The Trend-Cycle Connection*

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Abstract: Long-run growth in Latin America over the past 50 years has been low and volatile, characterized by frequent Sudden Stops. We develop a theory that links these growth dynamics to financial frictions and recurrent capital flow reversals in emerging markets. The key mechanism relies on the fact that trade balance reversals during Sudden Stops occur primarily through sharp declines in imports—especially investment goods—rather than increases in exports. Because imported investment has a lasting effect on capital accumulation, financial crises can generate persistent losses in output. Our model features an endogenous growth trend shaped by investment dynamics and financial conditions, allowing Sudden Stops to permanently affect the trend. We estimate the model using Argentine data from 1951 to 2015 and show that financial shocks and frictions have a quantitatively important effect on long-run growth. This result reinforces our central insight: in emerging markets, the trend and the cycle are deeply intertwined.

Keywords: emerging markets, real business cycle, trend shocks, financial frictions.

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1 Introduction

This paper develops a theory of the business cycle of emerging countries that exploits the interaction between endogenous growth and the cycle in the context of recurrent Sudden Stops with financial frictions. Our main contribution is to show how financial crises can leave permanent scars on the economy by disrupting investment and slowing trend growth—thereby strengthening the connection between the cycle and the trend. The main hypothesis is that frequent Sudden Stops, when combined with financial frictions, generate the excess macroeconomic volatility that ultimately translates into the long-run stagnation observed in Latin American countries. In our framework, imported investment and its contribution to long-run growth are central to the link between business cycle fluctuations and the evolution of the trend.

We develop a dynamic stochastic general equilibrium (DSGE) model of a small open economy with three key features: (1) endogenous growth with trend shocks, (2) financial frictions in the corporate sector, and (3) reliance on imported investment goods. Financial frictions restrict firms' ability to import capital during periods of distress. During a Sudden Stop, these constraints lead to sharp declines in investment and slow the accumulation of capital, which lowers trend growth while simultaneously improving the trade balance through import compression. This mechanism generates the core dynamics of Aguiar and Gopinath (2007) endogenously and captures a relatively unexplored empirical regularity: trade balance reversals during Sudden Stops are driven more by falling imports than by rising exports, consistent with the findings of Alessandria et al. (2015) and Gopinath and Neiman (2014). Importantly, our model endogenizes the relationship between trend growth and the cycle by making capital accumulation—particularly imported investment—responsive to financial conditions. This allows us to reconcile the observed macroeconomic volatility of emerging markets with the long-lasting effects of financial crises, as highlighted by Garcia-Cicco et al. (2010).

We bring the model to the data by estimating it using annual time-series data for Argentina from 1951 to 2015—a period that includes repeated Sudden Stops and large macroeconomic swings. The model fits the key moments of the data and replicates well-known business cycle facts, including the dynamics of financial crisis episodes. As in the data, a decline in imported capital plays a central role in improving the trade balance during Sudden Stops but also leads to a deterioration of future output growth.

We use the estimated model to decompose the role of real and financial shocks as well as the contribution of financial frictions during normal times and Sudden Stops. While transitory and permanent productivity shocks are important drivers of fluctuations, they alone cannot account for the comovement observed in the data. Financial frictions and shocks serve as critical transmission mechanisms, especially in amplifying downturns and slowing recoveries.

Focusing on Sudden Stops, we find that technology shocks and entrepreneurial risk play a central role in the development of the average crisis. On top of those factors, financial frictions explain part of the slow recovery of the trend after a Sudden Stop. The recovery operates strongly through the endogenous trend. We analyze the dynamics implied by the model around various Sudden Stops. Our model suggests that financial crises have a strong and persistent effect on the trend of the economy.

Related literature: Our paper contributes to the literature on business cycles in emerging economies. Aguiar and Gopinath (2007) show that trend shocks play a dominant role in these countries and that trend volatility accounts for their excess output volatility relative to developed economies. This view was challenged by Garcia-Cicco et al. (2010), who argue that financial frictions, not just trend shocks, are critical to understanding macroeconomic dynamics in emerging markets. These contributions initiated a growing literature, including Chang and Fernández (2013), Seoane (2016), Miyamoto and Nguyen (2017), and Akinci (2021), which examines the role of trend shocks and financial frictions in shaping emerging market cycles. However, in most of these models, trend growth is exogenous, and the degree of financial friction is often modeled as a reduced-form function of debt, output, or the terms of trade. Our paper advances this literature by explicitly modeling a mechanism in which financial frictions and imported capital jointly determine the trend, making long-run growth endogenous to financial conditions.

Our framework is also related to the medium-term macroeconomic literature developed by Comin (2004) and Comin and Gertler (2006), which explores how cyclical shocks can generate persistent effects. However, that literature does not focus on structural features that are central to emerging markets—such as exposure to volatile capital flows and dependence on imported investment goods.

More recent work has deepened the analysis of how financial frictions shape long-run growth in emerging markets. Ottonello and Winberry (2024) develop an endogenous growth model in which financial frictions distort firm-level investment and innovation, resulting in persistent aggregate growth losses. Similarly, Akcigit and Kerr (2024) introduce a framework with endogenous borrowing constraints that evolve with macroeconomic conditions, highlighting the joint dynamics of financial frictions and growth.

On the empirical side, Kim and Shin (2024) provide updated evidence on the macroeconomic consequences of Sudden Stops in emerging markets, while Sudo and Tanaka (2023) study how macroprudential policy can mitigate the long-run output losses associated with financial crises. These contributions underscore the relevance of our framework, which integrates financial shocks, imported investment, and endogenous growth to explain persistent stagnation following crises.

Two earlier studies are particularly relevant to our approach. Guerron-Quintana and Jinnai (2019) examine whether the 2008 financial crisis had permanent effects on U.S. output, using a closed-economy model with financial constraints. Queralto (2019) analyzes the long-term effects of financial crises on productivity and innovation, focusing on the 1997 Korean episode. While both studies highlight the persistent consequences of financial disruptions, neither features an endogenous trend nor considers the role of imported capital goods. Our contribution is to develop a framework that incorporates both mechanisms and to quantify their joint implications using long-run data from a representative emerging market. By contrast, our model focuses on an emerging economy context, endogenizes the trend, and explicitly accounts for imported investment, offering a more structural explanation for persistent post-crisis stagnation.

Finally, our paper relates to the literature on the interaction between endogenous growth and business cycles. Studies such as Ates and Saffie (2016), Matsumoto et al. (2018), and Benguria et al. (2020) analyze growth volatility in emerging markets, while Anzoategui et al. (2019) and Bianchi et al. (2019) examine related dynamics in advanced economies. Our contribution to this branch of the literature is to provide a quantitative decomposition of the drivers of growth volatility in an emerging market setting, with an emphasis on the long-run impact of financial crises via investment dynamics.

The rest of the paper is organized as follows. Section 2 presents motivating empirical evidence on Sudden Stops, trade dynamics, and investment patterns. Section 3 introduces the theoretical model. Section 4 describes the data and estimation strategy. Section 5 reports the main estimation results and model fit. Section 6 analyzes the contribution of different shocks and frictions in normal times. Section 7 focuses on Sudden Stops and their impact on the trend. Section 8 concludes.

2 Some facts during Sudden Stops

The typical financial crisis in small open emerging economies is a Sudden Stop. As studied in Kaminsky et al. (2004), Calvo et al. (2006), Mendoza (2010), and Seoane and Yurdagul (2019), among others, a Sudden Stop of international capital flows tends to occur together with output falls, a crash in asset prices and increases in sovereign spreads, and a reversal of the trade balance from deficit to surplus. A key feature of the adjustment that has not been studied so far relates to the sources of the trade balance reversal. If the trade balance turns to a surplus from competitiveness gains, the Sudden Stop could represent the start of a new growth cycle. If instead it stems from a fall in imports, it could contribute to lower output growth in the medium and long run. In this section, we study Sudden Stop dynamics for different groups of countries, with a focus on the dynamics of the trade balance and its components.[1]

2.1 Emerging economies

Table 1 presents some growth statistics for developed and emerging economies.

During the period 1960–2018, the weighted average annual growth rate in Latin America was 1.7 percent. Instead, developed small open economies have grown 2.2 percent per year on average. At the same time, output growth has been almost 80 percent more volatile in emerging economies despite its worst performance. The table also shows the number of Sudden Stop episodes in the data for each country and region.

[1]The data are annual and from the World Bank's World Development Indicators dataset. The sample period starts in 1960; however, the data availability varies across countries. To construct the statistics, we keep only data from selected countries for which we have at least 30 uninterrupted observations for output, exports, and imports.

Table 1: Growth and Sudden Stop statistics (1960-2018)

	Mean growth rate (%)	**Growth volatility (%)**	**Number of Sudden Stops**
Emerging SOEs	1.96	4.20	137 (4)
LA countries	1.72	3.70	66 (6)
Developed SOEs	2.21	2.39	23 (2)
US	1.96	1.97	1
UK	1.96	2.03	2
Japan	3.00	3.36	1
China	6.37	6.88	5
India	3.19	3.03	2

Notes: The statistics for emerging small open economies (SOEs), Latin American (LA) countries, and developed SOEs are the cross-sectional population-weighted average among the statistics of each country. Numbers in parentheses denote the average number of Sudden Stops per country. *Emerging SOEs:* Albania, Algeria, Argentina, Antigua and Barbuda, Barbados, Belize, Bolivia, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Grenada, Guatemala, Guyana, Honduras, Iran, Jordan, St. Lucia, Morocco, Mexico, Panama, Paraguay, Peru, Tunisia, Turkey, Uruguay, and Venezuela. *LA countries:* Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay, and Venezuela. Developed SOEs: Australia, Austria, Belgium, Canada, Denmark, Finland, Iceland, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, and Switzerland.

We define a Sudden Stop episode as a year in which the country presents at least a 2 percent fall in gross domestic product (GDP) and a 2 percentage point increase in the net exports–to–output ratio, following Seoane and Yurdagul (2019). Table 1 shows that emerging countries, and especially Latin American countries, suffered, on average, this type of crisis more often than developed countries. Not surprisingly, emerging and Latin American economies have also experienced the lowest average growth with the highest output volatility over the postwar sample. This last stylized fact suggests there is a persistent effect of Sudden Stops on economic development, one that influences the output growth rate for several periods. These patterns motivate a model in which the trend is not purely exogenous but partially determined by capital accumulation. In this way, financial frictions and collapses in imported investment during Sudden Stops can permanently alter the growth path, creating a structural link between short-term crises and long-term stagnation.

To study the dynamics during these events, we constructed a database of Sudden Stop episodes in emerging countries. We identify the year of the Sudden Stop as period $t = 0$ and plot the values of output growth, the net–exports–to–output ratio, the exports–to–output ratio, and the imports–to–output ratio during the five years before and after the episode. If the five years before and after were not contained in the sample period, or if another Sudden Stop occurred fewer than five years before, the event was discarded. With that methodology, we obtained 64 Sudden Stops. Figure 1 presents the mean values of the previously described variables across these episodes.

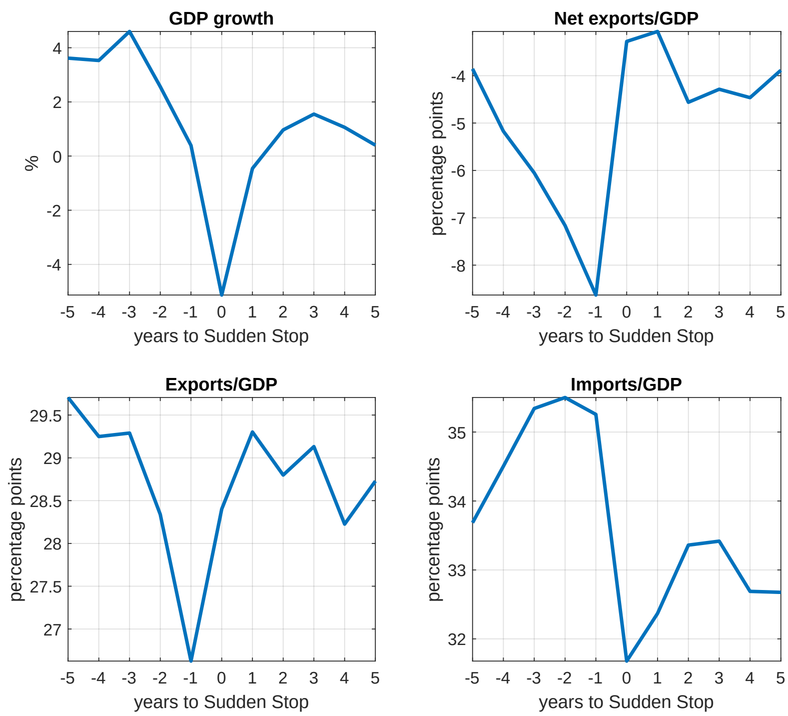

Figure 1: Sudden Stop dynamics in emerging countries

Note: The period 0 identifies the year of a Sudden Stop episode. The figure presents the mean values of variables in a sample of 64 Sudden Stops. Output growth is in percentages.

The trade balance follows a V-pattern–first deteriorating from -4 to -9 percentage points of GDP before the crisis and, then sharply reversing during the Sudden Stop. Changes in imports rather than exports primarily drive these swings. Exports seem to drop before, and slowly increase after, the Sudden Stop, but the changes in this variable are lower and smoother than those imports, as seen by the scale in the bottom panels of Figure 1. Additional evidence based on detrended series (reported in the section 9.2 of the appendix) shows that imports swing from 12 percent above trend before the crisis to 8 percent below trend within a year. At the same time, export adjustments are an order of magnitude smaller. This asymmetry aligns with the findings of the trade literature that export capacity cannot be quickly expanded.

In Figure 2, we plot the behavior of imported investment during Sudden Stops. This plot shows the average growth rate (in percentages) from a sample of 25 Sudden Stops in emerging countries in the period 1976–2018.[2] As seen in the plot, imported capital collapses during Sudden Stops. Its growth starts ameliorating four periods before the crisis, and its growth rate declines by approximately 30 percentage points at the Sudden Stop. Since this variable represents between 13 and 27 percent of total imports in emerging countries during the sample period, we argue it plays a fundamental role in reversing the trade balance during Sudden Stops.

[2]In this figure, imported investment goods are the sum of imports in capital goods (except transport equipment) and industrial transport equipment, according to Broad Economic Categories. For this variable, data are annual and comes from the World Integrated Trade Solution from the World Bank. The sample period is more limited due to data availability, as we explain in section 9.1 of the appendix. To construct this figure, we followed the same methodology as was used for the rest of the variables.

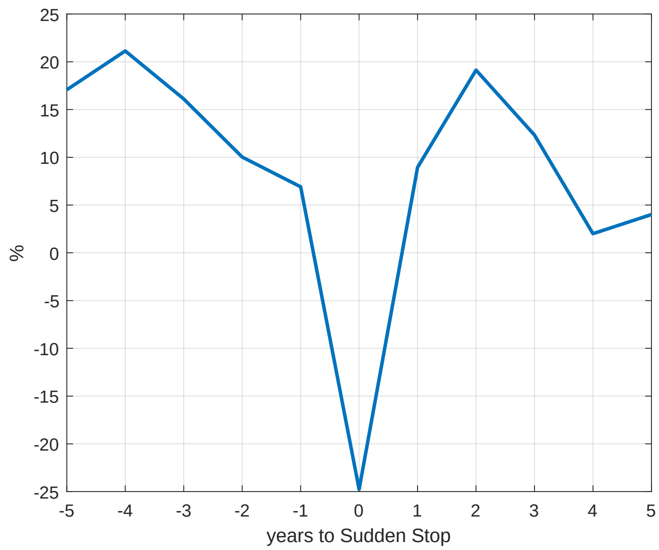

Figure 2: Sudden Stop dynamics in emerging countries: Imported capital growth rate

Note: The period 0 identifies the year of a Sudden Stop episode. The figure presents the mean value of the imported capital growth rate in a sample of 25 Sudden Stops from 1976 to 2018. The imported capital growth rate is in percentages. Details on the data used in this figure are available in the appendix.

2.2 Argentina's stylized facts

Argentinian data allows us to dig deeper into our working hypothesis. This section uses data from *Instituto Interdisciplinario de Economía Política de Buenos Aires*, IIEP (2018). In particular, our data separately measure investment in domestic transport and equipment goods and investment in imported transport and equipment goods. The sum of both variables constitutes the total imported investment. Figure 3 presents the main dynamics around Sudden Stops for the episodes in Argentina from 1951 to 2015. Following the methodology previously described, we identified nine Sudden Stop episodes in Argentina. However, to isolate the effect one Sudden Stop may have in the following episode, when we identify two events with fewer than five years of difference, we keep only the first one. Then, the statistics are obtained from five Sudden Stops.[3]

[3] The identified Sudden Stop episodes in Argentina occurred in 1959, 1963, 1976, 1982, 1985, 1988, 1989, 1995, and 2002. Plots and statistics come from Sudden Stops in 1959, 1976, 1982, 1995, and 2002.

