Firms' Investment and the Real Transmission of the Global Financial Cycle*

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Abstract

We study how fluctuations in global financial conditions transmit to firms' investment and economic activity in open economies. Using firm-level data from emerging markets, we show that increases in the global price of risk are followed by large investment contractions, especially among firms with higher default risk. Guided by these patterns, we develop a quantitative heterogeneous-firm open economy model in which firms finance investment with defaultable debt provided by risk-averse global investors. Our analysis identifies a strong risk channel through which increases in the price of risk raise firms' financing costs, with pass-through determined by their quantity of risk—the sensitivity of debt repayment to global shocks. This mechanism introduces a risk dimension for stabilization policy, where reducing firms' quantity of risk weakens the pass-through of external shocks. Through this lens, fixed exchange rate regimes amplify fluctuations because they raise firms' quantity of risk by preventing relative price adjustments.

Keywords: Investment dynamics, global financial cycle, default risk, firm heterogeneity, exchange rates, sudden stops, international transmission.

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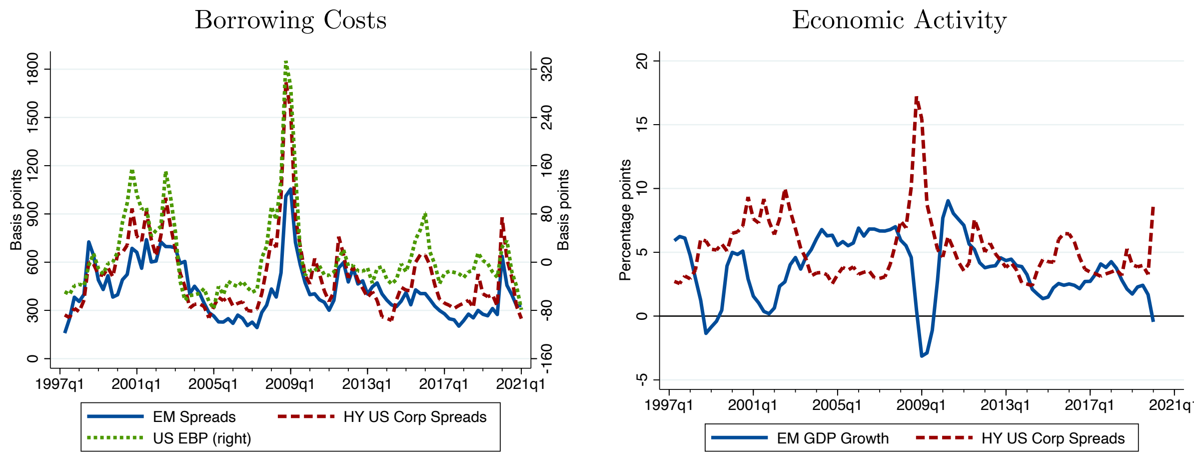
1. Introduction

Risky asset prices and capital flows in the global economy tend to be highly synchronized, reflecting the presence of a "global financial cycle," often linked to lenders' risk-bearing capacity and global risk appetite (Rey, 2013; Kalemli-Ozcan, 2019; Maggiori, 2021). As illustrated in Figure 1, emerging economies appear particularly exposed to these forces, experiencing large swings in economic activity, investment, and exchange rates following changes in global financial conditions. Based on these patterns, a central question is what drives the transmission of the global financial cycle to firms' real investment decisions. This question is often framed as a "bad luck vs. bad policy" debate in the context of external crises (Calvo, 2005): Do surges in global borrowing costs primarily drive investment adjustments, or are these adjustments instead induced by currency depreciations and other macroeconomic policies implemented in response to shifts in global financial conditions?

In this paper, we address this question using a micro-to-macro approach that combines a heterogeneous-firm open-economy model with new evidence on firms' responses to fluctuations in global borrowing costs. We show that firms' risk plays a key role in the transmission of the global financial cycle. First, we identify a quantitatively strong risk channel through which changes in the global price of risk affect firms' investment. Second, we show that this mechanism gives rise to a risk dimension through which macroeconomic policies can stabilize fluctuations originated in international capital markets. For instance, flexible exchange rate regimes mitigate the aggregate effects of changes in the global price of risk by reducing firms' exposure to risk and limiting the pass-through of the global price of risk to borrowing costs. In terms of our motivating question, our results indicate that "bad luck" plays a central role during external crises, but that its effects can be mitigated because the aggregate consequences of these crises hinge on an endogenous margin, firms' risk, that policy can shape.

Our analysis proceeds in three steps. First, we document empirically how fluctuations in the global financial cycle transmit to firms' investment in emerging markets, with a special focus on Latin America. To do so, we combine firm-level balance sheet data with informa-

Figure 1: U.S. Borrowing Costs and Economic Activity in Emerging Markets



Note: Panel (a) shows the average corporate bond spread in our emerging market data described in Section 2, Barclays U.S. Corporate High Yield Spread, and the U.S. Excess Bond Premium (Gilchrist and Zakrajšek, 2012). Panel (b) plots average U.S. spreads with the average year-over-year growth rate of real GDP in the same sample of emerging markets as panel (a). The emerging markets included are Argentina, Brazil, Chile, Colombia, India, Korea, Mexico, Peru, the Philippines, Thailand, Turkey, and Ukraine. Appendix Figure A.1 shows additional results for investment and real exchange rates.

tion on external borrowing costs. Using the decomposition of borrowing costs proposed by Gilchrist and Zakrajšek (2012), we show that borrowing costs for emerging market firms are largely driven by changes in the excess bond premium, that is, the component of credit spreads orthogonal to firms' default risk (measured using Merton (1974)'s default model). We then study how these movements are linked to firms' investment. Increases in the excess bond premium are followed by heterogeneous investment dynamics across firms, with sharper contractions among riskier firms.

Motivated by the empirical patterns, we construct a heterogeneous-firm open-economy model to study the macroeconomic transmission of fluctuations in the global price of risk. We consider a canonical open-economy framework in which households consume goods produced by the home economy and the rest of the world. In this environment, we introduce heterogeneous domestic firms that face idiosyncratic and aggregate productivity shocks and finance their investment with debt provided by risk-averse foreign investors subject to default risk (as in Khan and Thomas, 2008; Ottonello and Winberry, 2020). Our framework highlights three channels through which firms are affected by changes in the global price of risk. First, a risk channel: increases in the global price of risk raise borrowing costs, with its pass-through determined by each firm's quantity of risk (given by the covariance between debt repayment and global productivity innovations). Second, a debt-revaluation channel: the currency depreciation induced by these shocks leads to a revaluation of foreign-currency debt, negatively affecting the cash flows of indebted firms. Finally, an input-cost channel that dampens these contractionary effects: the decline in investment and labor demand induced by higher borrowing costs lowers capital prices and real wages, raising real investment incentives through lower input costs.

We then connect the model to the data by solving a quantitative version using global methods, and show that it is consistent with both micro- and macro-level patterns of investment dynamics following changes in the global price of risk. At the micro level, we estimate the same empirical regressions on model-simulated data and show that the model replicates the observed heterogeneity in investment responses across firms' risk. At the macro level, the model accounts for the decline in output and investment and the exchange rate depreciation that follow increases in the global price of risk. We then decompose the channels through which changes in the global risk premium affect firms' investment, leading to two main takeaways. First, the risk channel is the main driver of aggregate investment contractions, being four times larger than the debt-revaluation channel often emphasized in the "original sin" literature. Second, the input-cost channel plays an important role in mitigating the economic contraction. In a counterfactual in which capital prices and real wages do not respond to increases in the global price of risk, the contraction in aggregate investment would be 60 percent larger than in the baseline economy in which the cost channel is active.

Finally, we use our model as a laboratory to analyze how macroeconomic policies can stabilize fluctuations originating in international capital markets, with a particular focus on exchange rate regimes. Our analysis highlights a novel risk dimension in this comparison: how different regimes affect firms' quantity of risk, which determines the pass-through of the global price of risk to borrowing costs. In the presence of nominal rigidities, fixed exchange rate regimes weaken the input-cost channel by preventing the adjustment of relative prices, and lead to a higher quantity of risk. This higher quantity of risk alone accounts for a 25 percent larger contraction in investment following an increase in the global price of risk under a fixed exchange rate regime than under a flexible one. We also identify this risk dimension in macroprudential policies. For example, taxing firms' debt reduces the quantity of risk and can substantially mitigate the real effects of the global financial cycle.

Related literature Our paper contributes to various strands of the literature. First, it is related to the literature that studies the global financial cycle and imperfect international capital markets (see, e.g., Rey, 2013; Maggiori, 2021, and references therein). This literature has studied how global shocks propagate into international asset prices and domestic credit markets (see, for example, Baskaya, di Giovanni, Kalemli-Ozcan and Ulu, 2017; Hassan, Schreger, Schwedeler and Tahoun, 2021; Akinci, Kalemli-Ozcan and Queralto, 2022; Morelli, Ottonello and Perez, 2022; Bai, Kehoe, Lopez and Perri, 2025; Kekre and Lenel, 2025). We contribute to this literature by studying the transmission of the global financial cycle to real investment and economic activity. In this sense, our paper also relates to the closed-economy literature that stresses the role of risk premia and macroeconomic fluctuations (see, for example, He and Krishnamurthy, 2013; Kekre and Lenel, 2022).[1]

Second, our paper contributes to the literature on international business cycles and sudden stops (see, for example, Backus, Kehoe and Kydland, 1992; Aguiar and Gopinath, 2007; Mendoza, 2010). A strand of this literature, pioneered by Neumeyer and Perri (2005), identifies an important role for fluctuations in external borrowing costs in driving business cycles in open economies (see also Uribe and Yue, 2006; Garcia-Cicco, Pancrazi and Uribe, 2010; Chang and Fernández, 2013). Building on this view, our paper shows that the pass-through of external borrowing costs to economic activity depends on economies' level of risk and is endogenous to macroeconomic policy.

Finally, our paper relates to the literature that analyzes the role of firm dynamics in open economies. This literature has shown that firm heterogeneity plays a central role in

[1]A related literature in asset pricing studies the role of fluctuations in risk premia (see Cochrane, 2011, for a survey). In international asset pricing, fluctuations in risk premia have been relevant in explaining cross-sectional currency and sovereign risk (see, for example, Lustig and Verdelhan, 2007; Longstaff, Pan, Pedersen and Singleton, 2011; Gilchrist, Yue and Zakrajsek, 2012).

the transmission of sudden stops, sovereign risk, and monetary policy (e.g., Gopinath and Neiman, 2014; Ates and Saffie, 2021; Arellano, Bai and Bocola, 2020; Aruoba, Fernandez, , Lu and Saffie, 2022). Closest to our work, Castillo-Martinez (2020) studies the interaction between sudden stops and the exchange-rate regime in a model with firm heterogeneity. We contribute to this literature by showing how the distribution of firms' risk plays a key role in the transmission of external shocks and in policy analysis.

2. Descriptive Empirical Evidence

This section studies the relationship between external borrowing costs and firms' investment at the micro level. Section 2.1 describes our data and measurement. Section 2.2 provides a decomposition of firms' external borrowing costs and highlights the role of the excess bond premium component. Section 2.3 documents the heterogeneous investment dynamics following changes in the systemic component of the excess bond premium.

2.1. Data and Measurement

Our empirical analysis uses bond- and firm-level data for emerging markets. Our baseline analysis focuses on Latin America, which is the region with the most complete data coverage across all datasets. We use data from other emerging market countries for additional validation. The Latin American countries in our sample are Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The non-Latin American countries are India, Korea, the Philippines, Thailand, Turkey, and Ukraine. Appendix Table A.2 summarizes the data coverage across countries.

Bond-level data. We collect bond-level data from Bloomberg. For each country in our sample, we gather information on all corporate bonds denominated in U.S. dollars, with available price information for the period 1997 to 2021, which results in a merged sample of 561 bonds issued by 173 firms, of which 240 bonds are from Latin America. For each bond, we obtain information on its daily price, amount issued, coupon structure, maturity, and other characteristics. We also use data on U.S. Treasury bond prices for different maturities, which we use to compute emerging market bond spreads. Appendix A provides additional details on these data. We measure firms' external borrowing costs as the time-varying yield-to-maturity of their bonds. The median bond in our sample has a nominal yield of 5.1 percentage points. Additional summary statistics regarding the yields, spreads, maturity, and other bond characteristics are reported in Tables A.3 and A.4.

Firm-level data. Our empirical analysis uses balance-sheet data from Global Compustat. In addition, in our model analysis we use ORBIS data, which features information about private firms.

In the empirical analysis, our main variables of interest are firms' investment and Merton (1974)'s "distance-to-default" as a measure of their default risk. We define these variables following standard practices in the literature. We measure firms' investment with the log change in the book value of its gross plant, property, and equipment. We measure its distance to default as $\mathrm{dd}_{jt} = \frac{\log(\frac{V_{jt}}{D_{jt}})+(\mu_{jt}-0.5\sigma_{jt}^2)}{\sigma_{jt}}$, where V_{jt} denotes the total value of the firm, μ_{jt} the firm's annual expected return, σ_{jt} the annual volatility of its value, and D_{jt} the firm's debt. The interpretation of this measure is the number of standard deviations by which $\log V_{jt}$ must drop below its mean for the firm to default within a year (assuming the firm defaults when $V_{jt} < D_{jt}$). We provide more details on the data cleaning procedure and construction of variables used in the empirical analysis in Appendix A.2. Appendix Tables A.5 and A.6 report summary statistics of these variables, as well as other firm-level variables for the full sample and by country. We observe 736 unique Latin American firms, featuring roughly 29,000 firm-quarter observations. We supplement our measure of default risk with credit ratings data for the Latin America sample. We are able to match 14% of the firms in our sample to credit ratings from S&P and/or Moody's. Appendix A.2 describes the data collection and merging process and Appendix Figure A.3 shows the distribution of ratings for the merged sample.

Finally, we also use data from ORBIS for the quantitative analysis of the model. This dataset covers information about the annual balance sheet of private firms. We follow standard processing procedures as described in Kalemli-Özcan, Sørensen, Villegas-Sanchez, Volosovych and Yeşiltaş (2024), and make sample restrictions that closely mimic our main Compustat sample for Latin America. Appendix Tables A.7 and A.8 provide summary statistics by country. Appendix A.2 provides full details on the ORBIS sample construction as well as the aggregate data sources used in the quantitative analysis.

2.2. Decomposing Emerging Market Corporate Borrowing Costs

Fluctuations in firms' borrowing costs can be empirically decomposed into three components: a risk-free component, a component capturing the variation in expected default rates, and an excess bond premium (Gilchrist and Zakrajšek, 2012). Following this approach, we disentangle these components in two steps. We first separate the yields of each bond into a risk-free rate and a spread component, using a synthetic risk-free security with the same coupon structure as the bond.

Panel (a) of Figure 2 reports the dynamics of yields, spreads and the risk-free component. From this figure, one can see that spreads account for the majority of fluctuations in yields at a business cycle frequency, with their cyclical components (computed with an HP filter) featuring a correlation of 86%. The risk-free component of spreads plays an important role explaining the secular decline in rates since the late 1990s. Based on this decomposition, we henceforth focus on understanding the role of spreads driving fluctuations in borrowing costs.

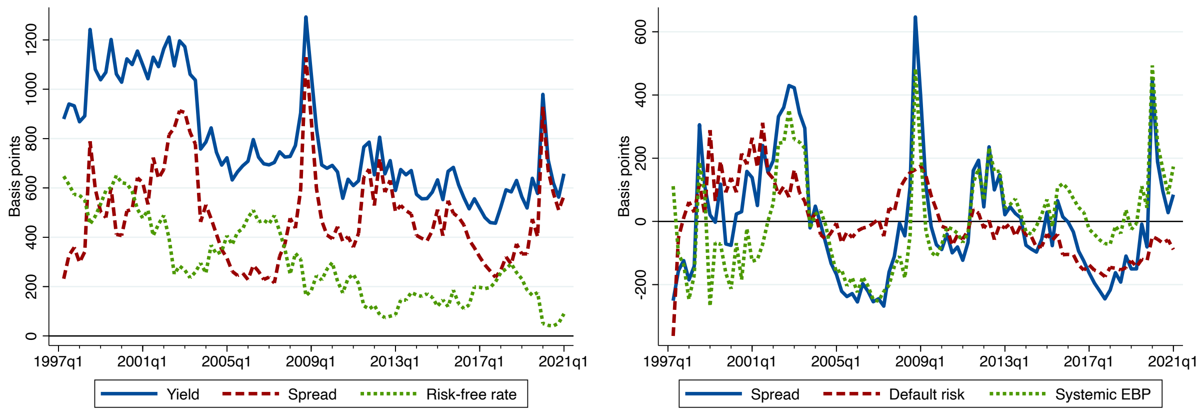
In the second step, we further decompose the bond spreads by projecting them onto distance-to-default and bond-specific characteristics. In particular, our baseline specification estimates the following regression:

$$\log S_{it} = \beta \mathrm{dd}_{jt} + \gamma' \boldsymbol{Z}_{it} + \epsilon_{it}, \tag{1}$$

where S_{it} is the spread of bond i in period t; dd_{jt} measures the distance-to-default of firm j (issuer of bond i) in period t, $\boldsymbol{Z}_{it}$ is the vector of bond-level characteristics; and ϵ_{it} denotes a normal randomly distributed error term. The bond-level characteristics included in the vector $\boldsymbol{Z}_{it}$ are duration, amount issued, coupon rate, and age of issue, all measured in logs;

Figure 2: Decomposition of Emerging Market Corporate Borrowing Costs

(a) Bond Yield Decomposition **(b)** Bond Spread Decomposition



Note: Panel (a) shows the decomposition of average yields into the spreads and risk-free components. Panel (b) shows the decomposition of average spreads into the portion predicted by default risk and the bond-specific excess bond premium, as defined in equation (2). All series are demeaned and computed using the sample of Latin American countries.

an indicator for whether the bond is callable; and fixed effects by sector.

Appendix Table A.9 reports the results from estimating (1) for the Latin American sample as well as for other emerging markets. These estimates indicate that firms with larger distance-to-default have lower bond spreads, and that roughly 50% of the variation in spreads can be accounted for by distance-to-default and other covariates included in $\boldsymbol{Z}_{it}$. Our baseline specification (1) assumes a homogeneous loading of spreads on distance-to-default for all bonds. In robustness analysis, we relax this assumption by estimating heterogeneous loadings across bonds of different countries and credit ratings. Appendix Tables A.10 and A.11 report results for these exercises.

Using the estimates from (1), we estimate the excess bond premium of a bond as follows:

$$E\hat{B}P_{it} \equiv S_{it} - \exp\left(\hat{\beta} dd_{jt} + \hat{\gamma}' Z_{it} + \frac{\hat{\sigma}^2}{2}\right), \tag{2}$$

where $\hat{\sigma}$ is the mean-squared error of the estimated ϵ_{it} shocks.

Finally, we construct measures of the systemic component of the excess bond premium by estimating:

$$E\hat{B}P_{it} = \rho_k + \rho_t + v_{it}, \tag{3}$$

where ρ_k and ρ_t denote country and time fixed effects. We refer to ρ_t as the systemic excess bond premium, and to v_{it} as its idiosyncratic component.[2] The R^2 of this regression is 0.30 for the Latin America subsample and 0.19 for the full emerging market sample.

Figure 2 Panel (b) shows that the systemic excess bond premium is the main driver behind the dynamics of average spreads, accounting for 69% of its variance and for the bulk of its increase during crisis periods, such as the Global Financial Crisis or the COVID-19 pandemic. Additionally, Appendix Figure A.4 shows similar dynamics of the excess bond premium for other regions and individual countries. Appendix Figure A.5 shows that the excess bond premium dynamics are similar across alternative functional form specifications. As detailed in the next section, fluctuations in the excess bond premium can be linked to changes in the global price of risk. Consistent with this view, Appendix Figure A.6 and Table A.12 show that the systemic excess bond premium for both Latin America and the full emerging market sample is correlated with other common measures of global risk, such as the VIX or the U.S. excess bond premium, again reflecting the correlation of risky asset prices in the global economy.

2.3. External Borrowing Costs and Investment

As motivated in Appendix Figure A.1, increases in global borrowing costs are correlated with decreases in investment growth in emerging markets. In this section, we study how changes in the systemic excess bond premium transmit to firms' investment and borrowing costs for firms with different default risk.

We start with the following local Jorda (2005) projection model:

$$\Delta_h \log(k_{jt+h}) = \alpha_{hj} + \beta_h \times \rho_t + \gamma_h' X_t + \omega_h' Z_{jt-1} + \epsilon_{jth}, \tag{4}$$

[2] We add country-level fixed effects to allow for persistent heterogeneity across countries that may confound our estimates of systemic variation across time. In doing so, we are unable to recover the level of the excess bond premium, as Gilchrist and Zakrajšek (2012) do. Our analysis will consider the systemic excess bond premium measured in standard deviations from the mean. Our results are robust to alternative choices of fixed effects, such as firm-level or bond-level.

where $\Delta_h \log(k_{jt+h}) \equiv \log(k_{jt+h}) - \log(k_{jt-1})$ denotes the period-t log cumulative change for h quarters in firm j's capital; α_{hj} denotes firm fixed effects; ρ_t measures the excess bond premium in period t; X_t is a vector of controls for U.S. macroeconomic variables that may be correlated with the excess bond premium in period t; and Z_{jt-1} is a vector of firm-level covariates. In our baseline model we include in the vector X_t U.S. GDP growth and an indicator for the U.S. Great Recession period (2007Q4 to 2009Q2), and include additional variables in robustness analysis. We include in the vector Z_{jt-1} measures of firms' size (measured as log total assets), capital growth, sales growth, fiscal quarter, current assets relative to total assets, and distance to default.

Figure 3 Panel (a) reports the average change in capital stock associated with movements in the excess bond premium. On average, increases in the excess bond premium are followed by a contraction in firms' investment, which is large and persistent: a 1-standard-deviation increase in the excess bond premium is associated with a 2% cumulative decline in the capital stock, which peaks 8 quarters after the shock.

Next, we study how the transmission of the systemic excess bond premium varies with firms' default risk. We modify the local projection above to include an interaction term:

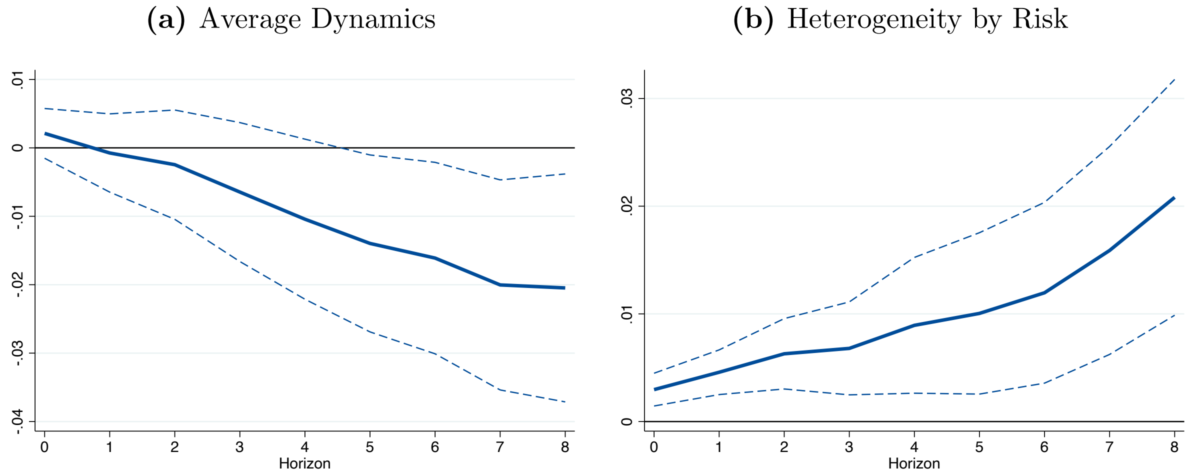
$$\Delta_h \log(k_{jt+h}) = \alpha_{hj} + \alpha_{hst} + \beta_h \times \rho_t \times dd_{jt-1} + \gamma_h' X_t \times dd_{jt-1} + \omega_h' Z_{jt-1} + \epsilon_{jth}, \tag{5}$$

where dd_{jt-1} is the lagged distance-to-default for firm j and α_{hst} denotes sector by time fixed effects. Our coefficient of interest, β_h, captures the relative cumulative change in investment for firms with 1-standard-deviation lower default risk. In our baseline model, we include in the vectors X_t and Z_{jt-1} the same set of aggregate and firm-level controls listed above. In robustness analysis, we consider alternative measures of firm risk and controls.

