter in the financial accelerator model that captures financial frictions is the monitoring cost coefficient, μ , or equivalently the bankruptcy recovery rate, 1- μ . The closest match for this parameter is from the World Bank's Doing Business database, which contains the variable, "recovery rate (%)", defined as "how many cents on the dollar claimants (creditors, tax authorities, and employees) recover from an insolvent firm."[17]

The database also provides data on the bankruptcy cost as a % of the estate. Despite the positive correlation of these two variables, we expect that the recovery rate measure to be a better representation of the deadweight bankruptcy cost parameter in our model. The reason is that the cost variable only measures the legal costs of the bankruptcy proceedings, while the recovery rate in addition to legal fees also considers the loss in the value of firms' assets due to time spent in these proceedings. Furthermore, when we checked the relationship between these two variables and other proxies for institutional quality provided by International Country Risk Guide (ICRG), we found that the correlations with the recovery rate were much higher. Indeed, quite a few number of countries that had low institutional quality according to ICRG (e.g. Georgia, Colombia, Tunisia) had lower bankruptcy costs (% of estate) than countries that ranked high in the ICRG survey (e.g. France, Germany, Ireland, Australia).[18] This data were available annually for the 2004-2008 period.

It is important to highlight a potential caveat in our analysis at this point. Notice that, due to data availability we are using a shorter period (2004-2008) to measure financial frictions than we use to estimate our VAR models (1984-2008). However, there is little time series variation in the recovery rate data and so the data that are available may be a good representation of earlier

[17] This survey follows the methodology developed by Djankov, et al. (2008).

[18] Alternatively, we used the dataset used in Djankov, et al. (2008). This dataset has legal fees and time spent during proceedings. To capture the overall costs of default we used different weighting schemes to measure both the legal fees and the time spent during proceedings. Our results were robust to these different experiments.

values for this variable. In addition, the more general institutional quality variables obtained from ICRG that are available beginning in 1984 also display little variation over time. This provides evidence that deeper features of an economy are quite stable, and so to the extent to which financial frictions are one of these features, they too should be reasonably constant and not depend on monetary policy shocks.[19] In addition, the fact that recovery rates are fairly constant over time suggests that they provide a source of exogenous variation in CCS across countries. In particular, potential endogeneity, arising from reverse causality for example, should be mitigated if recovery rates are mostly time invariant. As discussed later, we included alternative measures of financial frictions and again found a negative relationship.

Results

The top panel of Table 3 presents results from the estimation of equation (3) where CCS is measured using the response of output. Consistent with the simulation results in Section 2, we find a negative relationship between recovery rates and CCS. In particular, the coefficient of *RR* is negative and significant at the 5% level. The coefficient of the recovery rate variable implies that a one percentage point increase in the recovery rate leads to a 0.31 percentage point drop in the percent of the variation of output explained by the policy rate. A value of 0.31 implies that if Hungary were to increase its recovery rate to the level of the UK's, it would reduce the percent of the variation in output explained by the policy rate from 26.0% to 16.7%. The results are similar when we include stock market capitalization, the real interest rate, CBI, and various combinations of these variables. In the table we present result using central bank governor

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[19] There is a substantial research on the relationship between financial frictions and firms' investment decisions. A majority of this literature finds that the recovery rate could be a function of the shocks countries face (Acharya et al., 2007; Altman et al., 2005; Chen, 2008), especially in emerging market economies with volatile business cycles, or that there may be economies of scale in monitoring. By averaging the recovery rate data from 2004-2008, we hope to more accurately capture the financial friction in the model, a deep parameter that does not depend on the business cycle. In addition, as mentioned above, the recovery rate data display little time series variation, providing some evidence that monetary policy shocks do not significantly affect recovery rates.

turnover as a measure of CBI because data are available for 20 more countries. When we use the legal measure of CBI, the coefficient of *RR* becomes insignificant, although this is a result of the reduced sample size and not the inclusion of the legal variable itself. Specifically, if we run the regression without the legal variable but limit the sample to countries with data for the legal variable, the coefficient of *RR* is insignificant.

In the bottom panel of Table 3 we test whether the effect of financial frictions on CCS varies depending on the prevalence of small firms in the economy. Small firms are more likely to be credit constrained and so monetary policy should have a larger effect in economies with many small firms (Bean et al., 2002; Cecchetti, 1999; Kashyap and Stein, 1997). We therefore interact *RR* with indicators of small firm presence. The first indicator is the percent of firms using banks to finance investment, with higher values suggesting more small firms. We therefore expect a negative sign for the interaction term. We also use the % of workers employed by small and medium firms (Ayyagari et al. 2007). Finally, we use stock market capitalization as a % of GDP. In this case, higher values suggest more large firms, and so we expect a positive coefficient on the interaction term.

In addition, numerous papers argue that improvements in institutional quality are accompanied by an increase in the share of small firms in production (c.f. Brock and Evans, 1989; de Koning and Snijders, 1992; Acs, 1992; Beck, Demirguc-Kunt, Laeven, Levine, 2008). To the extent that financial frictions reflect institutional quality, higher recovery rates could therefore increase CCS by increasing the share of production by small firms. Controlling for the proxies for small firm presence allows us to obtain the effect of recovery rates that does not work through small firm presence.

To facilitate a comparison with the base specification results, we first present results including only the variables in the base specification but limiting the sample to countries with data on the interaction variables. We then present results for the regressions including the interaction terms. All the interaction terms have the predicted sign. Comparing columns 1 and 2, we see that when we include the interaction term of *RR* with the percent of firms using banks to finance investment, the coefficient of *RR* becomes insignificant while the coefficient of the interaction term has the predicted negative sign and is significant at the 5% level. This suggests that the initial negative coefficient of *RR* was the result of financial frictions augmenting the effect of monetary policy for smaller firms. Further calculations reveal that the effect of an increase in *RR* is significant but only for countries with the percent of firms using banks to finance investment greater than or equal to 14% (slightly below the average value for the full sample of countries). The size of the predicted impact on *CCS* when the value of this variable is 14% is equal to -0.45 percentage points. The coefficient of *RR* * % of workers employed by small firms has the predicted negative sign but is not significant. The coefficient of *RR* * Market Cap (% of GDP) has the predicted positive sign and is significant at the 5% level. Thus there is some evidence that the effect of financial frictions on *CCS* is magnified in countries with a larger presence of small firms. Finally, the coefficients of three variables measuring small firm presence by themselves (i.e. not their interaction with *RR*) also have the predicted signs and are significant in two of the three cases.

Table 4 presents results when the dependent variable is based on the response of the lending spread to monetary policy shocks, as opposed to the response of output. The financial accelerator model predicts that both lending spreads and the output response should be higher when the level of financial frictions is higher. In the top panel the coefficient of *RR* is again negative and significant. The coefficient of the recovery rate variable implies that a one percentage point increase in the recovery rate leads to a 0.33 percentage point drop in the variation of lending spreads explained by the policy rate. This result is robust to various specifications. In particular, as shown in Table 4, the results are very similar when we include stock market capitalization, the real interest rate, CBI, and various combinations of these variables.

In the bottom panel, we again test whether the effect of financial frictions on CCS varies depending on the prevalence of small firms in the economy. The interaction terms again have the predicted signs, but the coefficient is only significant in the last case. Finally, the coefficients of three variables measuring small firm presence by themselves (i.e. not their interaction with *RR*) also have the predicted signs, but again the coefficient is only significant in the last case.

5. Robustness Tests

Alternative measures of financial market development

We used other measures of financial market development, in addition to stock market capitalization. The results were very similar using the stocks-traded turnover ratio defined as the total value of shares traded during the year divided by the average market capitalization for the year, the total value of stocks traded (% of GDP), and domestic credit to the private sector (% of GDP).

Local projections (LP)

As an alternative to the SVAR model, we follow Jorda (2005) and use the LP method to obtain impulse responses to monetary policy shocks. Estimating the system with LP is similar to estimating a structural VAR in that the coefficients are estimated jointly and one can identify the structural coefficients through recursive methods such as a Cholesky decomposition. We use

Jordà's (2005) LP method to minimize the consequences of mis-specification that may arise when calculating FEVD (and impulse response functions) from a standard VAR.[20] While it is common practice to calculate FEVDs and impulse response functions from VARs for distant horizons, VARs are optimally designed for one-period ahead forecasting. If the VAR does not capture the true data generating process, the errors in the forecast from the mis-specification are compounded as the horizon increases. Hence, the interpretation of VAR impulse response functions and FEVDs may be misleading.[21] Jordà (2005) shows that with LP one can calculate impulse response functions and FEVDs with less concern over mis-specification and with only a minimal potential trade-off in efficiency (if it is the case that the VAR does better represent the data generating process).

