Essays on International Capital Flows

Nathan Converse

London School of Economics and Political Science

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Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I warrant that this authorisation does not, to the best of my belief, infringe the rights of any third party.

I declare that my thesis consists of approximately 30,000 words.

Statement of conjoint work

I confirm that Chapter 3 was jointly co-authored with Luca Fornaro and Dr. Gianluca Benigno, and that I contributed 80 percent of this work. The project was originally motivated by Luca Fornaro's and Gianluca Benigno's interest in empirically testing the model they developed in Benigno and Fornaro (2013). Other than brief passages in the chapter's introduction, all of the text was written by me. I carried out all of the empirical work in Chapter 3. My co-authors assisted in interpreting results and provided general guidance on the direction of the paper. The model setup was suggested by Luca Fornaro. I derived all of the analytical results presented in the chapter.

Abstract

This thesis examines the impact of international capital flows on small open economies from a theoretical and empirical perspective. The first chapter shows that where maturity mismatch is widespread, as in emerging markets, greater capital flow volatility negatively affects investment, output, and aggregate productivity. I build a model of a small open economy in which financial frictions force firms to engage in maturity mismatch, funding long-term projects with short-term debt. Greater uncertainty regarding the future availability of foreign borrowing causes firms to cut long-term investment, depressing aggregate investment and generating an endogenous drop in aggregate productivity.

The second chapter examines the relationship between capital flow volatility and economic performance using unique monthly frequency data set on international capital flows. I show that it is specifically the volatility of portfolio debt flows that negatively affects investment. Using financial development as a proxy for the extent of maturity mismatch in the economy, I find that the negative impact of debt flows is smaller where financial markets are more developed. Finally, I use industry-level data to show capital flow volatility depresses investment more in industries with longer average time-to-build. These findings are consistent with a role for maturity mismatch in transmitting volatility shocks.

The third chapter studies episodes of large capital inflows. These events are typically followed by an economic downturn and a reallocation of labor and capital into the non-tradables sector. The extent of labor reallocation is significantly related to the depth and length of the post-episode downturn. We interpret our results using a model of a two sector economy, showing that capital inflows episodes generated by a fall in international interest rates or a rise in future productivity will push labor into the notradables sector. Inflows caused by a productivity increase that has already occurred shift labor into tradables production. Allocation of labor therefore provides information on the underlying shock driving the capital inflows.

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Introduction

Since the late 1980s, emerging market economies have steadily liberalized controls on international capital flows (Chinn and Ito, 2006). This change in policy has coincided with a dramatic increase in the size of net capital flows to these economies, from an average of 30 billion dollars per year in the late 1980s to nearly one trillion dollars annually during the last five years (WEO, 2011), and an even greater increase in gross flows. The benefits to recipient countries during this period have been decidedly mixed, however (Kose et al., 2006; Rodrik and Subramanian, 2009). This dissertation presents new evidence on the costs and benefits of openness to international capital flows. The first two chapters use theory and empirical evidence to show that the financial uncertainty generated by the volatility of international capital flows adversely affects investment and output in emerging economies where financial markets are underdeveloped. The third chapter studies episodes of exceptionally large capital inflows and finds that these are typically followed by significant economic downturns, the length and severity of which is related to the sectoral allocation of resources during the inflows episode.

In Chapter 1, I build a model of a small open economy and show that changes in the level of uncertainty regarding the availability of foreign borrowing affect investment, output, and aggregate productivity in an economy where financial market imperfections force firms to engage in maturity mismatch, borrowing short-term to finance long-term projects. I begin the analysis by documenting a set of novel empirical facts on the relationship between capital flow volatility and output over the business cycle in 16 major emerging markets and 11 small, open high-income countries. These facts motivate my focus on maturity mismatch as a channel through which shocks to capital flow volatility affect the real economy. I then use the model to show that when maturity mismatch is widespread, as is the case in emerging markets, capital flow volatility contributes to the volatility of output and total factor productivity (TFP) and to the skewed distribution of growth rates. When financial frictions force firms to rely on short-term debt, long-term investments entail rollover risk. Greater uncertainty about the future availability of foreign borrowing increases rollover risk and causes firms to cut back on long-term investment, depressing both aggregate investment and TFP. As a result, capital flow volatility amplifies macroeconomic fluctuations in emerging markets, but not in advanced economies where firms can finance long-term projects without engaging in maturity mismatch. The interaction of uncertainty and maturity mismatch increases the negative effects of sudden stops and dampens the positive investment response to surges in capital inflows, contributing to the skewed distribution of growth rates.

Chapter 2 explores the empirical relationship between capital flow volatility and maturity mismatch and demonstrates that several features of this relationship are consistent with a role for maturity mismatch in transmitting shocks to capital flow volatility. I first confirm that the bivariate relationships discussed in Chapter 1 are robust to the addition of additional controls. Thus it remains the case that portfolio capital flow volatility affects output and investment emerging markets but not advanced economies, while it is specifically the volatility of portfolio debt flows that negatively affects investment, while the volatility of portfolio equity flows has no effect. Since debt flows can generate maturity mismatch while equity flows cannot, this is consistent with a role for maturity mismatch in transmitting shocks to volatility. Second, I use financial development as a proxy for the extent of maturity mismatch in the economy and find that the negative impact of debt flows is smaller where financial markets are more developed. Finally, I use industry-level data to show that increases in capital flow volatility have a larger negative impact on industries which have longer average time-to-build.

In Chapter 3, my co-authors and I analyzed the experiences of 69 middle- and high-income countries that underwent episodes of large capital inflows between 1975 and 2010. We show that while these events coincide with an initial increase in output and productivity, they are typically followed by a significant downturn. Large capital inflows are also associated with a reallocation of labor and capital into the nontradables sector. Episodes in which labor shifts the nontradables sector are followed by longer and deeper post-episode downturns. We interpret our empirical results using a model of a two sector open economy, showing that capital inflows episodes generated by a fall in the international interest rate or a rise in expected future productivity will push labor into the notradables sector. By contrast, inflows caused by a productivity increase which has already occurred shift labor into the tradables sector. Thus allocation of labor may provide an indication of the underlying shock driving the capital inflows.

Chapter 1

International Capital Flows, Financial Uncertainty, and Maturity Mismatch

1.1 Introduction

When comparing the growth performance of emerging markets to that of advanced economies, two major differences are evident. First, output is significantly more volatile in emerging markets.[1] Second, growth rates in emerging markets are more negatively skewed, exhibiting periodic sharp contractions without correspondingly large growth surges.[2] Recent work has showed that fluctuations in aggregate total factor productivity (TFP) are the key driver of both the volatility of growth and its skewed distribution.[3] These findings raise the question of why the efficiency with which capital and labor are

[1]Numerous studies have found that the volatility of GDP in emerging markets averages twice that of a typical advanced economy. Lucas (1988) comments on the greater volatility of growth rates in low income countries. Neumeyer and Perri (2005) and Aguiar and Gopinath (2007) systematically document the higher macroeconomic volatility of emerging markets in recent decades using quarterly frequency data. The greater volatility of developing and emerging economies over longer periods is documented by García-Cicco et al. (2010) and Koren and Tenreyro (2013) using annual data.

[2]Growth rates in advanced economies are also negatively skewed, but to a to a much lesser extent than in emerging markets. For emerging markets, the average skewness of annual rates from 1960 to 2010 was -1.25, while for small advanced economies skewness averaged around -0.4. Rodrik (1999), Raddatz (2007), and Mendoza (2010) provide evidence of the asymmetric distribution of growth rates in emerging markets.

[3]Bergoeing et al. (2002) show that this is the case for Mexico and Chile in the 1980s. Mendoza (2006) examines the role of TFP in the downturn and recovery that followed 1994 Mexican crisis. Evidence on the role of TFP in Argentina's volatile economic performance can by found in Kydland and Zarazaga (2007) and Kehoe (2007). Whereas these studies employ annual data, Aguiar and Gopinath (2007) use quarterly data to analyze the behavior of TFP in 13 emerging markets and 13 advanced economies. Meza and Quintin (2007) study the role of TFP in Indonesia, Korea, and Thailand during the Asian financial crisis

employed appears to fluctuate more substantially over time in some economies than in others. Is the elevated macroeconomic volatility observed in emerging markets simply a result of these economies being hit by larger fundamental shocks? Or does some feature of emerging markets cause them to respond differently when hit by shocks that affect all economies?

In this paper I show that when maturity mismatch is widespread, as is the case in emerging markets, capital flow volatility contributes to the volatility of output and TFP and to the skewed distribution of growth rates. When financial frictions force firms to rely on short-term debt, long-term investments entail rollover risk. Greater uncertainty about the future availability of foreign borrowing increases rollover risk and causes firms to cut back on long-term investment, depressing both aggregate investment and TFP. As a result, capital flow volatility amplifies macroeconomic fluctuations in emerging markets, but not in advanced economies where firms can finance long-term projects without engaging in maturity mismatch. The interaction of uncertainty and maturity mismatch increases the negative effects of sudden stops and dampens the positive investment response to surges in capital inflows, contributing to the skewed distribution of growth rates.

I begin by documenting two new empirical facts regarding fluctuations in capital flow volatility over the business cycle. First, I show that capital flow volatility in a set of 16 emerging markets is significantly countercyclical and leads the business cycle. By contrast, in a group of 11 small advanced economies capital flow volatility is acyclical. The difference in cyclicality motivates my focus on capital flow volatility as an explanation for the differing behavior of output.

I then separate the debt and equity components of portfolio capital flows and show that the negative relationship between volatility and output is much more pronounced for debt flows than for equity. This second empirical fact leads me to concentrate on the distinctive properties of portfolio debt flows. Unlike equity issuance, short-term debt can generate maturity mismatch on a firm's balance sheet if the firm's assets have a longer maturity. While maturity mismatch is a fundamental feature of banks, as in the canonical Diamond and Dybvig (1983) model, nonfinancial firms also incur maturity mismatch if they issue short-term debt to finance long-term investment projects.

To study the impact of capital flow volatility on output in the presence of maturity mismatch, I model firms' borrowing and investment decisions in a small open economy. Domestic firms owned by risk neutral entrepreneurs take on short-term foreign debt to finance investment in a portfolio of short- and long-term projects. The long-term technology is more productive but takes two periods to produce a return, so that long-term investments requires firms to engage in maturity mismatch. I incorporate capital flow volatility into the model by introducing uncertainty regarding the availability of borrowing during the intermediate period. If foreign borrowing is sufficiently scarce, firms will prematurely liquidate their long-term projects. Thus the combination of firms' inability to borrow long term and their uncertainty about future borrowing means that firms face rollover risk.

The presence of rollover risk means that firms face a trade-off when deciding how much to borrow and invest in long-term projects. Higher leverage increases their return on equity when borrowing is abundant during the life of the long-term project. If external funds are scarce, however, greater debt-financed long-term investment means that the firm must liquidate a larger share of the project, lowering the return. Moreover, the firm must take into account that higher debt also increases the probability that it will be forced to liquidate.