Figure 3 Panel (b) reports the slope coefficient from equation (5), with sector-time fixed effects to absorb aggregate conditions. The figure shows that the aggregate decline in capital stock is more pronounced for firms with higher risk. In particular, a 1-standard-deviation increase in the excess bond premium is followed by a 2.1% greater cumulative increase in the capital stock for firms with 1-standard-deviation higher distance-to-default.

Table 1 shows that the negative sensitivity of investment to the excess bond premium

Figure 3: Investment Dynamics Following Changes in the Excess Bond Premium



Note: The figure shows the estimated β_h coefficients of Equations (4) and (5), which correspond to the cumulative log change in capital stock in response to the excess bond premium in period t. Panel (a) reports the cumulative change in investment when the excess bond premium is 1-standard-deviation higher for the average firm. Panel (b) reports the change in the slope associated with 1-standard-deviation lower risk. The x-axes show the horizon h (quarterly frequency). The vector of controls includes firms' sales growth, investment, fiscal quarter, size, share of current assets, and distance to default. Panel (a) includes controls for U.S. GDP growth, inflation, and recession; Panel (b) includes the same aggregate controls interacted with distance to default. All controls are standardized. Standard errors are clustered by firm and time with Driscoll and Kraay adjustment. Dashed lines represent 90% confidence intervals.

is attenuated among low-risk firms across alternative specifications, with additional details provided in Appendix A.4.

1. *Alternative controls.* The results are robust to alternative specifications of controls. First, we drop the controls for U.S. variables and keep just sector-by-time fixed effects to absorb aggregate conditions, or drop firm-level controls. Second, we include as a control the interaction of distance-to-default with changes in other U.S. variables that could be correlated with the excess bond premium, such as the Fed funds rate or U.S. inflation. Third, we include as a control the interaction between the excess bond premium and other firm characteristics that could be correlated with risk, such as firm size (measured as log total assets), sales growth, or capital growth (see also Appendix Figure A.7). Fourth, we include the interaction terms between firm-level controls and firms' risk (see also Appendix Figure A.8).

Table 1: Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium Across Alternative Specifications

	h=1		h=8	
	β_1	SE	β_8	SE
Baseline	0.005	(0.001)	0.021	(0.007)
Alternative controls				
Without aggregate controls	0.004	(0.002)	0.020	(0.009)
Without firm characteristics	0.004	(0.001)	0.016	(0.006)
Interaction of firms' risk with other U.S. variables	0.006	(0.002)	0.012	(0.008)
Interaction of ρ_t with firms' characteristics	0.004	(0.001)	0.020	(0.006)
Interact firms' risk with characteristics	0.005	(0.001)	0.020	(0.007)
Measures of risk				
Binary	0.010	(0.002)	0.049	(0.015)
Investment grade	0.007	(0.003)	0.021	(0.014)
Credit rating	0.007	(0.002)	0.020	(0.011)
Alternative ρ_t specifications				
Emerging market sample	0.003	(0.001)	0.013	(0.007)
US EBP	0.003	(0.002)	0.010	(0.008)
Regional VIX	0.003	(0.001)	0.010	(0.004)
EBP with heterogeneity by country	0.004	(0.001)	0.019	(0.006)
EBP with heterogeneity by rating	0.004	(0.001)	0.019	(0.006)
Sector				
Tradable	0.006	(0.001)	0.026	(0.007)
Nontradable	0.005	(0.004)	0.028	(0.016)
Exchange rate regime				
Flexible	0.005	(0.001)	0.025	(0.007)
Fixed	0.004	(0.003)	0.011	(0.020)

Note: The first line of the table reports the coefficient and standard error estimates of Equation 5 for the cumulative change in capital stock between periods $t-1$ and $t+1$ or $t+8$. The remaining rows report the results from various robustness exercises. Full details are provided in Appendix A.4.

2. *Alternative measures of firms' risk.* The results are also consistent across alternative measures of firms' risk, whether measured using a binary classification of low distance-to-default or credit ratings (see also Appendix Figure A.9).

3. *Alternative measures of the excess bond premium.* The results are robust to alternative measures of the systemic component of the excess bond premium. These include a measure of the excess bond premium estimated using data from all emerging markets

(not only Latin America), the U.S. excess bond premium, the regional VIX (measured for Brazil), and measures of the excess bond premium obtained by estimating Equation (1) allowing for heterogeneous loadings by country and firm credit rating. Our results are similar across all of these measures (see also Appendix Figure A.10).

4. *Additional results*. Finally, Table 1 shows that the results are also observed for firms in both the tradable and nontradable sectors (see also Figure A.11) and across different exchange-rate regimes, although the estimates are stronger in fixed exchange-rate regimes (see also Appendix Figure A.12). Appendix Figure A.13 also shows that our results are not driven by any particular country and are observed for all samples dropping individual countries.

3. Model

We construct a theoretical framework to study the real transmission of the global financial cycle. The model is designed to connect with the cross-sectional evidence presented in the previous section and to study its macroeconomic implications. At the micro level, the model features heterogeneous firms, generating a realistic distribution of risk. At the macro level, the model includes shocks to the global price of risk as the driving force of the global financial cycle, as well as nominal rigidities that create scope for stabilization policies.

We study a small open economy that trades good and financial securities with the rest of the world. The domestic economy is populated by a representative household and a set of heterogeneous firms. In Subsection 3.1, we detail the heterogeneous firms' problem, which constitutes the main block of our model. Subsection 3.2 describes the global investors' problem and characterizes their stochastic discount factor, which allows us to introduce global risk premia. In Subsection 3.3, we describe the rest of the model, which includes the domestic households' problem, nominal rigidities, and the rest of the world.

3.1. Heterogeneous Firms

There is a unit mass of heterogeneous firms, which are owned by the domestic households. Firms produce a home good with a decreasing returns-to-scale technology using capital and labor, $(k_{i,t}, l_{i,t})$, as inputs:

$$y_{i,t} = (A_t z_{i,t})^{\varsigma} \left(k_{i,t}^{\alpha} l_{i,t}^{1-\alpha}\right)^{\chi}, \tag{6}$$

where $z_{i,t}$ and A_t denote idiosyncratic and global productivity, respectively; $\chi \in (0,1)$ governs the degree of decreasing returns; $\alpha \in (0,1)$ is the value-added share of capital; and $\varsigma \equiv 1-(1-\alpha)\chi$ is a normalization constant.[3] We assume that both $z_{i,t}$ and A_t follow first-order autoregressive processes given by $\ln(z_{i,t+1}) = (1-\rho_z)\ln(z^{\star}) + \rho_z \ln(z_{i,t}) + \sigma_z \epsilon^{z}_{i,t+1}$ and $\ln(A_{t+1}) = (1-\rho_A)\ln(A^{\star}) + \rho_A \ln(A_t) + \sigma_A \epsilon^{A}_{t+1}$, where $\epsilon^{z}_{i,t+1}$ and ϵ^{A}_{t+1} are Gaussian shocks.

Firms have access to a technology to accumulate capital by investing out of the final good subject to adjustment costs:

$$k_{i,t+1} = (1-\delta)\, k_{i,t} + I_{i,t} - \Psi_k \left(k_{i,t+1}, k_{i,t}\right), \tag{7}$$

where $I_{i,t}$ denotes investment expenditure in terms of the home good; $\delta \in (0,1)$ is the depreciation rate; and $\Psi_k(k_{i,t+1}, k_{i,t}) \equiv \frac{\psi_k}{2}\left(\frac{k_{i,t+1}-(1-\delta)k_{i,t}}{k_{i,t}}\right)^2 k_{i,t}$ are convex adjustment costs.

Firms sell their output and hire labor inputs in competitive markets. For a given choice of labor, their profits are given by $\Pi_{i,t} = (P_{H,t}\, y_{i,t} - W_t\, l_{i,t})$, where $P_{H,t}$ is the price of the home good, and W_t is the nominal wage. The demand for labor is given by

$$l^{d}_{i,t} = A_t\, z_{i,t}\, \left(k_{i,t}\right)^{\frac{\alpha\chi}{\varsigma}} \left(\frac{1-\varsigma}{W_t/P_{H,t}}\right)^{\frac{1}{\varsigma}}. \tag{8}$$

Given the optimal choice of labor, firm profits (expressed in terms of the households' consumption good bundle) are given by

$$\pi_{i,t} = \varsigma\, A_t\, z_{i,t}\, \left(k_{i,t}\right)^{\frac{\alpha\chi}{\varsigma}} \left(\frac{1-\varsigma}{w_t}\right)^{\frac{1-\varsigma}{\varsigma}} \left(p_{H,t}\right)^{\frac{1}{\varsigma}}, \tag{9}$$

where $p_{H,t} = \frac{P_{H,t}}{P_t}$ denotes the relative price of the home good; $w_t = \frac{W_t}{P_t}$ is the real wage; and

[3] We introduce this normalization so that firms' profits are linear in their productivity A_t and $z_{i,t}$.

P_t term denotes the price of the households' consumption bundle. Since $\varsigma \in (0,1)$, profits are increasing in capital input $k_{i,t}$ and in the relative price of the home good, and decreasing in real wages.

Firms face friction face frictions to finance their investments. On the debt side, firms face frictions from default risk (as in Khan, Senga and Thomas, 2020; Ottonello and Winberry, 2020). We consider long-term debt contracts denominated in foreign currency. We follow the quantitative literature (e.g., Chatterjee and Eyigungor, 2012), and assume that each bond matures in the next period with probability m and, if it does not mature, the firm pays a constant coupon υ. Given this bond structure, the proceeds from issuing new debt, net of debt repayment are given by

$$\Delta \mathcal{B}^{\star}_{i,t} = q^{\star}_{i,t} \left[b_{i,t+1} - (1-m) b_{i,t}\right] - \left[(1-m)\upsilon + m\right] b_{i,t} - \Psi_b \left(b_{i,t+1}, b_{i,t}\right), \tag{10}$$

where $q^{\star}_{i,t}$ denotes the foreign-currency price of a bond for a firm i, which, as detailed below, depends on the firm's choices of capital and debt, as well as its productivity; the term $q^{\star}_{i,t}\left[b_{i,t+1} - (1-m)b_{i,t}\right]$ denotes the proceeds from issuing new bonds; and $\left[(1-m)\,\upsilon + m\right] b_{i,t}$ denotes current debt services. Firms that default exit the economy and are replaced by a new entrant. On the equity side, we assume that firms face costs when raising equity, $\mathcal{C}(d_{i,t}) = -\mathbb{I}_{\{d_{i,t}<0\}} \varphi d_{i,t}$ (as in Cooley and Quadrini, 2001; Gilchrist, Sim and Zakrajšek, 2014) where $d_{i,t}$ denote firm i's dividends expressed in terms of the consumption bundle.

Given these assumptions, the firm's flow of funds constraint is given by

$$d_{i,t}(1 + \mathcal{C}(d_{i,t})) = \pi_{i,t} - p_{k,t}\, I_{i,t} + \varepsilon_t\, \Delta \mathcal{B}^{\star}_{i,t}, \tag{11}$$

where $p_{k,t} = \frac{P_{K,t}}{P_t}$ denotes the relative price of the capital good, $\varepsilon_t = \frac{\xi_t}{P_t}$ is the real exchange rate, with ξ_t denoting the nominal exchange rate (i.e., the price of a unit of the foreign currency in terms of the local currency). The value of a firm that does not default solves the Bellman equation

$$V^r_t\left(k, b, z\right) = \max_{k', b'}\; d + \mathbb{E}_t\left[\Lambda_{t,t+1}\, V_{t+1}\left(k', b', z', \epsilon'_d\right)\right], \text{ subject to (9), (10),} \tag{12}$$

where a firm's idiosyncratic states after repayment are given by (k, b, z) and the t subscript encapsulates the aggregate state; $V_t(k', b', z')$ is the continuation value of having the option to repay or default optimally, and is given by $V_t(k, b, z, \epsilon_d) = \max\{V_t^r(k, b, z), \epsilon_d\}$; $\epsilon^d \sim_{iid} N(0, \sigma^d)$ is a shock to the outside option of default, introduced for quantitative purposes; and $\Lambda_{t,t+1}$ denotes households' stochastic discount factor. Appendix B.1 provides additional details on the recursive representation of firms' problem and the bond price schedule faced by firms.

3.2. Global Investors

The global economy features a set of international investors who provide perfectly elastic supply of international credit to domestic firms and price firms' debt. Given a firm's choice of k' and b', its debt price schedule is given by

$$q_{i,t}^{\star} \equiv q_t^{\star}(k', b', z) = \mathbb{E}_t\left[\Lambda_{t,t+1}^{\star}\mathcal{R}_{t+1}(k', b', z', \epsilon_d')\right], \tag{13}$$

where $\Lambda_{t,t+1}^{\star}$ the investors' stochastic discount factor and $\mathcal{R}_t(k, b, z, \epsilon_d)$ is firm's repayment given by

$$\mathcal{R}_t(k, b, z, \epsilon_d) \equiv (1 - \iota(k, b, z, \epsilon_d))\mathcal{R}_t^r(k', b', z') + \iota(k, b, z, \epsilon_d)\ \mathcal{R}_t^d(k, b, z). \tag{14}$$

Here $\mathcal{R}_t^r(k, b, z) \equiv (1 - m)(\upsilon + q_{t+1}(k', b', z)) + m$ denotes the next-period repayment if the firm does not default, which depends on the next-period bond price. In the event of default, the lenders' recovery rate (in foreign currency units) is given by

$$\mathcal{R}_t^d(k, b, z) = \lambda\, \frac{\pi_t(k, z) + (1 - \delta)\, k\, p_{k,t}}{b}\, \frac{1}{\varepsilon_t}, \tag{15}$$

where λ captures the share of resources recovered by the lender.

We parameterize the global investors' stochastic discount factor as

$$\Lambda_{t,t+1}^{\star} = \beta^{\star} \times \exp\left(-\kappa_t\, \epsilon_{t+1}^{A} - \frac{1}{2}\kappa_t^2\, \sigma_A^2\right), \tag{16}$$

where $\beta^{\star}$ is the rest of the world's discount factor; κ_t is a stochastic exogenous variable that captures the market price of risk; and ϵ^A_{t+1} are the innovations of the global productivity process. We let κ_t to take two values, $\{\kappa_L, \kappa_H\}$, and we assume that the process for $\{\kappa_t\}$ is govern by a Markov transition matrix, Π_κ. This type of formulation of foreign investors' stochastic discount factor has been used in the sovereign debt literature (Arellano and Ramanarayanan, 2012; Bianchi, Hatchondo and Martinez, 2018) to provide a tractable representation that captures changes in the global price of risk. Under this formulation, global investors value bond payoffs more in states in which firms are more likely to default.

3.3. Rest of the model

Households. We assume a representative household with preferences over consumption (c) and labor (l) described by the lifetime utility function:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t, l_t\right), \tag{17}$$

here $\beta \in (0,1)$ denote the subjective discount factor. Households are risk neutral and have the following utility function over consumption and labor: $u(c_t, l_t) = c - \psi_l \frac{l^{1+\theta}}{1+\theta}$, where θ is the inverse of the Frisch elasticity. Given the these preferences, the labor supply is given by

$$l_t^S = \left(\frac{1}{\psi_l} w_t\right)^{\frac{1}{\theta}}. \tag{18}$$

The consumption good is a bundle of home and foreign goods, with a constant elasticity of substitution aggregation technology

$$c_t = \mathcal{C}\left(c_{H,t}, c_{F,t}\right) = \left[\omega_H^{1/\eta}\left(c_{H,t}\right)^{1-1/\eta} + \left(1-\omega_H\right)^{1/\eta}\left(c_{F,t}\right)^{1-1/\eta}\right]^{\frac{\eta}{\eta-1}}, \tag{19}$$

where $c_{H,t}$ and $c_{F,t}$ denote consumption of home and foreign goods; $\eta > 0$ is the elasticity of substitution; and ω_H captures the degree of home bias. Households are hand-to-mouth—in Appendix C.7 we relax this assumption and assume that households can save in domestic deposits. Their budget constraint expressed in local currency is given by

$$P_t\, c_t = W_t\, l_t + P_t\, d_t + P_t\, t_t, \tag{20}$$

where $P_t \equiv \left[\omega_H P_{H,t}^{1-\eta} + (1-\omega_H) P_{F,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}$ is the price aggregator and $P_{H,t}$ and $P_{F,t}$ are the prices of the home and foreign goods; $W_t\, l_t$ is the labor income; d_t is the aggregate real dividend paid by the firms (net of households' transfers to firms); and t_t are the government's lump-sum transfers, in terms of the c-bundle good. The optimal allocation of expenditures between domestic and foreign goods is given by

$$c_{H,t} = \omega_H \left(\frac{P_{H,t}}{P_t}\right)^{-\eta} c_t \tag{21}$$

$$c_{F,t} = (1-\omega_H) \left(\frac{P_{F,t}}{P_t}\right)^{-\eta} c_t. \tag{22}$$

Nominal rigidities. We assume that the labor market is characterized by nominal wage rigidities, which give rise to involuntary unemployment and a Mundellian role for exchange-rate stabilization. We follow the formulation in Schmitt-Grohé and Uribe (2016) and that the nominal wage faces downward rigidity, i.e., $W_t \geq \bar{W}$, where $\bar{W}$ captures the degree of nominal rigidities.[4] A higher $\bar{W}$ implies that nominal wages have a smaller margin to adjust in the event of a negative shock, which may lead to involuntary unemployment.

From Equation (8), we can integrate across firms to compute the aggregate demand for labor, which is given by

$$l_t^d \equiv \int_i l_{i,t}^d = A_t\, \tilde{K}_t \left[\frac{1-\varsigma}{w_t} p_{H,t}\right]^{\frac{1}{\varsigma}}, \tag{23}$$

where $\tilde{K}_t \equiv \int_i z_{i,t}\, (k_{i,t})^{\frac{\alpha\chi}{\varsigma}}$ captures the productive capacity of the economy. In any equilibrium, it must be the case that $l_t^d \leq l_t^s$. Because of the presence of rigid nominal wages, the labor market may not clear. At any point in time, wages and employment must thus satisfy the following slackness condition:

$$\left(l_t^s - l_t^d\right)\left(W_t - \bar{W}\right) = 0. \tag{24}$$

That is, in periods of unemployment, the wage constraint binds. If the constraint does not

[4] In Schmitt-Grohé and Uribe (2016), the downward rigidity is given by $W_t \geq \gamma W_{t-1}$, where W_{t-1} denotes the previous period nominal wage. In this paper, in order to reduce the dimensionality of our problem, we set a constant wage floor $\bar{W}$. This specification is similar to that in Bianchi, Ottonello and Presno (2023) and Bianchi and Sosa-Padilla (2023).

bind, then the economy is in full employment. Combining Equations (18) and (23), the full-employment (FE) real wage can be expressed as

$$w_t^{FE} = [(1-\varsigma)\, p_{H,t}]^{\frac{\theta}{\varsigma+\theta}} \times (\psi_l)^{\frac{\varsigma}{\varsigma+\theta}} \times \left(A_t \tilde{K}_t\right)^{\frac{\theta\varsigma}{\varsigma+\theta}}. \tag{25}$$

Given the nominal wage rigidities, the full-employment real wage may not be attained. The observed real wage in the economy is given by $w_t = \max\left\{w_t^{FE}, \frac{\bar{W}}{P_t}\right\}$ and unemployment is positive whenever $w_t > w_t^{FE}$. It is useful to rewrite this expression as a function of the nominal exchange rate, ξ_t:

$$w_t = \max\left\{w_t^{FE}, \frac{\bar{W}}{\xi_t} \times \varepsilon_t\right\}, \tag{26}$$

where $\varepsilon_t \equiv \xi_t / P_t$ is the real exchange rate.

Capital adjustment costs. There is a representative capital producer that produces capital goods from home goods subject to adjustment costs. Producing I_t units of capital requires $\Phi(I_t, K_t) = I_t + \frac{\phi}{2} K_t \left(\frac{I_t}{K_t} - \delta\right)^2$ units of the home good. Profit maximization yields the following expression for the relative price of capital:

$$p_{k,t} = p_{H,t}\left(1 + \phi\left(\frac{I_t}{K_t} - \delta\right)\right). \tag{27}$$

As standard in the literature, this formulation gives rise to responses in the price of capital to aggregate shocks.

Government. The government sets the path for the nominal exchange rate, $\{\xi_t\}$. We consider a flexible specification in which the government can set any linear combination between a fixed exchange rate regime and a flexible one that guarantees full employment. Let ξ_t^{Flex} denote the flexible exchange rate that achieves full employment in period t. From Equation (26), this is given by $\xi_t^{Flex} = \frac{1}{w_t^{FE}} \bar{W} \varepsilon_t$.[5] The exchange rate policy can be written as $\xi_t = \varrho \xi_t^{Flex} + (1-\varrho)\xi^{Peg}$, where we normalize $\xi^{Peg} = 1$. The parameter ϱ can be interpret as the degree of exchange rate flexibility. Notice that when $\varrho = 1$, the government effectively

[5]While we focus on the minimum ξ_t that leads to full employment, any ξ_t larger than ξ_t^{Flex} would also attain full employment.

eliminates the effects of the wage rigidity—and our model boils down to a model without nominal frictions.

Rest of the world. The rest of the world has a perfectly elastic supply of the foreign good at a fixed price in terms of foreign currency, which we also normalize ($P_F^\star = 1$). It has a downward-sloping foreign demand for the home-good given by

$$c_{H,t}^\star = \left(\frac{P_{H,t}^\star}{P_F^\star}\right)^{-\eta} c_t^\star, \tag{28}$$

where $c_t^\star$ denotes total consumption by the rest of the world, and $P_{x,t}^\star$ is the foreign-currency price of good $x = \{H, F\}$. These conditions can be micro-founded from the problem of a representative foreign household that has CES preferences over home and foreign tradable goods, and is infinitely large relative to the small open economy, but the share of home tradable good consumption in its consumption basket is infinitely small (see, for example, Gali and Monacelli, 2005). Both the home and foreign good satisfy the law of one price, i.e., $P_{F,t} = P_F^\star \xi_t$ and $P_{H,t}^\star = P_{H,t}/\xi_t$. Under these assumptions, the foreign demand is then given by $c_{H,t}^\star = \left(\frac{P_{H,t}}{\xi_t}\right)^{-\eta} c^\star$.

Equilibrium. Equilibrium is defined in a standard way, where firms and the household optimize given prices and government policies, and prices adjust to clear all markets, with the exception of the labor market that is demand determined given the wage rigidity. We provide a formal definition in Appendix B.2.

3.4. The Transmission of Global Price of Risk and the Risk Dimension of Macroeconomic Policies

To understand how changes in the global price of risk transmit to the economy, it is useful to analyze the bond price equation (16) using a first-order approximation:

$$q_{i,t}^\star \approx \beta^\star \, \mathbb{E}_t \left[\mathcal{R}_{i,t+1} \right] - \beta^\star \, \kappa_t \, \mathbb{C}ov_t \left[\epsilon_{A,t+1}, \mathcal{R}_{i,t+1} \right]. \tag{29}$$

This equation decomposes the bond price into two components: a risk-neutral expected repayment, $\beta^\star \mathbb{E}_t[\mathcal{R}_{i,t+1}]$, and a risk-premium term, $-\beta^\star \kappa_t \, \mathbb{C}ov_t[\epsilon_{A,t+1}, \mathcal{R}_{i,t+1}]$. The second term captures the *quantity of risk*: the covariance between the firm's next-period repayment and global productivity innovations. This covariance is non-negative because firms are more likely to default in bad aggregate states (low $\epsilon_{A,t+1}$), so repayment $\mathcal{R}_{i,t+1}$ co-moves positively with $\epsilon_{A,t+1}$. When $\kappa > 0$, lenders require compensation for bearing this risk, which lowers bond prices, raises borrowing costs, and reduces investment.

From (29), it follows that increases in the global price of risk transmit to the economy through higher borrowing costs, with pass-through determined by each firm's quantity of risk. We refer to this as the *risk channel*. The quantity of risk differs across firms. For a risk-free firm with near-zero default probability, repayment is insensitive to aggregate conditions, so the covariance term is approximately zero and borrowing costs are largely unaffected by changes in κ. For a risky firm, by contrast, the covariance is strictly positive and increasing in default risk. This cross-sectional variation in the quantity of risk is a key mechanism through which the model accounts for the heterogeneous investment responses documented in Section 2, as further analyzed in the next section.

In addition to the risk channel, firms in our model are affected by changes in the global price of risk through two additional channels that operate through general-equilibrium adjustments in prices set in motion by the aggregate contraction in investment and output triggered by the risk channel. First, the *debt-revaluation channel*: movements in the real exchange rate affect the real burden of firms' dollar-denominated debt. Second, the *input-cost channel*, through which movements in real wages and the relative price of capital affect firms' cash flows and investment incentives.