Hence, our proxy for CCS, the percentage of variation in output explained by the central bank rate, is generated from Jordà's (2005) method.[22] For the impulse response functions, the residuals are ordered: *ip*, *cpi*, *ls*, *r*, *wxpi*. Similarly, a lag length for the system is chosen by the corrected-AIC developed by Hurvich and Tsai (1989).

The results are provided in the second column of Table 5. Again CCS is measured using the response of output. The results are similar although the magnitude of the coefficient of *RR* and its significance are a little smaller than in the base case.

Separate Specifications

[20] The discussion in this section only provides a brief comment on the method. For a complete treatment of the LP method see Jordà (2005) and Jordà (2007).

[21] Chari et al. (2005) show that VAR impulse responses obtained by using artificial data from a simple RBC model contradict the responses from the model itself. The authors argue that the mis-specification stems from the inability of specifications involving few lags to capture the model data persistence due to capital's low rate of depreciation. Jorda (2005) proposes an alternative method for calculating impulse responses.

[22] For Canada, for example, the proxy variables calculated from a VAR and the LP methods have a correlation of 0.66. A table showing comparison of the estimates between the two methods is available upon request.

In this section, we test whether the negative relationship between financial frictions and CCS is artificially generated by applying different empirical models to countries that are at different stages of development. To do so, we use the identification strategy, originally applied to only G-8 countries for every country in our sample.

The results are provided in the first column of Table 5. Again CCS is measured using the response of output. The coefficient of *RR* is again negative and significant. The magnitude of the coefficient is much smaller than in the base case. A coefficient of 0.055 implies that if Hungary were to increase its recovery rate to the level of the UK's, it would reduce the percent of the variation in output explained by the policy rate from 26.0% to 24.5%. However, the dependent variable is very different using this identification strategy. The mean of the CCS variable using the default approach is 14.41% while the mean using this alternative approach is only 3.25%. Furthermore, the median using the default approach is 4.49 compared to only 0.30 using the alternative approach. The small coefficient value may indicate that changes in recovery rates have negligible effect on CCS. Given the higher coefficient value obtained from the LP approach (less vulnerable to model mis-specification), however, the small value suggests that the separate identification maybe a better way of capturing CCS in developing and advanced economies.

Separate Time-Periods

Central banks in recent years have had more success stabilizing the real economy (c.f. Rogoff, 2007; Cecchetti, Flores-Lagunes and Krause, 2006). Indeed, our measure of CCS indicates an improvement in the efficacy of monetary policy over time. It is possible that this increase in CCS means that there is more scope for financial frictions to impact the efficacy of monetary policy. We therefore break up the sample into different periods to investigate this possibility. The top panel of Table 5 provides results for the base specification but breaking the sample up into three equal sub-periods. Note that, the number of countries in each experiment is smaller than the number of countries in the full sample. Nevertheless, the coefficient of *RR* has the predicted negative sign for all sample periods but is only significant for the last two periods. The coefficient for the last period is much larger than the two previous periods. This may be a result of the fact that the recovery rate data are only available for recent years. This is also consistent, however, with a growing role of financial frictions in affecting CCS. A coefficient of 0.62 implies that if Hungary were to increase its recovery rate to the level of the UK's, it would reduce the percent of the variation in output explained by the policy rate from 26.0% to 7.4%.

Alternative Measures of Financial Frictions

We included a number of alternative measures of financial frictions. We include the logarithm of the number of days to enforce a contract and the creditor rights index (higher values mean better rights) from Djankov et al. (2008). The bottom panel of Table 5 presents the results. The former has the predicted positive sign and is significant at the 10% level, while the latter is not significant but has the predicted sign. The bankruptcy cost as a percent of the estate (from the Doing Business database) is also insignificant. Finally, the accounting standards variable (in sample range: 31-83) from La Porta, et al. (1998) has the predicted negative sign and is significant at the 1% level. In total, these results provide some further evidence that greater financial frictions increase CCS.

In the next section, we generate an alternative measure for financial frictions using one of the predictions of the financial accelerator model. We then investigate the relationship between financial frictions and CCS using this alternative proxy.

6. Leverage Sensitivity as a Proxy for Financial Frictions

Measuring Leverage Sensitivity

The financial accelerator model discussed above makes two important predictions. First, there is a positive relationship between CCS and the level of financial frictions in an economy. The previous section showed that this prediction was partially supported by cross-country data. Second, the optimality conditions imply that external finance premiums are more sensitive to leverage when financial frictions are high. This is a more subtle relationship in the model and can be seen more clearly if we linearize equation (1) as:

$$\tilde{EFP}_t = \alpha_1\left(\mu, \overline{A}_i\right)\tilde{LEV}_t \tag{5}$$

where $\alpha_1'(\mu) > 0$, $\tilde{EFP}_t = \tilde{R}_t^k - \tilde{R}_t$, $\tilde{LEV}_t = \tilde{Q}_{t-1} + \tilde{K}_t - \tilde{N}_t$, where "~" denotes percent deviation from steady state. Equation (4) shows that as the level of financial frictions (μ) increases, the external finance premium becomes more sensitive to firm leverage. The reason is that when monitoring costs are low, creditors are not as affected by bankruptcy since they can retrieve a greater portion of a bankrupt firm's assets. In this case, the risk free rate is a relatively more important determinant of external finance rates. In contrast, when monitoring costs are high, leverage plays a more predominant role.

The financial accelerator model therefore predicts that as the level of financial frictions increases, the external finance premium becomes more sensitive to firm leverage, i.e. leverage sensitivity increases (we verify that this relationship holds again using recovery rates as a proxy for financial frictions).[23] We can therefore use leverage sensitivity as another proxy for financial frictions. In this sub-section we estimate leverage sensitivity for each country. This approach is appealing since it allows the financial market data to predict the level of financial frictions in a country as an alternative to the survey data and indices used in the previous sections.

[23] Results are available if requested.

To capture leverage sensitivity for each country, we estimate using firm level data the effect of firm leverage on the external finance premium. We approximate the external finance premium for each country with corporate bond spreads. We use bond deals of non-financial firms and other firm-specific data from 47 countries, over the period 1995 to 2009, provided by the Thomson One Banker database. The available data are irregular unbalanced and span the period January, 1995 to February, 2009. We chose this data range to maximize the number of observations and thus include as many countries as possible in our estimation.

There is ample research on the determinants of corporate bond spreads both in developing and advanced economies (see Collin-Dufresne, Goldstein and Martin, 2001; Tang and Yan, 2008 for research focusing on the latter, and Cavallo and Valenzuela, 2007; Durbin and Ng, 2005; Huang and Kong, 2003 for studies on developing countries). Usually, this literature attributes the variations in corporate spreads to firm, industry and bond characteristics, macroeconomic variables, sovereign risk and other country-specific effects. In our estimation, we follow the literature and account for these effects to the extent that data are available.

Specifically, we estimate the following equation separately for each country:

$$E\tilde{F}P_{it} = \gamma_{0k} + \gamma_{1k} L\tilde{E}V_{it-1} + \xi_{1k} y_{it-1} + \xi_{2k} BC_{it} + \xi_{3k} MC_{tk} + \xi_{4k} SR_{tk} + \xi_{5k} T_k + \xi_{6k} I_k + v_{it} \tag{6}$$

where subscripts *i, k* and *t* denote the bond deal, the country and the time period. $E\tilde{F}P_{it}$ represents the spread on bond *i*, $L\tilde{E}V_{it-1}$ is the financial leverage of the firm and y_i denotes a vector of firm specific control variables. T_k and I_k are the time and industry dummy variables and BC_{it}, MC_{tk} and SR_{tk} represent a vector of bond characteristics, a vector of macroeconomic conditions and the sovereign risk measured at time *t*. We refer to the coefficient of the leverage variable, $\hat{\gamma}_{1k}$ as leverage sensitivity in the rest of the paper.