To analyze the impact of the fluctuations in capital flow volatility that I observe in the data, I examine how investment decisions change in response to an increase in uncertainty regarding the future availability of foreign lending. The uncertainty shock induces entrepreneurs to scale back their investments in long-term projects, and output falls even if external financing remains plentiful. This happens for two reasons. First, greater uncertainty increases the probability that firms will be forced to liquidate their projects. Second, a rise in uncertainty reduces the expected return on the long-term project in states of the world in which liquidation occurs. As a result, greater uncertainty reduces the optimal level of long-term investment. Uncertainty has no impact on the optimal level of investment in short-term projects, since these do not incur maturity mismatch.

The mechanism in my model increases the volatility of output and TFP observed in emerging markets and contributes to the skewed distribution of their growth rates. Because volatility shocks alter long-term investment while leaving short-term investment unchanged, they generate fluctuations in aggregate investment. For the same reason, volatility shocks alter the share of investment allocated to more productive long-term projects, leading to endogenous changes in aggregate TFP. This is in contrast to the existing literature on emerging market business cycles, which treats more volatile TFP as exogenous (e.g. Neumeyer and Perri, 2005; Aguiar and Gopinath, 2007). Since a jump in uncertainty both depresses investment and reduces TFP, output falls as well. Conversely, a reduction in uncertainty boosts investment, productivity, and output. Therefore when maturity mismatch is a feature of the macroeconomy, shocks to capital flow volatility constitute an additional source of variation in investment, productivity, and output, increasing their volatility.

My model implies that output and TFP are more volatile in emerging markets than in advanced economies because uncertainty shocks affect investment only where maturity mismatch is present. Where firms can easily issue long-term debt and equity, as in advanced economies, variations in capital flow volatility have little or no impact on investment, productivity, and output. Other models in which uncertainty shocks affect investment rely on either risk aversion (Fernández-Villaverde et al., 2011) or irreversible investment (Dixit and Pindyck, 1994; Bloom, 2009) to generate a response. However, since neither the degree of risk aversion nor the extent of irreversibility are different in emerging markets as compared to advanced economies, those models are not helpful in explaining why output volatility differs between the two groups of countries. Thus the maturity mismatch channel of transmission for volatility shocks that I introduce in this paper is not only novel, but particularly suited to explain the greater volatility of output and TFP in emerging markets.

The model presented here also provides an explanation for the negatively skewed distribution of growth rates in emerging markets. A sudden cutoff in capital inflows raises uncertainty about the future availability of foreign borrowing, depressing investment in addition to the negative effects of the shock itself. On the other hand, while a large jump in inflows will increase the capital available to fund investment, it will also generate uncertainty, thereby dampening the positive response. This asymmetric amplification means that the interaction of capital flow volatility and maturity mismatch contributes to the skewed pattern of output growth in emerging markets.

The paper proceeds as follows. In the next section, I motivate my focus on the role of capital flow volatility by documenting its business cycle properties. In Section 1.3, I model the interaction between capital flow volatility and maturity mismatch in a small open economy. Section 1.4 concludes and discusses directions for further research.

1.1.1 Related Literature

This paper contributes to several areas of literature. First, it relates to the growing body of work analyzing the distinctive properties of business cycles in emerging markets. From this perspective, the greater output volatility in emerging markets is the result of these economies being hit by different, more volatile shocks than advanced economies. The shocks in emerging market RBC models include not only productivity shocks (Aguiar and Gopinath, 2007) but also shocks to the level (Neumeyer and Perri, 2005) and volatility (Fernández-Villaverde et al., 2011) of interest rates. My approach differs from this literature in two important respects. First, in my model emerging markets respond differently when hit by the same shocks as advanced economies, rather than being hit by different shocks. The difference in response is due to the presence of realistic financial market imperfections in my model. Second, whereas the emerging market RBC literature treats the higher TFP as exogenous, in my model the greater volatility of TFP in emerging markets is generated endogenously by the interaction of volatility shocks and maturity mismatch.

Second, this paper contributes to research on maturity mismatch. Whereas others have documented the prevalence of maturity mismatch in emerging markets, empirically analyzed its effects, or used theory to understand its causes, I build a model analyze the consequences of maturity mismatch, in particular its implications for the transmission of uncertainty shocks. Although the average maturity of emerging market debt has lengthened somewhat in the last decade (Burger et al., 2012), the median share of short-term debt in the total debt of nonfinancial corporations remains 64 percent in emerging markets, compared with 39 percent in advanced economies (Fan et al., 2012).[4] Several recent empirical papers have studied the extent to which maturity mismatch amplifies the effects of financial crises (Bleakley and Cowan, 2010; Kalemli-Ozcan et al., 2010; Benmelech and Dvir, 2011; Kim et al., 2012).

Motivated by these empirical facts, many authors have explored how information frictions and agency problems can render it optimal for firms to borrow short-term to finance long-term investments in these economies (Chang and Velasco, 2000; Tirole, 2003; Jeanne, 2009; Broner et al., 2011; Bengui, 2011; Farhi and Tirole, 2012). In this paper, I highlight a previously unexplored consequence of the maturity mismatch for which others have provided empirical evidence and microfoundations.

Third, this paper contributes to the extensive literature on sudden stops, episodes in which rapid shifts from current account deficit to surplus are accompanied by large drops in output. Caballero and Krishnamurthy (2001, and subsequent work) show how maturity mismatch can amplify the effects of an exogenous drop in the availability of foreign capital. The mechanism in my model amplifies such negative shocks, but also dampens the effects of surges in capital inflows. It therefore helps explain the skewed growth patterns discussed above.

More recent work on sudden stops has focused on how fractional borrowing constraints amplify exogenous shocks via Fisherian debt deflation (Mendoza, 2010; Jeanne and Korinek, 2010; Bianchi, 2011). This class of models has had notable success in explaining not only the volatility of output in emerging economies, but also the volatility of TFP and the skewed distribution of growth rates. A key difference between these papers and my own approach is that whereas they employ a fractional borrowing constraint as a shorthand for a variety of credit market imperfections, the maturity mismatch present in my model is a directly observable feature of emerging market economies.

This paper compliments research on sudden stops in that I show that in addition to the

[4] The IMF's 2005 Global Financial Stability Report provides an overview of the evidence on maturity mismatch in emerging markets.

direct impact of sudden stops analyzed in the existing literature, the uncertainty generated by the possibility that a sudden stop will occur also has macroeconomic implications. Moreover, the uncertainty affects output, investment, and productivity not only during crisis episodes but also during tranquil times. In this regard, this paper provides a formal analysis of the claim by Joesph Stiglitz regarding financial crises in emerging markets that "it is not only the downturn itself which has lasting effects, but the very presence of the risk of instability that is likely to discourage investment" Stiglitz (2000) .

Several other studies seek to explain the empirical facts motivating this paper. Rancière et al. (2008) set out to understand the skewed distribution of emerging market growth rates and show that while high levels of investment in risky projects render the economy vulnerable to occasional crises, the net effect of this behavior is growth enhancing. However, they explain long-run growth rather than the business cycle fluctuations that are the focus of this paper.

In attempting to explain high volatility in emerging markets, my modeling approach is similar to that of Aghion et al. (2010), who demonstrate that maturity mismatch amplifies the effects of productivity shocks in the presence of a fractional borrowing constraint (due to their impact on net worth). The source of shocks in the models differs, however, in that I analyze the effects of variations in the volatility of borrowing constraints, rather than in the level of productivity.

Also studying the sources of volatility in developing and emerging economies, Koren and Tenreyro (2007, 2013) decompose aggregate output volatility into country-level, sector-level, and idiosyncratic volatility and build an endogenous growth model that explains the empirical facts they document. The model presented here proposes an additional source of cross-country differences in output volatility. In particular, investment and output in sectors with longer project durations will be more volatile in countries with less developed financial systems. My model also provides an explanation for the negative relationship between firm size and age, on the one hand, and output volatility, on the other, that Koren and Tenreyro observe in a broad sample of countries. Older firms are less reliant on the short-term debt, and therefore engage in less of the maturity mismatch that boosts output volatility in my model.

1.2 Capital Flow Volatility and the Business Cycle

In this section, I examine the business cycle properties of capital flow volatility. I begin by introducing a novel monthly frequency data set on portfolio capital flows to 16 major emerging markets and 11 small open advanced economies. I analyze portfolio flows rather than FDI in part due to data availability, but primarily because of the extensive evidence that the portfolio flows are significantly more volatile (Montiel and Reinhart, 1999; Albuquerque, 2003; Alfaro et al., 2007).

I then document two new empirical facts. First, I show that the volatility of portfolio capital inflows to emerging markets is countercyclical and leads the business cycle. In small open advanced economies, however, that volatility is acyclical or weakly procylcial. The difference in comovement suggests a role for capital flow volatility in explaining the distinctive patterns of output growth in emerging markets. Second, I find that the countercyclicality of portfolio capital flow volatility is driven by the volatility of debt flows rather than equity. As a result, I focus my analysis on properties specific to such debt flows.

1.2.1 Data Description

To capture fluctuations in capital flow volatility over time, I use monthly frequency data on capital flows to a set of emerging markets and small open advanced economies. Where possible, I collect monthly balance of payments data directly from central banks.[5] In five cases, the data were supplemented with data on purchases and sales of equities and bonds by foreigners obtained from financial markets and regulatory agencies.[6] Appendix A provides details of the data sources for each country in the sample.

In supplementing balance of payments data with financial market data, I strike a balance between covering a wide sample of countries and capturing all capital flows to each country. My use of financial market data is in line with its increasing use in studies of international capital flows (e.g. Henry, 2003; Bekaert et al., 2005; Gupta and Yuan, 2009). Several recent studies have also made use of data on transactions by mutual funds, which are available for a larger group of countries than are included in my sample (e.g. Hau and Rey, 2008; Raddatz and Schmukler, 2011; Jotikasthira et al., 2011; Fratzscher, 2011). However, the mutual fund data capture only around 15 percent of the capital flows in the balance of payments (Lambert et al., 2011). By contrast, the financial data I collect account for between 74 and 100 percent of the flows in the IMF's quarterly balance of payments data.[7] Thus while using balance of payments data narrows my sample, it ensures that the data more fully capture capital flows to the countries in my data set.

The monthly data capital flows data that I collect measure the net change in the value of

[5]Specifically, the data on portfolio capital flows come from the line "portfolio investment, liabilities" of the financial account, as defined in the fifth edition of the IMF Balance of Payments Manual (BPM5).

[6]Financial market data were used for Colombia, India, Indonesia, Mexico, and South Africa.