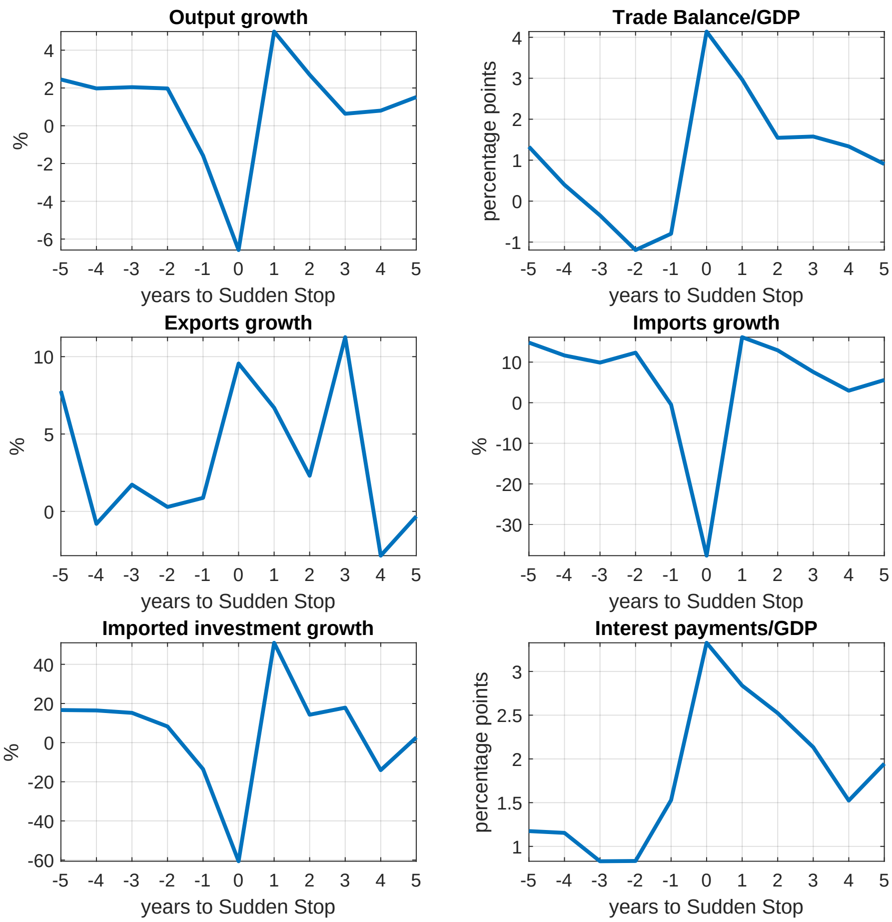

Figure 3: Sudden Stop dynamics in Argentina

Note: The period 0 identifies the year of a Sudden Stop episode. The figure presents the mean values of variables in a sample of five Sudden Stops in the past 50 years. Output, exports, imports, and imported investment growth are in percentages. trade-balance-to-output and interest-payments-to-output are in percentage points.

The dynamics of a Sudden Stop episode in Argentina share many of the features of the typical Sudden Stop episode in emerging economies, but imports seem to increase more quickly after the Sudden Stop than in Figure 1. The dynamics of imported investment, which collapses around 60 percentage points in the crisis, appears to be the main driver of the fall in imports during the Sudden Stop. Another feature from Argentinian data relates to the interest-payments-to-output ratio. This variable presents an abrupt increase in the year of the crisis, playing an essential role in the reversal of the trade balance. Furthermore, this variable is of vital importance for two reasons. First, and differently from Calvo et al. (2006), our definition of a Sudden Stop does not include the interest rate behavior because of the lack of interest rate data availability before the 1980s. Thus, the behavior of this variable provides suggestive evidence that we are identifying the correct events. Second, as we explain in more detail in the estimation section, this variable is critical in our analysis as it gives information regarding the financial sector in the economy, allowing us to identify financial frictions and shocks.

2.3 Taking stock

Both international data for emerging economies and Argentinian data point to a few stylized facts. First, in emerging economies, output tends to be more volatile and, on average, grows less than in developed economies. Second, Sudden Stops tend to be a more frequent phenomenon in emerging countries than in developed countries. Third, a distinctive feature of Sudden Stops is that the trade-balance dynamics seems to be dominated by the dynamics of imports and, in particular, imported investment.

In the following section, we develop a theory consistent with these facts and use it to measure the importance of domestic and foreign shocks in the context of financial frictions and endogenous output growth, as well as the main drivers of Sudden Stops. This theory allows endogenizing the hypothesis of Aguiar and Gopinath (2007). The cycle is the trend in emerging countries, but the trend is largely affected by Sudden Stops. In this way, our theory explains the business cycle and the medium run in the terminology of Comin et al. (2009). The model in this paper makes clear that growth and cycle are interrelated and affected by Sudden Stops because of their effect on the financing of firms that import investment goods. In what follows, we present the theory and describe the strategy to take it to the data.

3 The model

The model is a small open economy augmented with financial frictions and endogenous growth. The economy is populated by households, final goods producers, capital goods producers, domestic investment goods producers, entrepreneurs, and the government. We assume two symmetric productive sectors for intermediate input producers and entrepreneurs: imported and domestic capital. Capital goods producers sell only the intermediate product to entrepreneurs in the corresponding sector. Entrepreneurs from both sectors rent the capital to final goods producers. In addition to this specification, the rest of the world is populated by consumers and financial intermediaries that lend to entrepreneurs.

3.1 Households

Households own all the firms in the economy. Every period, they maximize the present discounted value of lifetime utility given by GHH preferences–introduced by Greenwood et al. (1988)–augmented with habit formation:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \nu_t \beta^t \left[\left(C_t - \alpha \tilde{C}_{t-1} - X_{t-1} \frac{h_{f,t}^{\omega_f}}{\omega_f} - X_{t-1} \frac{h_{d,t}^{\omega_d}}{\omega_d} \right)^{1-\sigma} \frac{1}{1-\sigma} \right],$$

subject to an infinite set of budget constraints, $\forall$ t,

$$C_t + D_t R_t = W_{d,t} h_{d,t} + W_{f,t} h_{f,t} + D_{t+1} + \Lambda_t, \tag{1}$$

Households choose consumption C_t, external borrowing D_{t+1} and labor supply $h_{d,t}$, $h_{f,t}$. They do not internalize habit formation, characterized by parameter α, where $\tilde{C}$ is aggregate consumption. We assume a specific labor supply for the domestic investment sector, $h_{d,t}$, and the final goods sector, $h_{f,t}$, with their corresponding wages $W_{d,t}$ and $W_{f,t}$. Parameters ω_d, and ω_f characterize the corresponding labor supply elasticity. R_t is the domestic interest rate. X_{t-1} is the trend of the economy, which we explain in detail in the following sections. Λ_t is transfers and profits received by households every period t:

$$\Lambda_t = \Pi_{ki,t} + \Pi_{kd,t} + \Pi_{Id,t} + T_{i,t} + T_{d,t} - S_t.$$

Here $\Pi_{ki,t}$, $\Pi_{kd,t}$, and $\Pi_{Id,t}$ denote profits of imported capital and domestic capital and investment goods producers. $T_{i,t}$ and $T_{d,t}$ are net real transfers–to new, and from old, entrepreneurs–of imported and domestic capital. S_t is lump-sum taxes paid to the government. We provide a detailed description of profits and transfers in the following section. Finally, ν_t is a preference shock that follows an AR(1) process:

$$\ln \nu_{t+1} = \rho_\nu \ln \nu_t + \epsilon_{t+1}^{\nu}; \quad \epsilon_t^{\nu} \sim N\left(0, \sigma_\nu^2\right); \quad |\rho_\nu| < 1. \tag{2}$$

As discussed by the existing literature, the country's interest rate is subject to shocks and an endogenous spread. The exogenous components include risk-free interest rate shocks, $R_{f,t}$, and spread shocks, μ_t. The latter represents exogenous variations in the interest rate that the domestic economy has to pay for its debt and is independent of its fundamentals. The timing for the debt and spread shocks follows the timing in Justiniano and Preston (2010), where spread shocks affect contemporaneously the cost of repaying the debt. The interest rate is $R_t = R_{o,t-1}e^{\mu_t - 1}$, with

$$R_{o,t} = R^* + \exp\left(R_{f,t} - 1\right) + \psi_D\left[\exp\left(\frac{\tilde{D}_{t+1} + \tilde{B}_{t+1}}{X_t} - (\bar{d} + \bar{b})\right) - 1\right] + \psi_Y\left[\exp\left(\frac{Y_t}{X_{t-1}} - \bar{y}\right) - 1\right]. \quad (3)$$

We assume the endogenous spread has two parts: the first depends on deviations of detrended debt (from households and firms) to the average debt level. The parameter that measures this debt elasticity of the interest rate is ψ_D, which is assumed to be positive since a higher debt level is associated with higher default risk. The second part depends on deviations of detrended output to the average output in the economy. The parameter ψ_Y allows us to capture the fact that the interest rate may fall when output is growing. The representative household does not internalize the effect of her decisions on the country's interest rate, which is affected by aggregate variables ($\tilde{D}$, $\tilde{B}$, and GDP Y_t).

R^* is the average interest rate, and $\bar{d}, \bar{b}, \bar{y}$ are steady-state values. We assume $R_{f,t}$ and μ_t follow a zero mean AR(1) process in logs:

$$\ln R_{f,t+1} = \rho_{R_f} \ln R_{f,t} + \epsilon^{Rf}_{t+1}; \qquad \epsilon^{Rf}_t \sim N\left(0, \sigma^2_{R_f}\right); \qquad |\rho_{R_f}| < 1, \quad (4)$$

$$\ln \mu_{t+1} = \rho_\mu \ln \mu_t + \epsilon^{\mu}_{t+1}; \qquad \epsilon^{\mu}_t \sim N\left(0, \sigma^2_{\mu}\right); \qquad |\rho_\mu| < 1. \quad (5)$$

3.2 Capital goods producers

We model capital goods producers similarly to Christiano et al. (2010) and Fernández-Villaverde (2010). Capital goods production is divided into two symmetric, perfectly competitive, productive sectors. A representative firm in sector I imports installed capital, $K_{i,t}$, at price $q_{i,t}$ and adds new investment, $I_{i,t}$, to generate new capital stock for the next period. It sells it to an entrepreneur in sector I for the same price $q_{i,t}$. The relative price of imported capital investment is $P_{i,t}$. The ratio of the relative price of imported investment to domestic goods has a clear trend in the data. For this reason, we assume $P_{i,t} = p_{i,t}\Xi_{t-1}$, where $p_{i,t}$ is stationary and Ξ_{t-1} is a deterministic trend. $p_{i,t}$ follows an AR(1) process with mean $\bar{p}$.

A producer in the second sector, sector D, buys installed capital, $K_{d,t}$, at price $q_{d,t}$, and adds investment, $I_{d,t}$, to generate a new capital stock for the next period, $K_{d,t+1}$. It sells the new capital for the same price to entrepreneurs in sector D. The price of the investment is $p_{d,t}$. The domestic investment price does not grow, so we have $P_{d,t} = p_{d,t}$. All producers are competitive, so they take the price of capital and investment goods as given.

For $j = \{I, D\}$, the optimization problem of a representative producer is

$$\max_{K_{j,t+1}, I_{j,t}} \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\tilde{\lambda}_t}{\tilde{\lambda}_0} \Big(q_{j,t} K_{j,t+1} - q_{j,t} K_{j,t}(1-\delta_{kj}) - P_{j,t} I_{j,t} \Big),$$

subject to

$$K_{j,t+1} = K_{j,t}(1-\delta_{kj}) + I_{j,t} - \Phi_j\Big(\frac{K_{j,t+1}}{K_{j,t}}\Big) K_{j,t}. \tag{6}$$

As is standard in the literature, we assume quadratic capital adjustment costs, which take the following functional forms for domestic capital,

$$\Phi_d\Big(\frac{K_{d,t+1}}{K_{d,t}}\Big) = \frac{\phi_d}{2}\Big(\frac{K_{d,t+1}}{K_{d,t}} - \bar{g}\Big)^2,$$

and for imported investment capital,

$$\Phi_i\Big(\frac{K_{i,t+1}}{K_{i,t}}\Big) = \frac{\phi_i}{2}\Big(\frac{K_{i,t+1}}{K_{i,t}} - \frac{\bar{g}}{\bar{g_\Xi}}\Big)^2.$$

Here, $\bar{g}$ is the average growth rate of the economy, and $\bar{g_\Xi}$ is the average growth rate of the imported investment price. The difference is that the price of domestic investment is stationary, while $P_{i,t}$ is allowed to grow in the model to replicate the data. The different growth rates in investment prices generate different growth rates in investment between sectors and then in domestic and imported capital, as we show in section 9.3 of the appendix.

Importantly, note that, in each sector the new and used capital are both net of adjustment costs. Hence, it is the same type of good and, as such, they have the same price.

3.3 Entrepreneurs

The economy has two types of entrepreneurs that manage capital: those in the imported capital sector (j = i) and those in the domestic capital sector (j = d). Entrepreneurs in sector j purchase capital $K_{j,t+1}$ from capital producers in their respective sectors. While both types behave symmetrically, we allow their parameters to differ in the empirical analysis to capture sector-specific characteristics. Throughout this section, we describe the behavior of an entrepreneur N of type j, following Christiano et al. (2014) closely.

Every period t, an entrepreneur N_j buys capital $K^N_{j,t+1}$ from a capital producer in sector j, refurbishes it using a stochastic linear technology, and rents it to the final goods producer. In order to purchase the capital, entrepreneurs can use their net worth, $N_{j,t+1}$, or issue defaultable debt, $B^N_{j,t+1}$, lent by an international financial intermediary. Hence,

$$q_{j,t}K^N_{j,t+1} = N_{j,t+1} + B^N_{j,t+1}. \tag{7}$$

The effective capital the entrepreneur obtains is $\omega^N_{j,t+1}K^N_{j,t+1}$, where ω^N_j is an idiosyncratic shock for each entrepreneur N, type j. This shock is independently drawn across time, type, and entrepreneurs.

We assume the shock ω^N_j follows a log-normal distribution $F(\omega^N_j)$ with parameters $\mu_{\omega_j,t}$ and $\sigma^j_{\omega,t}$ such that $E_t(\omega^N_{j,t+1}) = 1$ for all t, for $j = \{i, d\}$. Given the properties of log-normal distributions,

$$\mathbb{E}_t\omega^N_{j,t+1} = e^{\mu_{\omega_j,t+1}+\frac{1}{2}\sigma^{2,j}_{\omega,t+1}} = 1.$$

Hence, $\mu_{\omega_j} = -\frac{1}{2}\sigma^{2,j}_{\omega,t+1} = \mu^j_{\omega,t+1}$. Assume, following Christiano et al. (2014) and Fernández-Villaverde (2010) that the dispersion $\sigma^j_{\omega,t}$ varies stochastically over time and follows

$$log(\sigma^j_{\omega,t}) = (1-\rho^j_\sigma)log(\mu^j_\sigma) + \rho^j_\sigma log(\sigma^j_{\omega,t-1}) + \eta^j_\sigma\epsilon_{\sigma^j,t}, \quad \epsilon_{\sigma^j,t} \sim N(0,1).$$

The shock to the dispersion of ω_j^N can be interpreted as a financial shock. A higher dispersion implies riskier entrepreneurs and then a higher premium on external financing.

The transformation of raw capital into effective units takes one period. Then entrepreneurs buy $K_{j,t+1}^N$ at period t, but rent the capital services at period $t+1$, at rate $r_{j,t+1}$. At the end of period $t+1$, entrepreneurs are left with $(1-\delta_{kj})\omega_{j,t+1}^N K_{j,t+1}^N$ and sell it to a capital producer in sector j.

The entrepreneur's return per unit of capital purchased in t is $R_{j,t+1}\omega_{j,t+1}^N$, and the average return per unit invested in period t and sector j is

$$R_{j,t+1} = \frac{r_{j,t+1} + q_{j,t+1}(1-\delta_{kj})}{q_{j,t}}. \tag{8}$$

The foreign lender is risk neutral. Hence, the optimal contract determines a return that implies that expected returns equal the cost of funds. Define $R_j^{N,l}$ as the return on the loan that gives expected zero profits to financial intermediaries. This return takes into account that entrepreneurs with low enough productivity may default and those with high productivity will repay. However, since the idiosyncratic shock is the private information of the entrepreneur, under default, the lender pays a monitoring cost to verify the actual state of business. Then it takes all remaining assets. The zero-profit condition is

$$[1-F(\bar{\omega}_{j,t+1}^N)]R_{j,t}^{N,l}B_{j,t+1}^N + (1-\mu_{kj})\int_0^{\bar{\omega}_{j,t+1}^N} \omega_j^N dF(\omega_j^N)R_{j,t+1}q_{j,t}K_{j,t+1}^N = R_{t+1}B_{j,t+1}^N, \tag{9}$$

where $1-\mu_{kj}$ is the fraction of the return that can be captured by the financial intermediary in case of default after screening in sector j. On the right-hand side, we have the cost of raising $B_{j,t+1}^N$ funds. This cost comes from the gross interest rate, R_{t+1}, that the financial intermediary pays.