We follow the standard practice in the literature and measure corporate bond spreads, $E\tilde{F}P_{it}$ as the difference between corporate bond yields and government bond yields of similar maturity.[24] Let $YTM^{i}_{t,T}$ and $YTM^{g}_{t,T}$ denote yield to maturity at time t of corporate and government bonds that mature at time T respectively. Corporate bond spreads can be expressed as,

$$E\tilde{F}P_{it} = YTM^{i}_{t,T} - YTM^{g}_{t,T} \tag{7}$$

In our benchmark data set, we include bonds that are denominated in local and foreign currency. If a 5 year Brazilian bond is denominated in dollars for example, we use the yield on a 5-year US treasury bond when measuring the spread. Alternatively, we considered only local currency denominated bonds. Despite decreasing the number of countries with sufficient observations, this alteration did not change our results significantly.

The database has three ratios that can approximate the financial leverage variable $L\tilde{E}V_{it}$. Total Debt/Equity, Total Debt/Market Capitalization, Proceeds/Equity. In our analysis, we use all three variables. To limit causality concerns, we use the leverage data that was last reported prior to the issue date. For example is the issue date is May 23rd 1999, we used the leverage ratio reported at the end of 1998 or the first quarter of 1999, if quarterly data is available.

Recent research finds that the firm-specific characteristics explain the largest portion of variation in corporate bond spreads (c.f. Cavallo and Valenzuela, 2007). Therefore, in addition to financial leverage, we follow Altman (2000) and include other firm specific variables. These variables are: return on assets, earnings before interest and taxes/Assets, retained earnings before interest and taxes/Assets, liquidity measured by the current ratio, capitalization measured by

[24] Our main reason for using yield to maturity was the availability of data. There is research, however, that highlight the limitations of using this variable. For example, Cavallo and Valenzuela (2007) argue that it is very difficult, especially in developing countries, to find bonds of similar maturity and/or to determine maturity when there are contingent cash flows. The authors use option-adjusted spreads from Bloomberg to make bond spreads more comparable. In our estimation we only use bonds that don’t have contingent cash flows due to such features as put or call options. Therefore, using yield to maturity is not unreasonable.

Equity/Capital, and size measured by Total Assets. Additionally, we accounted for the openness of the firm (foreign sales/total sales) and tried different ratios that proxy liquidity, debt structure and profitability. The results were robust to these alterations.

To capture the non-default component of corporate spreads, we control for several bond-specific characteristics such as issue size, the credit rating of the bond, and time to maturity. Issue size has been associated with the liquidity of the bond. Specifically, research (c.f. Chacko et al., 2008) finds that bonds with higher issue sizes are usually more liquid.

Sovereign risk and macroeconomic indicators are included to measure the asymmetric effects these variables may have across firms. For example Durbin and Ng (2005) find that the sovereign ceiling (the concept that no firm is more creditworthy than its government) does not apply to every emerging market firm in their sample. We included GDP growth rate, inflation and the external balance in our estimation to account for the macroeconomic conditions. There is recent evidence that there are significant differences -- considerably larger than cross country differences-- in the transmission of monetary policy across industries. Therefore we include sector specific dummies to account for these differences. We also include annual time dummies.

Table 6 reports leverage sensitivities that are estimated using equation 5 for each country. The first column lists the number of bond deals that were reported in each country during sample period. The second column displays the number of bond deals for which we could find the necessary information to estimate equation 6. The remaining bonds were either government bonds or the financial data for the companies that issued these bonds – mostly private—were not available. As expected, the third column mostly reveals a positive relationship between leverage and corporate bond spreads and that these coefficients are highly significant in general. Furthermore, results indicate that changes in leverage have a considerable effect on corporate spreads. Indeed, according to our results, a 1 percent increase in leverage has a 0.23 percent increase in bond spreads on average.

These results are parallel to the recent findings in the literature (Cavallo and Valenzuela, 2007; Collin-Dufresne Goldstein and Martin, 2001; Durbin and Ng, 2005; Huang and Kong, 2003) and clearly imply that firm specific effects play an important role in determining corporate bond spreads.

Leverage Sensitivity and CCS

Next, we replace the recovery rate variable in equation (3) with $\hat{\gamma}_1$ and investigate how this proxy for financial frictions is related to the CCS variables, CCS_i measured in Section 3.

$$CCS_i = \alpha_0 + \alpha_1 \hat{\gamma}_{1i} + \beta x_i + \varepsilon_i \tag{8}$$

We argue that using the leverage sensitivity variable instead of recovery rates is a better way of accounting for financial frictions. This is due to two reasons. First, despite the significant relationship between recovery rates and our leverage sensitivity proxy, a brief observation of the two variables shows that a considerable amount of variation in the leverage sensitivity variable is independent of recovery rates. Second, as explained above, due to data availability we were restricted to estimate equation (3) using recovery rates from 2004 to 2009 and the monetary policy proxy estimated using data from 1984-2008.

Pagan (1984) proves that in models with generated regressors similar to that in equation (8), if the hypothesis to be tested is $\alpha_1 = 0$, the OLS estimator of the variance of $\hat{\lambda}_1$ is consistent, and the asymptotic t-statistics are valid. Therefore, we use OLS as an estimation strategy.

Table 7 displays the results. The three columns correspond to which measure of financial leverage was used to generate the leverage sensitivity variable. In the first column, the coefficient of leverage sensitivity is significant at the 5% level. In the next two columns, the effect is almost significant at the 10% level. In all three cases we find a positive relationship between the financial friction proxy and CCS. A one percentage point increase in leverage sensitivity leads to a 0.3 - 0.44 percentage point increase in the percent of the variation of output explained by the policy rate. The results were similar when we excluded the government quality variable and GDP per capita. These results therefore provide further evidence that greater financial frictions are associated with an increase in CCS.

7. Conclusion

In this paper we focus on two predictions of general equilibrium models characterized by agency costs and financial frictions. First of these is the well documented positive relationship between the level of financial frictions and the effects of monetary policy shocks on the economy. The second prediction is the positive relationship between the level of financial frictions and the leverage sensitivity of borrowing costs.

Consistent with the first prediction we find, simulating the widely used financial accelerator model that the effect of monetary policy shocks on output is higher (lower) when we calibrate the model using data from a country with low (high) levels of financial frictions. The main contribution of this paper, however, is to test the empirical relevance of this prediction using cross-country data. In doing so, we construct a variable that gages CCS across countries and find a positive relationship between financial frictions and CCS.

We also use the second prediction mentioned above to generate an alternative measure for financial frictions. Using firm level data, we measure the sensitivity of bond spreads (our measure for borrowing costs) to financial leverage of firms that issue these bonds. Our second stage, cross country regression results provide support for the second prediction and reveal a positive relationship between leverage sensitivity and CCS.

This paper, to the best of our knowledge, is the first attempt at examining the relationship between CCS and the level of financial frictions across countries. However, our results should be interpreted modestly given the difficulty of controlling for country specific effects and the limited data set (especially for less developed countries). Despite the shortcomings, however, our results were robust to various tests.

One important implication of our results is that as institutions improve, perhaps as part of the process of joining political unions with countries with stronger institutions (Djankov et al. 2008), monetary policy becomes less effective if these improvements center on reducing financial frictions. Of course, if there are more broad improvements in institutional quality that bring more credibility to central banks, the *overall* impact on the effectiveness of monetary policy is ambiguous. At the very least therefore, our results imply that the effect of institutional improvement on the strength of monetary policy is not clear-cut and that any analysis in this area requires a nuanced approach.