[7]Appendix A includes a discussion of the relationship between the monthly data in my sample and quarterly balance of payments data

domestic equities and bonds held by foreigners each month, or what the literature refers to as gross portfolio capital inflows (Rothenberg and Warnock, 2011a; Forbes and Warnock, 2012a; Broner et al., 2013).[8] This paper does not analyze capital flows initiated by domestic residents, which are generally called gross capital outflows. Although so-called capital flight has in many cases contributed to large outflows in times of crisis, the vast majority of sudden stop episodes are driven by the actions of foreign investors rather than domestic residents (Calderón and Kubota, 2011; Rothenberg and Warnock, 2011a). Moreover, the disruption in terms of growth, consumption, and investment associated with capital flow driven by foreign investors is generally larger than that following outflows driven primarily by residents (Rothenberg and Warnock, 2011a).

Having compiled monthly data on capital flows, I measure their realized volatility by calculating a trailing 12-month standard deviation each month. I then normalize by trend quarterly GDP so that my measure captures the magnitude of capital flow volatility relative to the size of the economy. Thus capital flow volatility in country i month t ($Vol_{i,t}$) is defined as:

$$Vol_{i,m} = \frac{\sqrt{\frac{1}{12}\sum_{j=0}^{11}(flow_{i,m-j} - \overline{flow}_{i,m})^2}}{Trend\ GDP_{i,m}} \text{ where } \overline{flow}_{i,m} = \frac{1}{12}\sum_{j=0}^{11} flow_{i,m-j}$$

Where $flow_{i,m}$ is the level of capital inflows in country i in in month t and $\overline{flow}_i$ is the mean level of capital inflow over the previous 12 months. The term $Trend\ GDP_{i,m}$ refers the the trend level GDP for the quarter in which month m falls. Alternative measures of capital flow volatility are discussed in Appendix A.

Table 1.1 presents descriptive statistics on the resulting data on capital flow volatility. The data cover 16 emerging market economies for periods ranging from 7 years to more than 20 years. All regions containing emerging markets are represented. The sample includes 14 of the 32 countries that make up the JPMorgan Emerging Markets Bond Index-Global (EMBI-G). These account for nearly 70 percent of the combined GDP of the EMBI-G economies.[9] Also in the data set are India, Korea, and the Czech Republic, which are included in the S&P/International Finance Corporation Emerging Markets Database Investable Index (S&P IFCI Index). The advanced economies in the sample include four southern European countries and four Scandinavian countries, as well as Austria, Belgium, and Canada. The data therefore provide a meaningful view of major emerging market economies and of small open advanced economies.

[8] Somewhat confusingly, the term gross capital inflows in fact refers to the net purchases of domestic assets by foreigners.

[9] Published by JPMorgan, the EMBI-G a widely used index of the yield on debt issued by low- and middle-income countries.

Table 1.1: Capital Flow Volatility in Emerging Markets, Descriptive Statistics

	Total Portfolio Inflows[1]			Portfolio Equity Inflows[1]			Portfolio Debt Inflows[1]		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Emerging Markets									
Overall	0.04	1.28	9.23	0.02	0.66	7.9	0	0.92	7.01
Turkey	0.38	1.13	2.83	0.04	0.23	0.59	0.33	1.05	2.5
South Africa	0.63	1.44	2.78	0.35	0.81	1.55	0.51	1.08	2.23
Brazil	0.25	0.92	3.15	0.1	0.45	1.02	0.16	0.7	2.43
Chile	0.57	1.06	1.94	0.13	0.38	0.85	0.5	0.98	1.88
Colombia	0.04	0.43	2.4	0.02	0.32	2.36	0	0.17	0.5
Mexico	1.11	4.23	9.23	1.17	3.9	7.9	0.07	0.61	1.87
India	0.08	0.39	1.05	0.06	0.34	1.01	0.02	0.11	0.33
Indonesia	–	–	–	0.08	0.26	0.98	–	–	–
Korea	0.24	1.03	2.36	0.04	0.68	1.79	0.23	0.69	1.9
Malaysia	–	–	–	–	–	–	1.41	3.49	7.01
Philippines	0.94	1.69	2.89	0.06	0.39	1.1	0.95	1.58	2.79
Thailand	0.15	0.87	2.46	0.13	0.63	1.59	0.02	0.57	2.14
Bulgaria	0.24	1.08	4.31	0.03	0.19	1.02	0.24	1.1	5.03
Czech Republic	0.42	1.43	2.84	0.19	0.48	0.9	0.29	1.32	2.76
Hungary	–	–	–	0.11	0.52	1.43	–	–	–
Poland	0.72	1.31	2	0.11	0.32	0.6	0.39	1.24	1.97
Advanced Economies									
Overall	0.51	3.66	13.34	0.05	1.15	4.29	0.45	3.11	12.36
Austria	0.61	2.54	5.13	–	–	–	–	–	–
Belgium	3.1	5.28	7.57	–	–	–	–	–	–
Canada	0.51	1.55	3.11	0.05	0.7	2.93	0.45	1.29	2.4
Denmark	2.22	4.67	9.2	0.24	1.17	3.54	2.2	4.49	8.71
Finland	2.16	5.24	9.81	0.24	1.36	4.29	1.62	4.86	9.72
Norway	0.9	2.59	6.02	0.31	0.74	1.89	0.81	2.36	6.01
Sweden	5.71	9.13	12.37	0.21	0.49	0.92	5.9	9.2	12.36
Greece	2.89	5.85	13.34	–	–	–	–	–	–
Italy	1.18	2.73	5.03	0.47	1.22	2.9	1.24	2.73	4.96
Portugal	0.73	2.88	5.87	0.58	1.94	3.6	0.54	2.13	4.28
Spain	1.21	3.1	5.64	0.37	1.28	2.41	0.91	2.4	4.56

Source: IFS, national sources

In all but four countries, monthly debt flows are on average more volatile than equity. Among the emerging markets in the sample, the volatility of equity flows relative to the size of the economy is largest in Mexico in late 1994 and early 1995, at eight percent of trend GDP. The maximum debt flow volatility is 7 percent of GDP and occurs in Malaysia in late 2008. The minimum values of volatility as a share of GDP both occur in Colombia in the early 2000s, a time when the country had capital controls in place.

Capital flows to advanced economies are significantly more volatile than they are in emerging markets, with an average volatility of total portfolio inflows three times as large. The volatility of the two components of portfolio inflows is larger by a similar margin. The maximum and minimum values of volatility are likewise dramatically larger in the small open advanced economies than in emerging markets. The generally higher volatility in high-income countries presumably reflects their greater openness to capital inflows. According to the index of captial account openness constructed by Chinn and Ito (2006), the emerging markets in the sample are on average somewhat less open than the worldwide average, while the advanced economies are typically much more open than the world average.[10]

Figure 1.1 plots the standard deviation of monthly capital flows as a percentage of trendl GDP for the economies in my dataset. The figures make clear that capital flow volatility varies substantially across countries and over time. Volatility is generally high during crisis episodes, including the 1994 Mexican crisis, the 1997 Asian crisis, the 1998 Russian crisis, and the 2008 global financial crisis. At the same time, there is substantial variation in relatively tranquil periods such as the mid-2000s.

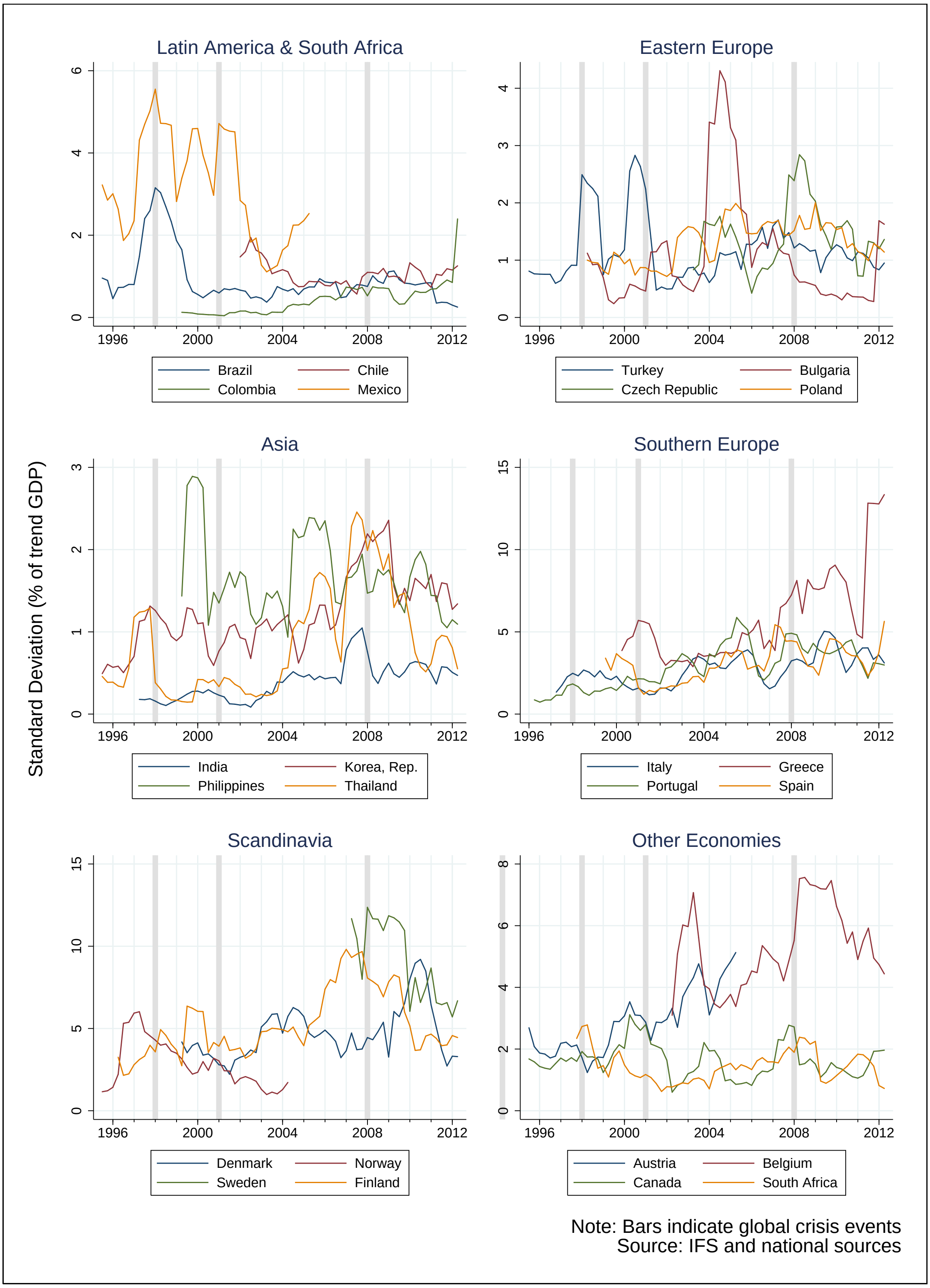
1.2.2 Stylized Facts on Capital Flows and their Volatility

The figures in the previous section made clear that the volatility of portfolio capital flows varies over time. To get a sense of how changes in volatility relate to the business cycle in these economies, I examine their comovements with real GDP.[11] I take as the value of volatility in each quarter the value of my monthly volatility measure in the final month of the quarter, since realized volatility was calculated using a backward-looking standard deviation. Figure 1.2 presents the correlation between capital flow volatility and output at different lags. Volatility leads the business cycle by three quarters and is significantly countercyclical. This pattern, evident for these economies as a whole, is the same in 8

[10] The emerging markets average a Chinn-Ito score of -0.22 while the advanced economies average is 1.5.