To better characterize these channels and illustrate how they interact, it is useful to consider a simplified version of the model in which we abstract from adjustment costs and recovery values and disregard the effect of capital choices on bond prices—see Appendix for the full derivation. Under these assumptions, the firm's optimal debt issuance satisfies:

$$\mu\left(\cdot\right)\, q^{\star}(k',b',z,\boldsymbol{S}) = \beta\mathbb{E}_{(z',\boldsymbol{S}')|(z,\boldsymbol{S})}\left[\frac{\varepsilon'}{\varepsilon}\,\mu'\left(\cdot\right)\, \mathcal{R}^{r}\left(k',b',z',\boldsymbol{S}'\right)\right] - \mu\left(\cdot\right)\, \frac{\partial q^{\star}(k',b',z,\boldsymbol{S})}{\partial b'}\,\Delta b', \tag{30}$$

where $\Delta b' \equiv b' - (1-m)b$ and $\mu\left(\cdot\right) \equiv 1 + \varphi \mathbb{I}_{\{d<0\}}$ is the Lagrange multiplier associated with the non-negative dividend constraint. When $\mathbb{I}_{\{d<0\}} = 1$, that constraint binds, forcing the firm to raise costly equity.

The left-hand side of (30) is the marginal benefit of issuing one additional unit of debt: the bond price $q^{\star}(.)$, scaled by the shadow value of relaxing the non-negative dividend constraint, $\mu(.)$. The right-hand side captures the marginal costs, which consist of two terms: the discounted expected repayment obligation in the following period and the endogenous decline in the bond price from higher leverage—the latter reflecting that additional borrowing raises default risk and lowers $q^{\star}(.)$.

The first-order condition for investment, k', is:

$$\mu\left(\cdot\right)\, p_k = \beta\mathbb{E}_{(z',\boldsymbol{S}')|(z,\boldsymbol{S})}\left[\left[1 - h\left(k',b',z',\boldsymbol{S}'\right)\right]\, \mu'\left(\cdot\right)\, \mathrm{MRPK}\left(k',z',\boldsymbol{S}'\right)\right]. \tag{31}$$

The left-hand side of (31) is the marginal cost of acquiring one additional unit of capital, $\mu(.)p_k$. The right-hand side is the expected marginal benefit: the MRPK multiplied by the next-period shadow value of relaxing the non-negative dividend constraint, weighted by the probability of non-default, $1 - h(k',b',z',\boldsymbol{S}')$, reflecting that the firm realizes the return to capital only in states where it does not default. The MRPK is given by $\mathrm{MRPK}(k',z',\boldsymbol{S}') = \partial\pi(k',z',\boldsymbol{S}')/\partial k' + (1-\delta)p_k'$, which captures the flow return from capital and its resale value net of depreciation.

Equations (29)–(31) summarize the transmission mechanisms of changes in the global price of risk. An increase in κ reduces $q^{\star}(.)$ for firms with positive risk, raising borrowing costs and tightening the non-negative dividend constraint. From (31), the resulting increase in the marginal cost of investment leads to a contraction in capital, whose magnitude scales with each firm's quantity of risk. This is the *risk channel.* The aggregate decline in investment then gives rise to two additional general-equilibrium forces. First, reduced demand for labor and domestic goods lowers real wages w and the relative price of capital p_k, which raises the MRPK and partially offsets the initial contraction—this is the *input-cost channel*. Second, movements in the real exchange rate $(\varepsilon'/\varepsilon)$ alter the local-currency value of dollar-denominated debt repayments, tightening the constraint in (30) for highly leveraged firms—this is the *debt-revaluation channel*.

A distinguishing feature of our framework is that these general-equilibrium adjustments feed back into the quantity of risk itself. That is, $\mathbb{C}ov_t[\epsilon_{A,t+1}, \mathcal{R}_{i,t+1}]$ depends on how sensitive firms' repayments are to aggregate conditions, which in turn is shaped by how wages and prices respond to aggregate shocks. To illustrate, consider an economy in which nominal wages are downwardly rigid. Firms' profits then fall more sharply in bad times, making repayments more correlated with aggregate productivity and raising the quantity of risk. The higher quantity of risk amplifies the pass-through of κ to borrowing costs, deepening the contraction. Conversely, more flexible wage adjustment reduces the quantity of risk and dampens the risk channel. This feedback implies that the strength of the risk channel is not fixed but depends on general-equilibrium responses. With endogenous default risk, macroeconomic policies can therefore stabilize the economy by reducing the quantity of risk, thereby limiting the pass-through of κ to borrowing costs. We refer to this margin as the *risk channel of macroeconomic policies*, which we study in Section 5.

3.5. Discussion of Baseline Assumptions

This section discusses the model's baseline assumptions and their macroeconomic implications. First, for our baseline analysis we assume that firms' debt is denominated in foreign currency. This assumption is motivated by the large predominance of dollar debt in external corporate debt of emerging economies (Du and Schreger, 2015). An implication of this assumption is that firms bear the currency risk, as emphasized above. In Appendix C.6, we consider an extension with firms' debt denominated in local currency, which shifts the bearing of the currency risk to foreign investors.

Second, our baseline model assumes that firms issue debt directly to foreign investors. This is a tractable modeling feature that captures both external debt and loans from domestic financial institutions, given the high pass-through of foreign shocks to domestic credit conditions from financial institutions, documented in Baskaya *et al.* (2017). In Appendix C.7 we analyze an extension in which firms' debt is financed by domestic banks that are funded with a mix of international and domestic funds.

Finally, our baseline model assumes that firms are owned by domestic households. We choose this assumption to maintain our model close to canonical business-cycle open-economy models (see, e.g., Uribe and Schmitt-Grohé, 2017, for a review), including those that study the effects of shocks to the global price of risk (Bai, Kehoe and Perri, 2019). In Appendix C.8, we consider a specification in which firms' are priced by foreign investors.

4. The Transmission of the Global Financial Cycle

We combine our data and model to quantitatively study the transmission of changes in the global price of risk. Section 4.1 details the model's parameterization and compares its predictions with their empirical counterparts. Section 4.2 uses the calibrated model to analyze the channels through which changes in the global price of risk transmit to the real economy.

4.1. Parameterization and Model Fit

Our quantitative analysis targets a prototypical Latin American economy, using the same sample of countries as in the empirical analysis of Section 2.3. Given the importance of risk in our heterogeneous-agent framework, we solve the model using global methods and an approximation of the distributions that constitute the state vector. Appendix C.2 summarizes the computational algorithm.

The calibration is conducted at a quarterly frequency and targets both cross-sectional and aggregate moments. We proceed in three steps. First, we fix a subset of parameters to standard values commonly used in the literature, listed in Panel (a) of Table 2. For technologies, we set the capital share to $\alpha = 0.3$ and the degree of decreasing returns to scale to $\chi = 0.85$, a common value in the heterogeneous-firm literature. For preferences, we set the

Table 2: Model Parameterization

(a) Fixed Parameters

Parameter	Description	Value
Panel 1. Domestic Economy		
α	Capital share	0.3
χ	Dec. returns to scale	0.85
m	Bond maturity	0.052
c	Bond coupon	0.018
θ	Frisch elasticity	0.5
ω_H	Home bias	0.66
η	Trade elasticity	1.5
Panel 2. Rest of the World		
$\tilde{\beta}$	Lenders discount factor	0.992
$\Pi_\kappa(\kappa_L, \kappa_H)$	Probability of global crisis	0.05
$\Pi_\kappa(\kappa_H, \kappa_L)$	Duration of global crisis	0.15

(b) Calibrated Parameters

Parameter	Description	Value
Panel 1. Cross-Sectional Moments		
β	Firms discount factor	0.967
ρ_z	TFP, persistence	0.95
σ_z	TFP, volatility	0.14
ψ_k	Capital adjustment costs	0.25
ψ_b	Debt adjustment costs	2.5
λ	Recovery rate	0.12
σ_d	Exit value	3.05
φ	Equity issuance cost	0.16
Panel 2. Aggregate Moments		
ρ_A	Aggregate TFP, persistence	0.98
σ_A	Aggregate TFP, volatility	0.026
δ	Depreciation rate	0.045
ϕ	Tobin's q	1.5
$\bar{W}$	Wage rigidity	1.04
ϱ	Nominal exchange rate	0.25
κ_H	Price of risk	45.0

Note: Panel (a) reports the parameters fixed in the calibration: the top panel lists those for domestic firms and the bottom panel those for foreign lenders. Panel (b) reports the calibrated parameters: the top panel lists parameters governing the targeted cross-sectional moments and the bottom panel those governing aggregate responses.

inverse Frisch elasticity to $\theta = 0.5$, the degree of home bias in consumption to $\omega_H = 0.66$ (as in Auclert, Rognlie, Souchier and Straub, 2021), and the elasticity of substitution between home and foreign goods to $\eta = 1.5$ (from Itskhoki and Mukhin, 2021). Regarding firms' bond characteristics, we set m to match the average duration of nonfinancial firms' debt in our sample, and υ to target the observed annualized coupon yield (reported in Table A.4). For foreign lenders, we fix the discount factor $\beta^\star$ to target a 3% annual risk-free rate. We also fix the Markov transition matrix governing the global price of risk, Π_κ, to capture a quarterly crisis probability of 5% and an average crisis duration of five quarters.[6]

[6] The 5% target corresponds to the frequency with which our EMEBP measure exceeds one standard deviation. Similarly, the five-quarter target is based on the average number of quarters that the EMEBP remains above this threshold. In Table 3 we show that this simple two-state Markov structure generates a risk premium that closely replicates the observed persistence and volatility of our EMEBP.

In the second step, we calibrate the parameters governing a set of firms' cross-sectional moments, reported in Panel (b) of Table 2. To compute these data moments, we use our Orbis dataset (unless stated otherwise) and average across all countries in our sample (see Appendix C.3 for details). Although all calibrated parameters influence all moments in the model, we describe the calibration in terms of the main moments most directly affected by each parameter. The parameters governing the idiosyncratic productivity process, ρ_z and σ_z, are calibrated to match the dispersion of firms' investment rates. Specifically, we set $\rho_z = 0.95$ and calibrate σ_z to match the cross-sectional standard deviation of firms' investment rates. We calibrate the discount factor β and firms' outside-option volatility σ_d to match an annual exit rate of 7.5% and the observed average book-value leverage ratio of 0.31 (as described in Appendix Table A.5).[7] The debt adjustment cost parameter, ψ_b, is calibrated to match the cross-sectional standard deviation of leverage, and the capital adjustment cost parameter, ψ_k, to match the correlation between firm size and age. The recovery value parameter, λ, targets an average recovery rate of 25%.[8] Finally, we calibrate the equity issuance cost parameter to match an annual frequency of equity issuance of 14%.[9]

In the third step, we calibrate the parameters governing aggregate responses. The data sources for these moments are described in Appendix C.3. For the global productivity process, we calibrate ρ_A and σ_A to match the observed autocorrelation and volatility of GDP. We calibrate δ to match the observed investment-to-GDP ratio and set ϕ to match the observed volatility of aggregate investment relative to output. We calibrate the nominal wage rigidity parameter, $\bar{W}$, to match the correlation between the unemployment rate and

[7] In the model, we define leverage as the b/k ratio. We view the exit rate target as a conservative estimate, as it is consistent with estimates for the U.S. nonfinancial sector. For instance, Hopenhayn, Neira and Singhania (2022) report an average annual exit rate of 7.5%. Our target is also consistent with recent studies on emerging markets. Andreasen, Bauducco, Dardati and Mendoza (2023) report an average exit rate of 8% for the universe of Chilean manufacturing establishments, and Majerovitz (2023) finds an average of 7.5% for Indonesian manufacturing establishments.

[8] This is consistent with Arellano, Bai and Zhang (2012), who target an average recovery rate of 25% for nonfinancial firms in an emerging economy.

[9] Because we do not observe actual equity issuances in our dataset, we compute this value by identifying firms with large increases in their reported book equity. In particular, we classify a firm as issuing equity if its equity value increases by more than 50% within one year. Our target implies a value for φ of 0.16, which is in line with other studies. For instance, Gomes (2001) set the cost of seasoned equity issuance to 0.08; Gilchrist *et al.* (2014) to 0.12; and Cooley and Quadrini (2001) to 0.30.

Table 3: Model Fit: Targeted and Untargeted Moments

(a) Cross-sectional Moments

Moment	Data	Model
Panel 1. Targeted		
Leverage	0.31	0.31
Exit rate	7.5%	8.12%
Investment/k (cs std)	0.25	0.25
Leverage (cs std)	0.22	0.28
Correlation size and age	0.28	0.26
Recovery rate	25.0%	26.29%
Share firms issuing equity	14.0%	11.08%
Panel 2. Untargeted		
Distribution of leverage		
perc 10	0.04	0.03
perc 25	0.11	0.07
perc 50	0.25	0.23
perc 75	0.44	0.48
perc 90	0.62	0.73
Spreads(*)	4.57%	5.46%
Spreads(*) (cs std)	3.66%	5.30%
Quarterly Profits-to-Capital	10.00%	10.45%
Age median firm	10.0	12.9
Age median public firm	30.0	29.4

(b) Aggregate Moments

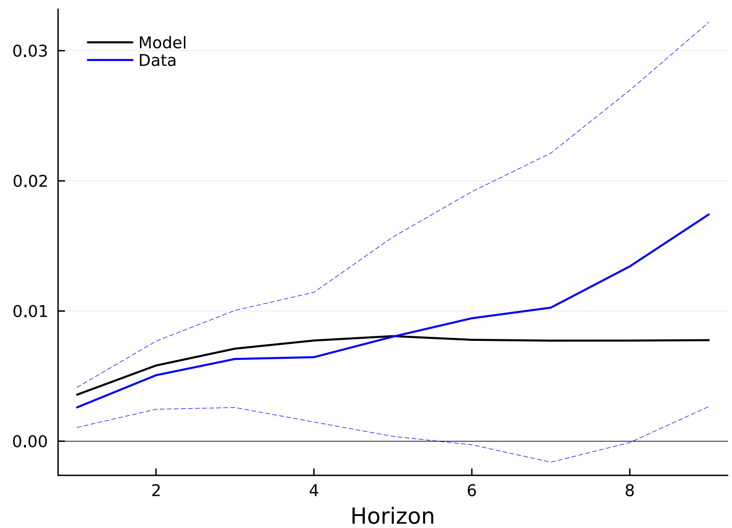
Moment	Data	Model
Panel 1. Targeted		
$\sigma(GDP)$	2.3%	2.42%
GDP autocorrelation	0.93	0.89
Investment-to-GDP	14.0%	15.77%
$\sigma(I)/\sigma(GDP)$	2.9	3.144
$\rho(Unemprate, GDP)$	-0.36%	-0.29%
Δ Risk premium(*)	1.18%	1.15%
ΔP	0.0%	0.02%
Panel 2. Untargeted		
$\rho(I, GDP)$	0.84	0.898
$\rho(C, GDP)$	0.8	0.93
$\sigma(C)/\sigma(GDP)$	1.0	0.751
$\sigma(Emp)/\sigma(GDP)$	0.65	0.676
$\rho(GDP, Spreads)$	-0.55	-0.506
$\rho(I, Spreads)$	-0.48	-0.656
RP, autocorrelation(*)	0.76	0.753
RP innovations, std(*)	0.39	0.305

Note: The table reports model-implied moments and their data counterparts. Panel (a) shows targeted and untargeted cross-sectional moments, and Panel (b) shows aggregate moments. Asterisks denote moments computed for the pool of Compustat firms used in our empirical analysis.

output. For the market price of risk, we normalize κ_L to 0 and calibrate κ_H so that the on-impact increase in the risk premium during a global crisis (i.e., when moving from $\kappa_{t-1} = \kappa_L$ to $\kappa_t = \kappa_H$) corresponds to a one-standard-deviation increase in the data.[10] For the analysis, we assume that foreign consumption, $c_t^\star$, is constant and orthogonal to changes in the global price of risk. In practice, increases in the global price of risk may coincide with a contraction in $c_t^\star$, lowering foreign demand for the H-good and affecting investment and output. By keeping $c_t^\star$ fixed, the model isolates the aggregate implications of a shock to the global price of risk. Finally, we set the parameter governing exchange rate policy, ϱ, so that the consumer

[10] Our empirical analysis identifies changes in the EMEBP but cannot pin down its level. For this reason, we set $\kappa_L = 0$ in the calibration and calibrate κ_H to match the observed EMEBP volatility.

Figure 4: Heterogeneous Firm Responses to Changes in the Global Price of Risk

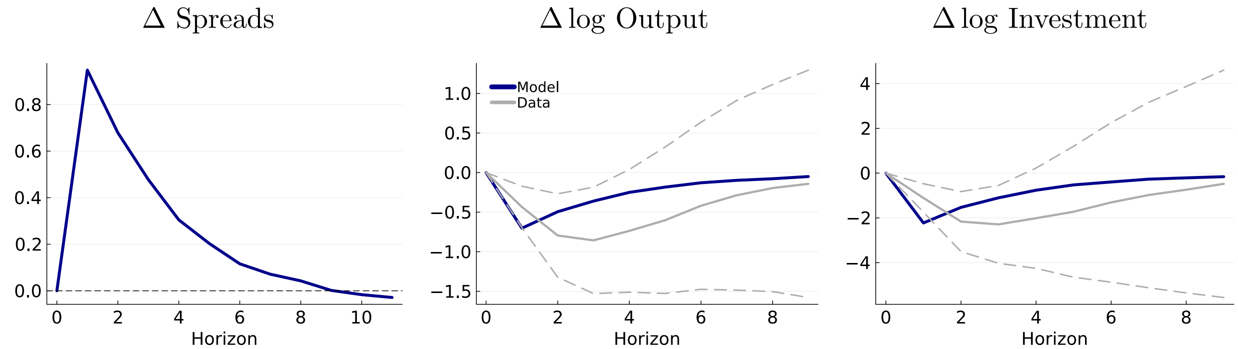


Note: Note: The figure compares the model-implied local projection estimates with those from the empirical analysis. Blue lines show the empirical estimates with 90% confidence intervals, and black lines show the model-implied estimates. In both cases, the variable ρ_t is standardized using its empirical standard deviation. For the model-generated data, we retain only "Compustat" firms, defined as those with age $>$ $a\bar{g}e$. The x-axis shows the horizon h.

price index, P, remains constant after an increase in the global price of risk, consistent with what we observe in the data.

The top panels of Table 3 compare the model-implied targeted cross-sectional and aggregate moments with their data counterparts, while the bottom panels report a set of untargeted moments. Central to our analysis, the model closely replicates the distribution of firms' leverage in our Orbis data, a key feature for drawing implications about changes in risk and borrowing costs. The model is also consistent with the empirical findings in Section 2 for our sample of Compustat firms. To account for selection into Compustat, we condition on firms' age (as in Ottonello and Winberry, 2020). The median firm in our Compustat dataset is three times older than the median firm in Orbis (30 years versus 10 years, respectively). In the model, we define "Compustat" firms as those with $age > \overline{age}$ and set $\overline{age}$ to match this relative age. After conditioning on age, we compare the model's predictions with the empirical results. Figure 4 shows that the model replicates the differential investment responses of risky and risk-free firms to a shock to the price of risk.

Figure 5: Aggregate Responses to Global Price of Risk Increases



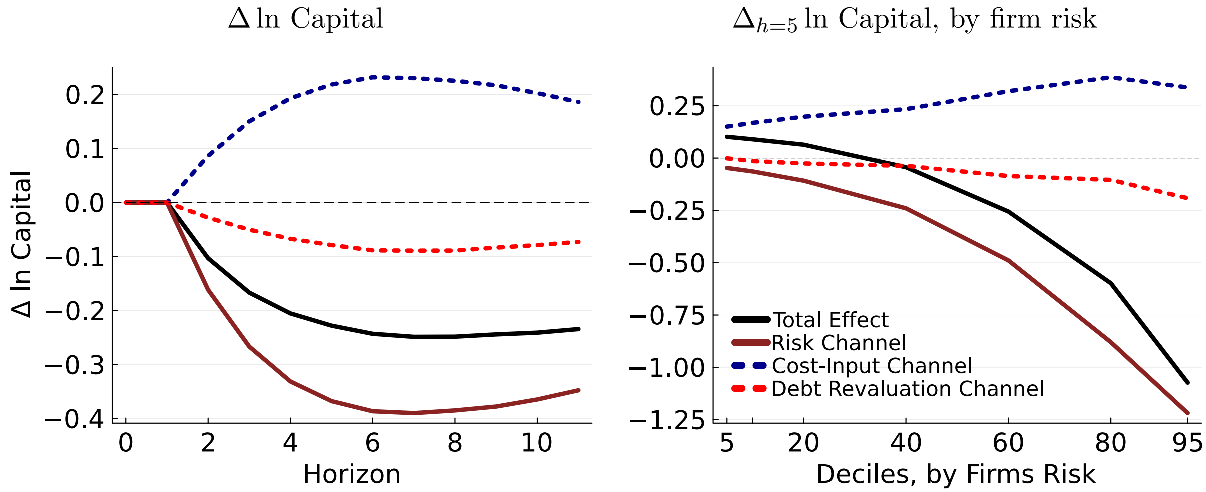
Note: Impulse responses to a shock to the global price of risk ($\Delta\kappa > 0$). The panels display the dynamics of firms' average borrowing spreads, aggregate output, and the aggregate investment rate. Blue lines depict model-implied dynamics; gray lines show estimated responses from the data.

The model also closely matches the aggregate responses of investment and output to changes in the global price of risk. Figure 5 shows that a one standard deviation shock to the market price of risk raises bond spreads by about one percentage point and reduces economic activity by almost one percentage point. Investment declines by more than 2 percentage points. Although untargeted in our calibration, these model implied dynamics align with those observed in the data following a one standard deviation increase in the EMEBP measure (gray lines). In Appendix Figure C.2, we compare the 2008 global financial crisis with the model's response to an increase in the market price of risk calibrated to match the EMEBP surge around the Lehman collapse (a four standard deviation shock). The model accounts for about half of the contraction in investment and output, highlighting the role of global conditions, particularly the price of risk, in driving investment in emerging economies.

4.2. Channels of Transmission

Next, we decompose the mechanisms underlying the real transmission of changes in the global price of risk. To this end, we construct two counterfactual exercises aimed at isolating each channel. First, we consider a counterfactual in which prices do not respond to changes in κ, allowing us to isolate the risk channel. Second, we consider a counterfactual in which debt is denominated in units of the home good, allowing us to isolate the debt-revaluation

Figure 6: Transmission Channels of Global Price of Risk Increases



Note: The figure shows the transmission channels of a shock to the global price of risk ($\Delta\kappa > 0$). The left panel reports cumulative impulse responses for aggregate capital. The right panel reports the cumulative change in capital at horizon $h = 5$ across firms sorted by pre-shock default probability. In both panels, the solid black line shows the total effect and the solid brown line shows the risk channel. The dotted blue and red lines decompose the indirect (general-equilibrium) effects into the cost-input and debt-revaluation channels, respectively.

channel.

The left panel of Figure 6 shows the cumulative effect of a global price-of-risk shock on capital accumulation. The solid dark-blue line depicts the total effect, while the solid brown line isolates the risk channel, defined as the direct impact of higher borrowing costs holding all prices fixed. The two dotted lines decompose the remaining indirect, or general-equilibrium (GE), effects into a *debt-revaluation* and a *cost-input* channel. In our model, a rise in the price of risk triggers a real exchange rate depreciation, which raises the real burden of firms' dollar-denominated debt, giving rise to the debt-revaluation channel. At the same time, the contraction in economic activity compresses real wages and the relative price of capital, providing cost relief to firms and dampening the investment contraction through the cost-input channel. The figure reveals an important asymmetry: the cost-input channel substantially *mitigates* the investment decline, and its effect dominates the amplification from the debt-revaluation channel. At the peak of the crisis, the net indirect contribution dampens the total decline in cumulative investment by around 30%.

The right panel traces the same decomposition across the firm risk distribution. Firms are sorted by their pre-shock default probability, and cumulative investment is evaluated at the crisis peak (horizon $h = 5$). For the safest firms, those with near-zero default risk, the risk channel is negligible. The channel grows monotonically with default risk, underscoring the importance of the firm-level risk distribution for aggregate outcomes. The debt-revaluation channel is similarly increasing in firm risk, reflecting higher leverage among riskier borrowers. The cost-input channel also provides greater relief to riskier firms because the fall in real input costs disproportionately eases the binding financial constraints they face.