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Table 1: Credit Channel Strength: Ours vs. Literature

	CCS	Literature
Canada	15.7%	Kim (1999) 5.9% -17.0%, Italiano (2001) 2.0% - 20.6%, Bordo and Redish (2003) 16.0%-17.9%
Czech Republic	7.2%	Anzuini and Levy (2007) 2.0%-11.9%
France	4.2%	Anzuini and Levy (2007) 5.6%-17.7%, Kim (1999) 6.2% - 17.7%
Germany	15.8%	Anzuini and Levy (2007) 9.3%-23.1%, Holtemoller (2003) 21%, Kim (1999) 7.6% - 26.9%
Greece	2.7%	Markidou and Nikoladou (2008) 1.1% - 7%
Hungary	26.0%	Anzuini and Levy (2007) 12.0%-18.1%
India	13.2%	Roy and Darbha (2000) 0.8%-11.43%
Italy	7.2%	Anzuini and Levy (2007) 4.3%-8.9%, Kim (1999) 4.3% - 8.9%
Japan	2.4%	Kim (1999) 1.8% - 8.8%
Nigeria	16.2%	Olusegun (2001)18.2%-24%
Poland	13.5%	Anzuini and Levy (2008) 7.5%-17.3%
Tunusia	13.3%	Boughrara (2008) 2%-12%
U.K.	7.2%	Anzuini and Levy (2007) 9.8%-15.3%, Kim (1999) 9.8% - 15.3%
U.S.	5.8%	Bernanke, Boivin, Eliasz (2005) 5.4%, Kim (1999) 7.6% - 26.9%, Eichenbaum (1996) 29.4%, Rossi and Zuabiry (2009) 3.5%-27.1%, Bordo and Redish (2003) 10.85%-13.5%

NOTE: This table compares our CCS proxy with those found in other studies. CCS column shows the forecast error variance decomposition of output explained by shocks to the policy rate.

Table 2: Summary Statistics and Correlation Matrix

	obs.	mean	median	s.d.	min.	max.
CCS (output)	74	14.41	4.49	21.73	0.01	94.87
CCS (lending spread)	73	10.49	2.56	20.33	0.03	97.48
RR	74	43.29	38.32	26.26	0.00	92.62
GDP per capita	74	14,586	10,814	10,942	427	50,512
GOVQ	74	3.81	3.66	1.27	0.74	5.99
Market Cap. % GDP	70	51.43	32.58	52.34	0.71	280.07
real interest rate	73	6.18	6.13	10.38	-37.07	51.61
CBI-Turnover	67	0.21	0.20	0.14	0.00	0.93
days to enforce a contract	74	581	516	307	120	1,442
creditor rights	69	2.08	2.00	1.11	0.00	4.00
cost of bankruptcy (% of estate)	73	13.07	9.00	9.19	1.00	42.00
accounting standards	37	61.97	64.00	12.25	31	83
% firms using banks to finance investment	50	18.77	17.12	12.41	2.61	74.55
% workers employed by small firms	57	59.24	60.30	18.21	12.74	90.27

Correlation Matrix

	CCS (output)	*CCS* (lending spread)	*RR*	creditor rights	days to enforce a contract	accounting standards
CCS (lending spread)	0.51					
RR	-0.36	-0.35				
creditor rights	-0.20	-0.19	0.15			
days to enforce a contract	0.00	0.14	-0.34	-0.13		
cost of bankruptcy (% of estate)	0.06	0.03	-0.58	0.10	0.10	
accounting standards	-0.60	-0.35	0.50	0.30	-0.32	-0.20

NOTES:

1. Unless otherwise noted, all data are annual. Growth rates and ratios are expressed in percentage terms. All variables are averaged over the sample period.

Table 3: Equation 3 - Credit Channel Strength (Output) and the Recovery Rate

Dependent variable: *CCS*						
RR	-0.310	-0.307	-0.261	-0.254	-0.260	-0.234
	(0.150)**	(0.147)**	(0.116)**	(0.130)*	(0.114)**	(0.123)*
log GDP per capita	1.229	4.559	2.183	3.548	3.932	4.311
	(3.542)	(3.870)	(3.741)	(3.912)	(3.979)	(4.050)
GOVQ	-0.417	-2.619	-2.621	-1.411	-2.584	-1.726
	(3.630)	(3.788)	(3.365)	(3.760)	(3.736)	(3.959)
Market Cap. % GDP		-0.073			-0.056	(0.066)
		(0.030)**			(0.027)**	(0.034)*
real interest rate			0.930		1.114	1.035
			(0.239)***		(0.330)***	(0.319)***
CBI-Turnover				56.456		30.133
				(19.227)***		(15.852)*
Obs.	74	70	73	67	69	63
R^2	0.13	0.20	0.32	0.26	0.37	0.44

RR	-0.425	0.099	-0.381	-0.263	-0.317	-0.483
	(0.211)**	(0.232)	(0.169)**	(0.420)	(0.149)**	(0.212)**
log GDP per capita	6.305	6.931	12.530	12.573	3.948	4.767
	(4.870)	(4.860)	(4.944)**	(5.100)**	(3.938)	(3.681)
GOVQ	-1.449	-2.133	-7.919	-8.126	-3.588	-1.732
	(5.434)	(4.808)	(4.475)*	(4.727)*	(3.818)	(3.877)
% firms using banks to finance investment		1.216 (0.631)*				
RR * % firms using banks to finance investment		-0.030 (0.014)**				
% workers employed by small firms				0.091 (0.291)		
RR * % workers employed by small firms				-0.002 (0.005)		
Market Cap. % GDP						-0.232
						(0.093)**
RR * Market Cap. % GDP						0.003
						(0.001)**
Obs.	50	50	57	57	70	70
R^2	0.10	0.17	0.23	0.23	0.18	0.22

NOTES:
1. See Appendix C for variable definitions and sources.
2. * significant at 10%; ** significant at 5%; *** significant at 1%.
3. Cross-section regressions estimated by Ordinary Least Squares (OLS). Robust standard errors in parentheses. Robust standard errors in parentheses.

Table 4: Equation 3 - Credit Channel Strength (Lending Spread) and the Recovery Rate

Dependent variable: *CCS*						
RR	-0.328	-0.268	-0.295	-0.326	-0.231	-0.241
	(0.150)**	(0.143)*	(0.115)**	(0.137)**	(0.098)**	(0.105)**
log GDP per capita	-0.621	-3.170	0.217	0.089	-3.656	-4.470
	(4.837)	(3.660)	(4.813)	(5.767)	(3.620)	(4.084)
GOVQ	2.057	3.792	0.306	1.284	3.823	4.642
	(3.890)	(3.519)	(3.872)	(4.468)	(3.472)	(3.896)
Market Cap. % GDP		-0.043			-0.030	(0.051)
		(0.026)			(0.027)	(0.035)
real interest rate			0.755		0.901	0.839
			(0.317)**		(0.463)*	(0.498)*
CBI-Turnover				17.561		4.915
				(29.498)		(23.390)
Obs.	73	69	72	66	68	62
R^2	0.13	0.15	0.28	0.16	0.31	0.32
	-	-	-	-	-	-
RR	-0.365	-0.235	-0.331	-0.238	-0.274	-0.402
	(0.201)*	(0.181)	(0.164)**	(0.299)	(0.144)*	(0.195)**
log GDP per capita	-3.178	-3.198	-1.258	-1.410	-3.544	-2.984
	(4.355)	(4.663)	(6.283)	(6.296)	(3.590)	(3.630)
GOVQ	6.592	6.794	1.929	1.756	3.225	4.457
	(4.593)	(4.939)	(4.665)	(4.966)	(3.448)	(3.594)
% firms using banks to		0.219				
finance investment		(0.551)				
RR * % firms using banks		-0.008				
to finance investment		(0.011)				
% workers employed by				0.134		
small firms				(0.231)		
RR * % workers employed				-0.002		
by small firms				(0.004)		
Market Cap. % GDP						-0.165
						(0.070)**
RR * Market Cap. % GDP						0.002
						(0.001)**
Obs.	49	49	56	56	69	69
R^2	0.11	0.11	0.16	0.17	0.14	0.17

NOTES:
1. See Appendix C for variable definitions and sources.

2. * significant at 10%; ** significant at 5%; *** significant at 1%.
3. Cross-section regressions estimated by Ordinary Least Squares (OLS). Robust standard errors in parentheses. Robust standard errors in parentheses.