[11] In particular, quarterly real GDP data obtained from the IMF's International Financial Statistics were seasonally adjusted using the TRAMO-SEATS algorithm implemented in the Demetra+ software available from Eurostat. As is standard in exercises of this type, detrending was done using a Hodrick-Prescott filter. Results were nearly identical when deviations from a quadratic trend were used.

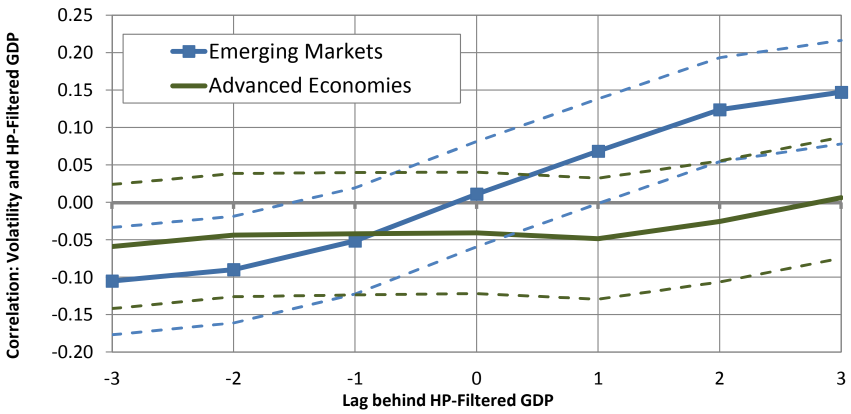
Figure 1.1: Portfolio Capital Flow Volatility



of the 13 individual countries for which data are available, and capital flow volatility is never significantly procyclical (see Section A.4 of Appendix A for data on the cyclicality of capital flows in individual countries).

In contrast, capital flow volatility is not significantly correlated with output at any lag in a the small open advanced economies for which monthly capital flows data were available. Volatility is leading significantly and countercyclical in Portugal, but this is not the pattern in any of the other advanced economies. The lack of a relationship between output and capital flow volatility is particularly striking giving that portfolio capital flow volatility is much larger relative to the size of the economy in high-income countries as in emerging markets (Table 1.1). Even though advanced economies experience greater capital flow volatility, it appears unrelated to the business cycle. This difference in the cyclical properties of capital flow volatility motivates my focus on capital flow volatility as a potential factor explaining the distinctive features of the growth performance in emerging markets.

Figure 1.2: Cyclicality of Portfolio Capital Flow Volatility, Emerging Markets and Advanced Economies

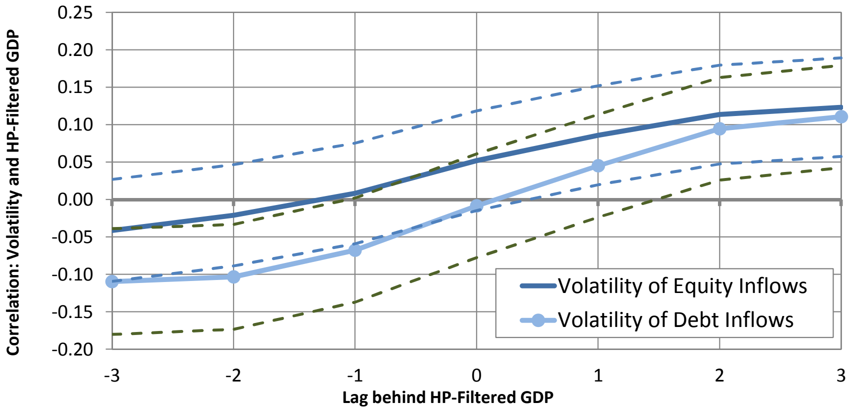


Dotted lines indicate 95% confidence intervals. Quarterly real GDP seasonally adjusted and HP-filtered. Capital flow volatility is the trailing 12-month standard deviation of gross portfolio inflows normalized by trend quarterly GDP. Sources: IFS and National Sources.

In Figure 1.3, I disaggregate portfolio capital inflows into their two component parts. Overall, portfolio debt flow volatility leads the business cycle and is countercyclical to a statistically significant extent. This pattern also holds for the majority of individual countries. By contrast, portfolio equity flow volatility does not significantly lead the business cycle and is procyclical at lags of one quarter and longer. The contemporaneous correlation between the volatility of equity and output is positive in 13 of the 16 emerging markets in the dataset (significantly so in six of these) and is never significantly countercyclical. This difference in cyclicality, with the volatility of debt flows countercyclical and the volatility of equity flows acyclical or procyclical, leads me to focus on the specific properties of short-term debt flows, in particular, their potential to generate maturity mismatch.

Figure 1.3: Cyclicality of Portfolio Capital Flow Volatility,

Equity and Debt Flows to Emerging Markets



Dotted lines indicate 95% confidence intervals. Quarterly real GDP seasonally adjusted and HP-filtered. Capital flow volatility is the trailing 12-month standard deviation of gross portfolio inflows normalized by trend quarterly GDP. Sources: IFS and National Sources.

The two novel empirical facts discussed in this section motivate my focus on capital flow volatility and maturity mismatch. In emerging markets portfolio capital flow volatility leads the business cycle in a countercyclical manner, while in advanced economies volatility is uncorrelated with output. This leads me to focus on changes in the volatility of portfolio capital flows as a potential contributor to business cycle fluctuations in emerging economies. The data presented also indicate that portfolio debt flows are more volatile than equity, and that their volatility is more countercyclical. Because a key difference between equity and debt financing is that only the latter can generate maturity mismatch, I look to such mismatch as a potential channel through which capital flow volatility impacts the growth performance of emerging markets.

1.3 Model

In this section I develop a model that captures key features of emerging market economies. Entrepreneurs borrow from abroad to finance domestic investment. In particular, they have the opportunity to invest in high-yielding long-term projects that can be prematurely terminated, but such liquidation yields a net return of at most zero. Credit markets are imperfect in two respects. First, agents' borrowing is restricted to one-period riskless bonds, so that firms cannot issue equity or long-term debt. This reflects the well-documented fact that financial markets in emerging economies are underdeveloped, forcing firms to rely disproportionately on short-term debt (IMF, 2005; Schmukler and Vesperoni, 2006; Fan et al., 2012).

Second, firms are subject to an exogenously determined borrowing constraint. The borrowing constraint is stochastic, so that entrepreneurs are uncertain about how much they will be able to borrow in the future. This uncertainty corresponds to the capital flow volatility documented in the previous section. The exogenous constraint is realistic in light of substantial recent work showing that so-called push factors in the advanced economies play a far greater role than pull factors in recipient countries in determining the pattern of international capital flows.[12]

In the remainder of this section, I first develop a model in which entrepreneurs may only invest in a long-term, linear technology. The simplified model makes clear the mechanism by which increased uncertainty about the availability of financing depresses long-term investment. I then introduce a richer version of the model, in which firms invest in a portfolio of long- and short-term projects with standard concave production functions. In this full model, increases in capital flow volatility will not only reduce aggregate investment but also shift the composition of investment away from long-term projects and towards short-term projects, resulting in lower aggregate TFP.

1.3.1 A Model of Long-Term Investment

I consider a small open economy populated by identical risk-neutral entrepreneurs who live for three periods. In the initial period ($t = 0$), entrepreneurs have the opportunity to invest in projects which yield gross return R after two periods (time-to-build). In the intermediate period ($t = 1$), entrepreneurs can choose to liquidate a portion L_1 of the long-term investment, with capital goods converted back into consumption goods one-for-one, so that investment is fully reversible.[13] Firms finance these investments using an exogenous endowment y_0 and by issuing a quantity D_1 of non-state-contingent, one-period bonds on international capital markets at an exogenously determined interest rate (r). The return on domestic projects is sufficiently high that financing investment with debt is profitable if the project reaches maturity ($R > (1 + r)^2$). Again, the divergence in the maturity of firms' projects and their liabilities captures the pervasive maturity

[12]The evidence comes not only from research on the macro-level determinants of capital flows (Forbes and Warnock, 2012a; Fratzscher, 2011) and liquidity conditions (González-Rozada and Levy-Yeyati, 2008; Foley-Fisher and Guimaraes, 2012; Edwards, 2012), but also from empirical finance research on the portfolio allocations of institutional investors holding assets in emerging markets Didier et al. (2010); Jotikasthira et al. (2011).

[13]Introducing partial irreversibility is straightforward and increases the impact of uncertainty shocks in the model.

mismatch in emerging markets. In these economies, long-term debt and equity financing are prohibitively expensive for most firms.

In what follows I abstract from any interest rate uncertainty. The full model presented in Section 1.3.2 is virtually identical to a model in which firms are initially uncertain about the interest rate on borrowing at $t = 1$.[14] In the latter case, firms would partially liquidate their long-term projects when the cost of new borrowing in the intermediate period exceeded the long-term projects' marginal product of capital. The mechanism emphasized in this section remains the same, in that firms' borrowing and investment in long-term projects determines their exposure to rollover risk.

When deciding how much to borrow and invest at time $t = 0$, entrepreneurs face uncertainty regarding κ_2, the quantity of credit that will be available at time $t = 1$. This stochastic borrowing constraint has distribution $\kappa_2 \sim F(\kappa)$. As a result of this uncertainty, when the entrepreneur borrows in order to invest in the long-term technology he runs the risk that he will be unable to roll over his debts, forcing him to partially liquidate the project.

Entrepreneurs thus maximize the discounted sum of dividends:

$$\max_{I_0, D_1, D_2, L_1} d_0 + \beta d_1 + \beta^2 d_2 \tag{1.1}$$

where

$$\begin{aligned} d_0 &= y_0 + D_1 - I_0 && (1.2) \\ d_1 &= y_1 + D_2 + L_1 - (1+r)D_1 && (1.3) \\ d_2 &= y_2 + R(I_0 - L_1) - (1+r)D_2 && (1.4) \end{aligned}$$

and y_t are exogenous endowments. In addition to the borrowing constraint ($D_2 \leq \kappa_2$), the firm is subject to a non-negativity constraint on dividends ($d_t \geq 0 \ \forall t = \{0, 1, 2\}$). This means that the firm cannot issue equity—a realistic assumption in the context of emerging economies. The firm's choice of liquidation must be feasible, so that it cannot be greater than the total quantity invested ($L_1 \leq I_0$). Nor can liquidation be negative ($L_1 \leq I_0$), which means the firm cannot expand the scale of projects once they have been initiated.[15]

I abstract from default risk and assume that creditors will never lend the entrepreneur more than he can feasibly pay back. Thus the entrepreneur's borrowing is also subject to

[14] Chari et al. (2005) make a similar point regarding the mapping between interest rate fluctuations and quantity constraints in the context of DSGE models of small open economies.