Define $\bar{\omega}_{j,t+1}^N$ as the productivity threshold below which the entrepreneur N in sector j defaults:

$$R_{j,t+1}^{N,l}B_{j,t+1}^N = \bar{\omega}_{j,t+1}^N R_{j,t+1}q_{j,t}K_{j,t+1}^N.$$

That is, for all realizations below $\bar{\omega}_{j,t+1}^N$, the returns of having purchased $K_{j,t+1}^N$ will not be enough to repay the loan. We can rewrite equation 9 and characterize the debt contract in terms of $\bar{\omega}_{j,t+1}^N$ rather than in terms of $R_{j,t+1}^{N,l}$.

Define $\Gamma(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t})$ as the share of entrepreneurial earnings that are used to pay financial intermediaries per unit of investment:

$$\Gamma(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t}) = \bar{\omega}^N_{j,t+1} \left(1 - F(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t})\right) + G(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t}),$$

with

$$G(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t}) = \int_0^{\bar{\omega}^N_{j,t+1}} \omega^N_j dF(\omega^N_j, \sigma^j_{\omega,t}).$$

Here, $\Gamma(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t})$ is the sum of the average return for those entrepreneurs that repay, plus the conditional mean of productivity of those that default. Moreover, using Θ for the CDF of a Normal distribution, we can rewrite $G(\cdot)$ as

$$G(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t}) = 1 - \Theta\left(\frac{\frac{1}{2}\sigma^{2,j}_{\omega,t} - \log \bar{\omega}^N_{j,t+1}}{\sigma^j_{\omega,t}}\right).$$

The zero profit condition is rewritten as

$$\frac{R_{j,t+1}}{R_{t+1}}\left[\Gamma(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t}) - \mu_{kj} G(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t})\right] q_{j,t} K^N_{j,t+1} = B^N_{j,t+1}. \tag{10}$$

Define the loan to net worth ratio as $\varsigma^N_{j,t} = B^N_{j,t+1}/N_{j,t+1}$. The problem of an entrepreneur is to pick the ratio $\varsigma^N_{j,t}$ and a cut-off for default to maximize the entrepreneur's expected net worth given the zero-profit condition of the intermediary:

$$\max_{\varsigma^N_{j,t}, \bar{\omega}^N_{j,t+1}} \mathbb{E}_t \left\{ \frac{R_{j,t+1}}{R_{t+1}} \left(1 - \Gamma(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t})\right)(1 + \varsigma^N_{j,t}) \right.$$

$$\left. + \eta_{j,t} \left[\frac{R_{j,t+1}}{R_{t+1}} \left[\Gamma(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t}) - \mu_{kj} G(\bar{\omega}^N_{j,t+1}, \sigma^j_{\omega,t})\right](1 + \varsigma^N_{j,t}) - \varsigma^N_{j,t} \right] \right\}.$$

Notice that since the idiosyncratic shock ω^N_j is independent of all other shocks and across time, and it is identical across entrepreneurs in sector j, all entrepreneurs in sector j will make the same decisions. Then, we can define the solutions of the entrepreneur's problem as $(\varsigma_{j,t}, \bar{\omega}_{j,t+1})$ and remove the dependencies of variables on N, working with aggregate variables B_j, K_j.

From the first-order conditions, we get

$$\mathbb{E}_t \left[\frac{R_{j,t+1} q_{j,t} K_{j,t+1}}{R_{t+1} N_{j,t+1}} \left(1 - \Gamma\left(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}\right)\right) \right] =$$
$$\mathbb{E}_t \left[\frac{1 - F\left(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}\right)}{1 - F\left(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}\right) - \mu_{kj} \bar{\omega}_{j,t+1} F_\omega\left(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}\right)} \right]. \tag{11}$$

Given such a contract, the law of motion of entrepreneurial net worth is given by

$$N_{j,t+1} = \frac{1}{1 - e^{\bar{\gamma}^e}} \left[R_{j,t} q_{j,t-1} K_{j,t} - R_t B_{j,t} - \mu_{kj} \int_0^{\bar{\omega}_{j,t}} \omega dF(\omega) R_{j,t} q_{j,t-1} K_{j,t} \right] + w^e_j X_{t-1}, \tag{12}$$

where $\bar{\gamma}^e$ regulates the survival rate of entrepreneurs. Exiting entrepreneurs transfer their net worth to households, and these fund incoming entrepreneurs by transferring w^e_j. The net of these operations is reflected in the term $T_{j,t}$ observed in the households' budget constraint, which is given by

$$T_{j,t} = \left(1 - \frac{1}{1 - e^{\bar{\gamma}^e}}\right) V_{j,t} - w^e_j X_{t-1}. \tag{13}$$

Here, $V_{j,t}$ is the net worth before the fraction of $\bar{\gamma}^e$ firms leaves the market and is given by

$$V_{j,t} = R_{j,t} q_{j,t-1} K_{j,t} - R_t B_{j,t} - \mu_{kj} \int_0^{\bar{\omega}_{j,t}} \omega dF(\omega) R_{j,t} q_{j,t-1} K_{j,t} \tag{14}$$

Notice that we are imposing the same survival rate for entrepreneurs in the domestic and imported capital sectors.

3.4 Domestic investment producer

Domestic investment goods $I_{d,t}$ are produced using labor $h_{d,t}$ with a decreasing returns to scale technology:

$$I_{d,t} = \tilde{a}^d_t (h_{d,t})^\rho,$$

with $0 < \rho < 1$ and $\tilde{a}^d_t = \bar{a}_d a^d_t X_t$. $\bar{a}_d$ is a constant that determines the average productivity level, and a^d_t is a specific TFP shock that follows an AR(1) in logs and is correlated with a TFP shock in the final goods production function. Notice that we assume that the TFP in the domestic investment sector follows the same growth trend as in the final goods production. The optimization problem of this firm is the following:

$$\max_{h_{d,t}} \Pi_{Id,t} = p_{d,t} a_t^d (h_{d,t})^\rho - W_{h,t} h_{d,t}$$

The firm pays wages equal to its marginal product, and profits are distributed to the households.

3.5 Final goods producer

The final good production sector is competitive and operated by a representative firm that rents labor and imported and domestic capital to produce the final consumption and export/import goods. The profit function of this firm is

$$\Pi_{f,t} = Y\left(K_{i,t}, h_{f,t}, K_{d,t}, a_t, X_t\right) - r_{d,t} K_{d,t} - W_{f,t} h_{f,t} - r_{i,t} K_{i,t}$$

This firm solves an intratemporal problem and pays its marginal cost to each input.

The production function is the following:

$$Y_t = a_t (X_t h_{f,t})^\gamma K_t^{1-\gamma}, \tag{15}$$

where K_t represents the total capital services. The Armington aggregator for capital is given by

$$K_t = \left(a_1 K_{d,t}^{\mu_1} + (1-a_1)\left(\Xi_{t-1} K_{i,t}\right)^{\mu_1}\right)^{\frac{1}{\mu_1}}.$$

The CES specification implies imperfect substitutability between domestic and imported capital, and it is similar to the one used in Mendoza and Yue (2012) and Park (2017).

As discussed before, Ξ_{t-1} is the deterministic trend in the imported investment price $P_{i,t}$. The previous expression implies that the aggregate capital K_t grows at the trend of the economy X_{t-1}. X_t is given by

$$X_t = \Gamma_t^{\eta} \left[\left(a_1 \tilde{K}_{d,t}^{\mu_1} + (1 - a_1) \left(\Xi_{t-1} \tilde{K}_{i,t} \right)^{\mu_1} \right)^{\frac{1}{\mu_1}} \right]^{1-\eta} \tag{16}$$

and the growth rate of the trend is $g_{x,t} = \frac{X_t}{X_{t-1}}$. Γ_t is an exogenous stochastic trend such that $\frac{\Gamma_t}{\Gamma_{t-1}} = g_t$, which follows an AR(1),

$$\ln\left(g_{t+1}/\bar{g}\right) = \rho_g \ln\left(g_t/\bar{g}\right) + \epsilon_{t+1}^{g}; \qquad \epsilon_t^g \sim N\left(0, \sigma_g^2\right); \qquad |\rho_g| < 1, \tag{17}$$

while $\tilde{K}_{d,t}$ and $\tilde{K}_{i,t}$ are aggregate (non-internalized) capital inputs that drive the endogenous component of the trend.

The expression in Eq. (16) nests the trend specification of Aguiar and Gopinath (2007) as a special case when $\eta = 1$, in which growth is fully exogenous. We generalize this by introducing an endogenous component, inspired by AK-type growth models, whereby the trend depends on the level of productive capital—both imported and domestic. Intuitively, the long-run growth rate is partly determined by capital accumulation, which allows financial frictions and Sudden Stops to influence the trend through their effect on investment. This mechanism endogenizes the "cycle is the trend" hypothesis and provides a reconciliation with the evidence in Garcia-Cicco et al. (2010), who emphasize the role of financial frictions in emerging markets.[4]

The productivity a_t is a mean reverting productivity shock and follows an AR(1) process in logs:

$$\ln a_{t+1} = \rho_a \ln a_t + \rho_{a,ad}\epsilon_{t+1}^{a,ad} + \epsilon_{t+1}^{a}; \qquad \epsilon_t^a \sim N\left(0, \sigma_a^2\right); \qquad |\rho_a| < 1, \tag{18}$$

where $\epsilon_{t+1}^{a,ad}$ is a shock that affects the TFP in both the production of domestic investment and the production of the consumption goods sector. That is, this shock allows us to account for a potential correlation between the mean-reverting component of TFP.

[4]We adopt this specification for tractability and identification purposes. Because we have disaggregated data on domestic and imported capital stocks, we can discipline the endogenous growth mechanism directly. Alternative growth models, such as those driven by R&D or learning-by-doing, are conceptually appealing but not feasible here due to the lack of consistent historical data on innovation inputs for Argentina.

3.6 Government

We follow Garcia-Cicco et al. (2010) and model government consumption as a domestic spending shock s_t that follows an AR(1) process:

$$s_{t+1} = (1-\rho_s)\bar{s} + \rho_s s_t + \epsilon^s_{t+1}; \quad \epsilon^s_t \sim N\left(0, \sigma^2_s\right); \quad |\rho_s| < 1,$$

where $s_t = \frac{S_t}{X_{t-1}}$. Households finance this government spending through lump-sum taxes. We include this shock to align with the existing literature and to make our definition of output in line with that of the data. After estimation, we find that this shock plays a minor role in model dynamics.

3.7 Balance of payments

From the definitions for the net worth of entrepreneurs, equation 12, together with equations 13 and 14, we get

$$T_{i,t} = V_{i,t} - N_{i,t+1},$$
$$T_{d,t} = V_{d,t} - N_{d,t+1}.$$

Using these equations, definition 7, the definition of intermediate input producers' profits, optimality conditions for final goods producers, and the household budget constraint 1, we get

$$GDP_t = C_t + p_{d,t}I_{d,t} + P_{i,t}I_{i,t} + S_t + TB_t, \tag{19}$$

where TB_t is the trade balance:

$$TB_t = R_t D_t - D_{t+1} + R_t(B_{i,t} + B_{d,t}) - (B_{i,t+1} + B_{d,t+1}).$$

GDP_t, the variable we observe in the data, is

$$GDP_t = Y_t + p_{d,t}I_{d,t} - \mu_{ki}G(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t})R_{i,t}q_{i,t-1}K_{i,t-1} - \mu_{kd}G(\bar{\omega}_{d,t+1}, \sigma^d_{\omega,t})R_{d,t}q_{d,t-1}K_{d,t-1}. \tag{20}$$

Moreover, we define the net interest rate payments to the rest of the world as follows:

$$rby_t = (R_t - 1)\frac{D_t + B_t}{GDP_t}$$

Notice that in this setting, we have two types of foreign debt: household debt (D_t) and corporate debt (B_t). Each has a different role: the former is used to smooth consumption, and the latter is used to buy capital for intermediate capital producers, either imported or domestic.

We present the complete set of equilibrium equations in the appendix.

4 Empirical strategy

We log-linearize the stationarized equilibrium conditions of the model and estimate it with a Bayesian strategy using annual data for Argentina for 1951 to 2015 from IIEP (2018). We calibrate some of the parameters to match first-order moments of the data and to align with standard values in the existing literature. We estimate the remainder of the parameters with Metropolis-Hastings and informative priors.

Table 2 presents the value of constrained parameters with their corresponding source or target. The CRRA coefficient, σ, which defines the curvature of the period utility function, is set to 2, and the depreciation rates (δ_{ki}, δ_{kd}) to 8 percent. The discount factor β equals 0.94 to target an annualized interest rate of 8 percent in the steady state. We set $\bar{g}$ to 1.01, the average gross growth rate of output per capita, and $\bar{g_{\Xi}}$ to 0.9756, the imported investment price. The average trade-balance-to-output ratio is 1.4 percent, like in Argentina in the period under study. γ and ρ, the coefficients of labor in the production function of the final good and domestic investment, are set equal to 2/3. We set the Armington weight of domestic capital, a_1, to 0.62, in line with Mendoza and Yue (2012)'s calibration for imported inputs. The preference parameter ω_d is set equal to 1.2, as in Akinci (2021).[5]

We set the ratio B/N in each sector to the average leverage ratio in industrial investment for firms in Argentina in the period 2007-16.[6] We fix $\bar{\gamma}^e$ to match the

[5]We also tried to estimate this parameter, and in most of the trials, the chain of this parameter approached 1. To avoid convergence issues, we decided to fix it to a low value that aligns with the literature.

[6]To the best of our knowledge, information about this ratio is available only since 2007.

average percentage of surviving firms per year, equal to 89 percent in Argentina from 2007 to 2016.

Finally, we set the relative price of imported investment in steady state to the average value in the data, $\bar{p} = 1.22$.

Table 2: Calibrated Parameters

Parameter	**Value**	**Definition**	**Source or Target**
σ	2	Risk aversion	Standard
γ	2/3	Labor coefficient in final good	Standard
ρ	2/3	Labor coefficient in domestic investment	Standard
β	0.94	Discount factor	8% average interest rate
δ_{kj}	0.08	Depreciation rate ($j = i, d$)	Standard
$\bar{\gamma}^e$	2.068	Entrepreneur survival rate	10% annual firm exit, Argentina 2007–2016
w_d^e	0.038	Transfer to entrepreneurs (domestic capital)	$(B/N)_d = 0.6$, Argentina 2007–2016
w_i^e	7.24e–04	Transfer to entrepreneurs (imported capital)	$(B/N)_i = 0.6$, Argentina 2007–2016
$\bar{p}$	1.22	Avg. relative price of imported investment	Argentina 1951–2015
$\bar{g}_{\Xi}$	0.9756	Growth rate of imported investment price	Argentina 1951–2015
$\bar{g}$	1.01	Growth rate of output per capita	Argentina 1951–2015
a_1	0.62	Armington weight on domestic capital	Mendoza and Yue (2012)
ω_d	1.2	Preference parameter	Akinci (2021)

We include eight observables: (1) GDP growth (gy); (2) private consumption growth (gc); (3) domestic investment growth (gi_d); (4) imported investment growth (gi_i); (5) the trade-balance-to-output ratio (tby); (6) the ratio of the relative price of imported capital investment goods to the GDP deflator, in demeaned growth rates

(gp_i); (7) the real risk-free interest rate (R_f);and (8) the ratio of net interest rate service on the foreign net asset position to output (rby). In all cases, we work in per capita terms and take natural logs, except for tby and rby. We incorporate the latter variable with R_f to identify financial frictions and shocks in the estimation.[7]

In the estimation, we add measurement errors to all observables. We plot the described time series in the appendix. There, we can see the variable gp_i has a negative mean equal to -0.024 during the period, showing the negative trend in imported capital investment prices, as in the model.

The estimated parameters and the prior distributions are in Table 3. We consider loose priors in all cases because, given the complexity of the likelihood function, the estimation with flat priors tends to work poorly, as many estimates would hit the parameter bounds.