Table 5: Equation 3 - Credit Channel Strength (Output) and the Recovery Rate - Robustness Tests

Dependent variable: *CCS*	LP method	Kim	sub-sample (1)	sub-sample (2)	sub-sample (3)
RR	-0.126	-0.055	0.023	-0.254	-0.618
	(0.068)*	(0.031)*	(0.136)	(0.100)**	(0.171)***
log GDP per capita	-4.029	0.576	-0.530	-4.997	3.960
	(4.000)	(1.465)	(3.795)	(3.360)	(3.701)
GOVQ	2.752	-0.719	-2.636	3.653	2.781
	(2.102)	(1.365)	(3.403)	(2.388)	(3.508)
Obs.	51	72	49	63	66
R^2	0.16	0.04	0.05	0.22	0.25

Dependent variable: *CCS*	Alternative financial friction variables			
log of days to enforce a contract	5.348			
	(3.094)*			
creditor rights		-3.092		
		(2.466)		
cost of bankruptcy (% of estate)			-0.167	
			(0.280)	
accounting standards				-0.831
				(0.257)***
log GDP per capita	0.895	0.753	-0.265	6.772
	(3.898)	(3.804)	(3.653)	(4.622)
GOVQ	-3.658	-4.688	-4.871	-7.522
	(3.393)	(3.132)	(3.184)	(3.866)*
Obs.	69	69	73	37
R^2	0.10	0.10	0.07	0.40

NOTES:
1. See Appendix C for variable definitions and sources.
2. * significant at 10%; ** significant at 5%; *** significant at 1%.
3. Cross-section regressions estimated by Ordinary Least Squares (OLS). Robust standard errors in parentheses. Robust standard errors in parentheses.

Table 6. Equation (6) – External Finance Premium – Leverage

	NOBS	In our sample	$\hat{\gamma}_{1k}$	$\hat{\sigma}_{\gamma_{1k}}$	t-stats	R-Squared
Argentina	1242	730	0.52	0.05	10.09	0.90
Australia	7514	3155	0.17	0.01	21.06	0.91
Austria	1707	1142	0.34	0.02	14.98	0.52
Belgium	698	324	0.35	0.06	5.55	0.79
Bolivia	171	161	-0.01	0.00	-2.37	0.74
Brazil	2130	699	0.06	0.01	4.23	0.91
Canada	8816	4636	0.11	0.01	15.86	0.92
Chile	821	469	0.08	0.04	2.07	0.35
China	949	580	0.16	0.04	4.61	0.73
Colombia	1031	113	-0.13	9.10	-0.01	0.33
Denmark	1055	615	0.03	0.01	2.51	0.28
Finland	963	653	0.28	0.04	7.84	0.55
France	7056	3799	0.06	0.01	9.03	0.92
Germany	16052	9111	0.22	0.01	28.81	0.40
Greece	367	149	0.28	0.57	0.48	0.91
Hong Kong	3425	1800	0.48	0.02	21.18	0.97
Iceland	314	79	0.04	0.23	0.16	0.39
India	3760	2921	0.09	0.02	5.49	0.69
Indonesia	667	497	1.31	0.12	11.25	0.48
Ireland	4148	900	0.18	0.02	9.51	0.46
Israel	347	275	0.17	0.04	4.06	0.38
Italy	3527	886	0.11	0.02	5.04	0.19
Japan	12225	9078	0.12	0.00	39.63	0.33
Korea, South	18138	8542	-0.37	0.08	-4.53	0.58
Luxembourg	3859	3859	-0.05	0.02	-2.49	0.09
Malaysia	1965	1647	0.53	0.04	13.48	0.34
Mexico	1717	607	0.07	0.04	1.63	0.74
Netherlands	8349	4306	0.08	0.01	7.00	0.56
New Zealand	447	201	0.09	0.19	0.49	0.38
Norway	1306	716	0.36	0.02	17.54	0.73
Panama	269	105	0.12	0.05	2.36	0.82
Peru	1020	529	0.84	0.28	2.99	0.41
Philippines	583	398	0.63	0.13	4.72	0.36
Portugal	846	175	0.37	0.05	6.83	0.92
Puerto Rico	688	508	0.10	0.04	2.48	0.89
Russia	398	290	0.21	0.11	1.87	0.74
Singapore	1398	970	0.04	0.01	3.00	0.93
South Africa	205	93	0.04	0.28	0.13	0.59
Spain	3051	986	0.12	0.02	6.22	0.36
Sweden	2534	1439	0.27	0.02	13.86	0.56
Switzerland	2000	1709	0.05	0.01	4.04	0.61
Taiwan	3510	2573	0.05	0.01	8.51	0.24
Thailand	961	687	0.06	0.02	3.22	0.32
Turkey	217	146	0.40	0.29	1.39	0.01
United Kingdom	17453	5555	0.10	0.01	14.32	0.38
United States	40424	17269	0.23	0.00	56.48	0.38
Venezuela	242	114	0.46	0.02	22.95	0.90

NOTE: This table displays the results from the estimation of Equation 6. γ_{1k} is the coefficient of the leverage variable in Equation 6 and σ_{1k} is the standard error of this coefficient.

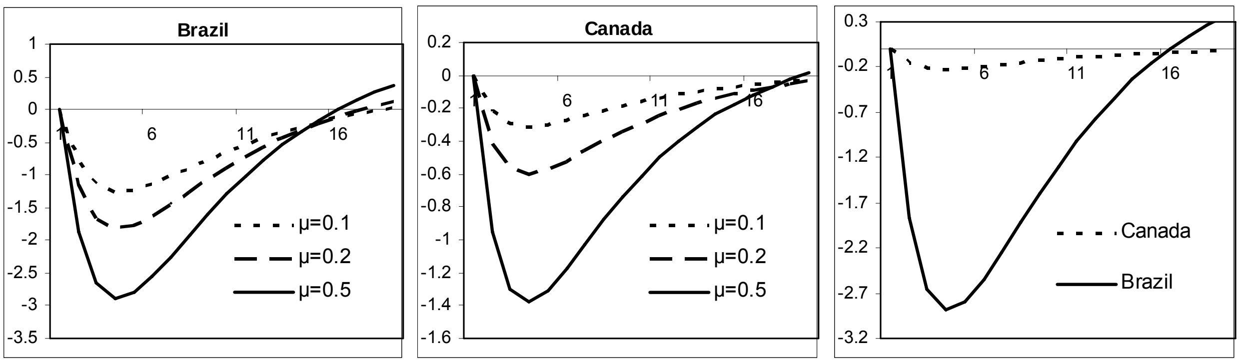
Table 7: Equation 8 - Credit Channel Strength (Output) and Leverage Sensitivity

Dependent variable: *CCS*	financial leverage measured using:		
	Proceeds/Equity	debt/capitalization	debt/equity
leverage sensitivity	0.442	0.292	0.393
	(0.191)**	(0.209)	(0.232)
log GDP per capita	10.588	6.077	6.126
	(5.311)*	(5.438)	(5.327)
GOVQ	-14.821	-9.620	-7.960
	(5.033)***	(5.793)	(5.745)
Obs.	25	31	31
R^2	0.50	0.29	0.33

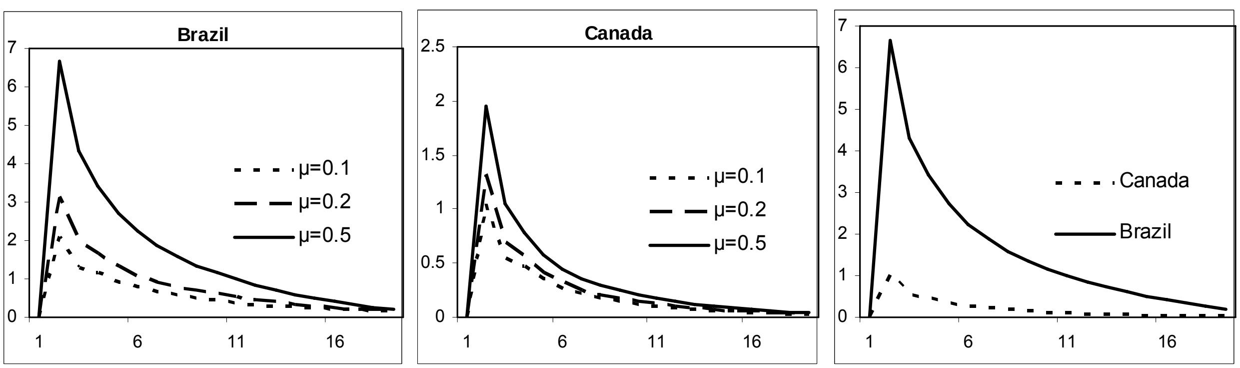
NOTES:
1. See Appendix C for variable definitions and sources.
2. * significant at 10%; ** significant at 5%; *** significant at 1%.
3. Cross-section regressions estimated by Ordinary Least Squares (OLS). Robust standard errors in parentheses. Robust standard errors in parentheses.