[15] This assumtion captures the fact that managers cannot dramatically increase the size of an investment project without seeking new financing and significantly extending the project's timeline.

two solvency constraints, which I discuss in detail in the Mathematical Appendix to this chapter (Appendix B). Importantly, the solvency constraints are not so tight as to prevent the entrepreneur from borrowing an amount large enough that he risks being forced to prematurely liquidate part of his long-term project. Moreover, for realistic values for the world interest rate and for the return on long-term projects, these solvency constraints will not bind in the neighborhood of the solution to the entrepreneur's problem.

The entrepreneur will choose investment to equate the shadow value of resources in the initial period ($1+\lambda_0$, where λ_t is the Lagrange multiplier on the non-negativity constraint on dividends) with the discounted return on the long-term project,

$$1 + \lambda_0 = \beta^2 R E_0[1 + \lambda_2] + \beta E[\zeta_1^{(2)}], \tag{1.5}$$

where $\zeta_1^{(2)}$ is the Lagrange multipliers on the upper bound on liquidation ($L_1 \leq I_0$). The second term on the right-hand side of (1.5) captures the fact that resources used for long-term investment can also be accessed in the intermediate period through liquidation. Optimal borrowing is set according to an Euler equation, subject to the borrowing constraint in the second period, with μ_1 the multiplier on this constraint:

$$\begin{aligned} 1 + \lambda_0 &= \beta(1 + r)E_0[1 + \lambda_1] && (1.6) \\ 1 + \lambda_1 &= \beta(1 + r)(1 + \lambda_2) + \mu_1. && (1.7) \end{aligned}$$

The first order condition for the liquidation of long term projects is

$$(1 + \lambda_1) + \zeta_1^{(1)} = \beta R(1 + \lambda_2) + \zeta_1^{(2)} \tag{1.8}$$

where $\zeta_1^{(1)}$ is the Lagrange multiplier on the non-negativity constraint on liquidation. The non-negativity constraint is binding when entrepreneurs have additional borrowing capacity available after rolling over their debts in the intermediate period. They would like to expand the scale of their long-term projects, which corresponds to negative liquidation, but are unable to do so.

The profitability of long-term projects means that entrepreneurs are better off investing and deferring consumption until those projects mature. Firms will therefore never pay dividends in the first period ($d_0 = 0$). Nor will they issue dividends in the second period, due to the cost of capital and the presence of the borrowing constraint. Thus firms will pay dividends only in the final period (for a proof of this, see Section B.2 of Appendix B).

Since long-term projects have a higher return than bonds, it will never be optimal to liquidate when the borrowing constraint does not bind (see the proof of Proposition

B.2.3 in the Appendix B). With both dividends and liquidation set to zero, from the budget constraint (1.3) it is clear that when the borrowing constraint does not bind, the entrepreneur borrows exactly the amount needed to cover his outstanding obligations: $D_2 = (1+r)D_1 - y_1$. In this case, the entrepreneur's final period consumption will be equal to net profits on long-term investment, along with the final-period value of his endowments.

$$C^H = [R - (1+r)^2]D_2 + [Ry_0 + (1+r)y_1 + y_2]. \tag{1.9}$$

Since uninterrupted projects are profitable ($R > (1+r)^2$), higher initial borrowing translates into greater consumption in states in which the second-period borrowing constraint does not bind.

Agents use second-period borrowing only to roll over debt. As a result, the borrowing constraint will bind when the borrowing available at $t = 1$ combined with the entrepreneur's $t = 1$ endowment is less than his debt service payments: $\kappa_2 + y_1 \leq (1+r)D_1$.

When the borrowing constraint does bind, it will be the case that $D_2 = \kappa_2$. Since no dividends are paid at $t = 1$, the budget constraint (1.3) makes clear that the entrepreneur will liquidate a portion $L_1 \in [0, I_0]$ of the long-term project in order to service his debts. In particular, he will liquidate just enough of his investment to repay his first period borrowing: $L_1 = (1+r)D_1 - (y_1 + \kappa_2)$ (for a proof, see Proposition B.2.4 in Appendix B). In this case, final period consumption is given by

$$\begin{aligned} C^L &= R(I_0 - L_1) - (1+r)\kappa_2 + y_2 \\ &= [R - (1+r)]\,\kappa_2 - rRD_1 + [Ry_0 + Ry_1 + y_2] \end{aligned} \tag{1.10}$$

The conditions for optimal borrowing (1.7) and liquidation (1.8), along with the results discussed above, give

$$\mu_t = \beta(1+r)\left[\frac{R}{1+r} - 1\right](1+\lambda_2).$$

This illustrates that when the borrowing constraint binds ($\mu_t > 0$), firms carry out liquidation that appears inefficient, in that the present value of allowing the project to mature is $R/(1+r) > 1$ while liquidating yields a gross return of one. However, this liquidation is in fact an optimal response to the capital market imperfections present in the economy.

Optimal Borrowing

Once the uncertainty regarding the $t = 2$ borrowing constraint has been resolved, the entrepreneur's decisions are mechanical. The key decision is therefore the choice of initial borrowing, and the entrepreneur's problem reduces to

$$\max_{D_1}[1 - F(\underline{\kappa})]E_0[C^H|\kappa_2 > \underline{\kappa}] + F(\underline{\kappa})E_0[C^L|\kappa_2 < \underline{\kappa}] \tag{1.11}$$

where $\underline{\kappa} = (1+r)D_1 - y_1$ is the level below which the borrowing constraint binds. Thus the probability that the constraint will bind is endogenously determined by the entrepreneur's choice of initial borrowing, because $\underline{\kappa}$ is a function of D_1. The more he borrows, the more likely it is that he will be unable to roll over the debt in the intermediate period. Substituting using (1.9) and (1.10) into the simplified objective function (1.11) gives

$$\begin{aligned}\max_{D_1}&[1 - F(\underline{\kappa})]\left\{[R - (1+r)^2]D_1 + [Ry_0 + (1+r)y_1 + y_2]\right\} \\ &+ \int_{-\infty}^{\underline{\kappa}} \left\{[R - (1+r)]\,\kappa_2 - rRD_1 + [Ry_0 + Ry_1 + y_2]\right\} dF(\kappa_2)\end{aligned} \tag{1.12}$$

This expression makes clear that when the borrowing constraint does not bind (on the first line of 1.12), the more the entrepreneur has borrowed, the larger will be his final-period consumption. When the borrowing constraint binds, greater borrowing reduces consumption by forcing the entrepreneur to liquidate a larger share of the long-term project. The level of the borrowing constraint will affect the return on investment only when it binds (κ_2 appears only in the second line of 1.12). I show in the next section that this asymmetry, along with endogeneity of the entrepreur's exposure to rollover risk, means that symmetric changes in the distribution of κ_2 will affect the expected return on long-term investments.

The first order condition for the entrepreneur's borrowing is

$$\begin{aligned}[1 - F(\underline{\kappa})][R - (1+r)^2] - C^H f(\underline{\kappa})\frac{\partial \underline{\kappa}}{\partial D_1} \\ = F(\underline{\kappa})rR - C^L f(\underline{\kappa})\frac{\partial \underline{\kappa}}{\partial D_1}\end{aligned} \tag{1.13}$$

Intuitively, the entrepreneur chooses the level of debt-financed investment which equalizes the expected marginal returns across the two types of states—those in which the borrowing constraint binds and those in which it does not. Since $C^H = C^L$ when $\kappa_2 = \underline{\kappa}$, the second terms on each side of this equation cancel. Simplifying gives:

$$F(\underline{\kappa}) = \frac{R - (1+r)^2}{R\,(1+r) - (1+r)^2} \tag{1.14}$$

Since $\underline{\kappa} = (1+r)D_1 - y_1$, this pins down the optimal level of borrowing and thus initial investment.[16] In what follows, I refer to the term on the right-hand side of (1.14), which will lie between zero and one, as Ψ. As one would expect, optimal investment is increasing in the gross return on long-term investment (R) and decreasing in the cost of capital, the world interest rate r.

Increased Uncertainty

In order to understand the effects of the fluctuations in capital flow volatility that I observed in the data, I now examine how increased uncertainty regarding the value of the second-period borrowing constraint (κ_2) affects initial investment and borrowing. More specifically, I consider a shift in the distribution of borrowing constraints from $F(\kappa)$ to a distribution $G(\kappa)$ which is a mean-preserving spread. In other words, I examine an increase in risk as defined by Rothschild and Stiglitz (1970): $\int_0^t [G(\kappa) - F(\kappa)]dt \geq 0 \; \forall t$ so that $F(\kappa)$ second-order stochastic dominates $G(\kappa)$. This will isolate the impact of greater uncertainty regarding the borrowing constraint, independent of any changes in the level.

Remembering that $\underline{\kappa}$ is increasing in the amount of initial borrowing, equation (1.14) makes clear that greater uncertainty will reduce investment when the optimal level of investment lies in a region in which $F(\underline{\kappa}) < G(\underline{\kappa})$. Second-order stochastic dominance ensures that at least one such region exists. For most distributions, to fall in such a region $\underline{\kappa} = (1 + r_1)D_2^* - y_2$ must lie in the left tail of the distribution. This will be the case for realistic parameter values for the return on long-term domestic projects and international interest rates.

When will a mean-preserving spread *increase* initial borrowing and investment? When optimal borrowing is high enough that the greater mass in the right tail of the distribution reduces the probability that the borrowing constraint will bind. This occurs if the spread between the return on long-term projects (R) and the world interest rate $(1+r)$ is so large that the entrepreneur finds it optimal to incur very high rollover risk. In this situation, the reward in situations where he avoids liquidation is sufficiently large to make high debt the optimal choice even though he will most likely be forced to liquidate. Although some entrepreneurs may take on a high degree of financial risk in pursuit of very high-yield projects, in what follows I explore a situation in which excess returns on long-term projects are modest and firms avoid liquidation in most states of the world.

To illustrate the mechanism at work in the model, I now assume that the borrowing constraint κ_2 has a lognormal distribution and assign the parameter values given in Table 1.2. The world interest rate is set to match the average real interest rate on

[16] This is indeed a maximum, as $\frac{\partial^2 E_0[C^s]}{\partial D_1^2} = f(\underline{\kappa})(1+r)[(1+r)^2 - (1+r)R] < 0$ because I am assuming that long-term investment is profitable and the world interest rate is non-negative.