5 Estimation results

Table 3 presents the prior information, the posterior mean and median, and high probability density intervals (HPDI) of 10 percent and 90 percent for each estimated parameter. Posterior distributions are in similar orders of magnitude as in the existing literature. The HPDI of the debt elasticity to the interest rate, ψ_D, ranges from 0.02 to 0.14, smaller than the posterior mean in Garcia-Cicco et al. (2010), yet large enough to be quantitatively relevant for the dynamics. The model includes two features that explain the lower interest rate debt elasticity: first, the role of ψ_Y (absent in Garcia-Cicco et al. (2010)) and, second, the existence of additional financial frictions. The elasticity of the interest rate to output, ψ_Y, has a negative posterior mean equal to -1.31, supporting the hypothesis that financial frictions tend to relax during the expansive part of the cycle. Our estimates suggest that imported investment is subject to higher screening costs–indeed, about two times the standard calibration for this parameter in the case of the US, with a posterior mean of 0.27 for μ_{ki}. However, there seems to be a lower degree of financial friction in the domestic investment sector, where μ_{kd} takes a posterior mean of 0.03.[8]

[7] Due to data availability, our price deflators are Fisher chained indexes. Our original data for the NIPA accounts are nominal, so we can be consistent with the model and deflate output and consumption by using the GDP deflator. We deflate domestic investment and imported investment by using their own deflators. We provide a full description of the data treatment in the appendix.

[8] See Bernanke et al. (1999) and many others who calibrate this parameter to 0.12.

A key parameter in our analysis is η, as it characterizes the importance of the endogenous component in the growth rate of this economy: the lower this parameter is, the more relevant is the endogenous component of the trend and the less important is the shock. The estimation places substantial mass around medium to large values of this parameter. Its posterior mean equals 0.69, and it has a high probability density interval of 0.46 and 0.96.

Table 3: Priors and estimation results

	Prior					Posterior			
	Dist.	**LB**	**UB**	**Mean**	**s.d.**	**Mean**	**Median**	**10%**	**90%**
μ_σ^i	IG		1.00	1.00	0.25	0.82	0.81	0.66	0.97
μ_σ^d	IG		1.00	1.00	0.25	0.89	0.86	0.59	1.18
σ_G	IG			0.02	0.03	0.03	0.03	0.02	0.04
σ_A	IG			0.02	0.03	0.01	0.01	0.01	0.02
σ_{A^d}	IG			0.02	0.03	0.01	0.01	0.01	0.02
σ_μ	IG			0.02	0.03	0.07	0.07	0.06	0.08
η_σ^i	IG			0.60	1.00	1.64	1.49	0.71	2.54
η_σ^d	IG			0.60	1.00	0.42	0.36	0.16	0.69
σ_{R^f}	IG			0.02	0.03	0.02	0.02	0.01	0.02
σ_ν	IG			0.02	0.03	0.08	0.08	0.05	0.13
σ_p	IG			0.02	0.03	0.21	0.21	0.18	0.24
σ_s	IG			0.02	0.03	0.01	0.01	0.01	0.01
ρ_G	Beta			0.30	0.10	0.41	0.41	0.24	0.58
ρ_A	Beta			0.30	0.10	0.47	0.47	0.34	0.60
ρ_A^d	Beta			0.30	0.10	0.50	0.50	0.36	0.64
ρ_μ	Beta			0.30	0.10	0.30	0.30	0.20	0.40
ρ_σ^i	Beta			0.30	0.10	0.54	0.55	0.38	0.70
ρ_σ^d	Beta			0.30	0.10	0.30	0.30	0.14	0.46
ρ_{R^f}	Beta			0.30	0.10	0.48	0.48	0.36	0.59
ρ_ν	Beta			0.30	0.10	0.34	0.33	0.15	0.52
ρ_p	Beta			0.50	0.10	0.71	0.71	0.62	0.79
ρ_s	Beta			0.20	0.10	0.29	0.28	0.12	0.46
$\rho_{a,ad}$	Normal			0.20	0.50	0.02	0.02	0.01	0.03
$\rho_{ad,a}$	Normal			0.20	0.50	0.04	0.04	0.03	0.06
ϕ_{k^i}	Gamma			3.00	2.00	6.78	6.67	5.10	8.36
ϕ_{k^d}	Gamma			3.00	2.00	5.48	5.43	3.16	7.69
ψ_D	Normal	0.0	10.0	1.50	2.00	0.08	0.08	0.02	0.14
ψ_Y	Normal	-5.0	0.0	-1.00	0.25	-1.31	-1.31	-1.59	-1.04
μ_{ki}	Normal	0.0	1.0	0.12	0.10	0.27	0.27	0.13	0.41
μ_{kd}	Normal	0.0	1.0	0.12	0.10	0.03	0.03	0.00	0.07
ω_f	Normal	1.0	7.0	2.00	1.00	2.96	2.88	2.03	3.87
μ_1	Normal		0.9	0.50	2.00	0.80	0.80	0.72	0.91
α	Beta			0.25	0.10	0.13	0.13	0.06	0.19
η	Beta			0.50	0.25	0.69	0.70	0.46	0.96

Note: Posterior distributions from a random walk Metropolis-Hastings algorithm of 1,000,000 draws, with 500,000 burn-in draws.

The Armington curvature parameter μ_1 takes a posterior mean of 0.80, corresponding to an imperfect but quite high elasticity of substitution between domestic and imported capital, equal to $1/(1-\mu_1) = 5$. The fact that imported and domestic inputs are substitutes aligns with the results of Mendoza and Yue (2012) and Park (2017), among others.

Table 4: Second-order moments

	g_y	g_c	g_{i_d}	g_{i_i}	tby	rby
Standard deviations (in %)						
Model	5.3	6.1	12.5	45.9	4.3	2.7
Data	5.2	6.8	12.9	41.3	3.2	2.1
Correlation with gy						
Model	1.00	0.91	0.94	0.23	-0.18	-0.11
Data	1.00	0.91	0.92	0.62	-0.20	-0.35
Correlation with tby						
Model	-0.18	-0.26	-0.16	-0.07	1.00	0.71
Data	-0.20	-0.28	-0.22	-0.22	1.00	0.59

Note: Theoretical moments obtained by evaluating the parameters at their posterior means, imposing measurement errors' standard deviation equal to zero.

Table 4 shows the main second-order moments from the data and the model. The model fits the data: it produces the volatility ranking and a strong negative correlation between output growth and the trade balance, capturing the main stylized facts observed in emerging economies, as described in Aguiar and Gopinath (2007). This exercise is a test for the model, given that none of the numbers in the table are targeted during the estimation. It also generates the right volatility of the novel variables, the growth rate of imported investment, and the interest-rate-payments-to-GDP ratio.[9]

Given the results in this section, we consider this model an adequate laboratory to study the anatomy of the business cycle dynamics and Sudden Stops in emerging countries.

6 Quantitative results

This section studies the main quantitative features of the model. We start by revisiting the business cycle drivers in emerging markets. Then we focus on how financial frictions operate as transmission channels of the shocks.

6.1 Drivers of the business cycle

In this section, we analyze the relative contribution of different shocks to business cycle fluctuations by presenting the variance decomposition in Table 5. Trend shocks, however important, play a secondary role as a driver of consumption, output, and investment but are the main driver of the trade-balance-to-output ratio and the debt-service-to-output ratio.[10] These results are in line with those of Garcia-Cicco et al. (2010) and Akinci (2021), where the transitory shock tends to explain the largest part of the output, consumption, and domestic investment growth.[11] Financial shocks (including spread, risk-free rate, and risk shocks), as well as imported investment prices, mainly explain imported investment and, to a lesser extent, the trade-balance-to-output ratio, the interest-payments-to-output ratio, and consumption dynamics

[9] In contrast to the standard approach in the literature–for instance, those of Aguiar and Gopinath (2007), Garcia-Cicco et al. (2010), and even Chang and Fernández (2013) or Akinci (2021)–our framework imposes a new set of identifying restrictions on the estimation exercise, as we include domestic and imported investment and imported investment price data as observables. The dynamics of these variables over the business cycle and during Sudden Stops are virulent and allow us to better characterize the trade balance adjustment. Producing the right moments is, hence, challenging.

[10] Being a key driver of the debt-service-to-output ratio is an important feature of trend shocks because it suggests that this shock can play a central role in over-borrowing and external default phenomena, both of which are outside the scope of this paper but are considered in Seoane and Yurdagul (2019) and Aguiar and Gopinath (2006), respectively.

[11] In this table, the contribution of the transitory productivity shocks to variance decomposition is the sum of TFP shocks in the final production good (a_t), the one in the domestic investment sector (ad_t), and the covariance between them, which absorbs the greater share of the explained variance. In the appendix, we present the desegregated contribution of each shock.

but do not affect output. The preference shock plays no role in the decomposition of output growth. Still, it explains around 10 percent of consumption growth and the trade-balance to output ratio and also helps generate the observed co-movement and volatility rank of the observables.

Table 5: Variance decomposition (%)

Shock	g_y	g_c	$g_{i_{ved}}$	$g_{i_{vei}}$	tb_y	rb_y
Production						
Transitory (a_t, $a_{d,t}$, $\epsilon^{a,ad}$)	80.0	58.1	72.2	3.3	28.6	19.6
Trend (g_t)	15.2	10.9	10.5	0.9	39.8	44.8
Financial						
Spread (μ_t)	2.8	8.1	4.9	2.3	13.2	31.5
Risk (σ_t^d, σ_t^i)	0.6	0.2	0.3	69.5	0.5	0.1
Risk free ($R_{f,t}$)	1.2	3.9	2.6	0.4	5.9	1.8
Other						
Gov. spending (s_t)	0.0	0.2	0.0	0.0	3.0	0.4
Preference (ν_t)	0.1	9.8	0.1	0.0	8.9	1.6
Investment price ($p_{i,t}$)	0.0	0.0	0.0	23.5	0.1	0.1
Measurement error	0.0	8.8	9.4	0.0	0.0	0.2

These variance decompositions might mask important interaction effects between shocks and the endogenous growth mechanism. To isolate this channel, Table 6 presents a counterfactual analysis comparing our baseline model with one without endogenous growth by calculating the ratio of moments for the model without endogenous growth divided by the baseline model.

We find that endogenous growth exacerbates the cyclical properties of consumption, output, and investment growth with the trade balance-to-output ratio instead of explaining the excess volatility phenomenon. The negative correlation between output growth and the trade-balance-to-output ratio without endogenous growth is 50 percent smaller than in the model with endogenous growth. The negative comovement of these variables with the trade balance is a feature stressed by recurrent Sudden Stop episodes. Hence, the endogenous trend augments the drop in output, consumption, and domestic investment growth in Sudden Stops. This finding implies that the cycle affects the trend, exacerbating its response during Sudden Stops, which, in turn, affects the cyclical feature of the economy. In other words, the feedback effects between cycle and trend matter.

Table 6: Relative second order moments

g_y	g_c	g_{i_d}	g_{i_i}	tby	rby
Relative standard deviations					
1.004	0.974	0.994	0.997	1.058	1.007
Relative correlations with tby					
0.52	0.70	0.58	0.74	-	0.98
Relative correlations with gy					
-	0.99	1.00	0.96	0.52	0.64

Note: Theoretical moments in the counterfactual economy relative to the baseline estimation. For the baseline, we use the moments implied by the model evaluated at its posterior mean. For the counterfactual economy, we fix all parameters at their posterior means except η, which is set to 1, and σ_g, which is set to 0.0205. We choose the value of σ_g that generates the same volatility of the trend growth rate (gx_t) in both scenarios, baseline and counterfactual.

The findings of this section suggest that analyzing the contribution of different shocks provides only a partial picture. The full effect of shocks, particularly financial ones, depends crucially on how they interact with the economy's growth process. This fact motivates our examination of financial frictions as key transmission mechanisms, which we explore next.

6.2 The interaction between the trend and financial factors

This section studies whether financial factors affect the trend, one of the key questions we address in this paper. Figure 4 plots the trend response, in percentage deviations from the steady-state trend growth, to a one standard deviation increase in each financial factor.[12] The blue solid line displays results under the baseline model, revealing that financial shocks have a permanent effect, driving the trend persistently below its steady-state value. The effect of these shocks on the trend is significant,

[12]The steady state trend is defined as $X_{ss,t} = g_{ss} \times t$, where we normalize the initial value of X to 1.

with all financial shocks showing similar magnitudes of effect, although the response to idiosyncratic productivity shocks is slightly smaller.

In all cases, the effects are persistent. The transmission mechanism is as follows. An increase in firms' productivity dispersion raises the cost of funding, negatively affecting both imported and domestic investment, leading to a decline in output.

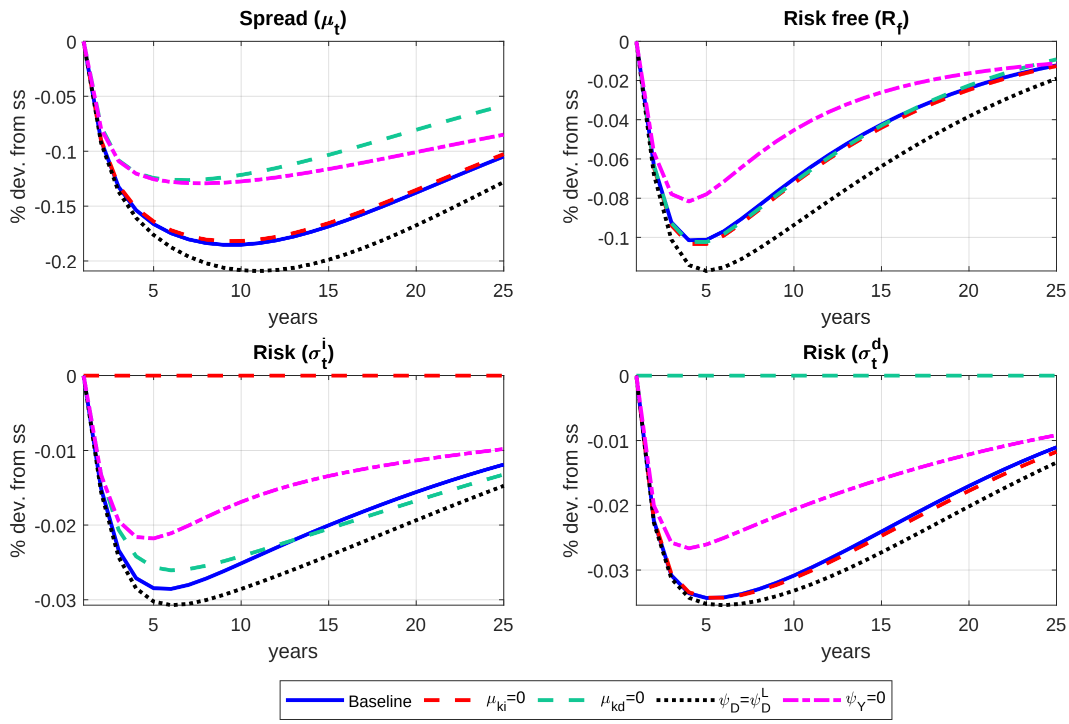

Figure 4: Impulse Response Function (in %) for the trend

Note: Trend (X_t) impulse response function (in logarithms) as percentage deviations (in %) from the steady-state trend growth ($X_{ss,t} = g_{ss} \times t$), to a one standard deviation shock in μ_t, $R_{f,t}$, σ_t^i, and σ_t^d. The trend is obtained as $ln(X_t) = ln(X_{t-1}) + ln(gx_t)$.