Figure 1: Impulse Responses to a 100 basis point Annualized Interest Rate Shock

Output



External Finance Premium



Appendix A: The Model

In our simulations we use a standard dynamic New-Keynesian small open economy framework that has financial frictions and price stickiness. There are six types of agents: households, entrepreneurs, a domestic bank, retailers, capital producers, and a central bank. Households work, consume, and invest in deposits denominated in domestic and foreign currency. Entrepreneurs do not have sufficient internal funds and thus, borrow from domestic banks to finance the production of wholesale goods. The bank uses consumers' deposits to finance entrepreneurs. Retailers transform wholesale goods into final consumption goods. Retailers are monopolistically competitive in order to motivate price stickiness. Capital producers turn investment into capital goods. Finally, a central bank conducts monetary policy using a Taylor (1993) rule.

A.1 Households

Households consume a composite good, C_t; a CES aggregation of domestic and foreign goods, C_t^H and C_t^F respectively, where, C_t^H is a composite of the goods sold by the retailers.

$$C_t = \left[(\gamma)^{\frac{1}{p}} \left(C_t^H\right)^{\frac{p-1}{p}} + (1-\gamma)^{\frac{1}{p}} \left(C_t^F\right)^{\frac{p-1}{p}} \right]^{\frac{p}{p-1}} \tag{A.1}$$

The corresponding price index is given by, $P_t = \left[(\gamma)\left(P_t^H\right)^{1-p} + (1-\gamma)\left(P_t^F\right)^{1-p} \right]^{\frac{1}{p-1}}$.

Households exhibit habit formation and maximize,

$$E_t \left[\sum_{i=0}^{\infty} \beta^i \left[\left(C_{t+i} - bC_{t+i-1}\right)^{1-\Omega} / 1 - \Omega + x \ln\left(M_{t+i} / P_{t+i}\right) - k \ln\left(1 - L_{t+i}^h\right) \right] \right] \tag{A.2}$$

s.t $C_t + \left(M_t + (1+R_{t-1})D_{t-1} + (1+R_{t-1}^*)s_t D_{t-1}^*\right)/ P_t + T_t = \left(W_t^h L_t^h + M_{t-1} + D_t + s_t D_t^*\right)/ P_t + \Pi_t$ (A.3)

Consumers buy goods, hold money, M_t, pay lump sum taxes, T_t. Their income comes from wages, profits received from the retailers, Π_t, the returns on deposits, and their money holdings. Furthermore, consumers can borrow in terms of foreign currency at the risk free interest rate R_t^*, or in domestic currency at an interest rate R_t. Nominal foreign and domestic debt payments are denoted by $(1+R_{t-1})D_{t-1}$ and $(1+R_{t-1}^*)s_t D_{t-1}$ respectively, and s_t represents the exchange rate. Given this setup, the first order conditions are derived from the consumer's optimization problem. Consumption allocation and intertemporal efficiency:

$$\frac{C_t^H}{C_t^F} = \frac{\gamma}{1-\gamma}\left(\frac{P_t^H}{P_t^F}\right)^{-p} \tag{A.4}$$

$$\lambda_t \frac{W_t^h}{P_t} = k\frac{1}{1-L_t^h} \tag{A.5}$$

marginal utility of consumption and intermtemporal efficiency:

$$\lambda_t = \left(C_t - bC_{t-1}\right)^{-\Omega} - \beta b\left(C_{t+1} - bC_t\right)^{-\Omega} \tag{A.6}$$

$$\lambda_t = \beta E_t\left(\lambda_{t+1}(1+R_t)P_t / P_{t+1}\right) \tag{A.7}$$

uncovered interest parity condition, law of one price, and foreign demand for home goods is:

$$E_t\left(\lambda_{t+1}\frac{P_t}{P_{t+1}}\left[(1+R_t)-(1+R_t^*)\frac{s_{t+1}}{s_t}\right]\right) = 0 \tag{A.8}$$

$$P_t^H = s_t P_t^{H*}, \quad P_t^F = s_t P_t^{F*} \tag{A.9}$$

$$C_t^{H*} = \left(\frac{P_t^{H*}}{P_t^*}\right)^{-\varepsilon} Y_t^* \tag{A.10}$$

where P_t^{F*} P_t^{H*}, are the foreign price of home and foreign goods and P_t^{F*}=1 in every period. Y_t^* is foreign income, and the foreign aggregate price level P_t^* is exogenously determined.

A.2 Entrepreneurs

Wholesale firms are managed by entrepreneurs and produce according to:

$$Y_{it} = A_t K_{it}^{\alpha} L_{it}^{1-\alpha} \tag{A.11}$$

where A_t is an i.i.d. aggregate productivity shock. Aggregate production function is given by, $Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$, where the labor input $L_t = \left(L_t^h\right)^{\omega}\left(L_t^e\right)^{1-\omega}$ is a composite of household's and entrepreneurs labor supply. This modification is needed to provide some net worth to entrepreneurs that start producing for the first time. In our simulations ω is set equal to 0.05 and entrepreneurs' labor supply decision does not affect output significantly. The following sections describe the agents in the economy.

Capital expenditures are financed by banks and the entrepreneurs' net worth such that,

$$Q_{t-1} K_{it} = N_{it} + B_{it} \tag{A.12}$$

where N_{it} is the net worth of the firm at the end of period t-1 and at the beginning of period t, B_{it} denotes the funds borrowed from the banks, and Q_{t-1} is the price of assets in period t-1. In the benchmark model we assume that households' domestic deposits equal the aggregate borrowing requirement of the entrepreneurs such that $B_t = D_t / P_t$. In addition to the economy wide technology shock, entrepreneurs face idiosyncratic, iid, returns to capital shocks, A_{it}. Real returns to capital are composed of A_{it} and the real return, averaged across firms, R_t^k.

$$R_{it}^k = A_{it}\left(\alpha \frac{P_t^w A_t K_t^{\alpha} L_t^{1-a}}{P_t} + (1-\delta)\frac{Q_t}{P_t}\right) / \frac{Q_{t-1}}{P_{t-1}} = A_{it} R_t^k \tag{A.13}$$

P_t^w is the price of the wholesale good, and P_t is the price level. Firms hire labor according to:

$$(1-\alpha)\omega \frac{Y_t}{L_t} = \eta_t \frac{W_t^h}{P_t}, \quad (1-\alpha)(1-\omega)\frac{Y_t}{L_t} = \eta_t \frac{W_t^e}{P_t} \tag{A.14}$$

where $\eta_t = P_t / P_t^w$ and $1/\eta_t$ represents the relative price of wholesale goods.

The Contract between the Domestic Bank and Entrepreneurs

There is a continuum of entrepreneurs with insufficient net worth to internally finance their investments. Entrepreneurs borrow the difference between their desired investment and net worth from a domestic bank. The external finance premium is determined according to the contract with the bank. Entrepreneurs' return on investment is subject to an idiosyncratic shock.

$$\left[1-F\left(\bar{A}_{it}\right)\right]\left(R_t + x_{it}\right)B_{it} + (1-\mu)\left[\int_0^{\bar{A}_{it}} A_{it} R_t^k Q_{t-1} K_{it} \delta F\left(A_{it}\right)\right] = R_t B_{it} \tag{2.1}$$

where, A_{it} is the idiosyncratic shock to returns to capital and is log normally, i.i.d. $\bar{A}_{it}$ is the expected cutoff value of the firm specific shock below which the firm is unable to pay back its debt. x_{it} , μ , Q_{t-1} , K_{it} , and R_t represent the external finance premium, monitoring cost coefficient, price of capital, capital stock, and the risk free rate respectively. The recovery rate is given by 1-μ. Equation (2.1) shows that banks set their expected returns equal to the risk free rate. The right hand side represents the opportunity costs of financing the entrepreneur. Expected returns consist of the principal and interest payments with probability $1-F\left(\bar{A}_{it}\right)$ and whatever the firm has if it defaults net of monitoring costs. Funds borrowed from the bank, B_{it}, and the return to capital, R_t^k , are given by:

$$B_{it} = Q_{t-1} K_{it} - N_{it} \tag{2.2}$$

$$R_t^k = \left(\alpha \frac{P_t^w A_t K_t^{\alpha} L_t^{1-a}}{P_t} + \left(1-\delta\right)\frac{Q_t}{P_t} \right) / \frac{Q_{t-1}}{P_{t-1}} \tag{2.3}$$

where N_{it} and $Q_{t-1}K_{it}$ are the net worth and the desired investment of entrepreneur *i* respectively, and P_t / P_t^w is the markup of retail goods over whole sale goods. We assume that entrepreneurs purchase their entire capital stock every period. This assumption ensures that the external finance premium is determined based on the overall leverage of the firm and not just the marginal investment. The second equation that characterizes the contract is as follows:

$$\overline{A}_{it} R_t^k Q_{t-1} K_{it} = \left(R_t + x_{it}\right) B_{it} \tag{2.4}$$