5. The Risk Dimension of Macroeconomic Policies

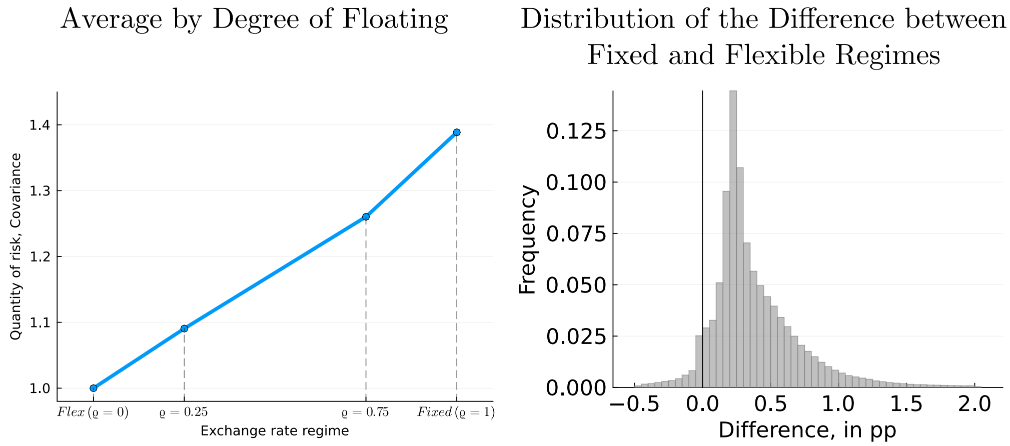
5.1. Exchange-Rate Regimes

In this section, we compare the effects of a shock to the global price of risk under a fully flexible ($\varrho = 1$) and a fixed ($\varrho = 0$) exchange rate regime. Under a flexible exchange rate, the government engineers nominal depreciations in each period to maintain full employment. Under a fixed exchange rate, this adjustment is absent, which, as we show next, attenuates the indirect channels and leads to a larger risk channel.

Figure 7 compares the quantity of risk across exchange rate regimes. On aggregate, the quantity of risk is about 40% smaller under a flexible exchange rate because nominal depreciations lower real wages in downturns and reduce the sensitivity of firms' default risk to aggregate conditions. The right panel shows that most firms are better off under the flexible regime. The exception is a small share of highly leveraged firms, for which the negative debt-revaluation effects of the depreciation dominate.

Figure 8 shows the impulse responses to an increase in the price of risk under the two regimes. In each case, we shock κ from $\kappa_L = 0$ to κ_H. The left panel shows the dynamics of the risk premium (i.e., $\Delta\kappa\,\mathbb{C}ov(.)$). The increase in the risk premium is substantially larger under the fixed regime because the absence of a nominal depreciation prevents the real wage adjustment that would otherwise reduce firms' exposure to aggregate risk. As

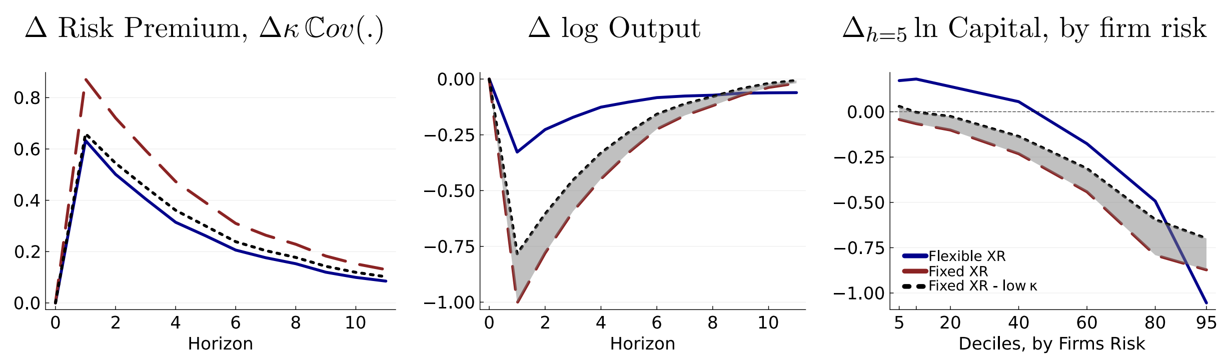
Figure 7: Firm Quantity of Risk across Exchange-Rate Regimes



Note: The figure reports the aggregate quantity of risk for different degrees of exchange rate flexibility ϱ (left panel) and the distribution of the firm-level difference in the quantity of risk between the fixed and flexible regimes (right panel).

a result, the covariance between firms' repayments and aggregate productivity innovations remains higher, amplifying the pass-through of the global price of risk to borrowing costs. The decline in output is correspondingly larger under the fixed regime, as is the cumulative contraction in investment across the firm distribution.

Figure 8: The Risk Dimension of Exchange-Rate Regimes: Responses to Global Price of Risk Increases



Note: Impulse responses to a shock to the global price of risk ($\Delta\kappa > 0$) across exchange rate regimes. Blue (red) lines show the dynamics under a flexible (fixed) exchange rate regime. The black dotted lines report the results for a fixed exchange rate regime in which we adjust the κ shock so that the dynamics of the risk premium match those under the flexible regime. The gray area captures the additional contraction attributable to the larger risk channel under the fixed regime.

The larger contraction under the fixed regime reflects both a stronger risk channel and weaker general equilibrium forces, as nominal wage rigidities prevent the real wage adjustment that would otherwise raise the MRPK and partially offset the decline in investment. To quantify their relative contributions, we construct a counterfactual in which the government follows a fixed exchange rate regime but reduces the magnitude of the κ shock so that the dynamics of the risk premium match those under the flexible regime (dotted black lines). Under this counterfactual, any remaining difference in output and investment dynamics between the two regimes is driven entirely by the indirect channels. The gray area captures the additional contraction attributable to the larger risk channel under the fixed regime. We find that the risk channel accounts for up to one-third of the additional decline in output and investment relative to the flexible regime.

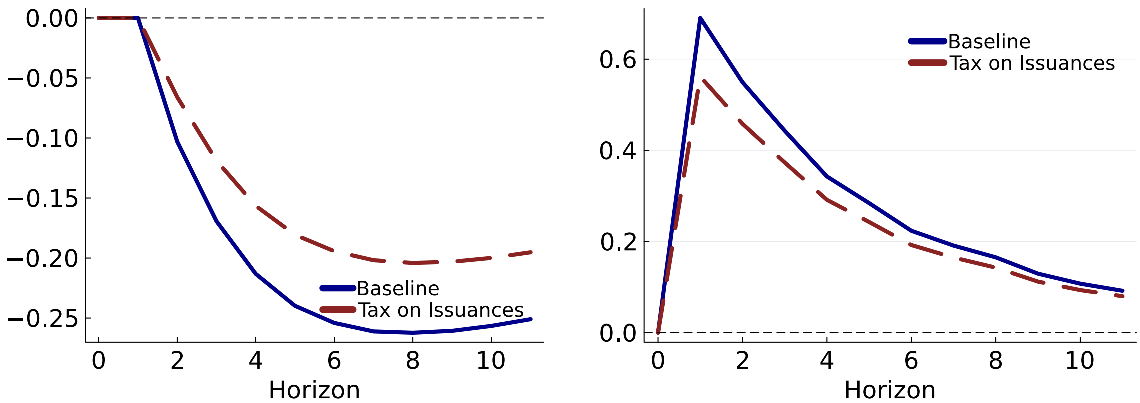
5.2. Macroprudential Policies

We also study the risk dimension of macroeconomic policies by analyzing debt taxes. For simplicity, we assume that the government imposes a 2% tax rate on the proceeds from new issuances of foreign debt. Panel (a) of Figure 9 shows the effects of a risk premium shock by comparing the aggregate dynamics of capital and the risk premium in our baseline model with those in a counterfactual economy in which the tax on debt is in place. Overall, the tax reduces the increase in the risk premium and dampens the contraction in aggregate capital. Panel (b) of Figure 9 shows that this dampening mainly reflects a smaller contraction in the investment of riskier firms, while the investment of risk-free firms is largely unaffected.

Figure 9: The Risk Dimension of Macroprudential Policies: Responses to Global Price of Risk Increases

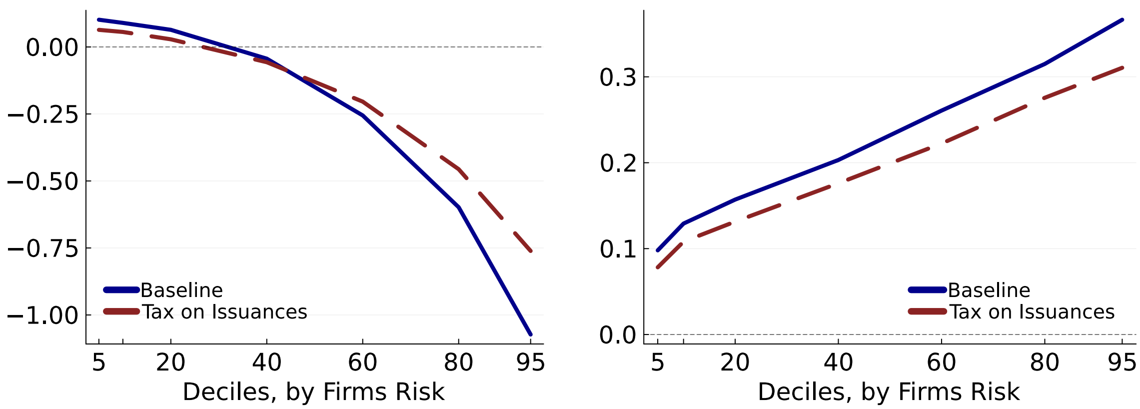
(a) Aggregate Response

(b) $\Delta \ln$ Capital **(c)** Δ Risk Premium



(d) Heterogeneous Response by Firm Risk

Investment ($\Delta_h \ln k$) Δ_h Risk Premium



Note: Panel (a) shows impulse responses to a risk-premium shock ($\Delta\kappa > 0$) for aggregate capital and risk premia. The blue lines show the dynamics for our baseline model. The red lines show the dynamics for an economy in which the government imposes a tax on debt issuances. Panel (b) shows impulse responses to a risk-premium shock ($\Delta\kappa > 0$) by firm risk. Firms are sorted into deciles based on their pre-shock default probability. The left panel shows the change in firms' capital and the right panel the change in risk premium. The blue lines show the results for our baseline model and the red lines show the results for an economy in which the government imposes a tax on debt issuances.

6. Conclusions

In this paper, we study how fluctuations in global financial conditions transmit to firms' investment and economic activity in open economies. We combine new evidence on firms' responses to changes in the global risk premium with a quantitative heterogeneous-firm open economy model in which firms finance investment with defaultable debt provided by risk-averse global investors. Our analysis highlights the central role of firms' risk in shaping the transmission of global financial shocks. Increases in the global price of risk raise firms' cost of financing investment, with pass-through determined by each firm's quantity of risk. This risk channel generates heterogeneous investment responses across firms and is the main driver of the aggregate contraction following global financial shocks.

A key implication of our framework is that macroeconomic policies influence the transmission of external shocks through their effect on firms' quantity of risk. Policies that facilitate input cost adjustments reduce firms' exposure to aggregate risk and dampen the pass-through of external shocks to borrowing costs and investment. While our analysis focuses on exchange rate regimes, an important avenue for future research is to examine how other policies, such as fiscal policy or institutional changes in credit markets, shape firms' risk exposure and thereby influence how fluctuations in international financial markets transmit to real economic activity in open economies.

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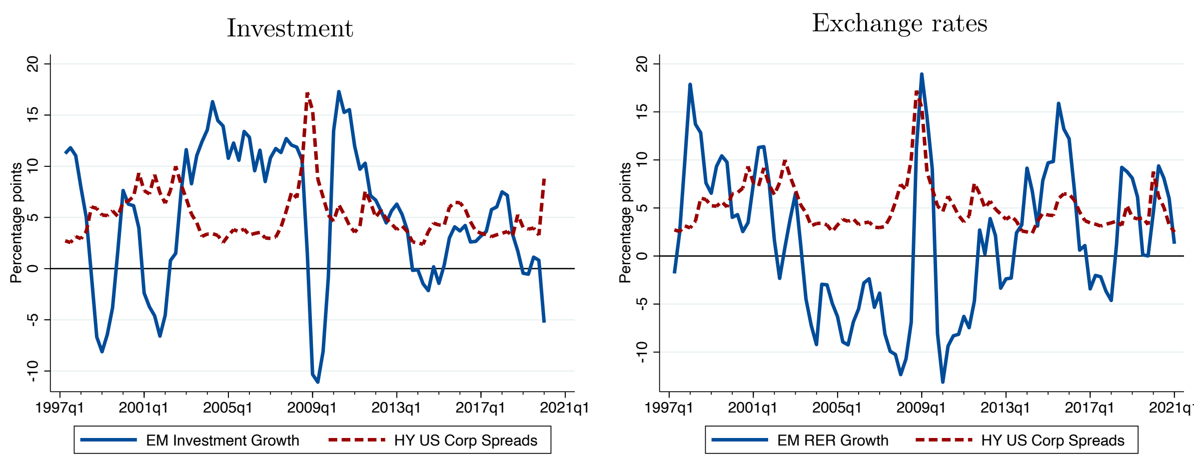
A. Empirical Appendix

A.1. Motivating evidence

Figure A.1 shows the comovement of U.S. borrowing costs with investment and exchange rate growth in emerging markets. Consistent with the high syncronization of borrowing costs shown in Figure 1, investment and real exchange rates in emerging markets are negatively correlated with U.S. borrowing costs.

Figure A.1: U.S. Borrowing Costs and Macroeconomic Dynamics in Emerging Markets



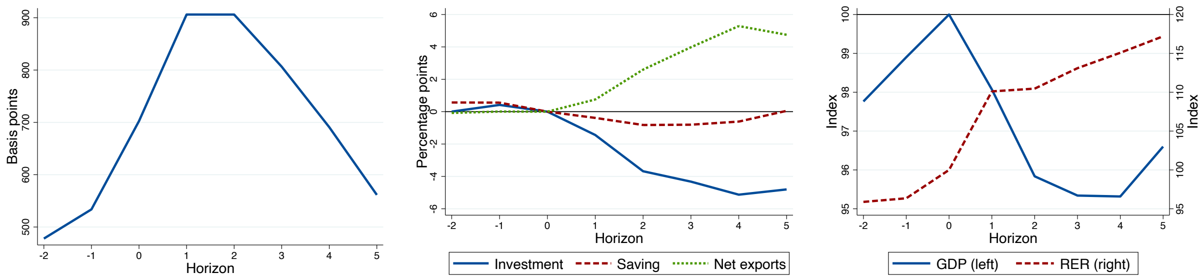
Note: The figure plot average U.S. high-yield corporate spreads with average growth rates of real investment and the real exchange rate with the U.S. dollar in the same sample of emerging markets included in our corporate bond data. Growth rates are calculated as year over year percent changes. The emerging markets included are Argentina, Brazil, Chile, Colombia, India, Korea, Mexico, Peru, the Philippines, Thailand, Turkey, and Ukraine.

The syncronization of risky asset prices and capital flows are especially apparent during systemic crises in emerging markets. As external risky borrowing costs surge, the economy exhibits a sharp contraction of aggregate investment, mirrored by current account adjustment or "sudden stops" in capital flows; economic activity declines and currencies depreciate. Salient examples, illustrated in Figure A.2, include the Latin American debt crises in the early 1980s, the East Asian/Russian crisis in the late 1990s, and the Global Financial Crisis that started in 2008. In particular, we identify sudden stops episodes as those identified by Calvo, Izquierdo and Talvi (2006), update this set to include episodes during the Global

Financial Crisis. We merge crisis dates with macroeconomic data from Uribe and Schmitt-Grohé (2017). We index each crisis episode to the peak of GDP and obtain a set of 33 crises, listed in Table A.1.

Figure A.2: Macroeconomic Dynamics in Emerging Markets during External Crises

U.S. Risky Corporate Borrowing Costs | EM Investment Rates and Net Exports | EM Output and Exchange Rates



Note: This figure shows selected variables for a set of emerging-market crisis episodes (described in Appendix Table A.1). Data are quarterly and horizon 0 indexes the peak in GDP. Panel (a) shows the average Barclays U.S. Corporate High Yield Spread. Panel (b) plots the difference in percentage points between investment-to-GDP (solid blue line), savings-to-GDP (dashed red line), and net-exports-to-GDP (dotted green line) in each horizon, relative to horizon 0. Panel (c) reports GDP relative to its peak (solid blue line) and the real exchange rate relative to the peak in GDP (dashed red line).

Table A.1: Emerging Market Crisis Episodes

Country	GDP Peak	Country	GDP Peak
Argentina	1980q3	Mexico	1981q4
	1994q4		1994q4
	1998q2		2008q2
Brazil	1980q4	Peru	1981q1
	2008q3		1997q2
Chile	1981q3		2008q1
	1998q2	South Africa	1981q4
	2008q2		2008q3
Colombia	1998q2	Thailand	1993q4
	2008q3		2008q1
Ecuador	1981q4	Turkey	1993q4
	1998q4		1998q3
	2008q4		2008q1
Korea	1997q3	Uruguay	1981q4
	2008q3		2008q4
Malaysia	1997q4		
	2008q3		

A.2. Data Description

For our empirical analysis, we combine firm-level data from Global Compustat with corporate bond data from Bloomberg. This section describes the process for cleaning the data and merging across sources.

Corporate Bond Data We collect corporate bond data from Bloomberg and match it to firm-level data using crosswalks to connect identifiers across the datasets. Firms in Compustat are uniquely identified by the gvkey variable. Bonds in Bloomberg are uniquely identified by a Bloomberg ID (bbgid) but are attached to firm identifiers—ISIN, CUSIP, and ticker. We use WRDS Capital IQ to create crosswalks between the Compustat gvkey and the other identifiers available from Bloomberg. Due to limits imposed by Bloomberg on the amount of data that can be downloaded from the terminal each month, we collect data in stages to minimize unnecessary data collection.

1. For each country except the United States, we download a list of corporate bonds that meet the following criteria: denominated in USD, fixed or zero coupon, and have some firm identifier data. We do this by country as a natural way to break the large download into smaller pieces. We exclude local currency bonds because we do not want to capture currency risk in our spreads relative to US treasury yields.

2. For each bond on the list, we match to Compustat gvkey first using ISIN, then CUSIP, then ticker, so we have one firm attached to each bond.

3. For bonds that are successfully matched to firms, we return to the Bloomberg terminal and download end-of-quarter price data (px_last).

4. For bonds that have non-missing price data, we download additional descriptive variables—coupon rate, coupon frequency, call options, etc.

In addition to the criteria listed in step 1, we only keep emerging market economies for which we have at least 100 observations. We limit our sample to bonds with a term to maturity of at least 1 year and no more than 30 years (744 observations). We drop firms in the financial (SIC 6000-6799) and utilities (SIC 4900-4999) industries (1,534 observations). We drop observations that are missing any data on duration, market value of issue, coupon, date of issue, maturity type (i.e. callable), or industry (1,037 observations). We start our sample in 1997q2 (11 observations). Table A.2 describes the coverage of our dataset. We have data from 12 countries in total, covering 561 bonds issued by 172 firms. Almost half of our sample is from Latin America.

Table A.2: Sample Composition

	Observations	Bonds	Firms	Min year
Argentina*	733	49	11	1997
Brazil*	563	37	15	1997
Chile*	547	33	7	1998
Colombia*	180	11	2	2005
India†	1313	101	42	2002
Korea†	1453	111	29	1997
Mexico*	1355	95	23	1997
Peru*	301	15	7	2012
Philippines†	494	29	7	1997
Thailand†	468	34	16	1997
Turkey	563	38	12	2002
Ukraine	115	8	1	2009
Total	8085	561	172	.

* Indicates countries in the Latin America subsample.

† Indicates countries in the Asia subsample.

One limitation of our data is that we observe quarterly prices but not the exact date on which the prices are measured, and we observe the first coupon payment date, but not future dates. These limitations introduce noise when we convert prices to yields. We assume that prices are observed after coupon payments are made for each quarter and that coupons are paid relative to the quarter in which the first coupon payment was made —i.e., if a bond had a semi-annual coupon and the first coupon was paid in the first quarter, we assume it will be paid in the first and third quarters going forward. All of our results are robust to excluding bonds that report either "Long first" or "Short first" for the first period coupon type (17.6% of our sample).

Using price data and bond characteristics, we construct a spread for each corporate bond relative to a risk-free security that accounts for the coupon structure of the bond and its maturity. We follow the methodology of Gilchrist and Zakrajšek (2012) to price a synthetic risk-free security with the same coupon structure and maturity as the corporate bond,

$$P_{it}^{f} = \sum_{s=1}^{S} C_i(s) D(t+s), \tag{A.1}$$

where P_{it}^{f} is the price of the risk-free security that corresponds to bond i in quarter t, $C_i(s)$ is the cash flow from the coupon and principal repayment in that quarter, and $D(t) = e^{-r_t t}$ is the discount function in period t. We implement this equation using the continuously compounded zero-coupon Treasury yields estimated by Gürkaynak, Sack and Wright (2007). Finally, we construct the spread, $S_{ijt} = y_{ijt} - y_{it}^{f}$, where y_{ijt} is the yield of corporate bond i issued by firm j in quarter t and y_{it}^{f} is the yield of the corresponding synthetic risk-free bond with the same cash flow structure.

We drop observations with spreads less than 5 basis points or more than 3,500 basis points (42 observations). Table A.3 provides descriptive statistics for the bonds in our full sample, and Table A.4 describes the Latin America subsample. Characteristics are relatively similar across the samples.

Distance to default We measure firms' time-varying default risk using the measure of distance to default proposed by Merton (1974), defined as $\text{dd}_{jt} = \frac{\log\left(\frac{V_{jt}}{D_{jt}}\right) + (\mu_{jt} - 0.5\sigma_{jt}^2)}{\sigma_{jt}}$, where V_{jt} is the value of firm j in quarter t, D_{jt} is the firm's debt, μ_{jt} is the firm's annual expected return, and σ_{jt} is the annual volatility of the firm's value. We measure debt, D_{jt}, as the sum of short-term debt (dlcq) and one-half of long-term debt (dlttq) from Compustat Global. We follow an interative procedure based on Gilchrist and Zakrajšek (2012) to impute the firm's value, V_{jt}. The procedure is as follows:

1. We set an initial value of the firm equal to the sum of debt and equity, $V = D + E$. We measure equity as the firm's stock price times the number of shares, using Global Compustat Security Daily.

2. We estimate the mean (μ) and variance (σ) of the return on the firm's value over a

Table A.3: Summary Statistics of Corporate Bond Characteristics

	Mean	SD	Min	p50	Max
Number of bonds per firm/quarter	2.31	2.27	1.00	2.00	23.00
Market value of issue (usd mil., 2000)	394	267	5	362	1779
Maturity at issue (years)	10.57	6.97	1.00	10.00	50.00
Term to maturity (years)	6.26	5.09	1.00	5.00	30.00
Duration (years)	5.03	3.10	0.97	4.48	20.36
Callable (pct.)	0.26	0.44			
Credit rating (Bloomberg)			CCC-	BBB-	AA
Coupon rate (pct.)	6.16	2.39	0.25	5.75	13.00
Nominal effective yield (pct.)	5.93	3.73	0.49	5.06	37.18
Credit spread (basis points)	385	357	5	282	3406

The table reports summary statistics for 561 bonds issued by 173 firms across 12 countries over 1997q2 to 2021q1. Callable includes bonds with a maturity type of "CALLABLE," "CALL/PUT," or "CALL/SINK." The Bloomberg composite credit rating is measured at time of data download and is only available for 184 bonds. The countries are Argentina, Brazil, Chile, Colombia, India, Korea, Mexico, Peru, Philippines, Thailand, Turkey, and Ukraine.

Table A.4: Summary Statistics of Corporate Bond Characteristics, Latin America

	Mean	SD	Min	p50	Max
Number of bonds per firm/quarter	2.31	2.27	1.00	2.00	23.00
Market value of issue (usd mil., 2000)	455	325	7	361	1779
Maturity at issue (years)	10.13	5.18	1.00	10.00	40.00
Term to maturity (years)	6.36	4.95	1.00	5.50	30.00
Duration (years)	5.07	2.96	0.97	4.72	19.85
Callable (pct.)	0.44	0.50			
Credit rating (Bloomberg)			CCC-	BB+	A-
Coupon rate (pct.)	7.02	2.21	1.48	6.75	12.75
Nominal effective yield (pct.)	6.79	3.70	0.81	5.96	36.83
Credit spread (basis points)	458	367	6	356	3406

The table reports summary statistics for 238 bonds issued by 64 firms across 6 countries over 1997q2 to 2021q1. Callable includes bonds with a maturity type of "CALLABLE," "CALL/PUT," or "CALL/SINK." The Bloomberg composite credit rating is measured at time of data download and is only available for 184 bonds. The countries are Argentina, Brazil, Chile, Colombia, Mexico, and Peru.

250-day moving window.