Table 1.2: Parameter Values

Symbol	Parameter	Value	Source
$1+r$	World interest rate	1.05	Mean real interest rate in emerging markets
R	Return on long-term projects	1.11	Term premium on speculative-grade US corporate debt
$E(\kappa_2)$	Expected Value of borrowing constraint (%GDP)	0.12	Mean portfolio debt liabilities in emerging markets (Lane and Milesi-Ferretti, 2007)
$[y_0, y_1, y_2]$	Endowments	[1,0,0]	Normalization

foreign borrowing for my sample of 16 emerging markets.[17] I set the return on long-term projects so that the spread between return on long-term projects and the world interest rate is equal to the average term premium on two-year BB-rated corporate bonds in the United States over the last 15 years. In a perfect capital market, any term premium would correspond to differences in returns on projects of different duration. The US is presumably closest to an ideal financial market. I use the term premium for speculative-grade bonds since it is the rating of the vast majority of corporates in emerging markets.

I set the expected value of the borrowing constraint so that average borrowing is equal to the average ratio of net portfolio debt liabilities to GDP in the emerging markets in my sample over the last 15 years, as reported in Lane and Milesi-Ferretti (2007). The parameter values in Table 1.2 imply that firms liquidate long-term projects seven percent of the time.

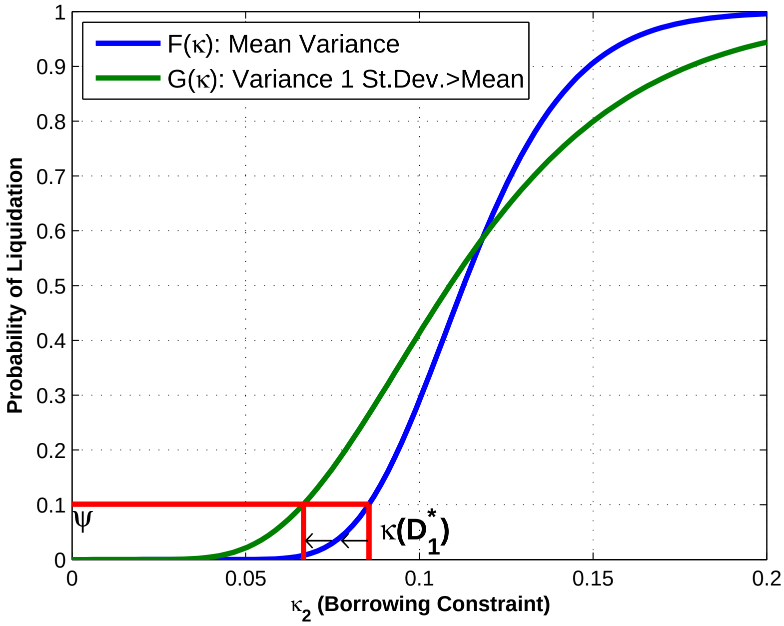
In Figure 1.4 a mean-preserving spread in the distribution of the borrowing constraint (κ_2) increases the variance of foreign borrowing from the observed mean to volatility one standard deviation above the mean. To maintain the equality in condition (1.14) the entrepreneur must reduce D_1 and thus investment in order to equate $G(\underline{\kappa})$ and Ψ, the optimal probability of liquidation from the solution to the entrepreneur's problem (1.14).

Intuitively, when agents borrow short-term to finance long-term investments they face a trade-off. On the one hand, greater leverage increases their return on equity if the borrowing constraint does not bind.[18] On the other hand, the risks associated with greater borrowing are twofold. Most obviously, when the borrowing constraint does bind the rate of return falls since the entrepreneur must liquidate part of the project. The greater the gap between outstanding liabilities and available borrowing, the lower the overall return on the investment.

[17] Following Neumeyer and Perri (2005), I measure the real interest rate on foreign borrowing as the real US three month T-Bill rate plus the relevant EMBI-G spread. For details on the sample of countries, see Section 1.2 and Appendix A.

[18] In the model, the leverage ratio is given by $(1+r)D_t / \sum_{s=0}^{t} y_s$. Return on equity is $[R-(1+r)^2]D_1 / \sum_{t=0}^{2} y_t$.

Figure 1.4: Mean-Preserving Spread

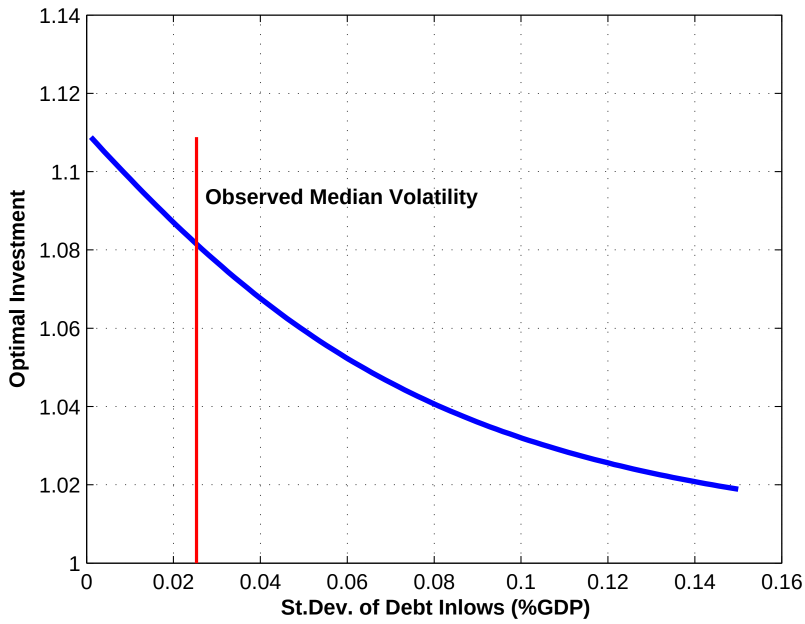


In addition, higher debt increases the entrepreneur's exposure to rollover risk, boosting the probability that the borrowing constraint will bind in the second period. Figure 1.4 makes clear that the probability of the borrowing constraint binding, $F(\underline{\kappa})$, depends on D_2. This introduces concavity into the entrepreneur's objective function, so that even when agents are risk neutral, in the presence of maturity mismatch second-moment shocks have first-order effects, and symmetric changes in the distribution of borrowing constraints affect the entrepreneurs' chosen investments in long-term projects.

Figure 1.5 graphs optimal investment for the range of portfolio debt flow volatility observed in the emerging market sample. A shift from the minimum volatility observed in the data (during the 1990s in India and Colombia) to the observed maximum value (Bulgaria in 2005) reduces investment by around 10 percent of the initial endowment.

Thus, I find that even when the agents making investment decisions are risk neutral, an increase in uncertainty about the future availability of borrowing will dampen investment and slow output growth. If agents were risk averse, this effect would be amplified, since the desire to smooth consumption would provide a further motive—above and beyond the need to roll over debt—to borrow in the intermediate period. Here I have abstracted from this effect in order to emphasize the role played by maturity mismatch in transmitting shocks to capital flow volatility. Moreover, in contrast to the literature on real options (Dixit and Pindyck, 1994; Bloom, 2009), uncertainty affects firms' investment decisions even in the absence of any irreversibility. Introducing partial irreversibility into the model presented here quantitatively strengthens the effect of uncertainty shocks by reducing

Figure 1.5: Capital Flow Volatility and Optimal Investment



the expected profits from debt-financed investment in states in which the borrowing constraint binds.

In order to compare the impact of capital flow volatility in emerging markets with its effects in advanced economies, I now compare the above result to a situation in which the entrepreneur does not face maturity mismatch. This means that in the initial period ($t = 0$), he can issue debt (D_2^L) with the same maturity as his investments, but faces uncertainty regarding the productivity of his investment. In this case, his problem becomes:

$$\max_{D_2^L} E_0[(R - (1 + r^L))D_2^L]$$

Where $1 + r^L$ is the interest rate on long-term bonds issued by the entrepreneur. With no interest rate uncertainty, this is simply:

$$\max_{D_2^L}[E_0[R] - (1 + r^L)]D_2^L$$

If the expected return on the investment exceeds the cost of capital, the entrepreneur will borrow up to the solvency constraint (B.2). If I assume (as in Rothschild and Stiglitz 1970) that $\kappa_2^{min} = 0$, or that the support of κ_2 is the entire real line, a mean-preserving spread will leave the solvency constraint unaffected and thus have no effect on investment.

The comparison case without maturity mismatch demonstrates why the interaction between this common feature of emerging markets and volatile capital flows can help to explain their greater output volatility. Where firms cannot borrow long-term when financing long-term projects, changes in capital flow volatility will affect the investment and output. Firms in countries with well-developed capital markets can issue long-term debt, and therefore will not alter their investment in response to changes in the uncertainty regarding the future availability of borrowing. By contrast models relying on risk aversion (Fernández-Villaverde et al., 2011) or irreversible investment (Dixit and Pindyck, 1994; Bloom, 2009) are not capable of generating a different response to uncertainty shocks in emerging markets, since neither risk aversion nor irreversibility is different in these countries as compared to advanced economies.

1.3.2 Full Model

I now consider a richer specification, in which the entrepreneur has the opportunity to invest in both a standard technology with the production function $y_t^s = f(I_{t-1}^s)$, which takes one period to mature, and a long-term technology with production function $y_2^L = zf(I_0^L - L_1)$, which takes two periods to mature. Long-term projects can be liquidated with a gross return $\phi \leq 1$, so that investment may be partially irreversible, although the results remain qualitatively the same regardless of any irreversibility. The long-term technology is more productive than the short-term technology, so that $z \geq 1$ (for simplicity I normalize the productivity of the short-term technology to one). For both technologies, $f'() > 0$ and $f''() < 0$.

As before the firm operates for three periods under the management of a risk neutral entrepreneur. Thus, this firm will maximize the discounted sum of dividends:

$$\max_{I_0^L, D_1, D_2, I_0^S, I_1^S, L_1} E_0 \sum_{t=0}^{2} \beta^t d_t \tag{1.15}$$

where dividends are given by

$$\begin{aligned} d_0 &= y_0 + D_1 - I_0^L - I_0^S \\ d_1 &= y_1 + f\left(I_0^S\right) + \phi L_1 + D_2 - (1+r_0)D_1 - I_1^S \\ d_2 &= y_2 + zf\left(I_0^L - L_1\right) + f\left(I_1^S\right) - C_2 - (1+r_1)D_2 \end{aligned}$$

and subject to non-negativity constraints ($d_t \geq 0 \ \forall t = \{0, 1, 2\}$). Now in addition to choosing initial-period borrowing and investment, the firm optimizes over short-term investment in both the first and second periods.

Apart from the different menu of production technologies, the model is the same as in the previous section. The firm's borrowing in the intermediate period is again subject to an exogenous borrowing constraint ($D_2 \leq \kappa_2$), the value of which becomes known at time

$t = 1$ and which is drawn from a distribution $F(\kappa)$. Any liquidation carried out while the long-term investment is gestating is subject to a non-negativity constraint ($L_1 \geq 0$) and an upper bound ($L_1 \leq I_0$).