Entrepreneurs need at least the cutoff value of the idiosyncratic shock to pay the principal and interest. $\overline{A}_{it}$ and the risk premium, x_{it}, are determined simultaneously using equations (2.1) and (2.2). Entrepreneurs in the model are assumed to be risk neutral and are exposed to both idiosyncratic and aggregate shocks. Therefore, technology-related risks are transferred from risk-averse domestic consumers to the entrepreneurs via the financial intermediary.[25] From the revenue maximization problem of the entrepreneur, subject to (2.1), we derive:[26]

$$\frac{E_{t-1}\left[R_t^k\right]}{R_t} = v\left(\frac{Q_{t-1}K_{it}}{N_{it}}\right) \qquad v'\left(\frac{Q_{t-1}K_{it}}{N_{it}}\right) > 0 \tag{2.5}$$

Equation (2.5) represents the supply of capital relation. When firms become more leveraged, banks charge a higher premium to compensate for the higher probability of default. Similarly, we can show by inverting (2.5) that leverage is positively related to the relative returns to capital.

$$\frac{Q_{t-1}K_{it}}{N_{it}} = \varphi\left(\frac{E_{t-1}\left(R_t^k\right)}{R_t}\right), \qquad \varphi'\left(\frac{E_{t-1}\left(R_t^k\right)}{R_t}\right) > 0 \tag{2.6}$$

The overall demand for capital is obtained by aggregating over all entrepreneurs.

$$Q_{t-1}K_t = \varphi\left(E_{t-1}\left(R_t^k\right)/R_t\right)N_t \tag{2.7}$$

[25] Assuming that the country is exposed to an adverse aggregate shock, the standard financial accelerator framework implies that the bank collects more from entrepreneurs that survive to compensate for the losses from bad loans. A more realistic contract in which foreign banks include the expected, instead of the ex post, returns to capital in the financial contract does not change the results. Proof is available on http://homepages.uconn.edu/~ula06001/.

[26] The derivation of this relationship is provided in BGG.

According to this relation, firms base their investment decisions on the expected returns to capital relative to the risk free rate. Furthermore, we can also show that in steady state higher monitoring costs correspond to lower leverage so that $\varphi'(\mu) > 0$.[27] The entrepreneurs' net worth evolves according to the following:

$$N_{it+1} = \gamma^e V_{it} + W_t^e / P_t \tag{2.8}$$

where W_t^e / P_t, V_{it} are an entrepreneur's real wage and equity. V_{it} is given by,

$$V_{it} = R_t^k Q_{t-1} K_{it} - \left(R_t + \frac{\mu \int_0^{\bar{A}_i} A_{it} R_t^k Q_{t-1} K_{it} dF(A_{it})}{Q_{t-1} K_{it} - N_{it}} \right) (Q_{t-1} K_{it} - N_{it}) \tag{2.9}$$

The first term on the right hand side of equation (2.9) represents the returns to capital given that the firm does not go bankrupt. The second term is the expected debt payment. γ^e in equation (2.8) is the survival probability of the entrepreneur. This variable is needed to prevent entrepreneurs from building up enough net worth and becoming self sufficient.[28] Net worth is composed of the net returns to capital if the firm stays afloat and real wages. Equations (2.8) and (2.9) define the second part of the financial accelerator mechanism. In particular, if there is an increase in asset prices, returns to capital along with firms' net worth increases as well.[29] If entrepreneurs do not survive, they consume the returns to capital net of debt payments such that $C_{it}^e = (1-\gamma^e) V_{it}$.

A.3 Capital Producers

There are increasing marginal costs to capital production. The capital stock evolves according to:

$$K_{t+1} = \Phi(I_t / K_t) K_t + (1-\delta) K_t \tag{A.15}$$

[27] Proof is available upon request.
[28] Because internal finance is cheaper, there is an incentive to be self sufficient.
[29] Equation (2.9) can be used to show that $dV_t / dQ_t > 0$.

Capital producers are perfectly competitive. They use wholesale goods as inputs to produce capital according to the production function: $\Phi\left(I_t / K_t\right) K_t$. The price of capital goods is derived from the producers' profit maximization problem. The final component of the accelerator mechanism is given by equation (A.16).

$$E_{t-1}\left[Q_t / P_t^w - \left[\Phi'\left(I_t / K_t\right)\right]^{-1}\right] = 0 \qquad \Phi'(\bullet) > 0 \tag{A.16}$$

If entrepreneurs experience a positive asset price shock, they borrow more and demand more capital. This leads to an increase in their expected net worth for the following period. In addition, as investment increases, there is upward pressure on asset prices, amplifying the initial response.

A.4 Retail Firms

Retail firms are monopolistically competitive. They buy wholesale goods and sell them after repackaging at no resource cost. The purpose of including these firms at this stage is to have a simple contract between the firm and the banking sector.[30] The other benefit of this framework is that it allows for sticky prices and therefore monetary policy that is not neutral in the short run. The demand for goods produced by retail firms is given by,

$$Y_t^H(z) = \left(\frac{P_t^H(z)}{P_t^H}\right)^{-\upsilon} Y_t^H \tag{A.17}$$

where $Y_t^H = \left(\int_0^1 Y_t^H(z)^{\frac{\nu-1}{\nu}} dz\right)^{\frac{\upsilon}{\upsilon-1}}$. Following the pricing scheme of Calvo (1983), we assume that only θ fraction of retailers adjust their prices at a specific time.

$$P_t^H = \left(P_{t-1}^H\right)^{\theta} \left(P_{t-1}^{*H}\right)^{1-\theta} \tag{A.18}$$

[30] A financial contract with a monopolistically competitive firm would complicate aggregation due to the different levels of leverage for each monopolistic firm.

Retailers maximize an intertemporal loss function and set their optimal price $P_t^{*H} = \mu_1 \prod_{i=0}^{\infty} P_{t+i}^{w^{(1-\beta\theta)(\beta\theta)^i}}$, where $\mu_1 = 1/(1-1/\nu)$ is the desired gross mark up over wholesale prices. Given this setup, one can solve for the domestic inflation rate as,

$$\frac{P_t^H}{P_{t-1}^H} = \left(\mu_1 \frac{P_t^w}{P_t^H}\right)^{\frac{(1-\theta)(1-\beta\theta)}{\theta}} E_t\left(\frac{P_{t+1}^H}{P_t^H}\right)^{\beta} \tag{A.19}$$

where the first term is retailers' marginal cost, and the second term is the expected inflation rate.

A.5 Central Bank and the Government

The central bank follows a Taylor rule, and sets interest rates to stabilize output and inflation rates around their target values:

$$R_t = \left[(1 + rr^{ss})(P_t / P_{t-1})^{\gamma_\pi} (Y_t^H / Y_t^{ss})^{\gamma_y}\right]^{1-\tau} R_{t-1}^{\tau} \tag{A.20}$$

The last item on the right hand side is the interest rate smoothing term. Y_t^{ss} and rr^{ss} are the steady state levels of output and the real interest rate respectively.