3. We estimate a new value of V using the Black-Scholes-Merton option-pricing framework $E = V\Phi(\delta_1) - e^{rT}D\Phi(\delta_2)$, where $\delta_1 \equiv \frac{\log(V/D)+(r+0.5\sigma^2)T}{\sigma^2\sqrt{T}}$ and $\delta_2 \equiv \delta_1 - \sigma\sqrt{T}$. Here, r

is the daily 1-year constant maturity Treasury yield and T is equal to 1 because the frequency is daily.

4. We repeat steps (a)-(c) until V converges.

Our methodology requires that firms have positive values for both debt and equity. To exclude extreme outliers, we trim distance to default at 1% and 99% of the global sample (-1.3 and 25.8).

Global Compustat We obtain quarterly data on firms' balance sheets from Global Compustat and construct variables using standard methodology in the literature, with some additional adjustments for currency. We only keep observations in which the reporting currency is either local currency or USD (99.8% of sample). For observations denominated in USD (8% of sample), we convert variables to local currency using average quarterly spot exchange rates. When considering changes in variables—e.g., sales growth or changes in the capital stock—we only compare observations reported in the same currency. For real variables, we deflate nominal variables with GDP deflators from each country.

Variable Definitions

1. *Investment:* We define investment as $\Delta \log(k_{jt+1})$, where k_{jt+1} is the stock of capital at firm j at the end of period t. We set the initial value k_{jt+1} to the level of gross plant, property, and equipment (ppegtq) in the first period in which this is available. We then compute the evolution of the capital stock using changes in net plant, property, and equipment (ppentq). This variable measures investment net of depreciation with more observations than ppegtq. We linearly interpolate ppentq if there is one missing observation between two non-missing. We only interpolate between observations reported in the same currency.

2. *Leverage:* We define leverage as the ratio of total debt (dlcq + dlttq) to total assets (atq).

3. *Real sales growth:* We define real sales growth as the percent change in sales (saleq), deflated by the local GDP deflator. We exclude observations if a firm changes reporting currency between consecutive quarters ($< 0.1\%$ of observations).

4. *Size:* We define size as the log of total real assets, converted to USD for comparability across countries. We deflate total assets by the price deflator for the US.

5. *Liquidity:* We define liquidity as the ratio of cash and short-term investments (cheq) to total assets.

6. *Cash flow:* We define operating cash flow as the ratio of operating income before depreciation (oibdp) minus interest (xint) minus taxes (txt) to lagged total assets.

7. *Sector:* We identify firms in tradeable and non-tradeable sectors using 2-digit NAICS codes. Tradeable industries are agriculture (11), mining (21), manufacturing (31-33), wholesale trade (42), retail trade (44-45), and transportation and warehousing (48-49). Non-tradeable industries are information (51), professional, scientific, and technical services (54), administrative services (56), education (61), health and social services (62), arts (71), hospitality (72), and other services (81). We exclude the construction industry (23) and a small number of firms with unclassified industries from our sector definitions.

Sample Construction We restrict our final sample to exclude extreme outliers. We make the following sample restrictions, in this order.

1. We only include firms with balance sheets reported in local currency or USD.

2. We drop firms in the financial (SIC 6000-6799 or NAICS 52-53) and utilities (SIC 4900-4999 or NAICS 22) industries.

3. We exclude firm-quarter observations with negative capital or assets.

4. We exclude firm-quarter observations for which acquisitions are larger than 5% of assets.

Table A.5: Summary Statistics

	Mean	SD	p10	Med	p90	N
Investment	-0.12	5.93	-4.74	-0.91	4.85	29,386
Real sales growth	1.33	21.59	-20.77	0.81	24.30	29,143
Tradeable sector	0.78	0.41	0.00	1.00	1.00	29,386
Book leverage	0.31	0.34	0.08	0.28	0.52	25,195
Distance to Default	6.57	5.11	1.08	5.38	13.78	17,455

Note: The table reports summary statistics for firm investment and default risk data. The sample includes Argentina, Brazil, Chile, Colombia, Mexico, and Peru over the time period 1997q2 to 2019q4. Investment is defined as the log change in capital stock multiplied by 100. Real sales growth is measured in percentage points. Size is log real total assets, measured in USD. Tradeable and nontradeable sectors are defined in Appendix A.2.

5. We exclude firm-quarter observations if net current assets as a share of total assets is higher than 10 or below -10.

6. We exclude firm-quarter observations if leverage is higher than 10 or negative.

7. We exclude firm-quarter observations with negative real sales or liquidity.

8. We trim investment at the 1st and 99th percentiles.

Table A.5 reports summary statistics for the Latin America Global Compustat sample. We have 29,030 observations across Argentina, Brazil, Chile, Colombia, Mexico, and Peru over the time period 1997q2 to 2019q4, with considerable variation in investment, sales growth, size, and financial position.

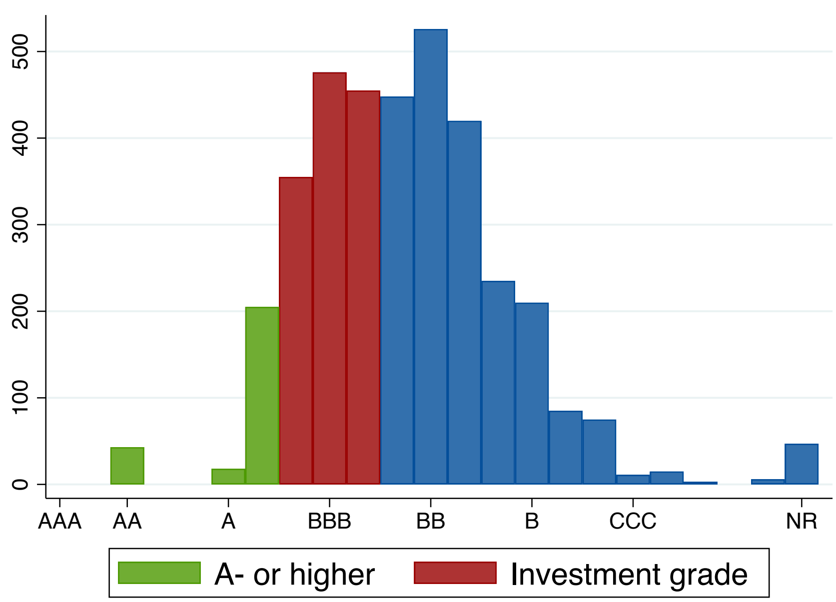
Credit Ratings We collect credit ratings from S&P and/or Moodys for the Latin American firms in our sample. We use crosswalks between Compustat ID (gvkey) and ticker symbols to find the firm on Bloomberg and extract long-term foreign issuer ratings and the date on which they took effect. We obtain historical ratings for 74% of firms in our bond sample, which cover 85% of bonds. We use a crosswalk from the BIS to locate the ratings on the same scale and construct an aggregate rating using the worse rating of the two when both are available. S&P and Moody's ratings coincide for 91% of observations and are within 2 steps for 80% of the remaining observations. Figure A.3 shows the distribution of ratings.

Table A.6: Summary Statistics by Country

	Observations	Firms	DD	Investment	Leverage	Tradable
Argentina	1,703	56	6.50	-3.15	0.25	0.76
Brazil	7,075	257	5.25	-0.19	0.33	0.81
Chile	2,985	103	8.47	0.22	0.29	0.73
Colombia	501	24	8.15	1.02	0.21	0.83
Mexico	3,443	105	8.04	0.26	0.28	0.67
Peru	1,748	64	5.43	0.65	0.24	0.86

Note: The table reports summary statistics for the sample of Latin American firms with non-missing distance to default (DD). The sample period is 1997q2 to 2019q4. DD, risk-free, leverage, tradeable, and non-tradeable are means by country. Risk-free indicates observations with distance to default above the 90th percentile. Leverage is book leverage.

Figure A.3: Distribution of Firms' Credit Ratings



Note: The figure reports the distribution of credit ratings from S&P and/or Moody's. When both ratings are available, the lower rating is used. y-axis reports the number of firm-by-quarter observations.

Table A.5 reports that 1% of firm-quarter observations in our sample are matched to ratings of A- or higher and 5% are matched to investment grade or better ratings.

ORBIS Our quantitative analysis of the model relies on data representative of both publicly traded and private firms. We use annual balance sheet data from ORBIS to cover a broad sample of firms from Argentina, Brazil, Chile, Colombia, Mexico, and Peru. We process the historical vintages of Orbis data using the guide provided by Kalemli-Özcan *et al.* (2024).

We define the following variables to use in the construction of moments.

- *Real capital:* We define capital stock (k_{jt}) as tangible fixed assets and deflate using the GDP deflator as described above.
- *Investment:* We define investment as ($k_{jt+1} - (1-\delta)k_{jt}$), assuming an annual depreciation rate of 11%.
- *Leverage:* We define leverage as the ratio of total debt (longtermdebt+loans+creditors) to total assets (totalassets).
- *Real sales growth:* We define real sales growth as the percent change in sales deflated by the GDP deflator.
- Size: We define size as the log of tangible fixed assets.
- *Liquidity:* We define liquidity as the ratio of net current assets (currentassets-currentliabilities) to total assets (totalassets).
- *Age:* We define firm age as the number of years since the incorporation date (dateofincorp).
- *Public/Private:* We define public and private firms based on firms' listed status (listeddelistedunlisted). We define public firms as listed firms and private firms as unlisted firms. Note that firms' listed status is a snapshot and will not vary over time, so we could theoretically miss firms that change status, though we think this issue is small in the short sample we focus on.
- *Equity issuance:* We proxy equity issuance as a percent change in shareholders' funds (shareholdersfunds) greater than 50%.

Table A.7: ORBIS sample description

	Argentina	Brazil	Chile	Colombia	Mexico	Peru
Number of firms	158	3,431	205	55,886	1,424	900
Number of public firms	52	181	101	35	90	83

The table reports the number of firms used in our Orbis sample and the composition of public firms.

We follow our sample restrictions for Compustat data as closely as possible when constructing our Orbis dataset. We make the following sample restrictions, in this order.

1. We drop delisted firms.

2. We drop firms in the financial (SIC 6000-6799 or NAICS 52-53) and utilities (SIC 4900-4999 or NAICS22) industries.

3. We exclude firm-year observations with negative capital or assets.

4. We exclude firm-year observations if net current assets as a share of total assets is higher than 10 or below -10.

5. We exclude firm-year observations if leverage is higher than 1 or negative.

6. We exclude firm-year observations with absolute value of real sales growth greater than 100%.

7. We exclude firm-year observations with negative sales or liquidity.

8. We calculate all cross-sectional moments in the year 2012, for which we have the best coverage across all six countries.

Table A.7 provides a summary of the size of our Orbis sample and the composition of private and public firms.

Aggregate data We collect quarterly real national accounts data for Argentina, Brazil, Chile, Colombia, Mexico, and Peru from the IMF's International Financial Statistics database or OECD's Main Economic Indicators, as available via FRED. For Argentina, Colombia, and

Table A.8: ORBIS summary statistics by country

(a) Targeted cross-sectional moments

	Target	Argentina	Brazil	Chile	Colombia	Mexico	Peru
Leverage	0.29	0.36	0.25	0.38	0.14	0.35	0.25
Investment/k (cs std)	0.25	0.26	0.26	0.15	0.28	0.29	0.25
Leverage(cs std)	0.22	0.21	0.25	0.23	0.22	0.23	0.20
Correlation size and age	0.28	0.22	0.19	0.20	0.35	0.36	0.34
Share firms issuing equity	0.14	0.14	0.06	0.12	0.17	0.18	0.15

(b) Untargeted cross-sectional moments

	Target	Argentina	Brazil	Chile	Colombia	Mexico	Peru
Ratio median age	2.99	1.77	1.50	1.92	3.80	1.64	1.43
Age median firm	10.00	21.00	27.00	16.00	10.00	15.00	14.00
Age median public firm	29.92	34.50	39.00	25.00	38.00	23.00	20.00
Share public firms, sales	0.13	0.61	0.58	0.62	0.13	0.46	0.14

The table reports summary statistics for the Orbis data by country relative to the aggregate moments used in the model calibration.

Peru, we supplement these with data directly from the Central Bank websites, which have older historical versions. For Argentina and Peru, we seasonally adjust the historical series. Then, we overlay the main data with the historical data.

A.3. Additional details about decomposing borrowing costs

Credit spreads and distance to default Table A.9 shows the results of the first-stage regression of corporate bond spreads on default risk and other bond characteristics, given by equation 1, for the full emerging market sample as well as the Latin America and Asia subsamples. The coefficient on distance to default is negative across all three samples, though the magnitude varies, with Asia exhibiting the largest sensitivity and Latin America the smallest.

We estimate three additional versions of the excess bond premium, in which we modify the model we use for the first stage to allow for the possibility that distance to default affects bond spreads nonlinearly or heterogeneously by country or firm rating. For the nonlinear

Table A.9: Credit Spreads and Distance to Default

	(1) EMEs	(2) Latin America	(3) Asia
Distance to default	-0.073***	-0.056***	-0.099***
	(0.011)	(0.012)	(0.012)
log(Duration)	-0.009	0.084	0.069**
	(0.038)	(0.063)	(0.035)
log(Amount issued)	-0.039	-0.019	-0.140***
	(0.043)	(0.054)	(0.052)
log(Coupon rate)	0.808***	1.037***	0.415***
	(0.095)	(0.132)	(0.093)
log(Age of issue)	-0.054**	-0.017	0.011
	(0.023)	(0.036)	(0.026)
Callable	0.334***	0.308***	0.211
	(0.056)	(0.064)	(0.141)
Observations	8085	3679	3728
R^2	0.488	0.556	0.510
Root MSE	0.527	0.463	0.511
Number of firms	172	65	94
Number of bonds	561	240	275

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Note: Sample period: 1997q2-2021q1. The table shows the estimated coefficients of Equation (1) for different samples of countries, as defined in Table A.2. The dependent variable is $\log S_{ijkt}$, the log of the corporate bond spread for bond i issued by firm j in country k and quarter t. The model includes fixed effects by sector, type of first coupon issued, and quarter interacted with coupon frequency and first coupon month. Standard errors are clustered by firm and quarter.

specification, we modify Equation 1 to include distance to default squared,

$$\log S_{ijkt} = \beta \text{dd}_{jkt} + \omega \text{dd}^2_{jkt} + \gamma' \boldsymbol{Z}_{it} + \epsilon_{ijkt}. \tag{A.2}$$

Next, we allow heterogeneous effects by firm credit ratings,

$$\log S_{ijkt} = \alpha_l + \beta_l \text{dd}_{jkt} + \gamma' \boldsymbol{Z}_{it} + \epsilon_{ijkt}, \tag{A.3}$$

Table A.10: Alternative first-stage specifications

	(1) Baseline	(2) Non-linear	(3) Rating heterogeneity
DD	-0.056***	-0.150***	-0.057***
	(0.012)	(0.023)	(0.013)
DD squared		0.006***	
		(0.001)	
Inv grade × DD			-0.004
			(0.021)
Any rating × DD			0.010
			(0.019)
Inv grade			-0.441***
			(0.150)
Any rating			-0.021
			(0.124)
N	3,679	3,679	3,679
R^2	0.556	0.593	0.601
Root MSE	0.463	0.443	0.439
Number of firms	65	65	65
Number of bonds	240	240	240

This table reports the results for estimating equations (A.2) and (A.3), which allow nonlinearity and heterogeneity by credit ratings in the first stage of our excess bond premium estimation. Standard errors in parentheses.

where l are indices for the following rating groups: no rating, rating below investment grade, and rating investment grade or higher. Finally, we allow heterogeneous effects by country, k,

$$\log S_{ijkt} = \alpha_k + \beta_k \text{dd}_{jkt} + \gamma' \boldsymbol{Z}_{it} + \epsilon_{ijkt}. \tag{A.4}$$

The results for equations (A.2) and (A.3) are reported in Table A.10. Allowing non-linearity and heterogeneity by credit ratings both improve the fit of the model similarly, increasing the R^2 from 0.56 to 0.59 or 0.60. For the ratings heterogeneity specification, the addition of ratings is more important than the interaction with distance to default.

Results for the country heterogeneity specification, given by equation A.4, are reported

Table A.11: Alternative first-stage specification: Heterogeneity by country

	(1) EMEs	(2) Latin America	(3) Asia	(4) Country Heterogeneity
Distance to default	-0.073***	-0.056***	-0.099***	
	(0.011)	(0.012)	(0.012)	
Argentina × Distance to default				-0.133***
				(0.016)
Brazil × Distance to default				-0.029**
				(0.012)
Chile × Distance to default				-0.056***
				(0.018)
Colombia × Distance to default				-0.055***
				(0.007)
India × Distance to default				-0.116***
				(0.020)
Korea × Distance to default				-0.083***
				(0.018)
Mexico × Distance to default				-0.053**
				(0.021)
Peru × Distance to default				-0.050*
				(0.026)
Philippines × Distance to default				-0.073**
				(0.035)
Thailand × Distance to default				-0.070***
				(0.020)
Turkey × Distance to default				-0.090***
				(0.020)
Ukraine × Distance to default				-0.115***
				(0.017)
Observations	8,085	3,679	3,728	8,085
R^2	0.488	0.556	0.510	0.717
Root MSE	0.527	0.463	0.511	0.404
Number of firms	172	65	94	172
Number of bonds	561	240	275	561

This table reports results for estimating Equation (A.4), which allows for heterogeneity by country in the first stage of our excess bond premium estimation, relative to our baseline estimates of Equation (1) by region. Standard errors in parentheses.

in Table A.11. Adding heterogeneous interaction terms and country fixed effects improves the fit of the model substantially, from an R^2 of 0.56 to 0.72. Coefficients on distance to default for the Latin American countries are relatively similar to the baseline, with a weaker pass-through for Brazil and a stronger pass-through for Argentina.

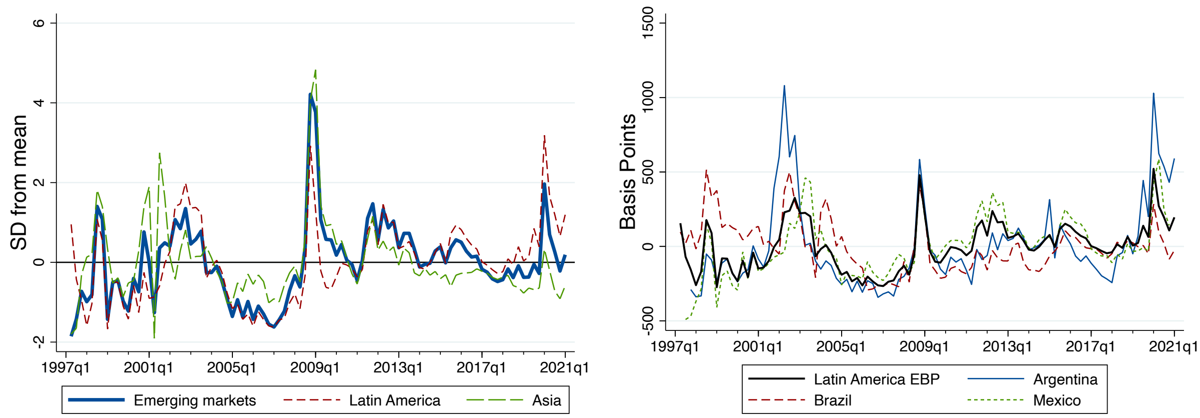
Table A.12: Global Risk Measure Correlations

	EM EBP	Latin America EBP	Asia EBP	U.S. EBP	Regional VIX
Emerging Market EBP	1.000	.	.	.	.
Latin America EBP	0.751	1.000	.	.	.
Asia EBP	0.744	0.184	1.000	.	.
U.S. EBP	0.671	0.319	0.736	1.000	.
Regional VIX	0.306	0.594	-0.151	0.531	1.000

Note: The table reports correlations between the excess bond premium (ρ_t) estimates from Equation 3 across subsamples of countres (as defined in Table A.2), as well as the U.S. Excess Bond Premium and the VIX.

Figure A.4: Excess Bond Premium: Regional Measures

(a) By region **(b)** By Country

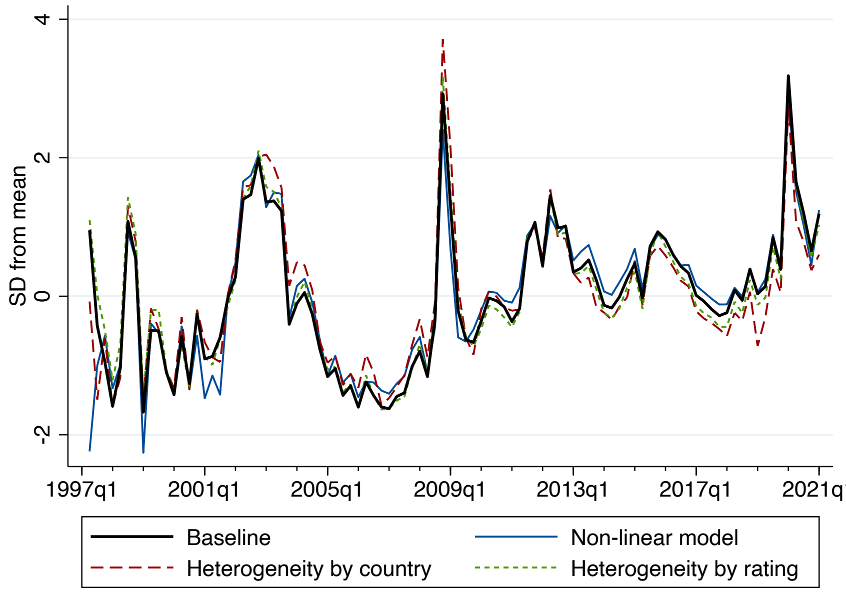


Note: Panel (a) shows excess bond premium estimates (ρ_t from Equation 3) for the regions defined in Table A.2. Panel (b) shows the estimates by country for the three largest countries in the Latin America sample.

Excess bond premium Figure A.4 Panel (a) shows our estimates of the systemic component excess bond premium using the full sample of emerging markets along with both regional subsamples. Table A.12 reports the correlations among the series. Panel (b) shows estimates by country for the three largest countries in our Latin America sample. Systemic excess bond premia by country are relatively similar to the aggregate, particularly for Mexico. Argentina experiences the most severe deviations from the aggregate.

Figure A.5 shows the estimates of the systemic excess bond premium with alternative first-stage relationships between corporate bond spreads and risk, given by equations A.2-A.4. Across the three specifications, second-stage results look remarkably similar to baseline.

Figure A.5: Alternative Excess Bond Premium Specifications



Note: The figure shows the baseline estimate of ρ_t for the Latin America sample and estimates obtained by replacing equation (1) with equations (A.2)-(A.4) to allow for nonlinearity, heterogeneity by country, and heterogeneity by rating in the relationship between distance to default and bond spreads.

Figure A.5 compares the excess bond premium estimates to other global risk measures. Table A.12 reports correlations.

A.4. Additional Results

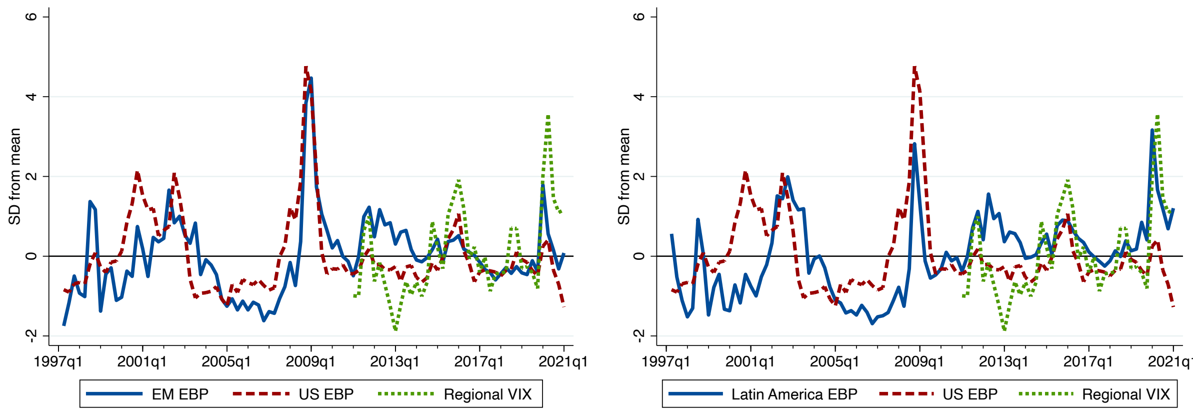
Other firm characteristics To ensure that we are not picking up differences in other firm characteristics and attributing them to firms' risk, we conduct multiple specifications in which we introduce interactions between firms' characteristics and excess bond premium ρ_t,

$$\Delta_h log(k_{jt}) = \alpha_{hj} + \beta_h^z \times \rho_t \times z_{jt-1} + \beta_h \times \rho_t \times dd_{jt-1} + \gamma_h \mathbb{I}_{j \notin \mathcal{R}_t^f} + \omega_h' Z_{jt-1} + \epsilon_{jth}, \quad \text{(A.5)}$$

where β_h is the coefficient of interest as before, but we add the interaction between variable z_{jt-1} and the excess bond premium. Results are reported in Figure A.7 for several choices of z_{jt-1}. Estimated coefficients β_h^R and β_h^F are remarkably similar with added controls for size,

Figure A.6: Excess Bond Premium and Global Risk Measures

(a) Emerging Market Sample **(b)** Latin America Sample



Note: The figure shows our measure of the excess bond premium (ρ_t) and compares it to the U.S. excess bond premium (US EBP) and the VIX. Units are standard deviations from the mean. Correlations are reported in Table A.12.

sales growth, and capital growth.