The figure also presents a sensitivity analysis under different financial frictions. Notice that the trend response to all shocks is stronger when the debt elastic interest rate coefficient (ψ_D) is set equal to $\psi_D^L = 0.041$, a value 50 percent smaller than its posterior mean. In that case, all shocks also last longer. Here, as firms reduce investment, they also reduce their leverage. The cost of funding, however, does not fall with low ψ_D as much as with the baseline ψ_D, leading to more adjustment in investment.[13]

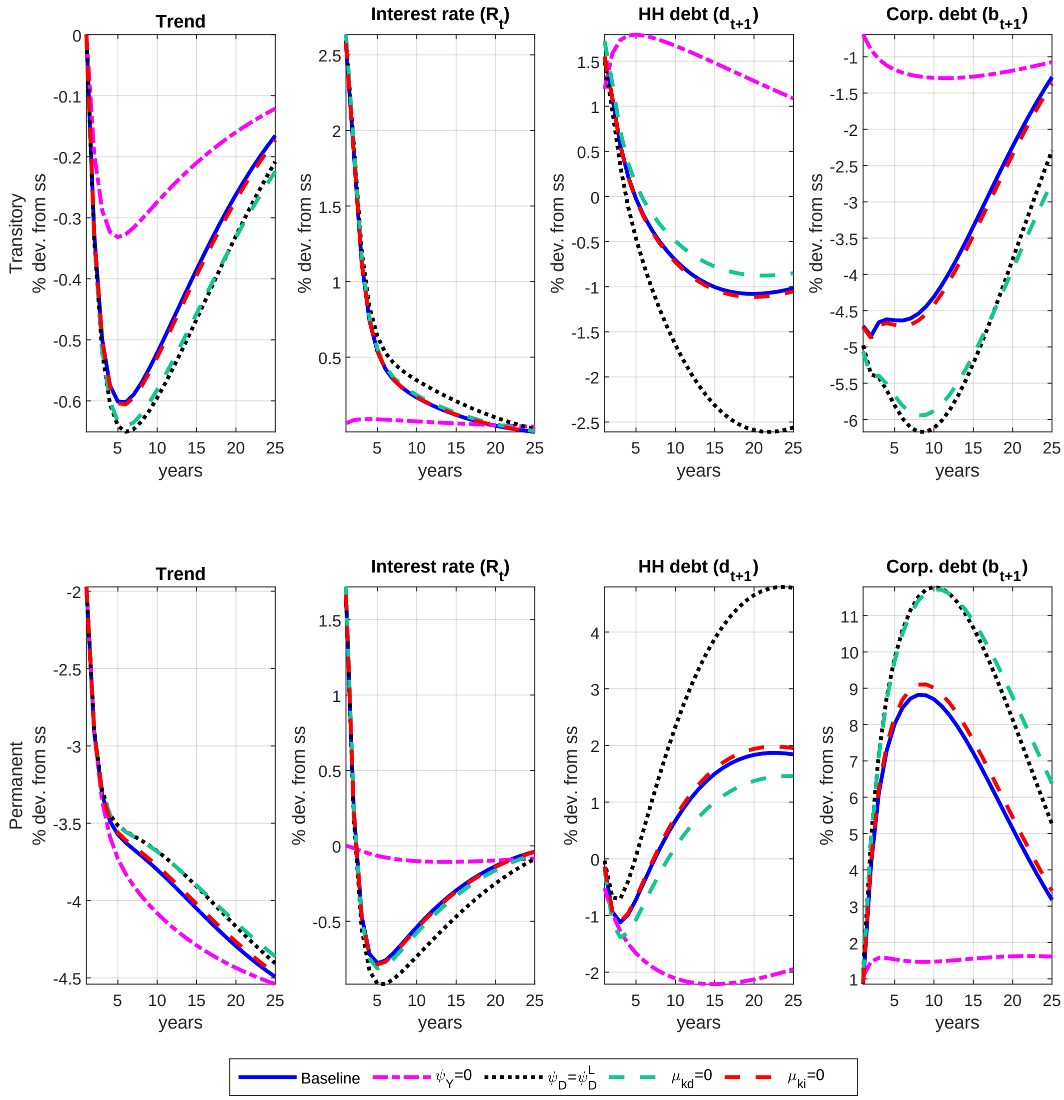

Figure 5: Impulse Response Function (in %) to negative productivity shocks

Note: Trend, interest rate (R_t), household debt (d_{t+1}), and corporate debt (b_{t+1}) impulse response function, as percentage deviations (in %) from the steady state, to a negative one standard deviation shock in $\epsilon^{a,ad,t}$ and g_t.

[13]There is yet some heterogeneity in the responses across investment sectors: for instance, risk and spread shocks with the baseline estimation of μ_{ki} have virtually the same effect on imported investment with ψ_D and ψ_D^L. For completeness, in section 9.6 of the appendix, we include the impulse responses of several relevant variables for the dynamics discussed in this section.

The screening cost in the imported capital sector also matters. The risk shock materializes through the corporate debt channel: the larger the risk is, the larger is the cost of funds driving down investment incentives. The output elasticity of the interest rate (ψ_Y) has the opposite effect ψ_D has. A positive ψ_Y slightly amplifies the effect of financial shocks through the interest rate and then on the trend.

6.3 The trend and the cycle

Transitory technology shocks play a major role in the variance decomposition. To complete the characterization of the dynamics of the model, we study the effect of productivity shocks and how the transmission channels operate.

Figure 5 shows the response of the interest rate, debt, and the endogenous growth rate of the economy to a negative mean-reverting productivity shock (in the upper block of the figure) and a trend shock (in the lower block). Under the baseline calibration, both shocks cause the endogenous trend to fall below its steady-state level and remain persistently depressed for 25 years, indicating long-lasting effects on growth. The interest rate response differs significantly in both cases and under different financial friction assumptions because of the different dynamics followed by debt accumulation at the household and corporate levels.

Consider first the baseline model. When the productivity shock is mean-reverting and affects TFP in the final goods production and domestic investment goods production sectors, the interest rate increases. Output falls because technology worsens, labor does not react to wealth effects, and both domestic capital and imported investment capital are fixed for that period. This development induces negative output growth. Households borrow more to smooth consumption, but firms borrow less because they plan to invest less. Overall, the effect is an increase in the interest rate because negative output growth dominates the interest rate dynamics. After that period, output starts recovering, which pushes interest rates down. In the subsequent periods, households' debt decreases, following the return of the interest rate to its steady-state value.

If we decrease the financial friction due to the debt elasticity of the interest rate, the behavior of the interest rate mimics the behavior of the growth rate of output with the opposite sign, as seen by the dotted black line. That said, if we shut down the interest rate elasticity to output growth, the dashed purple line exhibits the hump-shaped behavior of total debt without the initial spike of the interest rate.

When the productivity shock is permanent, the increase in the interest rate is smaller, and from period 1, it falls and remains below its steady-state value for around 20 periods. The role of household debt is critical here, as, given that the economy is permanently poorer, the household does not have incentives to borrow to smooth consumption. Thus, households' debt decreases. This effect generates negative pressure on the interest rate, dominated by the fall in detrended output. Thus, the interest rate increases in period 0. The response of corporate debt is very small on impact. As the growth rate of the trend returns to its steady state, the interest rate starts falling. Since financing cost goes down, corporate debt and then total debt increase, generating the hump shape in the interest rate. Again, if ψ_D is set equal to ψ_D^L, the behavior of R_t mimics the detrended output but with a positive sign, while if we shut down ψ_Y, the behavior of R_t mimics the total debt.

In sum, the previous figures suggest that trend dynamics strongly depend on the cost of financial frictions summarized by the interest rate dynamics. The findings in this section represent one of the main results of the paper. The dichotomy of trend shocks versus financial frictions to explain the business cycle in emerging countries represents a strong simplification, given that the behavior of both of them is closely interconnected.

7 The long-run effect of Sudden Stops

Sudden Stops are the most common financial crisis in emerging countries: they combine an increase in spreads, capital flow reversals, and an output fall. In this section, we study the effect of Sudden Stops on the long-run growth of the economy. We do it in two steps. First, we show that the model can replicate the dynamics around Sudden Stops. Second, we study the permanent effect Argentina's trend suffered around each Sudden Stop identified in the data. This question becomes relevant to understanding the long-run implications of short-run macroeconomic volatility in emerging countries.

7.1 Anatomy of Sudden Stops

This section studies the model implications for the average simulated Sudden Stop, the percentiles 32 and 68, and compares it with the average in the Argentinian data. As with the data, we define a Sudden Stop episode as a year in which the country presents a 2 percent fall in the GDP and a 2 percentage point increase in net-exports-to-output ratio. We simulate the economy for 500,000 periods, remove the first half of the observations, recover the episodes that fit into our definition of a Sudden Stop, and compute the cross-sectional average of all episodes, including the five years before and after. As in the data, we keep only the first event when two episodes have fewer than five years of difference. The frequency of Sudden Stops in the data (7.8 percent) and the model (6.7 percent) is aligned. Additionally, the model replicates the main dynamics involved in a Sudden Stop, both qualitatively and quantitatively, as Figure 6 shows.

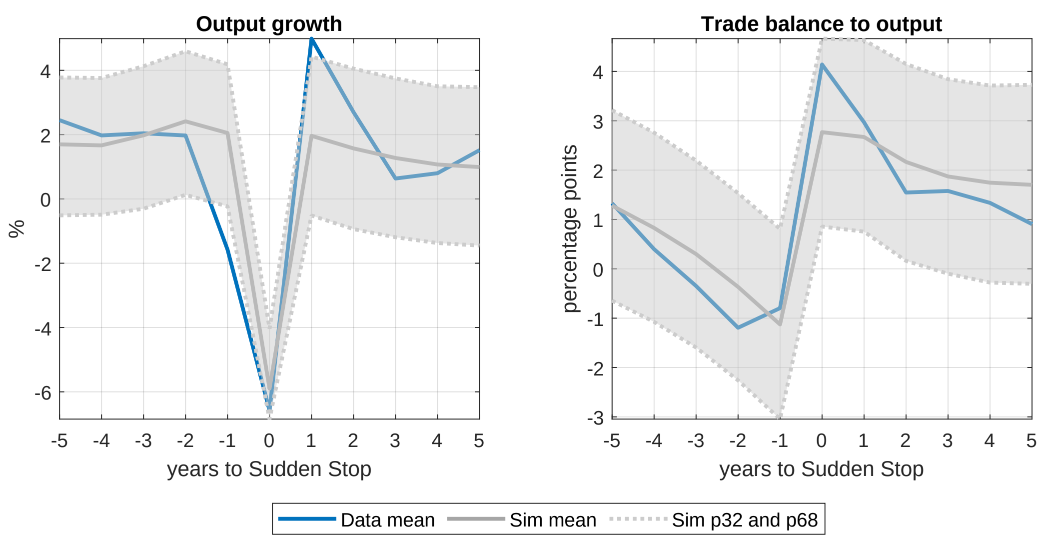

Figure 6: Average Sudden Stop in the data, simulated mean, percentiles 32 and 68

Note: Average simulated Sudden Stop, percentiles 32 and 68 (gray lines), and average Sudden Stop in the Argentinian data (blue line). Simulated events come from 500,000 simulation periods with half burn-in periods, where we recover the episodes that fit into our definition of Sudden Stop and compute the cross-sectional average of all episodes, including the five years before and after. We keep only the first event when two episodes have fewer than five years of difference, both in simulations and in the data.

The Sudden Stop emerges endogenously as a combination of various technological and financial shocks that affect the economy differently depending on the episode, as shown in the following section.

7.2 A quantitative view of the long-run effect of Sudden Stops

We now turn to quantifying the long-run effects of Sudden Stops on trend growth, episode by episode. Figure 7 presents the trend dynamics for each episode, decomposing it in productivity versus financial shocks. Each picture shows the logarithm of the trend in the baseline specification (blue solid line) and the counterfactual (with the left column shutting down technological shocks and the right one shutting down financial shocks).

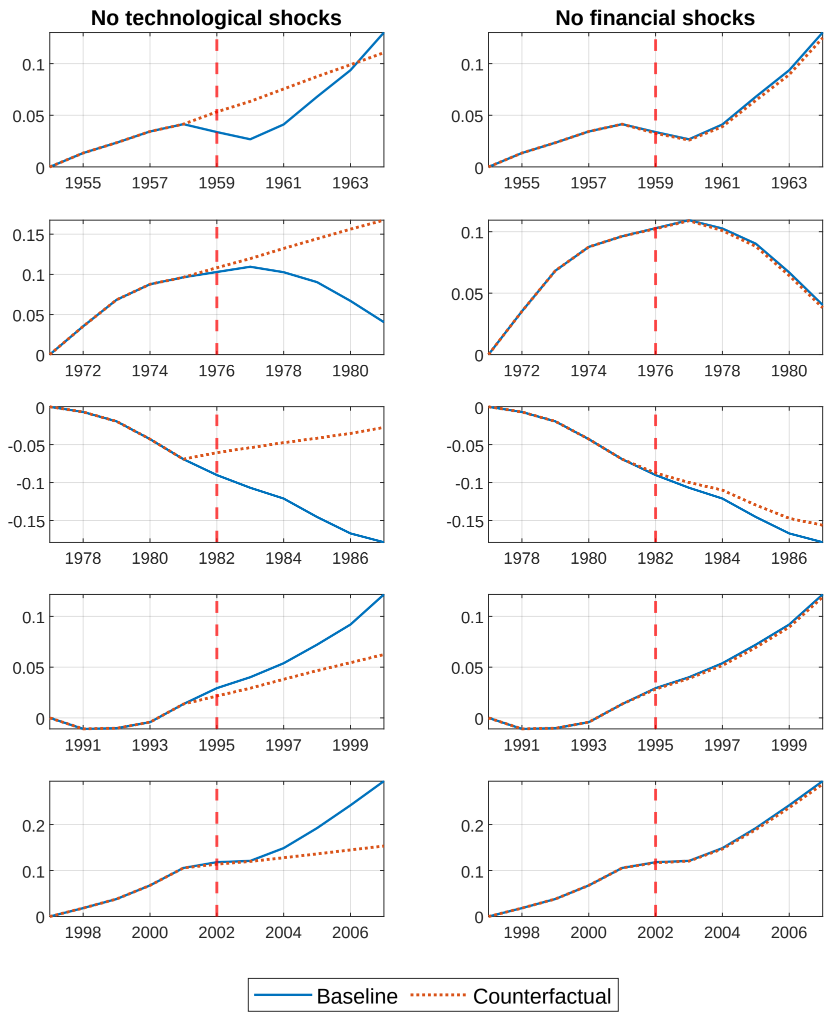

Figure 7: Observed and counterfactual trend dynamics (in logs)

Note: Smoothed and counterfactual dynamics around Sudden Stop episodes in Argentina. The plots show the log of the trend ($ln(X_t)$) calculated as $ln(X_t) = ln(X_{t-1}) + ln(gx_t)$, normalizing $X_1 = 1$. The baseline corresponds to the smoothed value of the trend growth rate (gx_t). In the counterfactual dynamics, we simulate gx_t from $t-1$ to $t+5$, taking the smoothed value at $t-2$ as the initial condition. We remove the corresponding shocks during the simulated periods. The first column sets the trend, TFP in the final production sector (a_t), TFP in the domestic investment sector (ad_t), and their covariance equal to zero, and the last column sets spread shocks (μ_t), risk shocks (σ_t), and risk-free interest rate shocks ($R_{f,t}$) equal to zero.

Without technology and financial drivers, the economy's trend would have been different from that of a smooth economy. The counterfactual trend remains above the smoothed one for the Sudden Stops in 1959, 1976, and 1982. For 1995 and 2002, the trend decelerated in the neighborhood of the crisis, but shutting down technology or financial shocks does not explain it.[14]

Financial shocks matter the most for the 1982 crisis. Removing them would have implied (persistently) a milder drop in the trend. The 2002 crisis is a very interesting one and deserves comment. The Sudden Stop occurred at the same time as the abandonment of the convertibility plan, i.e., the currency peg. Trend shocks, in turn, are meant to capture these events that are not otherwise included in the model. Then, by removing the trend shock in this context, we also remove the effect of the policy change, which in some way contributed to the recovery after 2003. For this reason, the counterfactual economy recovers slower after 2003 than the baseline economy.

The previous figure shows the importance of technology shocks in the Sudden Stops. This does not imply that the trend around Sudden Stops is determined by trend shocks. The endogenous component of the trend matters and also responds to trend shocks. We can disentangle the effect of trend shocks from the role of the endogenous trend by studying the dynamics of the trend around each Sudden Stop for different values of η. Figure 8 presents the baseline dynamic of the trend in the black solid line; the one with $\eta = 1$, which implies a fully exogenous trend; and the one with $\eta = 0$, which implies a fully endogenous trend. Figure 8 illustrates these dynamics, showing the baseline trend alongside the counterfactual paths for fully exogenous ($\eta = 1$) and fully endogenous ($\eta = 0$) trend scenarios. As seen in the figure, as expected, the baseline trend is an average of both exogenous and endogenous components. When the exogenous component is the determinant of the Sudden Stop, by construction the endogenous trend is above the smoothed estimate of the trend. We see this outcome in all Sudden Stops except in 2002. As seen in all these cases, when the trend shock is the main driver of the Sudden Stop, it falls during the period of the crisis. The persistence of the crisis comes from the endogenous trend. This is the case in all crises. In the 2002 crisis, trend dynamics are mainly driven by the endogenous component, and the recovery is pushed by the exogenous trend after 2003. This observation is in line with the previous findings of this section. The behavior of the endogenous component of the trend determines the key link between the business cycle and the long run. This is our central result; the business cycle translates into persistent long-run stagnation.

[14] In the appendix, we show the historical variance decomposition, demonstrating which shocks push the trend down in those periods.