The conditions for optimal borrowing remain (1.6) and (1.7), since the financial side of the model is the same as in the simplified model. Although the condition for optimal long-term investment is similar to equation (1.5), the marginal return on long-term investment now depends on the amount of liquidation that the firm expects to carry out during the project's gestation period:

$$(1 + \lambda_0) = \beta^2 E_0 \left[z f'(I_0^L - L_1)(1 + \lambda_2) \right] + E_0[\zeta_1^{(2)}], \tag{1.16}$$

where the Lagrange multipliers are defined as in the previous section. In this regard, equation (1.16) differs from the simple model where rollover risk entered the entrepreneur's optimization problem only through the Euler equation and did not affect marginal rates of return.

Apart from the more realistic production technology, the other difference from the model in the previous section is that the firm can also produce using a short-term technology that is less productive. The firm initially choses short-term investment so that its marginal return equals the cost of capital, as is standard (subject to the feasibility constraints):

$$(1 + r) = f'(I_0^s). \tag{1.17}$$

The second-period choice of short-term investment will depend on whether or not the borrowing constraint binds:

$$(1 + r) = f'(I_1^s) + \frac{\mu_1}{\beta}. \tag{1.18}$$

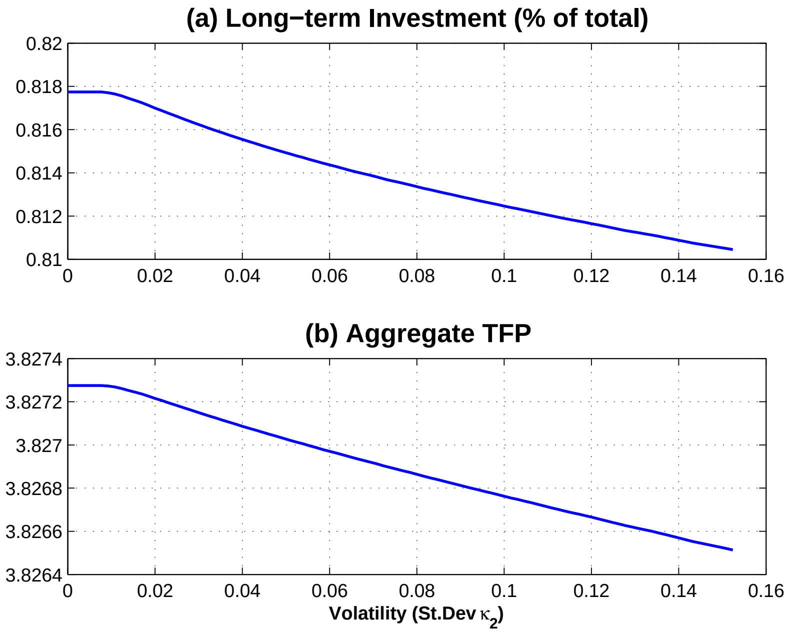
When the borrowing constraint binds the return on short-term projects will exceed the cost of capital, since the firm's investment is limited by the scarcity of external financing. At the same time, the firm will choose short-term investment to equate its marginal return with the return on any liquidated long-term investment:

$$\phi f'(I_1^s)(1 + \lambda_2) + \zeta_1^{(1)} = z f'(I_0^L - L_1)(1 + \lambda_2) + \zeta_1^{(2)}. \tag{1.19}$$

I solve this system numerically using the parameter values in Table 1.2 and setting the wedge in productivity between short- and long-term projects (z) to 3. I choose the functional form $f(k) = k^\alpha$ and set $\alpha = 0.3$ as is standard.

As was the case in the simplified model, liquidation and intermediate-period borrowing are functions of initial borrowing and investment, so that in principle I need only solve (1.16) taking this into account. However, because of the non-linearities in the full model, I cannot do this analytically. Rather, I find the solution to (1.16) by searching over a grid if values for long-term investment (I_0^L). For each gridpoint, I calculate the optimal levels of liquidation and $t = 1$ short-term investment, then impose the non-negativity constraint on liquidation. For a grid of values for κ_2 approximating the lognormal distribution, I check whether the borrowing constraint will bind. I then recalculate optimal liquidation and short-term investment for states in which the borrowing constraint binds. After calculating the values of the Lagrange multipliers in each state, I evaluate the two sides of (1.16).

Figure 1.6: The Composition Effect of Capital Flow Volatility



Changes in uncertainty regarding the future availability of borrowing affect aggregate investment, as was the case in the simplified model, but also the composition of investment and aggregate productivity. As in the simplified model, uncertainty shocks cause firms to scale back their long-term investments. Short-term investment remains unaffected, however, since it does not generate rollover risk. Aggregate investment will therefore fall, since the reduction in long-term investment is not offset by an increase in short-term investment. At the same time, the share of investment allocated to long-term project falls, as Figure 1.6(a) makes clear.

In turn, the change in the composition of investment reduces aggregate productivity. Economists generally calculate aggregate TFP using data on total output, which is given by $Y_2 = z(I_0^L)^\alpha + (I_1^S)^\alpha$ in the model; aggregate capital stock, which is $K_2 = I_0^L + I_1^S$; and employment, which is normalized to one. Aggregate TFP in the model is therefore given by $\hat{z} = \frac{Y_2}{K_2^\alpha}$. Figure 1.6(b) plots the level of aggregate TFP associated with varying levels of uncertainty. When higher uncertainty prompts entrepreneurs to reallocate investment towards short-term projects, aggregate TFP falls because long-term projects are more productive.

This mechanism at work in the model offers an explanation for the greater volatility of output and TFP in emerging markets and for the skewed distribution of growth rates. Shocks to capital flow volatility affect both advanced economies and emerging markets; however, those shocks will affect the macroeconomy only when maturity mismatch is widespread. Sudden stops in capital inflows directly affect the economy by reducing the availability of financing in the current period, but also increase agents' uncertainty about the level of financing that will be available in the future. The model that I have presented indicates that the uncertainty shock will amplify the impact of the sudden stop. A spike in the availability of foreign capital will also increase uncertainty. As a result, the direct benefits of more abundant foreign financing will be offset by the negative effect of the accompanying rise in uncertainty. This asymmetric amplification helps to explain the observed asymmetry in growth rates in emerging economies.

1.4 Conclusion

This chapter has demonstrated that the high output volatility and negatively skewed growth rates observed in emerging markets can be understood as an effect of shocks to capital flow volatility in economies where maturity mismatch is widespread. Small open economies, both advanced and emerging, face uncertainty regarding the future availability of foreign financing. However, the uncertainty will affect investment only where financial markets are not well developed and firms are forced to finance investment in long-term projects with short-term borrowing. An increase in uncertainty about the availability of foreign borrowing increases firms' exposure to rollover risk and reduces the expected return on long-term investment in states of the world in which firms are forced to liquidate long-term projects. As a result, greater uncertainty not only prompts a reduction in the level of aggregate investment, but also shifts its composition away from more productive long-term projects towards short-term projects which do not entail rollover risk. This composition effect generates endogenous fluctuations in aggregate TFP, increasing its volatility.

The interaction between capital flow volatility and maturity mismatch amplifies the impacts of fluctuations in capital inflows in an asymmetric way and thereby contributes to the skewed pattern of growth rates in emerging economies. Sudden stops increase uncertainty about the future availability of foreign capital. Through the mechanism modeled in this paper, that uncertainty amplifies the negative effects of sudden stops. On the other hand, surges in capital inflows also boost uncertainty, which will dampen the positive effects of such surges on investment and growth.

In advanced economies where firms can finance long-term investment by issuing equity or long-term debt, uncertainty shocks will not affect investment because firms to not face rollover risk. Thus changes in capital flow volatility will boost the volatility of investment, output, and aggregate productivity only in emerging markets. Models in which uncertainty affects investment because of risk aversion (Fernández-Villaverde et al., 2011) or the irreversibility of investment (Bloom, 2009) are not suited to explaining differences between advanced and emerging economies, since these features do not vary systematically between the two groups.

In order to mitigate the risks associated with openness to international capital flows, many governments have imposed capital controls to limit exposure to capital flow volatility. Since in the model developed in this paper firms' investment decisions are constrained efficient, capital controls will reduce welfare. The reduction in volatility comes at the cost of lower investment and output. Moreover, substantial evidence indicates that greater openness to international capital flows promotes financial development (Chinn and Ito, 2006; Baltagi et al., 2009; Calderón and Kubota, 2009). As a result, capital controls slow the deepening of equity markets and the lengthening of corporate yield curves that reduce the economy's vulnerability to volatility shocks by preventing maturity mismatch.

There is an obvious role for policy in mitigating the underlying financial frictions that prevent firms from financing long-term projects by issuing equity or long-term debt. However, financial market development entails institutional changes that take time to implement. More immediately, governments have sought to self-insure through the accumulation official reserves. To the extent that the authorities can credibly commit to provide liquidity to firms during sudden stop episodes, and thus mitigate rollover risk, this policy could be welfare enhancing. Such a policy would reduce the uncertainty regarding the future availability of financing and thus limit vulnerability to volatility shocks. However, accumulating reserves reduces the funds available for investment in productive projects, and thus entails a cost. I plan to explore this trade-off in future work.

Chapter 2

Capital Flow Volatility and Maturity Mismatch: An Empirical Analysis

2.1 Introduction

Between 2000 and 2010, annual capital flows to emerging markets grew more than five-fold, from 200 billion dollars to over one trillion dollars, a level they have maintained for the past two years (WEO, 2011). Although this surge was accompanied by strong growth performance in recipient economies, policy-makers both in emerging market governments and international financial institutions have reacted with concern. Major emerging markets including Brazil, Colombia, Indonesia, and Korea introduced new capital controls, while the IMF endorsed the use of capital controls as a necessary part of governments' policy toolbox (Ostry et al., 2010; WEO, 2011). However, the measures adopted and the policy prescriptions of the IMF did not constitute a return to the blanket capital controls in place in most countries prior to 1990. Rather, they targeted portfolio capital inflows, often referred to as hot money. In justifying these measures, policy-makers have frequently cited the volatility of portfolio flows as a major downside of this source of external funds. Doubts about the benefits of portfolio flows find support in the academic literature on the benefits of openness to international capital flows, which consistently found that these flows little if any positive effect on growth and has often mentioned volatility as possible explanation for this finding (Calderón and Schmidt-Hebbel, 2003; Mody and Murshid, 2005; Aizenman and Sushko, 2011).

This paper examines in detail the relationship between the volatility of portfolio capital flows and economic performance, with particular focus on the channel through which changes in volatility affect investment and output. I verify that the unconditional negative correlation between portfolio capital flow volatility and output documented in Section

1.2 remains once I control the level of capital inflows and other determinants of growth. Guided by the model presented in Chapter 1, I then show the relationship between portfolio captial flow volatiltiy is consistent with a role for maturity mismatch acting as a channel of transmission.