Alternative functional forms First, we assess the sensitivity of our results to the choice of controls for aggregate conditions and firm-level characteristics. To allow for the possibility that firms with lower default risk also have different patterns of sales growth, size, etc., we allow a version of the model that interacts distance to default with all of the control variables,

$$\Delta_h log(k_{jt+h}) = \alpha_{hj} + \alpha_{hst} + \beta_h \times \rho_t \times dd_{jt-1} + \gamma_h' X_t \times dd_{jt-1} + \omega_h' Z_{jt-1} + \omega_h^{dd} Z_{jt-1} \times dd_{jt-1} + \epsilon_{jth}, \tag{A.6}$$

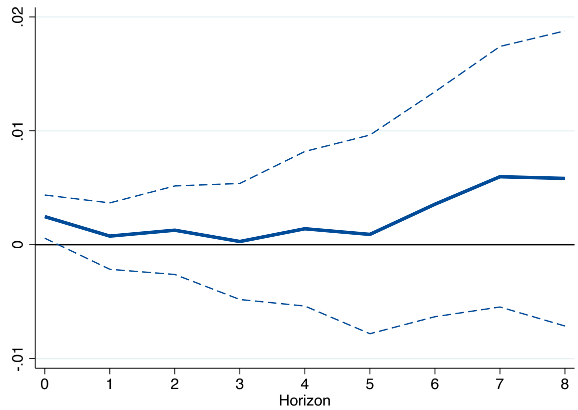
Results are shown in Figure A.8, and look very similar to the baseline.

Alternative risk definitions We replace distance to default in Equation 5 with alternative measures of firms' risk. We choose measures of low risk such that the sign lines up in theory with our baseline.

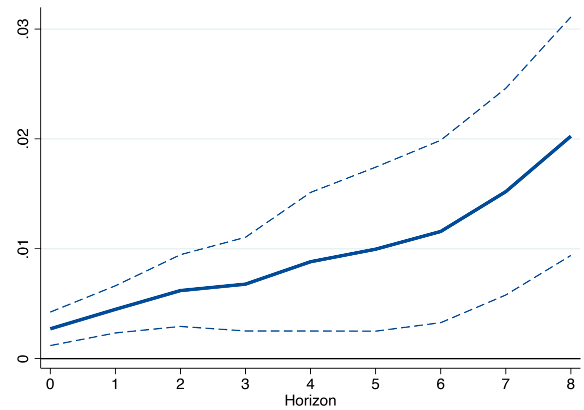
Figure A.9 Panel (a) shows that firms with high distance to default (above the 90th percentile) see larger cumulative changes in investment. Panel (b) shows that this pattern holds for a binary indicator for firms with investment grade or higher credit ratings (BBB-),

Figure A.7: Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium (EBP): Additional Interactions with Firm Characteristics

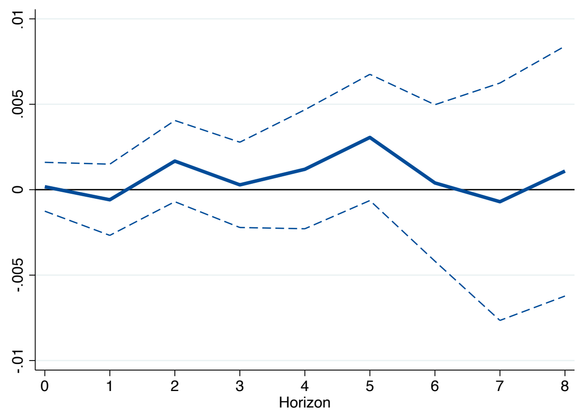
(a) Size (β_h^z)



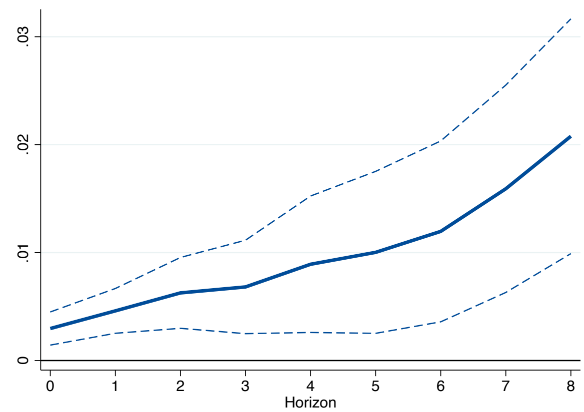
(b) Distance to default(β_h)



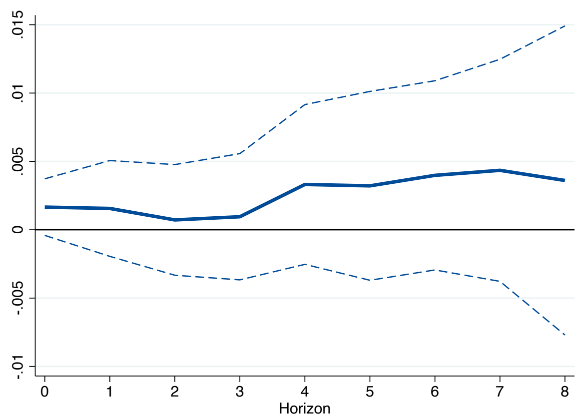
(c) Sales growth (β_h^z)



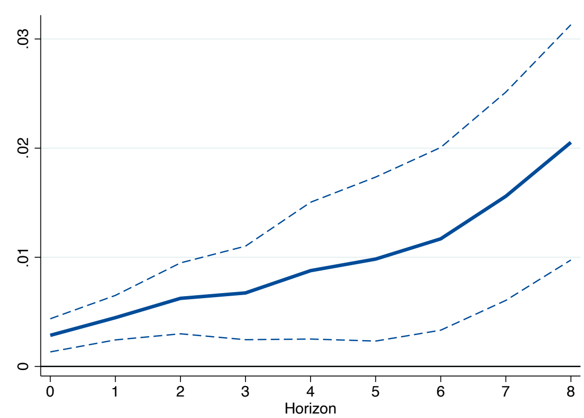
(d) Distance to default(β_h)



(e) Capital growth (β_h^z)



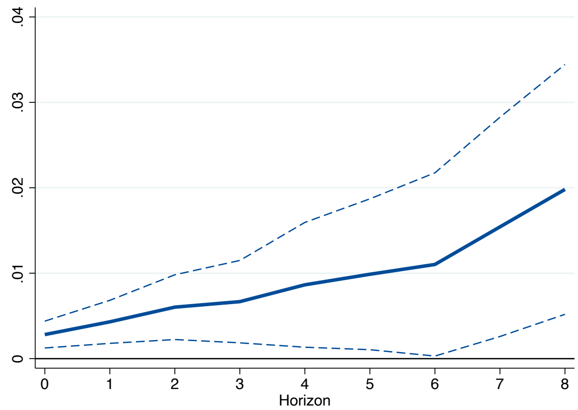
(f) Distance to default(β_h)



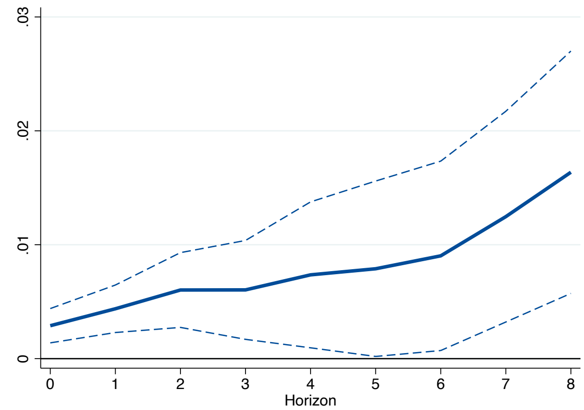
Note: The figure shows coefficient estimates from Equation (A.5). The left panel shows the coefficient β_h^z, from interacting the excess bond premium (ρ_t) with the variable labeled, and the middle and right panels report coefficients β_h^R and β_h^F, respectively. Coefficients in the left panel can be interpreted as the effect of a 1-standard-deviation higher level of each variable —i.e., size —on the cumulative log change in capital stock in response to the excess bond premium shock.

Figure A.8: Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium: Alternative Controls

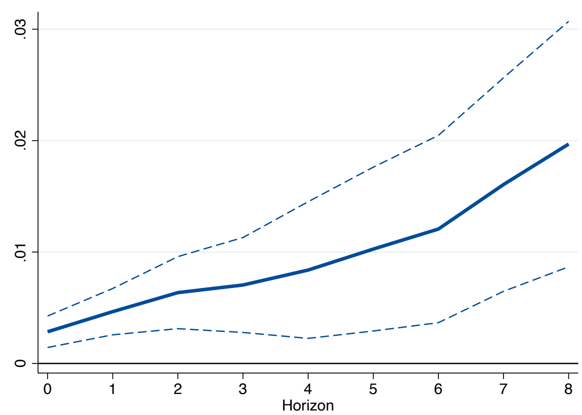
(a) Without aggregate controls



(b) Without firms' characteristics



(c) Interact firms' characteristics with risk

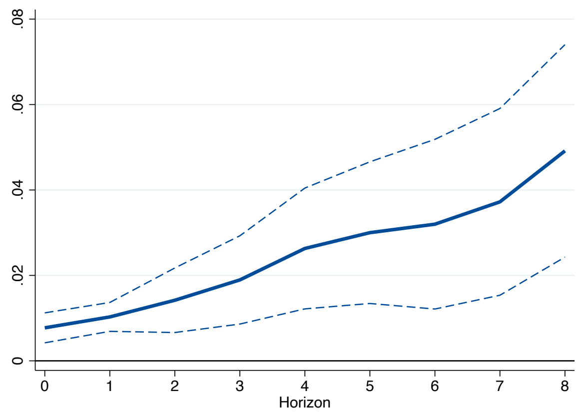


Note: The figure shows coefficient estimates from Equation (A.6) with aggregate controls, X_t, dropped, controls for firms' characteristics, Z_{jt}, dropped, and controls for firms' characteristics, Z_{jt}, fully interacted with risk.

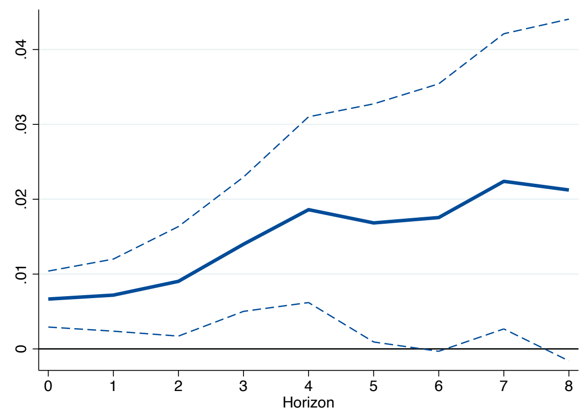
which constitutes 5% of firm-quarter observations in our sample. Lastly, we use a continuous measure of credit ratings, where each step is assigned an integer and we standardize the units such that a 1-standard-deviation increase in continuous credit rating is associated with a more favorable rating. We include observations for which we do not have ratings data with a dummy variable for whether we observe the rating or not. Consistent with the binary measures, Panel (c) shows that firms with higher credit ratings have greater cumulative investment.

Figure A.9: Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium: Alternative Measures of Firms' Risk

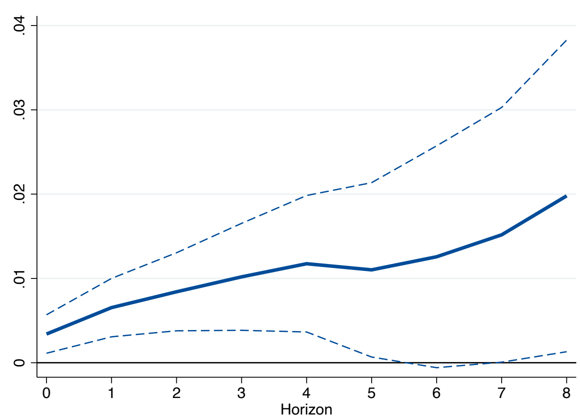
(a) High distance to default



(b) Investment-grade rating or higher



(c) Continuous credit rating

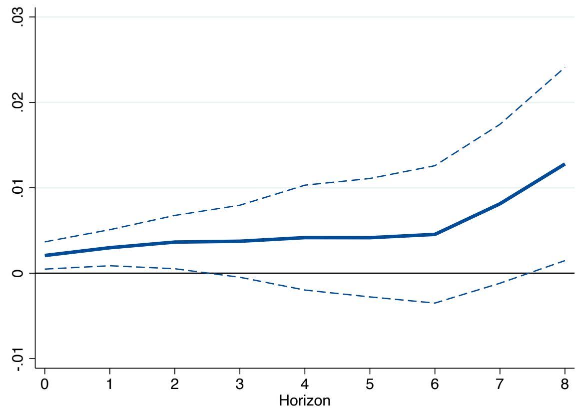


Note: The figure shows coefficient estimates from Equation (5) with alternative definitions of firm risk. Panel (a) uses a binary measure of distance to default. Panels (b)-(d) define risk based on credit ratings.

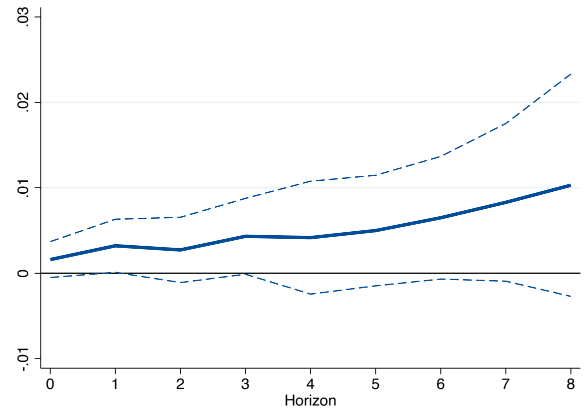
Alternative excess bond premium specifications We examine the sensitivity of our results for investment dynamics to the measure of the excess bond premium using alternative measures in Figure A.10. Panel (a) shows results using the excess bond premium estimated on the full set of emerging markets rather than just Latin America. Panel (b) shows results using the U.S. excess bond premium. Panel (c) shows results using the regional VIX measure for Brazil. Panels (d)-(e) show results using excess bond premium estimates from the above models that allow for heterogeneous effects of distance to default on spreads in the first stage of the excess bond premium estimation. Panel (d) allows for heterogeneity by country and Panel (e) heterogeneity by rating. Our results are similar across measures, which is unsurprising given the high correlation of the different estimates, which are plotted in Figure A.5.

Figure A.10: Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium (EBP): Alternative EBP Measures

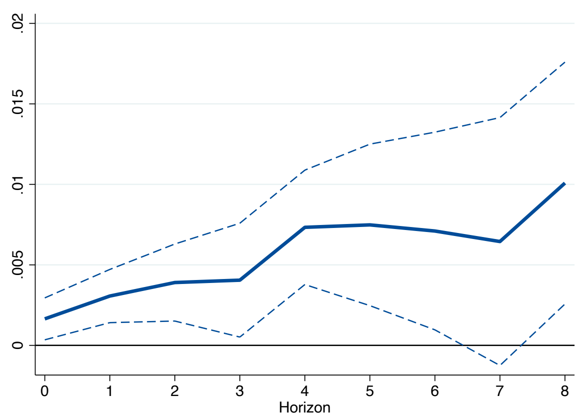
(a) EM EBP



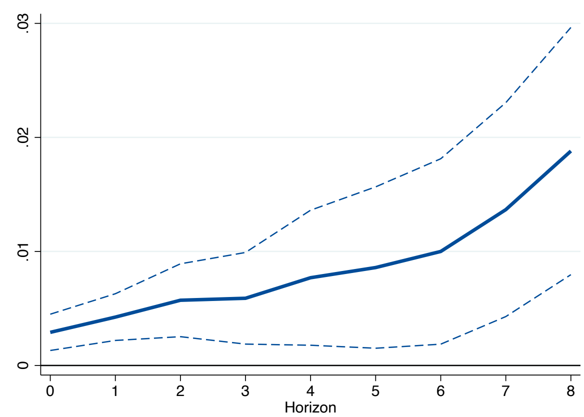
(b) U.S. EBP



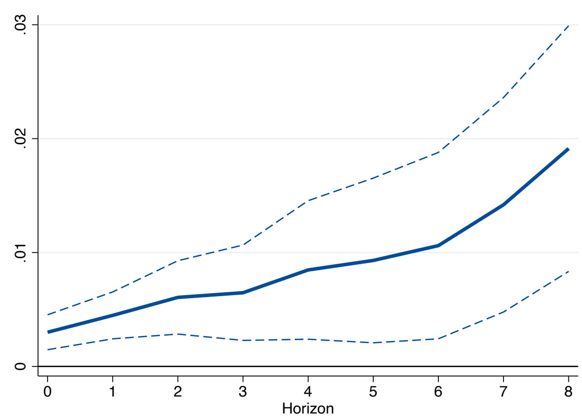
(c) Regional VIX



(d) EBP with Heterogeneity by Country



(e) EBP with Heterogeneity by Rating

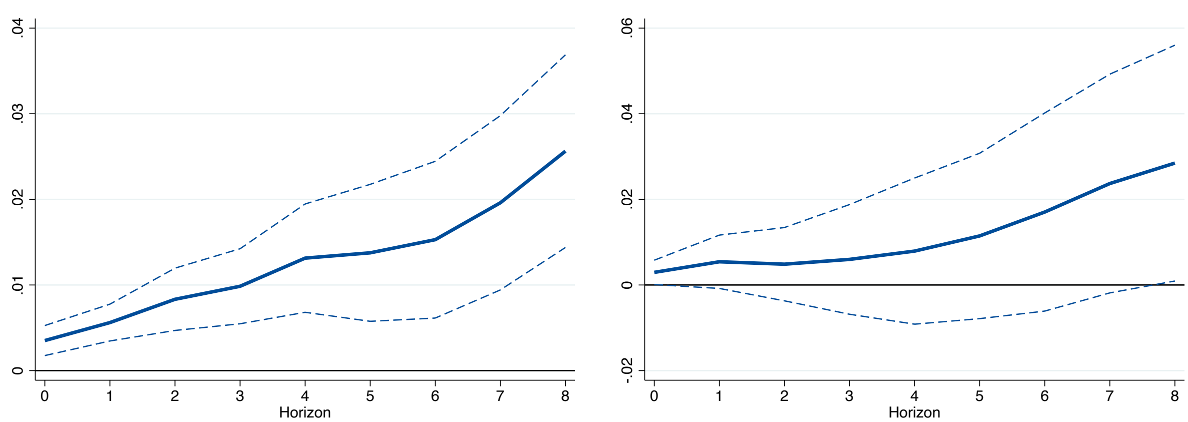


Note: The figure shows coefficient estimates from Equation (5) with alternative versions of the excess bond premium.

Subsamples Next, we show that our results are not highly sensitive to subsamples of industries or countries. Figure A.11 introduces interactions between risky and risk-free indicators with tradable and non-tradable sectors (defined in Appendix A.2). The results are noisier but show that the negative effects of the excess bond premium shock are concentrated among risky firms across both sectors. To address concerns about whether our results are driven by particular countries, we re-estimate Equation 5 on a subsample that drops one country at a time. Results are shown in Figure A.13. Negative results for risky firms are persistent across all subsamples. Results for risk-free firms are unsurprisingly much noisier but are generally positive, with the exception of the latter horizons when we drop Brazil, which accounts for 37% of our total sample. We do not estimate effects separately by country due to the low power of our sample size.

Figure A.11: Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium across Sectors

(a) Tradable **(b)** Non-tradable

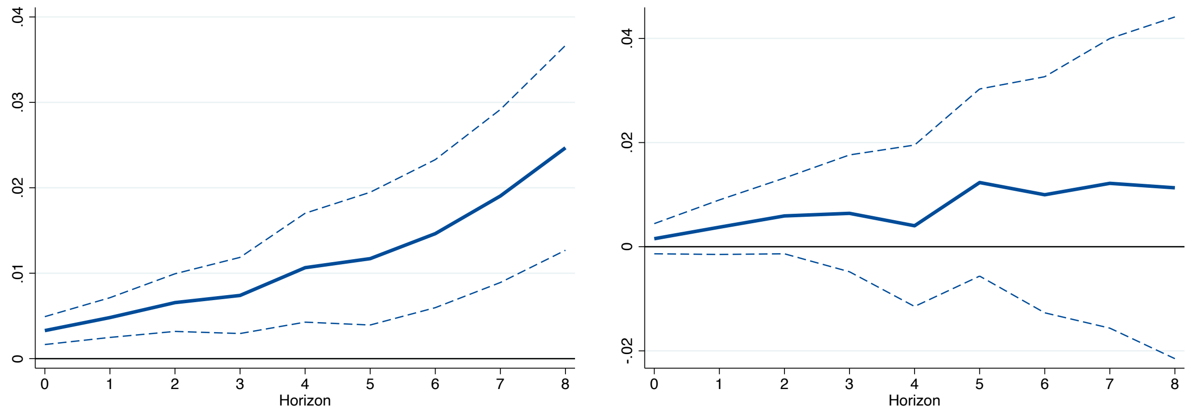


Note: The figure shows coefficient estimates from Equation (5) with additional interactions between tradeable and non-tradeable sectors.

Heterogeneity in external borrowing costs The heterogeneous investment dynamics across firms with different risk profiles are consistent with heterogeneity in borrowing cost dynamics. We show that spreads increase more for firms with low credit ratings following

Figure A.12: Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium across Exchange-Rate Regimes

(a) Floating Regime **(b)** Fixed Regime



Note: The figure shows coefficient estimates from Equation (5) with additional interactions for exchange rate regime.

increases in the excess bond premium. We use the following specification:

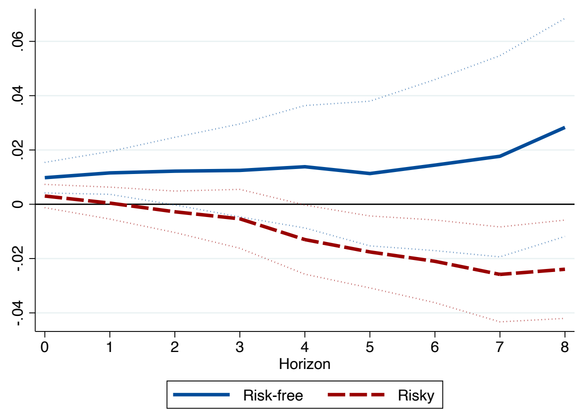
$$S_{ijt+h} = \alpha_{hi} + \beta_h^I \times \rho_t \times \mathbb{I}_{j \in \mathcal{R}_{t-1}^I} + \beta_h^N \times \rho_t \times \mathbb{I}_{j \notin \mathcal{R}_{t-1}^I} + \gamma_h \mathbb{I}_{j \in \mathcal{R}_{t-1}^I} + \omega_h' Z_{ijt-1} + \epsilon_{jth}, \quad \text{(A.7)}$$

where S_{ijt+h} is the spread of bond i issued by firm j at horizon $t+h$, α_{hi} are horizon-bond fixed effects, ρ_t is the excess bond premium estimated on the Latin America sample, R_{t-1}^I is the set of investment-grade firms in $t-1$, and Z_{ijt-1} is a vector of standard firm-level controls and the lagged bond spread.