In the appendix, we carry out an analogous analysis to disentangle the role of finan

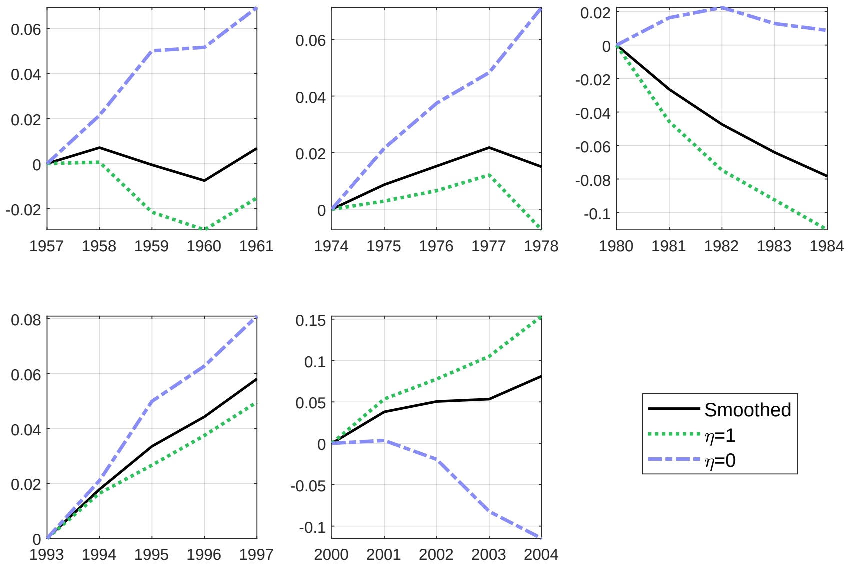

Figure 8: Smoothed and counterfactual trend dynamics (in logs)

Note: Smoothed and counterfactual dynamics around Sudden Stop episodes in Argentina. The plots show the log of the trend ($ln(X_t)$) calculated as $ln(X_t) = ln(X_{t-1}) + ln(gx_t)$, normalizing $X_1 = 1$. The baseline corresponds to the smoothed value of the trend growth rate (gx_t). In the counterfactual dynamics, we simulate gx_t from $t-1$ to $t+2$, changing the calibrated value of η and maintaining the rest of the parameters at their posterior mean.

8 Concluding remarks

We develop a framework that links financial crises, imported capital accumulation, and economic growth to explain the coexistence of low long-run growth, high volatility, and frequent crises in emerging economies. By linking Sudden Stops to the dynamics of imported capital goods, our theory shows that financial crises can have persistent effects through investment composition and endogenous growth channels. This framework provides a novel perspective on why emerging market volatility may impede long-run development.

A central innovation of our framework is that it endogenizes the long-run growth rate through capital accumulation. The evolution of the trend is not purely driven by exogenous factors, but also reflects financial conditions and investment dynamics. This channel allows financial frictions and Sudden Stops to have persistent effects on the trend, helping to reconcile the high volatility and frequent crises observed in emerging markets with their chronically low long-run growth. This mechanism formalizes the idea that cyclical dynamics can shape long-run outcomes in emerging economies.

Our analysis yields three main insights for emerging market dynamics. First, while the literature has debated the relative importance of trend versus transitory shocks, we show these forces are fundamentally interconnected. Financial crises affect trend growth by disrupting imported capital accumulation, creating feedback between short-run volatility and long-run growth. Indeed, we find that during the 1982 Argentine crisis, financial constraints and risk spreads not only shaped immediate trade and consumption dynamics but also had lasting effects on growth through their effect on investment composition.

Second, our findings highlight the dual role of financial factors in emerging markets, both as sources of shocks and as transmission mechanisms. Financial frictions prove particularly important for imported capital, with monitoring costs nearly twice as high as in the domestic sector. This asymmetry creates a powerful transmission channel through which financial shocks affect the economy beyond their immediate effect. When financial conditions tighten, the higher friction in the imported capital sector amplifies the initial shock and propagates it to longer horizons through the endogenous growth mechanism.

Third, we show that endogenous growth mechanisms significantly amplify crisis dynamics. Without endogenous growth, the correlation between output and the trade balance would be 50 percent weaker, indicating that financial shocks have long-lasting effects through their interaction with the growth process. This finding suggests that models abstracting from these linkages may substantially understate the costs of emerging market crises.

Our findings suggest several promising directions for future research. While we focus on capital accumulation, other channels such as human capital, technology adoption, or firm dynamics likely also link crises to growth. Understanding how these channels interact and their relative importance across countries could yield further insights.

9 Supplemental Appendix

9.1 Data

9.1.1 Estimation observables

In the estimation, we include eight observables: (1) GDP growth (gy); (2) private consumption growth (gc); (3) domestic investment growth (gi_d); (4) imported investment growth (gi_i); (5) the trade-balance-to-output ratio (tby); (6) the ratio of the relative price of imported capital investment goods to the GDP deflator, in demeaned growth rates (gp_i); (7) the real risk-free interest rate (R_f);and (8) the ratio of net interest rate service on the foreign net asset position to output (rby). National account data come from IIEP (2018). Due to data availability, our price deflators are Fisher-chained indexes.

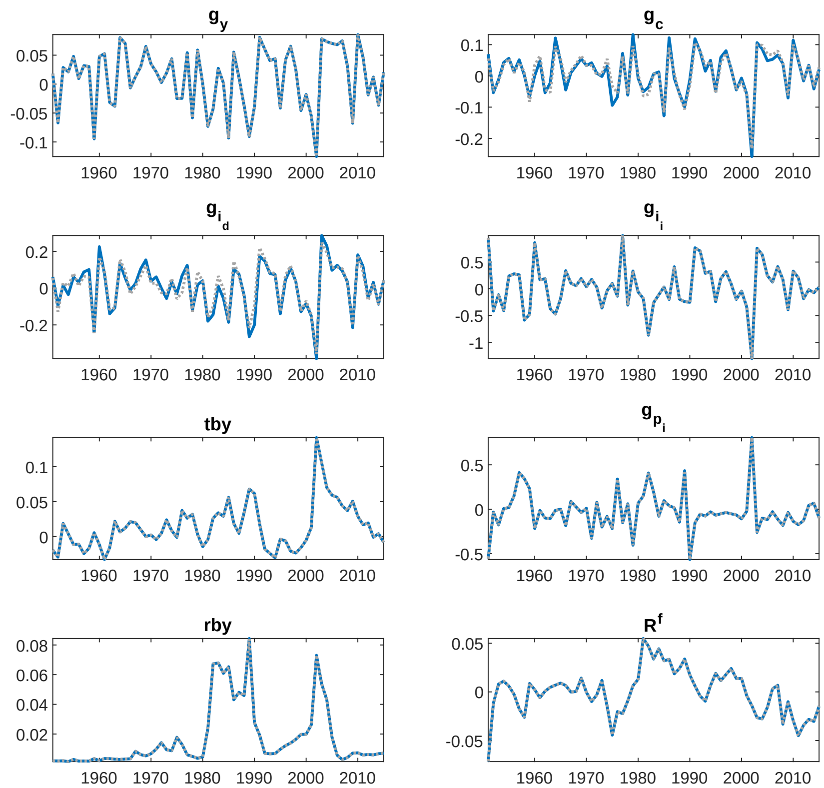

Figure 9: Observable variables and smoothed variables

Time series used in the Bayesian estimation: output growth (g_y); private consumption growth (g_c); domestic investment growth (g_{i_d}); imported investment growth (g_{i_i}); the trade-balance-to-output ratio (tby); interest rate payments (Rb_y); the ratio of the relative price of imported capital investment goods to GDP deflator, in demeaned growth rates (g_{p_i}); and the risk-free interest rate (R^f). The blue line is the data, the gray discontinued line is the smoothed variable.

Variables' definitions in the aggregate, nominal terms: output is the annual GDP. Consumption is private consumption. Total investment is gross fixed capital formation. In the data, gross fixed capital formation is the sum of constructions and durable production equipment. The latter is composed of imported and domestic transport material as well as imported and domestic machinery and equipment. We define domestic investment as the sum of three variables: constructions, domestic transport material, and domestic machinery and equipment. This variable is in real terms in the data. Output, consumption, and government spending are deflated by the GDP deflator. We work with per capita variables and obtain the growth rates by log differences.

To construct the imported investment and the price of imported investment, we proceed as follows. Real imported investment is the sum of real imported transports and real imported machinery and equipment. We also have data on nominal imported investment (transports plus machinery and equipment). To compute the implicit price deflator of imported investment, we divide nominal imported investment by real imported investment. To compute the relative price of imported investment in terms of domestic goods, we divide this price by the GDP deflator.

Finally, as an observable, we use per-capita imported investment in growth obtained as follows: $g_{i_{i,t}} = \ln(i_{i,t}) - \ln(i_{i,t-1})$.

The trade balance in nominal terms is nominal exports minus nominal imports. The trade balance to output ratio: it is the ratio of trade balance and output is in levels.

The variable *rby* is annual net interest rate payments to the rest of the world, divided by output.

The risk-free interest rate is the demeaned risk-free rate using the short-term nominal interest rate from Jordà et al. (2019) for the US in real terms, by removing US CPI (consumer price index) current inflation.

Population data comes from the World Bank and FRED (Federal Reserve Economic Data).

9.1.2 Stylized facts: International data

International data for capital imports come from the World Integrated Trade Solutions from the World Bank. This variable is the sum of two import categories in the Broad Economic Categories classification: Capital goods (except transport equipment), category 41, and Transport equipment, industrial, category 521. Data are in thousands of dollars, and imports include the rest of the world as partners. Due to data availability, the period under consideration is 1976 to 2018 but differs considerably among countries. In the following table, we present the sample period for each country and the average percentage of imported investment over total imports, for the corresponding period.

Country	Sample	Imported investment/Imports
Argentina	1980-2018	21%
Antigua and Barbuda	2005-2018	12%
Barbados	1980-2018	13%
Belize	1992-2018	16%
Bolivia	1977-2015	27%
Brazil	1983-2018	16%
Bulgaria	1996-2018	15%
Chile	1983-2018	24%
Colombia	1978-2018	24%
Costa Rica	1986-2018	15%
Dominican Republic	2001-2018	14%
Ecuador	1980-2018	23%
Egypt, Arab Rep.	1981-2018	13%
El Salvador	1986-2018	14%
Guatemala	1986-2018	16%
Guyana	1997-2018	20%
Honduras	1986-2018 (disc.)	17%
Iran	1986-2018 (disc.)	23%
Jordan	1981-2018	13%
Mexico	1986-2018	20%
Morocco	1976-2018	17%
Panama	1986-2018	13%
Peru	1976-2018	21%
Paraguay	1983-2018	24%
St. Lucia	1981-2018	13%
Tunisia	1980-2018	16%
Turkey	1985-2018	20%
Uruguay	1983-2018	16%
Venezuela	1983-2018	24%

9.2 Some facts during Sudden Stops: Emerging markets

The following figure complements the analysis in section 2.

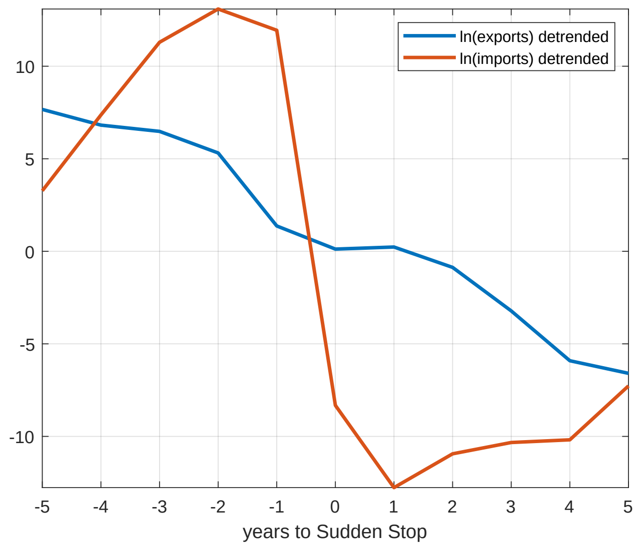

Figure 10: Detrended exports and imports during a Sudden Stop in emerging countries

Note: The period 0 identifies the year of a Sudden Stop episode. The figure presents mean values of percentage deviations of imports and exports from a linear trend in a sample of 64 Sudden Stops.

9.3 Equilibrium conditions

9.3.1 Equilibrium equations

Household's problem:

$$\nu_t \left(C_t - \alpha \tilde{C}_{t-1} - X_{t-1} \frac{h_{f,t}^{\omega_f}}{\omega_f} - X_{t-1} \frac{h_{d,t}^{\omega_d}}{\omega_d} \right)^{-\sigma} = \lambda_t X_{t-1}^{-\sigma},$$

$$\nu_t \left(C_t - \alpha \tilde{C}_{t-1} - X_{t-1} \frac{h_{f,t}^{\omega_f}}{\omega_f} - X_{t-1} \frac{h_{d,t}^{\omega_d}}{\omega_d} \right)^{-\sigma} X_{t-1} h_{f,t}^{\omega_f - 1} = W_{f,t} \lambda_t X_{t-1}^{-\sigma},$$

$$\nu_t \left(C_t - \alpha \tilde{C}_{t-1} - X_{t-1} \frac{h_{f,t}^{\omega_f}}{\omega_f} - X_{t-1} \frac{h_{d,t}^{\omega_d}}{\omega_d} \right)^{-\sigma} X_{t-1} h_{d,t}^{\omega_d - 1} = W_{d,t} \lambda_t X_{t-1}^{-\sigma},$$

$$\lambda_t = \beta g_{x,t}^{-\sigma} R_{t+1} \mathbb{E}_t \left[\lambda_{t+1} \right],$$

$$C_t + D_t R_t = W_{d,t} h_{d,t} + W_{f,t} h_{f,t} + D_{t+1} + \Lambda_t,$$

$$\Lambda_t = \Pi_{ki,t} + \Pi_{kd,t} + \Pi_{Id,t} + T_{i,t} + T_{d,t} - S_t.$$

Final goods producer:

$$r_{d,t} = a_t(1-\gamma)(X_t h_{f,t})^{\gamma} K_t^{1-\gamma-\mu_1} a_1 K_{d,t}^{\mu_1 - 1},$$

$$W_{f,t} = a_t \gamma K_t^{1-\gamma}(X_t h_{f,t})^{\gamma-1} X_t,$$

$$r_{i,t} = a_t(1-\gamma)(X_t h_{f,t})^{\gamma} K_t^{1-\gamma-\mu_1}(1-a_1)\Xi_{t-1}^{\mu_1} K_{i,t}^{\mu_1-1},$$

$$Y_t = a_t (X_t h_{f,t})^{\gamma} K_t^{1-\gamma},$$

$$K_t = \left(a_1 K_{d,t}^{\mu_1} + (1-a_1)\left(\Xi_{t-1} K_{i,t}\right)^{\mu_1}\right)^{\frac{1}{\mu_1}}.$$

Imported capital producer:

$$q_{i,t} - \Lambda_{i,t}\Big[1 + \Phi'_{K_{i,t+1}}\Big(\frac{K_{i,t+1}}{K_{i,t}}\Big)\Big] =$$

$$\mathbb{E}_t \beta \frac{\lambda_{t+1}}{\lambda_t} g_{x,t}^{-\sigma}\left(q_{i,t+1}(1-\delta_{ki}) - \Lambda_{i,t+1}\left[(1-\delta_{ki}) - \Phi\Big(\frac{K_{i,t+2}}{K_{i,t+1}}\Big) - \Phi'_{K_{i,t+1}}\Big(\frac{K_{i,t+2}}{K_{i,t+1}}\Big)\right]\right),$$

$$\Lambda_{i,t} = P_{i,t},$$

$$K_{i,t+1} = K_{i,t}(1-\delta_{ki}) + I_{i,t} - \Phi\Big(\frac{K_{i,t+1}}{K_{i,t}}\Big) K_{i,t},$$

$$\Pi_{ki,t} = q_{i,t} K_{i,t+1} - q_{i,t} K_{i,t}(1-\delta_{ki}) - P_{i,t} I_{i,t}.$$

Domestic capital producers:

$$q_{d,t} - \Lambda_{d,t}\Big[1 + \Phi'_{K_{d,t+1}}\Big(\frac{K_{d,t+1}}{K_{d,t}}\Big)\Big] =$$

$$\mathbb{E}_t \beta \frac{\lambda_{t+1}}{\lambda_t} g_{x,t}^{-\sigma}\left(q_{d,t+1}(1-\delta_{kd}) - \Lambda_{d,t+1}\left[(1-\delta_{kd}) - \Phi\Big(\frac{K_{d,t+2}}{K_{d,t+1}}\Big) - \Phi'_{K_{d,t+1}}\Big(\frac{K_{d,t+2}}{K_{d,t+1}}\Big)\right]\right),$$

$$\Lambda_{d,t} = p_{d,t},$$

$$K_{d,t+1} = K_{d,t}(1-\delta_{kd}) + I_{d,t} - \Phi\Big(\frac{K_{d,t+1}}{K_{d,t}}\Big) K_{d,t},$$

$$\Pi_{kd,t} = q_{d,t}K_{d,t+1} - q_{d,t}K_{d,t}(1-\delta_{kd}) - p_{d,t}I_{d,t}.$$