A.6 Closing the Model

To close the model, we assume that the government finances its expenditures by printing money and collecting lump sum taxes, and the resource constraint in the economy holds:

$$G_t = (M_t - M_{t-1})/P_t + T_t \tag{A.21}$$

$$Y_t^H = C_t^H + C_t^{eH} + C_t^{H*} + I_t^H + \mu\left(\int_0^{\bar{A}_i} A_i f(\bar{A}_i)\delta A_i\right) R_t^k Q_{t-1} K_t \tag{A.22}$$

where C_t^{eH} is entrepreneurial consumption, and $\mu\left(\int_0^{\bar{A}_i} A_i f(\bar{A}_i)\delta A_i\right) R_t^k Q_{t-1} K_t$ are the total monitoring costs. Finally, we obtain the balance of payments condition in the economy by adding consumers' and entrepreneurs' budget constraints:

$$C_t + C_t^e + I_t + \left[(1+R_{t-1})D_{t-1} + (1+R_{t-1}^*)s_t\left(D_{t-1}^* + B_{t-1}\right)\right]/P_t + \mu\left(\int_0^{\bar{A}_i} A_i f(\bar{A}_i)\delta A_i\right)R_t^k Q_{t-1}K_t = Y_t + \left[D_t + s_t\left(D_t^* + B_t\right)\right]/P_t + \Pi_t \tag{A.23}$$

Appendix B: Calibration Summary

Parameter	Description	Value	
		Brazil	Canada
β	quarterly discount factor	0.961	0.99
Ω	coefficient of relative risk aversion	2	1.21
λ	1- (import share in consumption)	0.8	0.88
ρ	elasticity of substitution between home and foreign goods	5	0.76
κ	labor supply elasticity	2	1.63
θ	Calvo parameter (probability of not adjusting prices)	0.65	0.48
γ_π	Taylor rule inflaiton parameter	0	3.27
γ_y	Taylor rule output parameter	0	0.47
τ	Taylor rule interest rate smoothing parameter	0.33	0.85
ε	price elasticity of export demand	1	1
α	capital share parameter	0.41	0.35
δ	depreciation rate	0.031	0.025
ι	elasticity of price of capital with respect to the investment capital ratio	0.25	0.25
χ	elasticity of marginal depreciation with respect to the utilization rate	1	1
η	markup rate	1.2	1.2
μ	bankruptcy cost coefficient	0.5	0.07
γ^e	survival rate of an entrepreneur	0.9728	0.9768
σ^i	standard deviation of the idiosyncratic shock	0.78	0.44

Parameter values used to calibrate the model to Canadian data are summarized in Appendix B. Parameters pertaining to preferences, the Taylor rule and Calvo pricing were obtained from Justiniano, Preston (2004). Bankruptcy cost coefficient is calibrated using data from the Doing Business database. Values for the survival rate of entrepreneurs and the standard deviation of the idiosyncratic imply that financial leverage and the annual failure rate are 2 and 1.14% respectively. The annual failure rate was obtained from Lecavalier (2006). Rest of the values are from Bernanke, Gertler and Gilchrist (1999), and Gertler, Gilchrist and Natalucci (2007). We also calibrated the model using data from New Zealand and Australia our results did not change significantly. In calibrating the model to Brazilian data, we adopt the parameter values used in Aysun (2008), as shown in Appendix B.

Appendix C: Data Summary

Table C1: Variables and Data Sources

Variable	Description and Source
RECOVERY RATE	The recovery rate is recorded as cents on the dollar recouped by creditors through the bankruptcy or insolvency proceedings. The calculation takes into account whether the business emerges from the proceedings as a going concern as well as costs and the loss in value due to the time spent closing down. If the business keeps operating, no value is lost on the initial claim, set at 100 cents on the dollar. If it does not, the initial 100 cents on the dollar are reduced to 70 cents on the dollar. Then the official costs of the insolvency procedure are deducted (1 cent for each percentage of the initial value). Finally, the value lost as a result of the time the money remains tied up in insolvency proceedings is taken into account, including the loss of value due to depreciation of the hotel furniture. Consistent with international accounting practice, the depreciation rate for furniture is taken to be 20%. The furniture is assumed to account for a quarter of the total value of assets. The recovery rate is the present value of the remaining proceeds, based on end-2006 lending rates from the International Monetary Fund’s International Financial Statistics, supplemented with data from central banks. Source: World Bank Doing Business database.
Bureaucracy Quality	Bureaucratic Quality, scale of 0-4. Source: International Country Risk Guide, published by The PRS group.
Corruption	Corruption in Government, scale of 0-6. Source: International Country Risk Guide, published by The PRS group.
Law and Order	Measures law and order tradition, scale of 0-6. Source: International Country Risk Guide, published by The PRS group.
Real GDP per capita	GDP per capita, (constant 2000 international $). Source: WDI
real interest rate	Source: WDI.
TURNOVER	*TURNOVER* is the average number of changes in the central bank governor per year in each decade. For example, if *TURNOVER* = 0.2, there are 2 changes per decade for an average tenure of 5 years. One observation per decade (1950's to 1980's). Source: Cukierman, et al., (1992). Data after 1990 obtained from Crowe and Meade (2007) and Dreher, et al. (2008).
LEGAL	One observation per decade (1950's to 1980's). Source: Cukierman, et al., (1992). Data updated by Jácome and Vázquez (2005) and Siklos (2008).
Stock market capitalization (% of GDP)	Source: WDI.
Domestic credit provided by banking sector (% of GDP)	Domestic credit provided by banking sector (% of GDP): includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net. The banking sector includes monetary authorities and deposit money banks, as well as other banking institutions where data are available. Source: WDI.
Stocks traded, total value (% of GDP)	Total value of stocks traded as percent of GDP. Source: WDI.
Stocks traded, turnover ratio %	The total value of shares traded during the year divided by the average market capitalization for the year. Average market capitalization is calculated as the average of the end-of-year values for the current year and the previous year. Source: WDI.
% of firms using banks to finance investment	Source: WDI.
% of workers employed by small and medium enterprises.	Source: Ayyagari et al. 2003). Data averaged over certain years during the 1990s. The years vary by country.
creditor rights	Source: Djankov et al. (2007).
logarithm of days to enforce a contract	Source: Djankov et al. (2007).
COSTESTATE	The cost of the bankruptcy proceedings as a percentage of the estate’s value. The cost is calculated on the basis of survey responses by insolvency practitioners and includes court fees as well as fees of nsolvency practitioners, independent assessors, lawyers and accountants. Respondents provide cost estimates from among the following options: less than 2%, 2–5%, 5–8%, 8–11%, 11–18%, 18–25%, 25–33%, 33–50%, 50–75% and more than 75% of the value of the business estate. Source: World Bank Doing Business database.
accounting standards	Accounting standards in 1990. Source: La Porta, et al. (1998).

Industrial Production Index	Source: IFS. Generally, the coverage of industrial production indices comprises mining and quarrying, manufacturing and electricity, and gas and water, according to the UN International Standard Industrial Classification (ISIC). The indices are generally compiled using the Laspeyres formula. For many developing countries the indices refer to the production of a major primary commodity, such as crude petroleum. Monthly indicators for economic activity when industrial production index is not available: Bahamas: tourist arrivals index; Bahrain: refined petroleum production; Belarus: number of employed; Bolivia, Ecuador, Gabon, Kuwait, Oman, Venezuela: crude petroleum production; Botswana, Congo Dem. Rep.: mining production; Chile, Latvia, Peru, Russia, Ukraine: industrial employment index; Colombia, Indonesia, Panama, Philippines, Singapore, South Africa, Uruguay, Zimbabwe: manufacturing production; Estonia, Hong Kong, Moldova, Thailand: number of employed; Taiwan: employees on payroll (source: Directorate-General of Budget, Accounting and Statistics).
CPI	Source: IFS.
Deposit rate	Source: IFS. Usually refers to rates offered to resident customers for demand, time, or savings deposits.
Lending rate	Source: IFS. Banks' rate that usually meets the short- and medium-term financing needs of the private sector.
World Export Price Index	Source: IFS. Indices for export prices are compiled from survey data for wholesale prices or directly from the exporter or importer (called "direct pricing").

Table C2: Countries

Algeria	Germany	Oman
Armenia	Greece	Panama
Australia	Hong Kong	Peru
Austria	Hungary	Philippines
Bahrain	India	Poland
Bangladesh	Indonesia	Portugal
Belarus	Ireland	Romania
Belgium	Israel	Russia
Bolivia	Italy	Serbia & Montenegro
Botswana	Japan	Singapore
Brazil	Jordan	Slovakia
Bulgaria	Kenya	Slovenia
Canada	Korea, South	South Africa
Chile	Kuwait	Spain
China	Latvia	Sweden
Colombia	Lithuania	Switzerland
Congo, Dem. Rep.	Luxembourg	Thailand
Croatia	Malawi	Trinidad & Tobago
Czech Republic	Malaysia	Tunisia
Denmark	Mexico	Turkey
Ecuador	Moldova	Ukraine
Estonia	Netherlands	United Kingdom
Finland	New Zealand	Uruguay
France	Nigeria	Venezuela
Gabon	Norway	