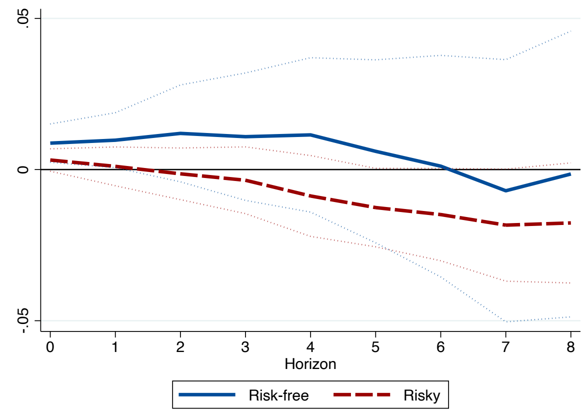
Figure **??** Panel (a) shows that firms with non-investment grade credit rating experience contractions in investment, consistent with our main results from Figure 3. Panel (b) shows that by the same definition, these firms also see bigger increases in spreads. Firms with an investment-grade or higher credit rating exhibit a 90-basis-point increase in spreads when the excess bond premium is 1 standard deviation higher. Meanwhile, firms with a credit rating below investment grade or not rated at all exhibit a 160-basis-point increase. This figure looks similar if we show the dynamics of bond-level excess bond premia instead of spreads. We interpret these results as suggestive evidence that the pass-through of global increases in borrowing costs is more severe for riskier firms both in terms of investment and

Figure A.13: Heterogeneous Investment Dynamics Following Changes in the Excess Bond Premium: Excluding Individual Countries

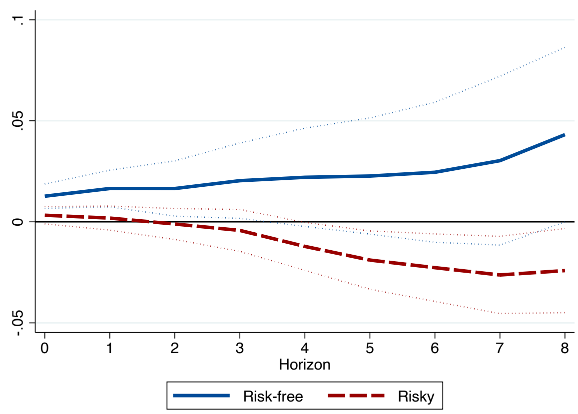
(a) ex. Argentina



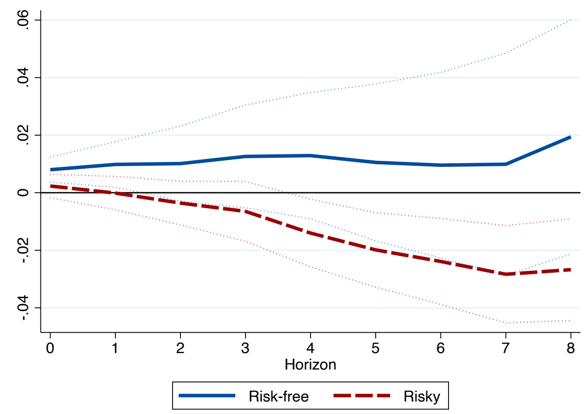
(b) ex. Brazil



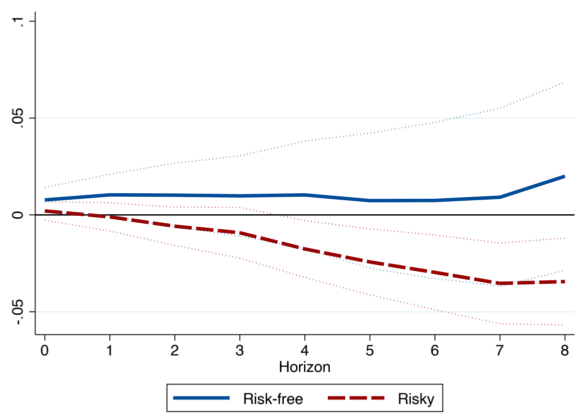
(c) ex. Chile



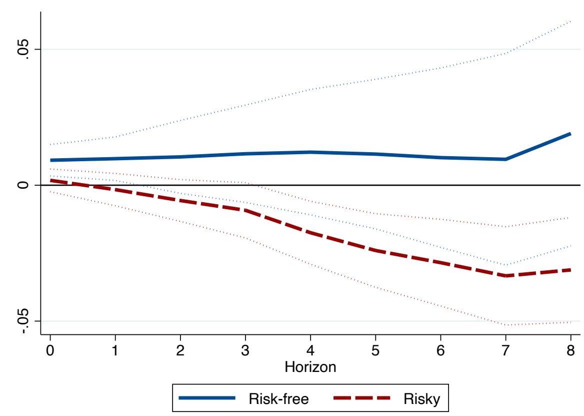
(d) ex. Colombia



(e) ex. Mexico



(f) ex. Peru



Note: The figure shows coefficient estimates from Equation (5), excluding one country at a time.

financing costs.

B. Model Appendix

B.1. Firms' Recursive Problem

A firm's state space can be written as the n-tuple $(k, b, z, \boldsymbol{S})$, where $\boldsymbol{S}$ denotes the aggregate state, which includes the firm distribution, Ω, and all the aggregate exogenous variables (i.e., the global productivity and price of risk). Conditional on repaying its debt, the equity value of a firm (in terms of the c good) solves the following Bellman equation:

$$V^r(k, b, z, \boldsymbol{S}) = \max_{k', b'} \; d + \mathbb{E}_{\left(z', \boldsymbol{S}', \epsilon'^d\right)|(z, \boldsymbol{S})} \left[\Lambda(\boldsymbol{S}, \boldsymbol{S'}) \; V\left(k', b', z', \boldsymbol{S}', \epsilon'^d\right)\right] \tag{B.1}$$

$$\text{s.t. } d(1 - \mathcal{C}(d)) = \pi(k, z, \boldsymbol{S}) - p_k(\boldsymbol{S}) I(k', k) + \varepsilon(\boldsymbol{S}) \Delta\mathcal{B}^\star(b', b, \boldsymbol{S})$$

$$\boldsymbol{S}' = \Upsilon(\boldsymbol{S}),$$

where $\Lambda(\boldsymbol{S}, \boldsymbol{S'})$ denotes households' stochastic discount factor, and $\Upsilon(\boldsymbol{S})$ denotes the conjectured law of motion for all of the aggregates and for the firm distribution, Ω.

At the beginning of each period, and after observing the realization of a default value, ϵ^d, the firm chooses whether to default or not. We interpret ϵ^d as an exogenous outside option, with $\epsilon^d \sim_{iid} N(0, \sigma^d)$. Given this outside option, the firm's value is $V\left(k, b, z, \boldsymbol{S}, \epsilon^d\right) = \max\left\{V^r(k, b, z, \boldsymbol{S}), \epsilon^d\right\}$, and the firm defaults whenever $V^r(k, b, z, \boldsymbol{S}) < \epsilon^d$. Before the outside option shock is realized, the firm valuation is $V(k, b, z, \boldsymbol{S}) = \mathbb{E}_{\epsilon^d}\left[V\left(k, b, z, \boldsymbol{S}, \epsilon^d\right)\right]$ and its default probability can be written as

$$h(k, b, z, \boldsymbol{S}) = \int_{V^r(k,b,z,\boldsymbol{S})}^{\infty} \mathrm{d}\Phi(\epsilon^d) = 1 - \Phi\left(V^r(k, b, z, \boldsymbol{S})\right), \tag{B.2}$$

where $\Phi(\epsilon^d)$ is the cumulative density function of a normal distribution with zero mean and standard deviation σ^d. In the case of a default, the firm liquidates all of its assets and permanently exits the economy (after production takes place). Firms that exit are replaced by an equal mass of new entrants. The initial stocks of capital, debt, and productivity for all entrants are drawn from a uniform distribution with supports $\{\underline{x}, \bar{x}\}$ for $x = \{k, b, z\}$.

Given a firm's current choice of k' and b', its debt price schedule is given by

$$q^{\star}(k', b', z, \boldsymbol{S}) = \mathbb{E}_{(z', \boldsymbol{S'})|(z, \boldsymbol{S})}\left[\Lambda_F^{\star}(\boldsymbol{S}, \boldsymbol{S}')\mathcal{R}_f(k', b', z', \boldsymbol{S}')\right], \tag{B.3}$$

where $\Lambda_F^{\star}(\boldsymbol{S}, \boldsymbol{S}')$ is the investors' stochastic discount factor; $\mathcal{R}_f(k', b', z', \boldsymbol{S}')$ is the next-period firm's repayment, which depends on the next-period default decision. That is,

$$\mathcal{R}_f(k', b', z', \boldsymbol{S}') \equiv [1 - h(k', b', z', \boldsymbol{S}')]\ \mathcal{R}_f^r(k', b', z', \boldsymbol{S}') + h(k', b', z', \boldsymbol{S}')\ \mathcal{R}_f^d(k', b', z', \boldsymbol{S}'), \tag{B.4}$$

where $\mathcal{R}_f^r(k', b', z', \boldsymbol{S}') \equiv (1-m)(\upsilon + q(k'', b'', z', \boldsymbol{S'})) + m$ denotes the next-period repayment if the firm does not default. This, in turn, depends on the next-period bond price, which is a function of next-period firm's choices $k'' \equiv k'(k', b', z', \boldsymbol{S}')$ and $b'' \equiv b'(k', b', z', \boldsymbol{S}')$. In the event of default, the lenders' recovery rate (in foreign currency units) is given by

$$\mathcal{R}_f^d(k, z, \boldsymbol{S}) = \lambda\, \frac{\pi(k, z, \boldsymbol{S}) + (1-\delta)\, k\, p_k(\boldsymbol{S})}{b}\, \frac{1}{\varepsilon(\boldsymbol{S})}, \tag{B.5}$$

where λ captures the share of resources recovered by the lender.

B.2. Definition of Equilibrium

***Definition* 1.** *Let $\boldsymbol{S} = (A, \kappa, \Omega)$ denote the aggregate state, where A is the global TFP component, κ is the market price of risk, and Ω is the distribution of firms across the idiosyncratic states (k, b, z). Let Ω^{ND} and Ω^{D} denote the distribution of non-defaulting and defaulting firms, respectively. Given a nominal exchange-rate policy, a recursive competitive equilibrium is a set of*

1. *Value functions for firms $\{V(k, b, z, \boldsymbol{S}), V^r(k, b, z, \boldsymbol{S})\}$,*
2. *Policy functions $\{k'(k, b, z, \boldsymbol{S}), b'(k, b, z, \boldsymbol{S}), h(k, b, z, \boldsymbol{S}), l^d(k, b, z, \boldsymbol{S}), l^s(\boldsymbol{S}), c(\boldsymbol{S})\}$,*
3. *A bond pricing kernel $q^{\star}(., \boldsymbol{S})$,*
4. *A real wage $w(\boldsymbol{S}) = W(\boldsymbol{S})/P(\boldsymbol{S})$ and a real exchange rate $\varepsilon(\boldsymbol{S}) = \xi(\boldsymbol{S})/P(\boldsymbol{S})$,*
5. *A conjectured law of motion for the aggregates $\Upsilon(\boldsymbol{S})$,*

such that:

i *Given prices and the perceived* $\Upsilon(\boldsymbol{S})$, $l^d(., \boldsymbol{S})$ *is given by Equation* (8)*; the policies* $\{k'(., \boldsymbol{S}), b'(., \boldsymbol{S}), h(., \boldsymbol{S})\}$ *solve the maximization problem in Equation* (B.1)*; and* $V(., \boldsymbol{S})$ *and* $V^r(., \boldsymbol{S})$ *are the associated value functions.*

ii *Given firms' optimal policies, the bond pricing kernel* $q^\star(., \boldsymbol{S})$ *satisfies Equation* (B.3)*.*

iii *Given prices and* $\Upsilon(\boldsymbol{S})$, $\{c(\boldsymbol{S})\, l^s(\boldsymbol{S})\}$ *solve the households' problem, as defined in Equations* (17)-(18)*.*

iv *The conjectured law of motion* $\Upsilon(\boldsymbol{S})$ *is consistent with agents' policies.*

v *The* H*-good market clears:*

$$Y(\boldsymbol{S}) = I(\boldsymbol{S}) + c_H(\boldsymbol{S}) + c_H^\star(\boldsymbol{S}),$$

where $Y(\boldsymbol{S})$ *denotes aggregate output, which is given by* $Y(\boldsymbol{S}) = \int y(., \boldsymbol{S})\, d\Omega(., \boldsymbol{S})$, *where* $y(., \boldsymbol{S})$ *is defined in Equation* (6)*.*[11] *The term* $I(\boldsymbol{S})$ *denotes aggregate investment:* $I(\boldsymbol{S}) = \int (I(., \boldsymbol{S}) + \mathcal{C}(d))\, d\Omega^{ND}(., \boldsymbol{S}) + \int \left(\bar{k} - (1-\delta)k\right) d\Omega^D(., \boldsymbol{S})$, *where* $I(., \boldsymbol{S})$ *is the investment function of non-defaulting firms, as defined in Equation* (7)*;* $\mathcal{C}(d) \equiv -\mathbb{I}_{\{d<0\}}\varphi \times d$ *captures equity issuance costs; and* $\bar{k} - (1-\delta)k$ *is the (net) investment of a new entrant that replaces a defaulting firm. Lastly,* $c_H(\boldsymbol{S})$ *and* $c_H^\star(\boldsymbol{S})$ *denote private domestic and foreign consumption of the* H*-good, as defined in Equations* (21) *and* (28)*, respectively.*

vi *The balance of payment (BOP) is satisfied:*

$$Y(\boldsymbol{S}) - I(\boldsymbol{S}) - P/P_H(\boldsymbol{S})\, c(\boldsymbol{S}) = (-)\xi/P_H(\boldsymbol{S}) \Big(\int \Delta\mathcal{B}^\star(., \boldsymbol{S})\ d\Omega^{ND} - \int \mathcal{R}_f^d(., \boldsymbol{S})\, b(.)\ d\Omega^D \Big),$$

where $\Delta\mathcal{B}^\star(., \boldsymbol{S})$ *denotes net debt payments to the rest of the world for non-defaulting firms, as defined in Equation* (10)*, and* $\int \mathcal{R}_f^d(., \boldsymbol{S})\, b(.)\ d\Omega^D$ *denotes the payments of defaulting firms, where* $\mathcal{R}_f^d(., \boldsymbol{S})$ *is defined in Equation* (B.5)*.*

vii *The condition* $l^d(\boldsymbol{S}) \leq l^s(\boldsymbol{S})$ *and the slackness condition of Equation* (24) *are both satisfied.*

[11] The timing assumption is such that firms that default at time t produce in that period and then they exit.

C. Quantitative Appendix

C.1. Model-implied Measure of Risk Premia

We describe here the process to construct the model-implied measure of risk premia. We first define the internal rate of return of a bond b as the rate $r(.)$ that satisfies

$$q\left(k', b', z, \boldsymbol{S}\right) = \frac{m + (1-m)\left(\upsilon + q\left(k', b', z, \boldsymbol{S}\right)\right)}{1 + r(k', b', z, \boldsymbol{S})}.$$

The spread of the bond with respect to the risk-free rate, r_f, is defined as $sp(k', b', z, \boldsymbol{S}) = \left(\frac{1+r(k',b',z,\boldsymbol{S})}{1+r_f}\right) - 1$. To compute the model-implied measure of the risk premium, we need to solve for debt prices under a hypothetical risk-neutral lender. Taking the firms' optimal default and debt policies as given, the risk-neutral pricing kernel would be given by

$$\tilde{q}\left(k', b', z, \boldsymbol{S}\right) = \mathbb{E}_{(z', \boldsymbol{S'})|(z, \boldsymbol{S})}\Bigg[\beta^{\star}\Bigg(\left[1 - h\left(k', b', z', \boldsymbol{S'}\right)\right] \times \mathcal{R}^r_f(k', b', z', \boldsymbol{S'}) + \\ + h\left(k', b', z', \boldsymbol{S'}\right) \times \mathcal{R}^d_f\left(k', z', \boldsymbol{S'}\right)\Bigg)\Bigg],$$

where $\mathcal{R}^r_f(k', b', z', \boldsymbol{S'}) \equiv (1-m)\left(\upsilon + \tilde{q}\left(k'', b'', z', \boldsymbol{S'}\right)\right) + m$, and the next-period policies h', k'', and b'' are obtained under the assumption that foreign lenders are risk averse. Let $\tilde{sp}(.)$ be the spread of the bond under risk-neutral pricing. Our model-implied measure of risk premium is given by

$$RP(k', b', z, \mathbf{S}) = sp(k', b', z, \boldsymbol{S}) - \tilde{sp}(k', b', z, \boldsymbol{S}). \tag{C.1}$$

C.2. Computational Algorithm

Our model features several state variables, including the firm distribution (an infinite dimensional object) and aggregate uncertainty, which renders it challenging to solve. The aggregate state of the problem can be written as $\boldsymbol{S} \equiv (A, \kappa, \Omega)$, where $\boldsymbol{s} = (A, \kappa)$ denotes the exogenous processes and Ω denotes the firms' distribution across the three idiosyncratic states (k, b, z).

To solve for the equilibrium of the model numerically, we follow a bounded rationality type of approach, as in Krusell and Smith (1998), and use as state variables a set of statistics that summarize the distribution of firms. Such a distribution is a relevant variable to solve firms' problem because of its implications for the economy's aggregates, prices, and real wages. First, let $\tilde{K}_t \equiv \int z_{i,t} \times (k_{it})^{\frac{\alpha\chi}{\varsigma}}$ denote the economy's production capacity. Notice that this is just a function of the economy's stock of capital, weighted by each firm's productivity. It is useful to include this variable as a state, since it allows us to pin down wages. Second, we use the economy's exports, $Z_t = \left(\frac{\xi_t}{P_{H,t}}\right)^{\eta} Y_F^{\star}$, as an auxiliary variable (i.e., a co-state). Although Z_t is not observed at the beginning of each period, we include Z_t as an auxiliary aggregate variable in the firms' problem and, in the simulation stage, we then solve for the value of Z_t such that the H-good market clears. Once we know $(\tilde{K}_t, Z_t)$, we can compute all of the prices of the economy. Combined with a conjectured law of motion for $(\tilde{K}_t, Z_t)$, we then have all the information needed to solve for firms' and households' problems.

Embedded inside $(\tilde{K}_t, Z_t)$, we have all of the relevant information describing the firms' distribution. Other firms' moments, such as average leverage or the cross-sectional standard deviation of capital, are only relevant to improve the forecast of $(\tilde{K}_{t+1}, Z_{t+1})$. However, to keep the solution tractable, we assume a forecasting rule independent of other moments of the firm distribution. Let $\tilde{\boldsymbol{S}} = \left(A, \kappa, \tilde{K}, Z\right)$ denote the (bounded) state space. We consider the following forecasting rule for $\tilde{K}'$:

$$\tilde{H}_K\left(\tilde{\boldsymbol{S}}\right) = e^{\Lambda_0 + \Lambda_1\left(\tilde{\boldsymbol{S}}\right)}. \tag{C.2}$$

As for $\tilde{Z}'$, we consider the following state-contingent forecasting rule:

$$\tilde{H}_Z\left(\tilde{\boldsymbol{S}}, A', \kappa', \tilde{K}'\right) = e^{\Theta_0 + \Theta_1\left(\tilde{\boldsymbol{S}}, A', \kappa', \tilde{K}'\right) + \Theta_2(Z)}. \tag{C.3}$$

The algorithm consists of three main steps. First, we guess the coefficients of the conjectured law of motions. Given these conjectures, we solve for firms' optimal choices following these sub-steps:

1. Guess the value function $V^r\left(k, b, z, \tilde{\boldsymbol{S}}\right)$ and the pricing kernel $q\left(k', b', z, \tilde{\boldsymbol{S}}\right)$ for each

point of the state space and for each possible choice of (k', b').

2. Taking the pricing kernel as given, solve the firms' problem and update the value function accordingly.

3. Using the optimal policies computed in the previous step, update the pricing function.

4. Iterate until convergence of both $V^r(.)$ and $q(.)$.

Since the firms' problem presents several non-convexities, we use a global optimization algorithm to solve for k' and b'. This step of the algorithm relies on the use of graphics processing units (GPUs) to speed computation. We approximate all functions using linear interpolation. The firm's idiosyncratic productivity (z) and the aggregate TFP processes (A) are discretized using Tauchen's method. Grids of evenly distributed points are constructed for all states. We use 20 points for k, 20 points for b, 9 points for z, 7 points for A, 2 points for κ, 5 points for $\tilde{K}$, and 5 points for Z.

The last step of the algorithm consists of simulating the economy in order to update the aggregate conjectures. The simulation follows Young's (2010) non-stochastic approach. By not relying on the simulation of individual firms, this approach avoids the sampling error associated with individual firm simulation. This is important in the context of the model, given that due to the firm's default cutoff, small sampling errors may lead to large swings in the aggregate default rate, and thus in Z and $\tilde{K}'$. In each step of the simulation, we use a simple bisection algorithm to solve for the value of Z such that the H-good market clears. We simulate the economy for T periods and use the simulated objects to update the coefficients of the aggregate conjectures $\tilde{H}_{\tilde{K}}$ and $\tilde{H}_Z$. We iterate on this algorithm until convergence of these coefficients.

C.3. Calibration Data

Cross-sectional moments. Our calibration strategy relies on data representative of both publicly traded and private firms. We use annual balance-sheet data from ORBIS to cover a broad sample of firms from Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The data are described in Appendix A.2. We construct the cross-sectional moment targets using the average of the country-specific moments. Table A.8 reports the disaggregated moments by country. For the age of the median firm and the share of public firms in sales, we target the moments from Colombia rather than the averages, since the representation of private firms is best there. Because we do not observe employment in ORBIS, we calculate the share of public firms in terms of sales.

The moments for the risk profile for Compustat firms reported in Table 3a are calculated using the pooled sample across countries and time of the spreads from our corporate bond dataset described in Appendix A.2.

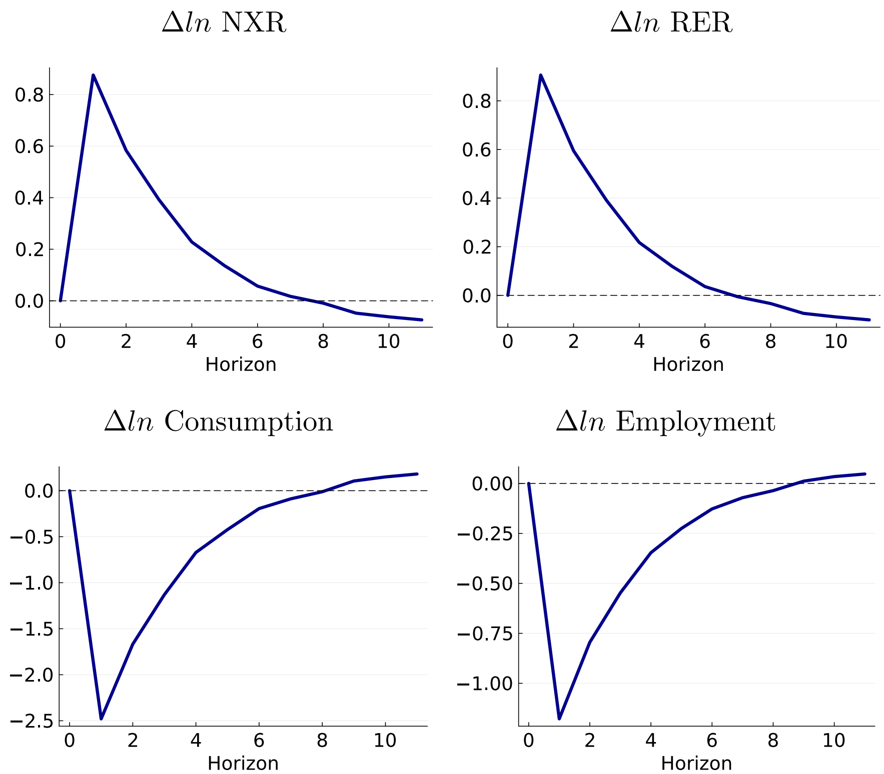
Aggregate moments. We calculate standard deviations and correlations separately by country and then take the average across countries to generate the moments presented in Table 3. We compute the change in risk premia as the average first difference in the Latin America excess bond premium described in Appendix A.2, expressed in percentage points.

C.4. Additional Figures

Figure C.1 shows the responses of the exchange rate, consumption, and employment to a one-standard-deviation shock to the market price of risk. Figure C.2, in turn, compares our model-implied dynamics of investment, GDP, and the real exchange rate during the Lehman Episode in 2008. To this end, we construct an impulse response to a four-standard-deviation risk-premia shock, which is in line with the increase in EBP that we document in Figure 2.[12]

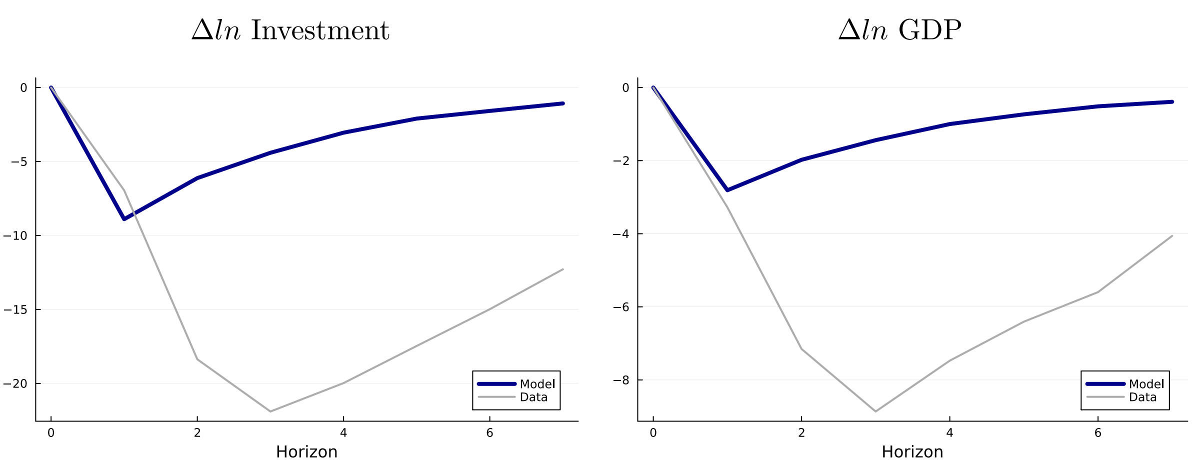
[12] In our quantitative analysis, we discipline the $\kappa = \{\kappa_L, \kappa_H\}$ process to match a one-standard-deviation increase in risk premia. To construct this figure, we linearly extrapolate the dynamics to a four-standard-deviation shock.