Imported capital entrepreneurs:

$$R_{i,t+1} = \frac{r_{i,t+1} + q_{i,t+1}(1-\delta_{ki})}{q_{i,t}},$$

$$\frac{R_{i,t+1}}{R_{t+1}}\left[\Gamma(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t}) - \mu_{ki}G(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t})\right](1+\varsigma_{i,t}) = \varsigma_{i,t},$$

$$\mathbb{E}_t\left[\frac{R_{i,t+1}q_{i,t}K_{i,t+1}}{R_{t+1}N_{i,t+1}}\left(1-\Gamma\left(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t}\right)\right)\right] =$$

$$\mathbb{E}_t\left[\frac{1-F\left(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t}\right)}{1-F\left(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t}\right) - \mu_{ki}\bar{\omega}_{i,t+1}F_\omega\left(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t}\right)}\right]$$

$$q_{i,t}K_{i,t+1} = N_{i,t+1} + B_{i,t+1},$$

$$N_{i,t+1} = \gamma^e\left[R_{i,t}q_{i,t-1}K_{i,t} - R_tB_{i,t} - \mu_{ki}\int_0^{\bar{\omega}_{i,t}}\omega dF(\omega)R_{i,t}q_{i,t-1}K_{i,t}\right] + WE_{i,t}.$$

Domestic capital entrepreneurs:

$$R_{d,t+1} = \frac{r_{d,t+1} + q_{d,t+1}(1-\delta_{kd})}{q_{d,t}}$$

$$\frac{R_{d,t+1}}{R_{t+1}}\left[\Gamma(\bar{\omega}_{d,t+1}, \sigma^d_{\omega,t}) - \mu_{kd}G(\bar{\omega}_{d,t+1}, \sigma^d_{\omega,t})\right](1+\varsigma_{d,t}) = \varsigma_{d,t},$$

$$\mathbb{E}_t\left[\frac{R_{d,t+1}q_{d,t}K_{d,t+1}}{R_{t+1}N_{d,t+1}}\left(1-\Gamma\left(\bar{\omega}_{d,t+1}, \sigma^d_{\omega,t}\right)\right)\right] =$$

$$\mathbb{E}_t\left[\frac{1-F\left(\bar{\omega}_{d,t+1}, \sigma^d_{\omega,t}\right)}{1-F\left(\bar{\omega}_{d,t+1}, \sigma^d_{\omega,t}\right) - \mu_{kd}\bar{\omega}_{d,t+1}F_\omega\left(\bar{\omega}_{d,t+1}, \sigma^d_{\omega,t}\right)}\right]$$

$$q_{d,t}K_{d,t+1} = N_{d,t+1} + B_{d,t+1},$$

$$N_{d,t+1} = \gamma^e\left[R_{d,t}q_{d,t-1}K_{d,t} - R_tB_{d,t} - \mu_{kd}\int_0^{\bar{\omega}_{d,t}}\omega dF(\omega)R_{d,t}q_{d,t-1}K_{d,t}\right] + WE_{d,t}.$$

Domestic Investment producer:

$$I_{d,t} = \tilde{a}^d_t(h_{d,t})^\rho,$$

$$\Pi_{Id,t} = p_{d,t}a^d_t(h_{d,t})^\rho - W_{h,t}h_{d,t},$$

$$W_{d,t} = \rho p_{d,t} \frac{I_{d,t}}{h_{d,t}}.$$

Exogenous shock processes:

$$\ln\left(g_{t+1}/\bar{g}\right) = \rho_g \ln\left(g_t/\bar{g}\right) + \epsilon^g_{t+1}; \qquad \epsilon^g_t \sim N\left(0, \sigma^2_g\right); \qquad |\rho_g| < 1,$$

$$\ln a_{t+1} = \rho_a \ln a_t + \rho_{a,ad}\epsilon^{a,ad}_{t+1} + \epsilon^a_{t+1}; \qquad \epsilon^a_t \sim N\left(0, \sigma^2_a\right); \qquad |\rho_a| < 1,$$

$$\ln a_{d,t+1} = \rho_{ad} \ln a_{d,t} + \rho_{ad,a}\epsilon^{a,ad}_{t+1} + \epsilon^{ad}_{t+1}; \qquad \epsilon^{ad}_t \sim N\left(0, \sigma^2_{ad}\right); \qquad |\rho_{ad}| < 1,$$

$$\ln \nu_{t+1} = \rho_\nu \ln \nu_t + \epsilon^\nu_{t+1}; \quad \epsilon^\nu_t \sim N\left(0, \sigma^2_\nu\right); \quad |\rho_\nu| < 1,$$

$$\ln \mu_{t+1} = \rho_\mu \ln \mu_t + \epsilon^\mu_{t+1}; \qquad \epsilon^\mu_t \sim N\left(0, \sigma^2_\mu\right); \qquad |\rho_\mu| < 1,$$

$$\ln R_{ft+1} = \rho_{R_f} \ln R_{ft} + \epsilon^{Rf}_{t+1}; \qquad \epsilon^{Rf}_t \sim N\left(0, \sigma^2_{R_f}\right); \qquad |\rho_{R_f}| < 1,$$

$$\ln\left(p_{i,t+1}/\bar{p}\right) = \rho_p \ln\left(p_{i,t}/\bar{p}\right) + \epsilon^p_{t+1}; \qquad \epsilon^p_t \sim N\left(0, \sigma^2_p\right); \qquad |\rho_p| < 1,$$

$$\ln \sigma^i_{\omega,t} = \left(1 - \rho^i_\sigma\right) \ln \mu^i_\sigma + \rho^i_\sigma \ln \sigma^i_{\omega,t-1} + \eta^i_\sigma \varepsilon_{\sigma,t}; \qquad \epsilon^\sigma_t \sim N\left(0, \sigma^{2,i}_\sigma\right); \qquad |\rho^i_\sigma| < 1,$$

$$\ln \sigma^d_{\omega,t} = \left(1 - \rho^d_\sigma\right) \ln \mu^d_\sigma + \rho^d_\sigma \ln \sigma^d_{\omega,t-1} + \eta^d_\sigma \varepsilon_{\sigma,t}; \qquad \epsilon^\sigma_t \sim N\left(0, \sigma^{2,d}_\sigma\right); \qquad |\rho^d_\sigma| < 1,$$

$$s_{t+1} = (1 - \rho_s)\bar{s} + \rho_s s_t + \epsilon^s_{t+1}; \quad \epsilon^s_t \sim N\left(0, \sigma^2_s\right); \quad |\rho_s| < 1.$$

Definitions:

$$R_t = R_{o,t-1} e^{\mu_t - 1},$$

$$R_{o,t} = R^* + \exp\left(R_{f,t} - 1\right) + \psi_D \left[\exp\left(\tilde{d}_{t+1} + \tilde{b}_{t+1} - (\bar{d} + \bar{b})\right) - 1 \right] +$$
$$\psi_Y \left[\exp\left(y_t - \bar{y}\right) - 1 \right],$$

$$B_t = B_{i,t} + B_{d,t},$$

$$F(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}) = \Theta\left(\frac{log(\bar{\omega}_{j,t+1}) + \frac{1}{2}{\sigma^j_{\omega,t}}^2}{\sigma^j_{\omega,t}} \right) \text{ for } j = i, d,$$

$$G(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}) = 1 - \Theta\left(\frac{\frac{1}{2}\sigma^{j2}_{\omega,t} - \log \bar{\omega}_{j,t+1}}{\sigma^j_{\omega,t}} \right) \text{ for } j = i, d,$$

$$\Gamma(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}) = \bar{\omega}_{j,t+1}\left(1 - F(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t})\right) + G(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}) \text{ for } j = i, d,$$

$$T_{i,t} = \left(1 - \frac{1}{1 - e^{\bar{\gamma}^e}}\right) V_{i,t} - w^e \Gamma_{t-1},$$

$$T_{d,t} = \left(1 - \frac{1}{1 - e^{\bar{\gamma}^e}}\right) V_{d,t} - w^e \Gamma_{t-1},$$

$$V_{i,t} = R_{i,t} q_{i,t-1} K_{i,t} - R_t B_{i,t} - \mu_{ki} \int_0^{\bar{\omega}_{i,t}} \omega dF(\omega) R_{i,t} q_{i,t-1} K_{i,t},$$

$$V_{d,t} = R_{d,t} q_{d,t-1} K_{d,t} - R_t B_{d,t} - \mu_{kd} \int_0^{\bar{\omega}_{d,t}} \omega dF(\omega) R_{d,t} q_{d,t-1} K_{d,t},$$

$$X_t = \Gamma_t^{\eta} \left[\left(a_1 \bar{K}_{d,t}^{\mu_1} + (1 - a_1) \left(\Xi_{t-1} \bar{K}_{i,t} \right)^{\mu_1} \right)^{\frac{1}{\mu_1}} \right]^{1-\eta},$$

$$TB_t = R_t D_t - D_{t+1} + R_t (B_{i,t} + B_{d,t}) - (B_{i,t+1} + B_{d,t+1}),$$

$$GDP_t = Y_t + p_{d,t} I_{d,t} - \mu_{ki} G(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t}) R_{i,t} q_{i,t-1} K_{i,t-1} - \mu_{kd} G(\bar{\omega}_{d,t+1}, \sigma^d_{\omega,t}) R_{d,t} q_{d,t-1} K_{d,t-1}.$$

9.3.2 Stationary equations

There are three sources of growth in the model: the trend in the imported investment price ($P_{i,t}$) given by Ξ_t, the trend productivity shock Γ_t and the trend of the economy X_t, which depends on capital accumulation and Γ_t. The corresponding growth rates are $g_{\Xi,t}$, g_t characterized by equation 17, and $g_{x,t}$.

In order to solve the model, we need to stationarize the equilibrium equations from section 9.3, dividing each variable by the corresponding trend. In general, we adopt the notation of working with capital letters for growing variables and lowercase letters for detrended variables. We make an exception for $q_{i,t}$ and $\Lambda_{i,t}$ whose detrended versions are $\tilde{q}_{i,t}$ and $\tilde{\Lambda}_{i,t}$.

First, from equation 19 we need each component of domestic absorption to grow at the same rate as output, X_{t-1}. In particular, $P_{i,t} I_{i,t}$ has to grow at rate $X_{t-1} g_{\Xi,t}$. This outcome happens only if the trend of imported investment is given by $\frac{X_{t-1}}{\Xi_{t-1}}$ and the growth rate of imported investment is $\frac{g_{x,t}}{g_{\Xi,t}}$.

Notice that this fact is consistent with the data. In the dataset, we see that output, consumption, domestic investment, and the trade balance have a similar growth rate, close to 1 percent on average, in the whole period. This growth rate is $\bar{g} - 1$ in the model. However, the imported investment grows at an average rate of 3.6 percent and the imported investment price grows at -2.4 percent, which means the gross growth rate of imported investment prices is 0.9756 on average what we call $\bar{g_{\Xi}}$. Then we have $\frac{\bar{g_{x,t}}}{\bar{g_{\Xi,t}}} = 1.034$, very close to the empirical gross growth rate of imported investment.

Since the price of domestic investment does not grow, the trend in domestic investment, and then, the one in domestic capital, is equal to X_{t-1}.

We follow an analogous approach to find the trend of the rest of the endogenous variables. The complete set of stationary equilibrium equations is the following.

Household's problem:

$$\nu_t \left(c_t - \alpha \frac{\tilde{c}_{t-1}}{g_{x,t-1}} - \frac{h_{f,t}^{\omega_f}}{\omega_f} - \frac{h_{d,t}^{\omega_d}}{\omega_d} \right)^{-\sigma} = \lambda_t,$$

$$\nu_t \left(c_t - \alpha \frac{\tilde{c}_{t-1}}{g_{x,t-1}} - \frac{h_{f,t}^{\omega_f}}{\omega_f} - \frac{h_{d,t}^{\omega_d}}{\omega_d} \right)^{-\sigma} h_{f,t}^{\omega_f - 1} = w_{f,t}\lambda_t,$$

$$\nu_t \left(c_t - \alpha \frac{\tilde{c}_{t-1}}{g_{x,t-1}} - \frac{h_{f,t}^{\omega_f}}{\omega_f} - \frac{h_{d,t}^{\omega_d}}{\omega_d} \right)^{-\sigma} h_{d,t}^{\omega_d - 1} = w_{d,t}\lambda_t,$$

$$\lambda_t = \beta R_{t+1} g_{x,t}^{-\sigma} \mathbb{E}_t \left[\lambda_{t+1} \right],$$

$$c_t + d_t R_t = w_{f,t} h_{f,t} + w_{d,t} h_{d,t} + d_{t+1} g_{x,t} + \tilde{\Lambda}_t,$$

$$\tilde{\Lambda}_t = \pi_{ki,t} + \pi_{kd,t} + \pi_{Id,t} + t_{i,t} + t_{d,t} - s_t.$$

Final goods producer:

$r_{i,t}$ grows at rate Ξ_{t-1}. $W_{f,t}$, K_t and Y_t grows at rate X_{t-1}. $r_{d,t}$ does not grow.

$$r_{d,t} = a_t (1-\gamma)(g_{x,t} h_{f,t})^{\gamma} k_t^{1-\mu_1-\gamma} a_1 k_{d,t}^{\mu_1 - 1},$$

$$w_{f,t} = a_t \gamma k_t^{1-\gamma} (g_{x,t} h_{f,t})^{\gamma-1} g_{x,t},$$

$$r_{i,t} = a_t (1-\gamma)(g_{x,t} h_{f,t})^{\gamma} k_t^{1-\mu_1-\gamma} (1-a_1) k_{i,t}^{\mu_1 - 1},$$

$$y_t = a_t (g_{x,t} h_{f,t})^{\gamma} k_t^{1-\gamma},$$

$$k_t = \left(a_1 k_{d,t}^{\mu_1} + (1-a_1) k_{i,t}^{\mu_1} \right)^{\frac{1}{\mu_1}}.$$

Imported capital producer:

Here, we have the following: $I_{i,t}$ and $K_{i,t}$ grow at rate: $\frac{X_{t-1}}{\Xi_{t-1}}$. $p_{i,t}$, $q_{i,t}$ and $\Lambda_{i,t}$ grow at rate Ξ_{t-1}. Π_t grows at rate X_{t-1},

$$\tilde{q}_{i,t} - \tilde{\Lambda}_{i,t}\left[1 + \Phi'_{k_{i,t+1}}\left(\frac{k_{i,t+1}}{k_{i,t}} \cdot \frac{g_{x,t}}{g_{\Xi,t}}\right)\right] =$$

$$\mathbb{E}_t\beta\frac{\lambda_{t+1}}{\lambda_t}\frac{g_{\Xi,t}}{g^{\sigma}_{x,t}}\Bigg(\tilde{q}_{i,t+1}(1-\delta_{ki}) - \tilde{\Lambda}_{i,t+1}\Big[(1-\delta_{ki}) - \Phi\left(\frac{k_{i,t+2}}{k_{i,t+1}} \cdot \frac{g_{x,t+1}}{g_{\Xi,t+1}}\right)$$
$$-\Phi'_{k_{i,t+1}}\left(\frac{k_{i,t+2}}{k_{i,t+1}} \cdot \frac{g_{x,t+1}}{g_{\Xi,t+1}}\right)\Big]\Bigg)$$

$$\tilde{\Lambda}_{i,t} = p_{i,t},$$

$$k_{i,t+1}\frac{g_{x,t}}{g_{\Xi,t}} = k_{i,t}(1-\delta_{ki}) + i_{i,t} - \Phi\Big(\frac{k_{i,t+1}}{k_{i,t}}\frac{g_{x,t}}{g_{\Xi,t}}\Big)k_{i,t},$$

$$\pi_{ki,t} = \tilde{q}_{i,t}k_{i,t+1}\frac{g_{x,t}}{g_{\Xi,t}} - \tilde{q}_{i,t}k_{i,t}(1-\delta_{ki}) - p_{i,t}i_{i,t}.$$

Domestic capital producers:
$q_{d,t}$, $p_{d,t}$ and $\Lambda_{d,t}$ do not grow. $K_{d,t}$, $I_{d,t}$ and $\Pi_{d,t}$ grow at rate X_{t-1},

$$q_{d,t} - \Lambda_{d,t}\left[1 + \Phi'_{k_{d,t+1}}\left(\frac{k_{d,t+1}}{k_{d,t}}g_{x,t}\right)\right] =$$

$$\mathbb{E}_t\beta\frac{\lambda_{t+1}}{\lambda_t}g^{-\sigma}_{x,t}\Bigg(q_{d,t+1}(1-\delta_{kd}) - \Lambda_{d,t+1}\Big[(1-\delta_{kd}) - \Phi\left(\frac{k_{d,t+2}}{k_{d,t+1}}g_{x,t+1}\right)$$
$$-\Phi'_{k_{d,t+1}}\left(\frac{k_{d,t+2}}{k_{d,t+1}}g_{x,t+1}\right)\Big]\Bigg)$$

$$\Lambda_{d,t} = p_{d,t},$$

$$k_{d,t+1}g_{x,t} = k_{d,t}(1-\delta_{kd}) + i_{d,t} - \Phi\Big(\frac{k_{d,t+1}}{k_{d,t}}\Big)k_{d,t},$$

$$\pi_{kd,t} = q_{d,t}k_{d,t+1} - q_{d,t}k_{d,t}(1-\delta_{kd}) - i_{d,t}p_{d,t}.$$