Figure C.1: Aggregate Responses to Global Price of Risk Increases: Additional Variables



Note: Impulse responses to an increase in the global price of risk ($\Delta\kappa > 0$). The panels show the dynamics for the nominal exchange rate (NXR), the real exchange rate (RER), consumption, and employment.

Figure C.2: Aggregate Responses during the Lehman Episode



Note: The figure compares the model-implied dynamics with those of the data around the collapse of Lehman in 2008.Q3.

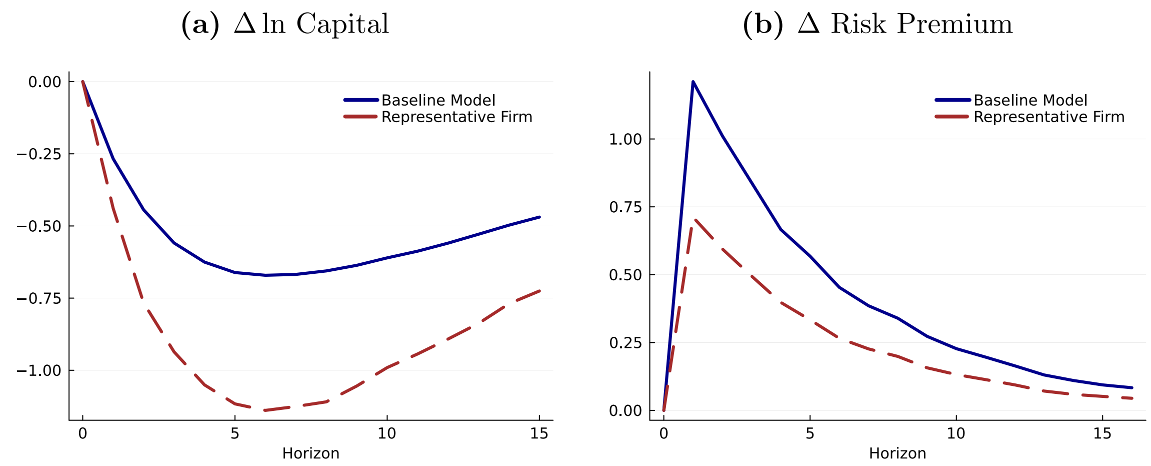
C.5. The Role of Firm Heterogeneity

In this appendix, we analyze the aggregate implications of firm heterogeneity for the tranmission of changes in the global price of risk. We provide a partial-equilibrium counterfactual in which we compare our model-implied aggregate dynamics to those of an economy in which all firms are identical. That is, we consider an economy in which all prices are fixed, we shock such an economy with a risk-premium shock, and we compare the outcomes of our baseline model with those of a representative-firm economy (i.e., an economy in which all firms are identical in terms of $\{k, b, z\}$). In this counterfactual, the only source of (ex-post) heterogeneity is the realization of the exit shock ϵ^d, which is i.i.d. In both cases, the model calibration is the same as that in Table 2a and Table 2b in the main text.

The advantage of focusing on a partial-equilibrium setting is that we can better isolate the direct effect of a risk-premium shock absent any price adjustment. This is important because those general-equilibrium adjustments may differ substantially in a representative-firm economy, making it difficult to assess the importance of firm heterogeneity in the transmission of a global risk-premium shock.

Figure C.3 presents the results. It shows that the aggregate contraction in capital is almost 40% *smaller* in our baseline model with heterogeneous firms, even though the increase in risk premia is 50% *higher* in that model. This simple exercise illustrates the importance of accounting for firm heterogeneity in the transmission of changes in global financial conditions and the difficulty of extrapolating firm-level responses to the aggregate economy.

Figure C.3: Aggregate Implications of Firm Heterogeneity: Responses to Global Price of Risk Increase



Note: Impulse responses to a risk-premium shock ($\Delta\kappa > 0$). The blue lines show the dynamics for aggregate capital and risk premia for our baseline model with firm heterogeneity. The red lines show the dynamics for an economy with a representative firm. The x-axes show the horizon h.

C.6. Local Currency Debt

Our baseline model assumes that firms' debt is denominated in foreign currency. In this appendix, we consider the opposite case in which firms' debt is denominated in local currency. We start by rewriting our baseline pricing function—Equation (B.3) in the main text. Since firms' repayments $\mathcal{R}_f(.)$ are now denominated in local currency, the bond price function becomes:

$$q\left(k', b', z, \boldsymbol{S}\right) = \mathbb{E}_{(z', \boldsymbol{S}')|(z, \boldsymbol{S})}\left[\Lambda_F^\star(\boldsymbol{S}, \boldsymbol{S}') \frac{\xi\left(\boldsymbol{S}\right)}{\xi\left(\boldsymbol{S}'\right)} \mathcal{R}_f\left(k', b', z', \boldsymbol{S}'\right)\right]. \tag{C.4}$$

When debt is denominated in local currency, firms' dividends are given by:

$$d(1 - \mathcal{C}(d)) = (1 - \tau)\, \pi(k, z, \boldsymbol{S}) - I\left(k', k\right) + \frac{1}{P} \Delta\mathcal{B}^\star(b', b, \boldsymbol{S}), \tag{C.5}$$

where $\Delta\mathcal{B}^\star\left(b', b, \boldsymbol{S}\right)$ is defined analogously to the expression in the main text—Equation (10). That is, $\Delta\mathcal{B}^\star\left(b', b, \boldsymbol{S}\right) = q(.)\left[b' - (1 - m)b\right] - \left[(1 - m)\upsilon + m\right] b - \Psi_b\left(b', b\right)$.

As in the main text, it is useful to write the previous pricing equation using a first-order approximation:

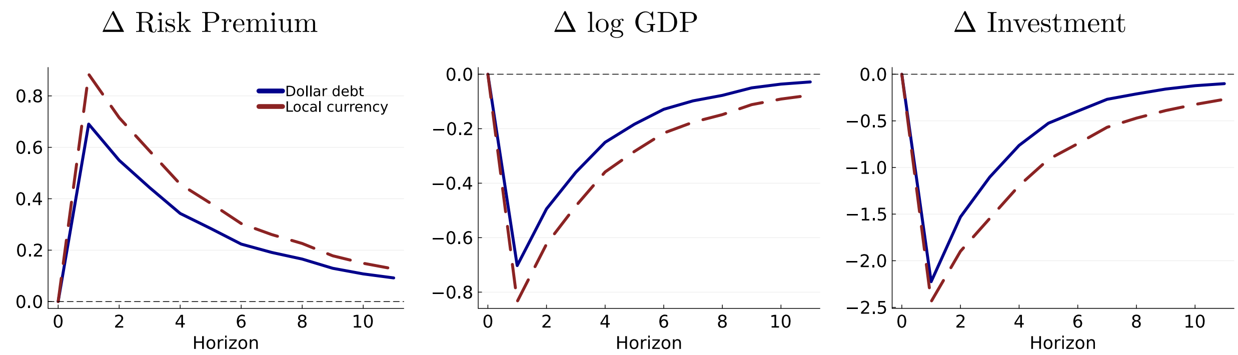
$$q\left(k', b', z, \boldsymbol{S}\right) \approx \beta^{\star}\, \mathbb{E}_{(z', \boldsymbol{S'})|(z, \boldsymbol{S})} \left[\frac{\xi}{\xi'}\, \mathcal{R}_f\left(k', b', z', \boldsymbol{S}'\right)\right] - \beta^{\star}\, \kappa\, \mathbb{C}ov_{(z', \boldsymbol{S'})|(z, \boldsymbol{S})} \left[\epsilon'_A, \frac{\xi}{\xi'}\, \mathcal{R}_f\left(k', b', z', \boldsymbol{S}'\right)\right]. \tag{C.6}$$

A firm's exposure to the global financial cycle—i.e., $\mathbb{C}ov_{(z', \boldsymbol{S'})|(z, \boldsymbol{S})} \left[\epsilon'_A, \frac{\xi}{\xi'}\, \mathcal{R}_f\left(k', b', z', \boldsymbol{S}'\right)\right]$—depends on the covariance between innovations to global TFP and the depreciation of the domestic currency. If next period the economy is hit with a low realization of ϵ'_A, the next-period real exchange rate will tend to depreciate to lower real wages and dampen the increase in unemployment. These forces imply a positive correlation between ϵ'_A and $\frac{\xi_t}{\xi_{t+1}}$ that amplifies a firm's exposure to changes in the global price of risk. In other words, whenever $\kappa > 0$, global investors will require a currency risk premium for holding bonds denominated in the H-economy currency.

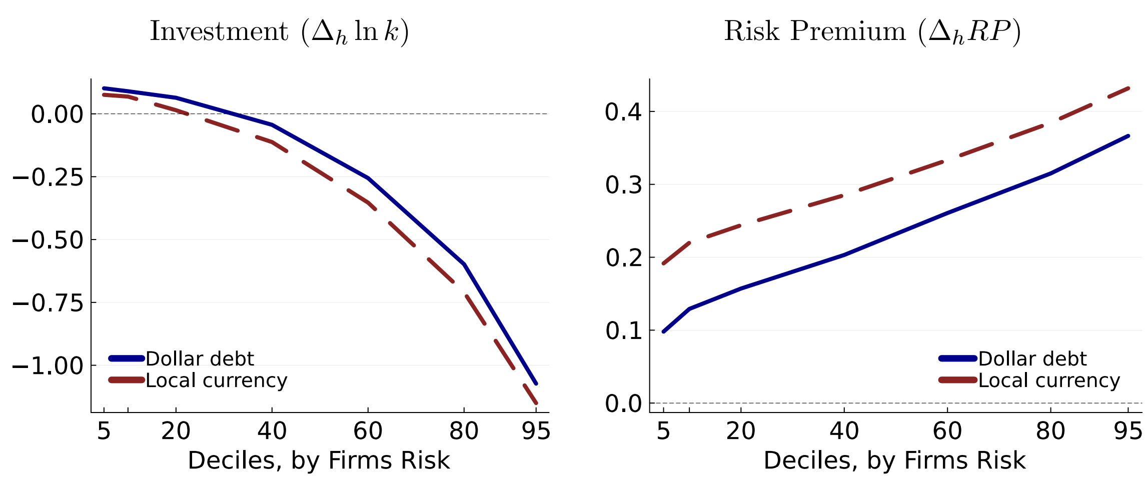
Figure C.4 shows the impulse response to an increase in the price of risk for our baseline economy with dollar-denominated debt and for an alternative economy in which firms' debt is entirely in local currency. In both cases, we let the government follow a dirty exchange-rate regime—as explained in the main text. While the increase in the price of risk is the same, we observe a larger increase in risk premia with local-currency debt, given the currency risk faced by investors. The larger increase in risk premia leads to a relatively larger drop in output and investment. In terms of heterogeneous effects, we find similar responses under local-currency debt relative to those in our baseline specification.

Figure C.4: Responses to Global Price of Risk Increases: The Role of Foreign-Currency Debt

(a) Aggregate Responses



(b) Heterogeneous Responses by Firm Risk



Note: Panel (a) shows impulse responses to a risk-premium shock ($\Delta\kappa > 0$). The panels report the dynamics of the aggregate risk premium, GDP, and investment. Panel (b) shows impulse responses by firm risk. Firms are sorted into deciles based on their pre-shock default probability. The left panel shows the change in firms' capital and the right panel the change in risk premium. Solid blue lines show the responses when firms' debt is denominated in foreign currency ("dollar debt," baseline model). Dashed red lines show the responses when debt is denominated in local currency.

C.7. Debt Held by Domestic Banks

Our baseline model assumes that firms borrow from a risk-averse global investor. In this section, we relax that assumption and allow firms to borrow from a domestic bank. This domestic bank, in turn, has local and foreign liabilities in the form of deposits and bonds issued in international markets.

For the case in which firms' debt is denominated in local currency, the domestic bank balance sheet identity can be written as:

$$\int_i q^B_{i,t} B_{i,t+1} = q^D_t D_{t+1} + \xi_t q^F_t F^\star_{t+1}, \tag{C.7}$$

where $\int_i q^B_{i,t} B_{i,t+1}$ denotes the bank's loans to the domestic firms; $q^D_t D_{t+1}$ is the market value of the bank's deposits; and $q^F_t F^\star_{t+1}$ captures dollar-denominated bond issuances in international markets.[13]

We let ω_t denote the bank's share of external liabilities relative to total liabilities:

$$\omega_t \equiv \frac{\xi_t q^F_t F^\star_{t+1}}{q^D_t D_{t+1} + q^F_t F^\star_{t+1}}. \tag{C.8}$$

From the bank's balance sheet, we get that $\omega_t = \frac{\xi_t q^F_t F^\star_{t+1}}{\int_i q^B_{i,t} B_{i,t+1}}$. Solving for D_{t+1},

$$D_{t+1} = \frac{1}{q^D_t} (1 - \omega_t) \int_i q^B_{i,t} B_{i,t+1}. \tag{C.9}$$

Using this expression, we can write the bank's profits (in local currency) as follows:

$$\Pi^B_t = \int_i \mathcal{R}^f_{i,t} B_{i,t} - D_t - \xi_t F^\star_t, \tag{C.10}$$

where $\mathcal{R}^f_{i,t}$ denotes the loan repayment of firm i (as defined in Equation B.4).

To keep the model tractable, we abstract from modeling the bank's investment and funding decisions explicitly. Instead, we assume that banks have some pre-existing financial position (as in De Leo, Gopinath and Kalemli-Özcan, 2024). In particular, we treat ω_t as an exogenous process that determines the share of the stock of firms' debt that is indirectly financed by global investors.

In addition, we assume that the marginal investor behind the local bank is the global investor. This implies that the stochastic discount factor of the bank follows the same process as the one in Equation (16), $\Lambda^\star_{F,(t,t+1)} = \beta^\star \times \exp\left(-\kappa_t \, \epsilon^A_{t+1} - \frac{1}{2}\kappa^2_t \, \sigma^2_A\right)$. We adopt this assumption for tractability. In a model in which banks are local and engaged in risky

[13] We use uppercase $B_{i,t}$ to denote banks' demand for firms debt. The lowercase $b_{i,t}$ denotes firms' supply of debt.

lending, changes in firms' riskiness affect banks' own SDF and the credit supply (see for instance Bocola, 2016). This type of mechanism can lead to a doom-loop in which an aggregate shock is amplified by further contractions in credit supply (as in Moretti, 2021). Since we abstract from these mechanisms, we view the magnitudes of our quantitative results as a lower bound.

With banks that are partially owned by the domestic households, their budget constraint is given by

$$P_t c_t + q_t^D D_{t+1} = W_t l_t + P_t d_t + P_t t_t + D_t + (1-\hat{\omega}_t)\Pi_t^B, \tag{C.11}$$

where $q_t^D D_{t+1}$ denotes households' new deposits, D_t are deposits that mature today, and $(1-\hat{\omega}_t)\Pi_t^B$ captures the bank's profits that are transferred to the household. Notice that we allow for $\hat{\omega}_t \in [0,1]$ to capture the fact that a share of the bank may be owned by the global investor.

From Equations (C.8)-(C.9), we get that foreign funding is $F_t^\star = \frac{1}{\xi_{t-1} q_{t-1}^F} \omega_{t-1} \int_i q_{i,t-1}^B B_{i,t}$ and deposits are $D_t = \frac{1}{q_{t-1}^D}(1-\omega_{t-1})\int_i q_{i,t-1}^B B_{i,t}$. Replacing these expressions in banks' profits and using the fact that $q_t^D D_{t+1} = (1-\omega_t)\int_i q_{i,t}^B B_{i,t+1}$, we can rewrite the budget constraint as:

$$\begin{aligned} P_t\, c_t + \left[(1-\omega_t)\int_i q_{i,t}^B B_{i,t+1}\right] &= W_t\, l_t + P_t d_t + P_t t_t + \\ + \Bigg((1-\hat{\omega}_t)\int_i \mathcal{R}_{i,t}^f B_{i,t} - (1-\hat{\omega}_t)\xi_t \frac{\omega_{t-1}\int_i q_{i,t-1}^B B_{i,t}}{\xi_{t-1} q_{t-1}^F} &+ \hat{\omega}_t \frac{1}{q_{t-1}^D}(1-\omega_{t-1})\int_i q_{i,t-1}^B B_{i,t}\Bigg). \end{aligned}$$

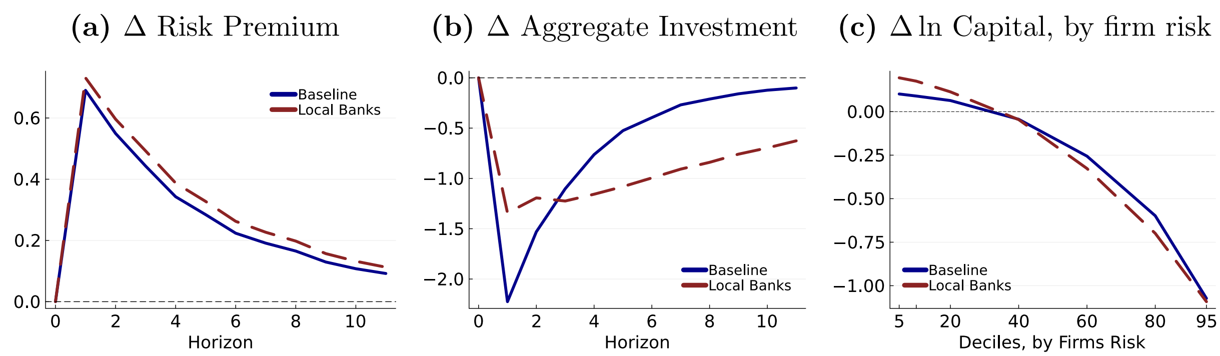
Under $\omega_t = \hat{\omega}_t \to 1$, households' budget constraint simplifies to $P_t\, c_t = W_t\, l_t + P_t d_t + P_t d_t$. This case thus captures our baseline specification in which banks are foreign-owned and all the credit to the domestic firms are provided by global investors. In the opposite case with $\omega_t = \hat{\omega}_t \to 0$ (i.e., under financial autarky), the budget constraint simplifies to:

$$P_t\, c_t = W_t\, l_t + P_t d_t + P_t t_t + \left(\int_i \mathcal{R}_{i,t}^f B_{i,t} - \int_i q_{i,t}^B B_{i,t+1}\right). \tag{C.12}$$

Relative to our baseline specification (Equation 20), adding local credit and banks that are fully owned by households thus introduces an additional term in the households' budget constraint, $\int_i \mathcal{R}^f_{i,t} B_{i,t} - \int_i q^B_{i,t} B_{i,t+1}$. For a constant aggregate loan demand ($B_{i,t+1} = B_{i,t}$ for every firm i), this term can be viewed as capturing the consolidated net gains (or losses) of the domestic banking sector. In the more general case in which $B_{i,t+1} \neq B_{i,t}$, it also captures changes in consumers' aggregate savings needed to finance the higher (lower) demand for credit.

In Figure C.5, we analyze the effects of a shock to the price of risk in a scenario in which banks are fully owned by the domestic households and banks.

Figure C.5: Aggregate Responses to Global Price of Risk Increases: Debt Held by Domestic Banks



Note: Impulse responses to a risk-premium shock ($\Delta\kappa > 0$). The first two panels compare the dynamics for aggregate risk premium and investment. The last panel shows heterogeneous responses of investment across firms with varying levels of default risk. Blue (red) lines show the dynamics in our baseline model (dirty exchange rate regime and foreign-currency debt held by global investors). The red dotted lines show the results for a counterfactual in which debt is denominated in local currency and held entirely by domestic banks.

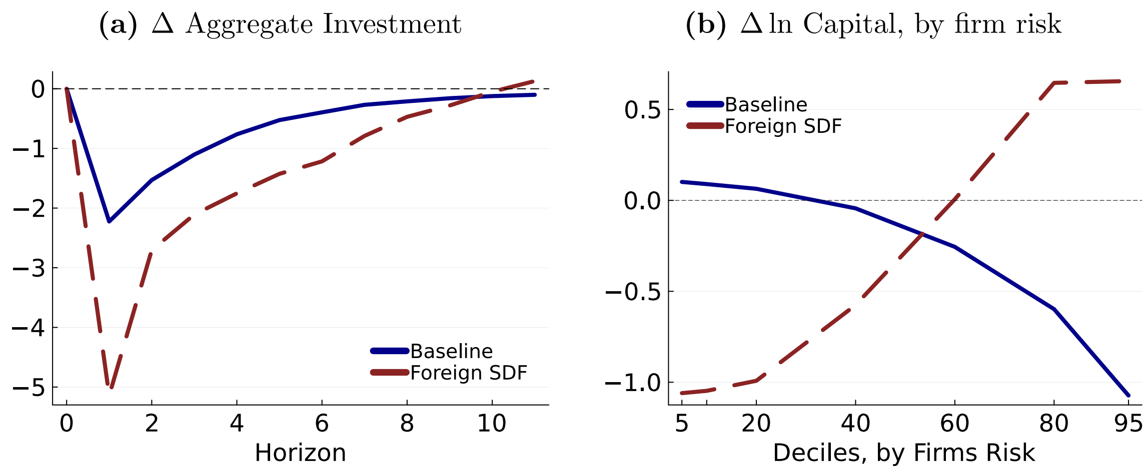
C.8. Global Investors Pricing Domestic Firms' Equity

In the baseline model, we assumed that firms are owned by domestic households. In this appendix, we instead consider an economy in which firms are owned by foreign investors and discount their payoffs using their SDF. Based on Equation (16) (which describes foreign investors' SDF), the firms' SDF is now given by:

$$\Lambda_{(t,t+1)} = \beta^\star \times \exp\left(-\kappa_t\, \epsilon^A_{t+1} - \frac{1}{2}\kappa_t^2\, \sigma_A^2\right) \times \frac{\varepsilon_t}{\varepsilon_{t+1}}, \qquad \text{(C.13)}$$

where $\frac{\varepsilon_t}{\varepsilon_{t+1}}$ captures the next-period change in the real exchange rate. In the baseline model, we assumed that households have a discount rate of β and calibrated $\beta < \beta^\star$ in order to

Figure C.6: Responses to Global Price of Risk Increases when Global Investors Price Domestic Firms' Equity



Note: The figure compares the responses of firms' investment to a risk-premium shock ($\Delta\kappa > 0$). The blue lines show the effects in our baseline model, in which firms' discount payoffs based on the households SDF. The red lines show a counterfactual in which firms discount payoffs based on the foreign lenders' SDF. The left panel shows the aggregate effect. The right panel shows the heterogeneous effects, by firm risk (at a fixed horizon). RF denotes risk-free firm.

match the average leverage observed in the data. For this appendix, instead, we assume that households' discount rate is $\beta^{\star}$ (i.e., that of the lenders), but firms have an exogenous death rate of ϖ such that $\beta = \beta^{\star} \times \varpi$ (similarly to Cooley and Quadrini (2001)). This exogenous exit rate effectively reduces the firms' discount factor and allows us to match a similar average leverage without the need to recalibrate the model. The rest of the calibration for this economy is identical to that in Table 2a and Table 2b in the main text.

Figure C.6 presents the results. When firms are priced by foreign lenders, their SDF decreases following an increase in the global price of risk (i.e., they become more impatient) and they optimally choose to reduce their investment. The drop in aggregate capital is therefore significantly larger than in our baseline economy (Panel a). More importantly, the heterogeneous effects across firms with different levels of risk are reversed. In this case, we find that the subset of safer firms is the one that reduces investment the most following the shock (Panel b), which is the opposite of what we find in our empirical analysis. Therefore, through the lens of our model, the cross-sectional patterns of firms are consistent with the view that the marginal investors in these firms are domestic households.