Imported capital entrepreneurs:
$R_{i,t+1}$ does not grow. N_t, $B_{i,t}$, and $WE_{d,t}$ grow at rate X_{t-1},

$$\frac{R_{i,t+1}}{g_{\Xi,t}} = \frac{r_{i,t+1} + \tilde{q}_{i,t+1}(1-\delta_{ki})}{\tilde{q}_{i,t}},$$

$$\frac{R_{i,t+1}}{R_{t+1}}\Big[\Gamma(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t}) - \mu_{ki}G(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t})\Big](1+\varsigma_{i,t}) = \varsigma_{i,t},$$

$$\mathbb{E}_t\left[\frac{R_{i,t+1}\tilde{q}_{i,t}k_{i,t+1}}{R_{t+1}n_{i,t+1}g_{\Xi,t}}\left(1-\Gamma\left(\bar{\omega}_{i,t+1},\sigma^i_{\omega,t}\right)\right)\right]=$$

$$\mathbb{E}_t\left[\frac{1-F\left(\bar{\omega}_{i,t+1},\sigma^i_{\omega,t}\right)}{1-F\left(\bar{\omega}_{i,t+1},\sigma^i_{\omega,t}\right)-\mu_{ki}\bar{\omega}_{i,t+1}F_\omega\left(\bar{\omega}_{i,t+1},\sigma^i_{\omega,t}\right)}\right]$$

$$\tilde{q}_{i,t}k_{i,t+1}=\left(n_{i,t+1}+b_{i,t+1}\right)g_{\Xi,t},$$

$$n_{i,t+1}g_{x,t}=\gamma^e\left[R_{i,t}\frac{\tilde{q}_{i,t-1}k_{it}}{g_{\Xi,t-1}}\left(1-\mu_{ki}\int_0^{\bar{\omega}_{i,t}}\omega dF(\omega)\right)-R_{i,t}b_{i,t}\right]+we_{i,t}.$$

Domestic capital entrepreneurs:

$$R_{d,t+1}=\frac{r_{d,t+1}+q_{d,t+1}(1-\delta_{kd})}{,}q_{d,t}$$

$$\frac{R_{d,t+1}}{R_{t+1}}\left[\Gamma(\bar{\omega}_{d,t+1},\sigma^d_{\omega,t})-\mu_{kd}G(\bar{\omega}_{d,t+1},\sigma^d_{\omega,t})\right](1+\varsigma_{d,t})=\varsigma_{d,t},$$

$$\mathbb{E}_t\left[\frac{R_{d,t+1}q_{d,t}k_{d,t+1}}{R_{t+1}n_{d,t+1}}\left(1-\Gamma\left(\bar{\omega}_{d,t+1},\sigma^d_{\omega,t}\right)\right)\right]=$$

$$\mathbb{E}_t\left[\frac{1-F\left(\bar{\omega}_{d,t+1},\sigma^d_{\omega,t}\right)}{1-F\left(\bar{\omega}_{d,t+1},\sigma^d_{\omega,t}\right)-\mu_{kd}\bar{\omega}_{d,t+1}F_\omega\left(\bar{\omega}_{d,t+1},\sigma^d_{\omega,t}\right)}\right]$$

$$q_{d,t}k_{d,t+1}=n_{d,t+1}+b_{d,t+1},$$

$$n_{d,t+1}g_{x,t}=\gamma^e\left[R_{d,t}q_{d,t-1}k_{d,t}\left(1-\mu_{kd}\int_0^{\bar{\omega}_{d,t}}\omega dF(\omega)\right)-R_{t-1}b_{d,t}\right]+we_{d,t}.$$

Domestic investment producers:

$$i_{d,t}=\bar{a}_d a_{t,d}g_{x,t}(h_{d,t})^\rho,$$

$$\pi_{Id,t}=p_{d,t}i_{d,t}-w_{h,t}h_{d,t},$$

$$w_{d,t}=\rho p_{d,t}\frac{i_{d,t}}{h_{d,t}}.$$

Exogenous shock processes: see section 9.3.

Definitions:

$T_{i,t}$ and $T_{d,t-1}$ grow at rate X_{t-1}.

$$R_t=R_{o,t-1}e^{\mu_t-1},$$

$$R_{o,t} = R^* + \exp\left(R_{f,t} - 1\right) + \psi_D \Bigg[\exp\Big(\tilde{d}_{t+1} + \tilde{b}_{t+1} - (\bar{d} + \bar{b}) \Big) - 1 \Bigg] +$$

$$\psi_Y \Bigg[\exp\left(y_t - \bar{y}\right) - 1 \Bigg],$$

$$b_t = b_{i,t} + b_{d,t},$$

$$F(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}) = \Theta \left(\frac{log(\bar{\omega}_{j,t+1}) + \frac{1}{2}{\sigma^j_{\omega,t}}^2}{\sigma^j_{\omega,t}} \right) \text{ for } j = i, d,$$

$$G(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}) = 1 - \Theta \left(\frac{\frac{1}{2}\sigma^{j2}_{\omega,t} - \log \bar{\omega}_{j,t+1}}{\sigma^j_{\omega,t}} \right) \text{ for } j = i, d,$$

$$\Gamma(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}) = \bar{\omega}_{j,t+1} \left(1 - F(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t})\right) + G(\bar{\omega}_{j,t+1}, \sigma^j_{\omega,t}) \text{ for } j = i, d,$$

$$t_{i,t} = \left(1 - \frac{1}{1 - e^{\bar{\gamma}^e}}\right) v_{i,t} - we_{i,t},$$

$$t_{d,t} = \left(1 - \frac{1}{1 - e^{\bar{\gamma}^e}}\right) v_{d,t} - we_{d,t},$$

$$v_{i,t} = R_{i,t} \frac{\tilde{q}_{i,t-1} k_{i,t}}{g_{\Xi,t-1}} - R_t b_{i,t} - \mu_{ki} \int_0^{\bar{\omega}_{i,t}} \omega dF(\omega) R_{i,t} \frac{\tilde{q}_{i,t-1} k_{i,t}}{g_{\Xi,t-1}},$$

$$v_{d,t} = R_{d,t} q_{d,t-1} k_{d,t} - R_t b_{d,t} - \mu_{kd} \int_0^{\bar{\omega}_{d,t}} \omega dF(\omega) R_{d,t} q_{d,t-1} k_{d,t},$$

$$g_{x,t} = g_t^{\eta} g_{x,t-1}^{1-\eta} \left[\left(a_1 \bar{k}_{d,t}^{\mu_1} + (1 - a_1) \left(\bar{k}_{i,t}\right)^{\mu_1} \right)^{\frac{1}{\mu_1}} \right]^{1-\eta},$$

$$tb_t = R_t d_t - d_{t+1} g_{x,t} + R_t (b_{i,t} + b_{d,t}) - (b_{i,t+1} + b_{d,t+1}) g_{x,t}$$

$$gdp_t = y_t + i_{d,t} p_{d,t} - \mu_{ki} G(\bar{\omega}_{i,t+1}, \sigma^i_{\omega,t}) R_{i,t} \frac{\tilde{q}_{i,t-1} k_{i,t}}{g_{\Xi,t-1}} - \mu_{kd} G(\bar{\omega}_{d,t+1}, \sigma^d_{\omega,t}) R_{d,t} q_{d,t-1} k_{d,t-1}.$$

9.4 Estimation

Table 7: Priors and estimation results: Measurement errors

	Prior					Posterior			
	Dist.	**LB**	**UB**	**Mean**	**s.d.**	**Mean**	**Median**	**10%**	**90%**
g_y	IG			0.001	0.003	0.00	0.00	0.00	0.00
g_c	IG			0.001	0.003	0.02	0.02	0.01	0.02
g_{i_d}	IG			0.001	0.003	0.04	0.04	0.03	0.05
g_{i_i}	IG			0.001	0.003	0.00	0.00	0.00	0.00
tby	IG			0.001	0.003	0.00	0.00	0.00	0.00
rby	IG			0.001	0.003	0.00	0.00	0.00	0.00
g_p	IG			0.001	0.003	0.00	0.00	0.00	0.00
R_f	IG			0.001	0.003	0.00	0.00	0.00	0.00

Note: Posterior distributions from Random Walk Metropolis Hasting algorithm of 1,000,000 draws, with 500,000 burn-in draws.

9.5 Quantitative results: Variance decomposition

In the following table, we present the decomposition of transitory shocks' contribution to the volatility of each observable variable.

Table 8: Variance decomposition (%)

Shock	g_y	g_c	g_{i_d}	g_{i_i}	tby	rby
a_t	16.9	10.0	3.3	0.7	2.1	2.4
ad_t	0.1	0.3	2.8	0.0	0.9	0.5
$\epsilon^{a,ad}$	63.0	47.8	66.1	2.6	25.6	16.7
Transitory	**80.0**	**58.1**	**72.2**	**3.3**	**28.6**	**19.6**

9.6 The interaction between the trend and financial factors: Supplementary figures

In this section, we present the impulse response function of the interest rate, investment, and debt to a one standard deviation shock in the spread (μ_t), the risk-free rate ($R_{f,t}$), or risk (σ_t^i, σ_t^d), to complement the analysis in section 6.2.

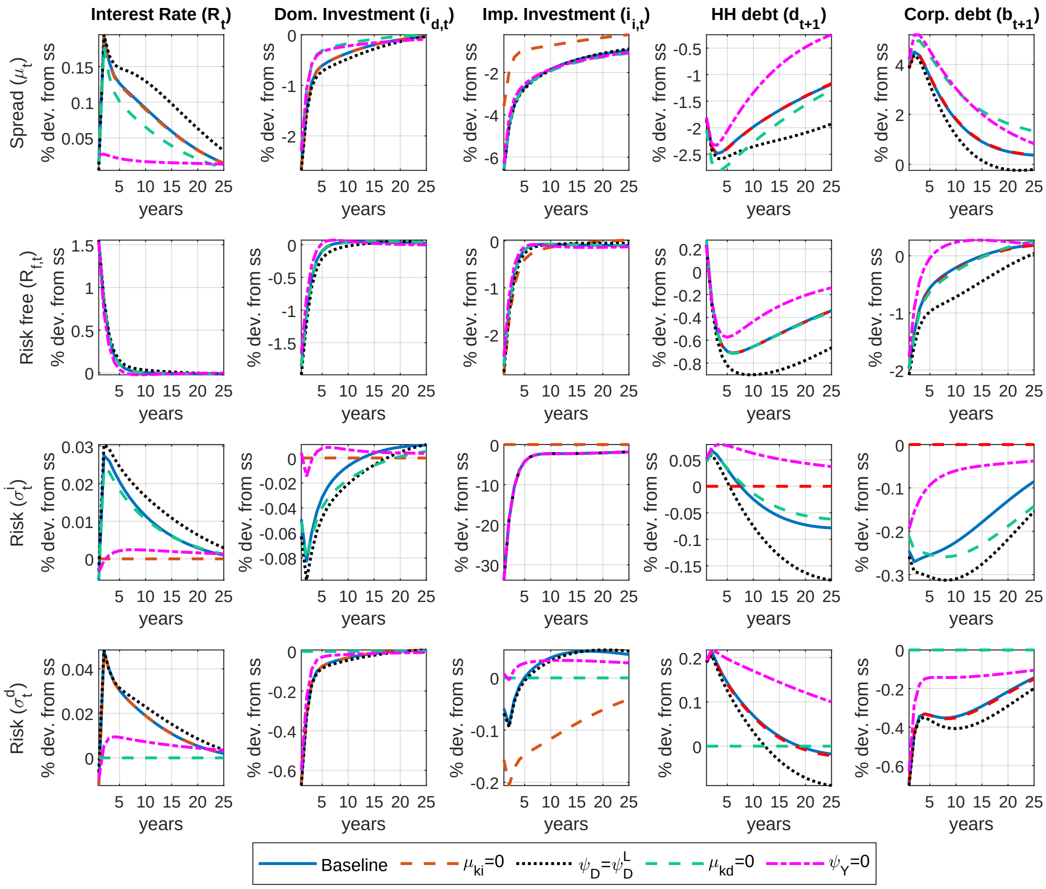

Figure 11: Impulse response function (in %) for the interest rate, investment, and debt

Note: R_t, $i_{d,t}$, $i_{i,t}$, d_{t+1}, and b_{t+1} impulse response function as percentage deviations in % from the steady state to a one standard deviation shock in μ_t, $R_{f,t}$, σ_t^i and σ_t^d.

9.7 A quantitative view of the long-run effect of Sudden Stops: Financial shocks

In this section, we disentangle the role of financial shocks. This role is shown in the third column of Figure 12. There, the counterfactual economy is one without financial shocks, but η is fixed in the posterior mean value. The picture compares them with a fully exogenous trend ($\eta = 1$) and a fully endogenous trend ($\eta = 0$). This figure highlights the interaction between the endogenous trend and financial shocks. In most of the crises, the trend would have been stronger without financial shocks if it were fully endogenous. This result implies that financial shocks affect the trend in a persistent way because of the endogenous component.

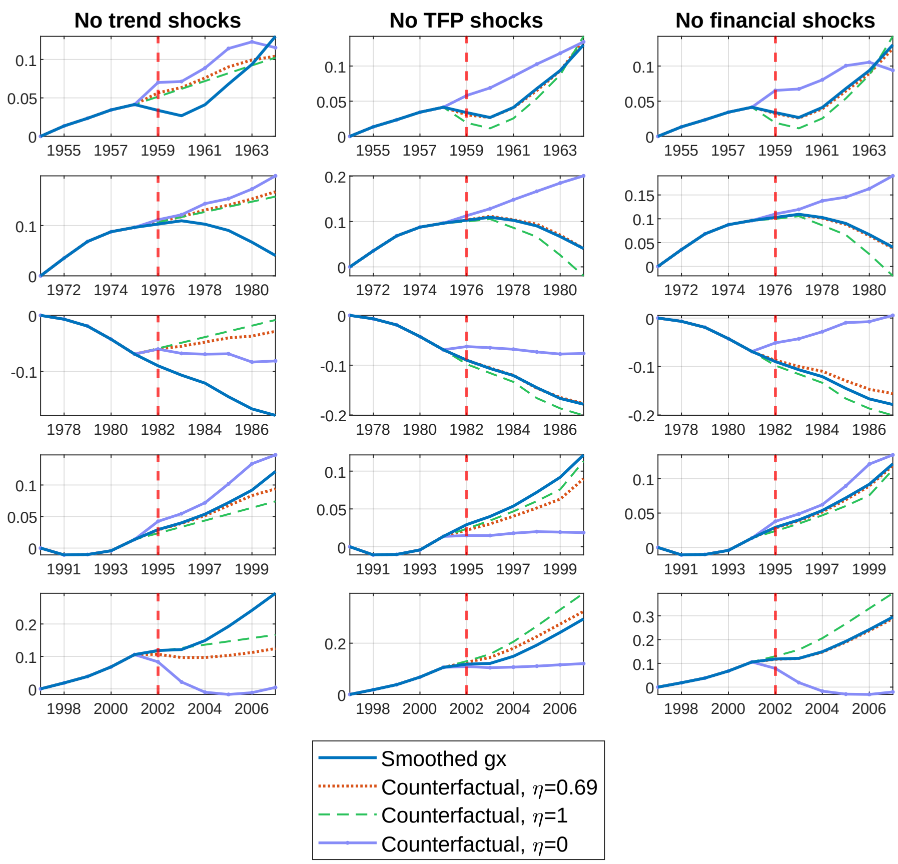

Figure 12: Smoothed and counterfactual trend dynamics

Note: Smoothed and counterfactual dynamics around Sudden Stop episodes in Argentina. The plots show the log of the trend ($ln(X_t)$) calculated as $ln(X_t) = ln(X_{t-1}) + ln(gx_t)$, normalizing $X_1 = 1$. The baseline corresponds to the smoothed value of the trend growth rate (gx_t). In the counterfactual dynamics, we simulate gx_t from $t-1$ to $t+5$, taking the smoothed value at $t-2$ as the initial condition. We remove the corresponding shocks during the simulated periods. The first column sets trend shocks equal to zero; the second column sets TFP in the final production sector (a_t), in the domestic investment sector (ad_t), and their covariance equal to zero; and the last column sets spread shocks (μ_t), risk shocks (σ_t), and risk-free interest rate shocks ($R_{f,t}$) equal to zero.

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