I begin my analysis by showing that the volatility of portfolio capital flows dampens growth by reducing investment, while the level of portfolio flows is positively related to output and investment in a panel of 16 emerging market economies. This result helps to explain the common empirical finding that foreign direct investment (FDI) benefits growth while portfolio flows have no effect or even reduce growth (Calderón and Schmidt-Hebbel, 2003; Mody and Murshid, 2005; Aizenman and Sushko, 2011). Once I condition on the volatility of portfolio flows, they too are beneficial. I then show that capital flow volatility has no significant relationship with output and investment in a panel of 11 small open advanced economies, despite the fact that capital flow volatility is larger relative to the size of the economy in this sample than in emerging markets.

In order to test whether the relationship between capital flow volatility and output is consistent with maturity mismatch acting as a transmission mechanism, I first separate portfolio capital flows into into their equity and debt components. I do this because short-term debt flows can generate maturity mismatch, while equity flows cannot not. Consistent with a maturity mismatch channel, I find that the volatility of debt flows dampens investment, while the volatility of equity inflows has no significant impact.

Second, I compare the effects of capital flow volatility on investment in economies with different levels of financial development. Recent empirical work has shown that the extent of maturity mismatch in an economy is highly correlated with widely used measures of financial development (Schmukler and Vesperoni, 2006; Fan et al., 2012). I therefore use measures of financial development, equity market capitalization and private credit, as a proxies for maturity mismatch in the economies in my sample. I find that the negative impact of capital flow volatility is greater where financial markets are less developed—precisely those economies where maturity mismatch is most widespread.

My final test of how maturity mismatch affects the relationship between capital flow volatility and investment makes use of industry-level variation in the duration of investment projects. Using the methodology developed by Rajan and Zingales (1998), I take US data on average time-to-build as indicative of the underlying technological features of each industry. Consistent with a role for maturity mismatch in transmitting volatility shocks, I find that capital flow volatility has a larger negative impact on industries with longer average project durations. In industries with the shortest time-to-build, which is just over one year in the US, capital flow volatility has essentially no negative effect on investment, while the effect on industries with project durations of two years or more is substantial.

My results show a robust negative relationship between the volatility of portfolio capital inflows and both output and investment. Several aspects of this relationship are consistent with a role for maturity mismatch as a channel through which shocks to capital flow volatility affect investment and output. The results therefore have ambiguous implications for the policy of imposing controls on portfolio capital inflows. On the one hand, such measures do dampen volatility, which my findings show will boost growth. At the same time, the impact of capital flow volatility is amplified by underdeveloped financial markets that force firms to engage in maturity mismatch. Policies to deepen capital markets are therefore a necessary compliment to any capital controls. However, research has shown that reduced openness to capital inflows slows financial development (Klein and Olivei, 2008; Baltagi et al., 2009). Thus capital controls may in fact prolong the time necessary to build the type of capital market infrastructure that ensures that the advanced economies studies in this paper are unaffected by capital flow volatility.

The paper proceeds as follows. Section 2.2 examines the relationship between capital flows, their volatility, and economic performance in using macro-level data and discusses the extent to which the findings are consistent with the predictions of the model presented in Chapter 1. In Section 2.3 I use industry-level data to further test whether the data suggest a role for maturity mismatch in transmitting shocks to capital flow volatility. Section 2.4 concludes and discusses directions for further research.

2.1.1 Related Literature

This paper contributes to the large literature on the costs and benefits of openness to international capital flows (for a survey, see Henry, 2007). Research comparing the relative benefits of different types of international capital flows has consistently found that FDI boosts growth while portfolio flows have no effect or even dampen growth (Calderón and Schmidt-Hebbel, 2003; Mody and Murshid, 2005; Aizenman and Sushko, 2011). These and other papers often cite the volatility of portfolio capital flows as an explanation for their findings but do not explicitly test the hypothesis that the volatility of portfolio capital flows offsets their benefits, which this paper does.

Research that does explicitly analyze the relationship has used annual capital flow data (Knill, 2005; Lensink and Morrissey, 2006; Alfaro et al., 2007; Rancière et al., 2008; Broner and Rigobon, 2011; Broner et al., 2013). The resulting measures of capital flow volatility describe ten- or twenty-year periods and capture little if any of the variation in capital flow volatility over time. By obtaining monthly balance of payments data directly from central banks and financial market regulators, I am able to measure capital flow volatility on a quarterly basis and to study the effects of the changes in capital flow volatility over time evident in Figure 1.1.

In evaluating the extent to which the observed relationship between capital flow volatility and economic performance is consistent with a role for maturity mismatch as a transmission mechanism, this paper also contributes to research into the effects of maturity mismatch. Work in this area has tested whether the financial crises more negatively affect investment in firms with large short-term liabilities (Bleakley and Cowan, 2010; Kalemli-Ozcan et al., 2010),[1] and whether greater exposure to short-term liabilities increased firms likelihood of bankruptcy (Benmelech and Dvir, 2011; Kim et al., 2012).

This paper contributes to the literature on maturity mismatch in two ways. First, to my knowledge this my work is the first to empirically examine how maturity mismatch alters the response of investment and output to second-moments shocks as opposed to first moment shocks. Previous research on the vulnerabilities generated by maturity mismatch examines how it affects firms' or economies' respond to a cutoff in funding, whereas this paper examine how the uncertainty generated by the possibility of a sudden stop or credit crunch affects firms behavior. Second, whereas the papers discussed in the the previous paragraph study how maturity mismatch affects investment and output during severe crisis episodes, my work also examines the effects of maturity mismatch during tranquil times as well as during crises.

2.2 Evidence from Macro Data

The unconditional relationship between output and capital flow volatility motivated the the model developed in Chapter 1. Here, I test the specific predictions of the model regarding the relationship between output and investment, on the one hand, and the uncertainty regarding future financial generated by capital flow volatility. The specific focus on changes in the level of financial uncertainty motivates me to modify slightly my measure of capital flow volatility. For each country in my sample, I estimate an autoregressive model of the following form

$$flow_{i,m} = \rho_{0,i} + \rho_{1,i} flow_{i,m-1} + e_{i,m}, \tag{2.1}$$

[1]More specifically, by comparing foreign- and domestically owned firms, Kalemli-Ozcan et al. (2010) demonstrate that inability to roll over short-term debt depresses investment in the aftermath of crises in six Latin American countries. Bleakley and Cowan (2010) come to the opposite conclusion based on a study of firms in 15 emerging markets. They find that the ratio of current liabilities to current assets has no significant effect on firms' investment response to sudden stop episodes.

where $flow_{i,m}$ is gross capital inflows to country i in month m. I then take as a measure of the uncertainty regarding future capital inflows in month m the backward-looking 12-month standard deviation of the residual $e_{i,m}$,

$$Vol_{i,m} = \frac{\sqrt{\frac{1}{12}\sum_{j=0}^{11}\widehat{e}^2_{i,m-j}}}{Trend\ GDP_{i,m}}. \tag{2.2}$$

As in the previous chapter, I normalize the volatility by trend GDP for the quarter in which month m falls in order to capture the importance of volatility relative to the size of the economy.

Table 2.1 presents the AR coefficients ($\rho_{1,i}$ in equation 2.1) for the 21 economies for which I have data, for total gross portfolio inflows as well as for gross portfolio equity and debt inflows separately. The results in Table 2.1 indicate that all coefficients fall well below unity. This is confirmed by Dickey-Fuller tests (the results of which are not shown). For approximately 60 percent of the countries, the AR coefficient is statistically different from zero, indicating that there is indeed a predictable component of capital inflows which my use of the AR residuals cleans out. The volatility measure used in in this chapter thus provides a reasonable approximation of uncertainty about future capital inflows.

The sources of my data on monthly capital flows and the method used to calculate capital flow volatility are discussed in Chapter 1 and listed in Appendix A. I obtained quarterly data on the level of capital flows from the IMF's Balance of Payments Statistics (BoPS). Quarterly data on GDP, investment, and consumer prices come from the IMF's International Financial Statistics (IFS). I seasonally adjust output, inflation, and the CPI using the TRAMO-SEATS algorithm implemented in the Demetra+ software available from Eurostat. Since all three variables are all non-stationary, I use the deviations of these variables from their quadratic trends in all regressions.[2]

I first verify that the relationship between output and capital flow volatility suggested by the correlations in Section 1.2 remain when conditioning other determinants of growth. Thus, I begin by estimating the following equation

$$y_{i,t} = \beta_1 Flow_{i,t-1} + \beta_2 Vol_{i,t-1} + X'_{i,t}\gamma + \alpha_i + \delta_t + \varepsilon_{i,t}, \tag{2.3}$$

Where $y_{i,t}$ is the deviation of log seasonally adjusted GDP from its quadratic trend, $Flow_{i,t-1}$ is the level of portfolio capital inflows as a percentage of trend GDP, and $Vol_{i,t-1}$ is the volatility measure defined in equation 2.2. The vector $X_{i,t}$ includes other relevant control variables. These include the level of FDI and the so-called other investment flows (consisting primarily of trade credits and loans) from the balance of payments (both

[2]All results presented in this section are robust to detrending using an HP filter.

Table 2.1: Portfolio Capital Flows: Autocorrelation Coefficients

	Total Portfolio	Portfolio Equity	Portfolio Debt
Emerging Markets			
Turkey	0.349***	0.319***	0.339***
South Africa	0.311***	0.492***	0.255***
Brazil	0.448***	0.269***	0.362***
Chile	0.300***	0.204**	0.155*
Colombia	-0.351***	-0.359***	0.0788
Mexico	0.052	0.009	0.166**
India	0.375***	0.351***	0.299***
Indonesia	–	-0.051	–
Korea, Rep.	0.323***	0.403***	0.407***
Malaysia	–	–	0.353***
Philippines	0.136*	0.422***	0.008
Thailand	0.431***	0.030	0.618***
Bulgaria	-0.012	0.042	-0.003
Czech Republic	0.089	0.074	-0.005
Hungary	–	0.358***	–
Poland	0.270***	0.359***	0.213***
Advanced Economies			
Austria	0.295***	–	–
Belgium	-0.047	–	–
Denmark	0.063	-0.051	0.049
Italy	0.078	0.069	0.165**
Norway	-0.132	0.160*	-0.149*
Sweden	-0.234*	-0.037	-0.246**
Canada	0.262***	0.221***	0.230***
Finland	-0.043	0.166**	-0.061
Greece	0.186**	–	–
Portugal	0.000	0.101	-0.177**
Spain	0.586***	-0.057	0.643***

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

normalized by trend GDP), as well as the log deviation of seasonally adjusted consumer prices from their quadratic trend.[3]

I include country fixed effects (α_i) to control for unobserved cross-country heterogeneity as well as time fixed effects (δ_t) to capture common shocks affecting all the countries in the sample.[4] Endogeneity is an obvious concern when estimating (2.3). While the level and volatility of capital flows in an economy may affect aggregate growth and investment, economic performance in part determines capital flows. For this reason I lag the regressors by one quarter.[5]

The results in regression 1 of Table 2.2 demonstrate that the *level* of portfolio capital

[3] I have estimated the model with a more extensive array of control variables, including trade as a share of GDP, institutional quality, and GDP per capita, but these were not consistently significant and did little to improve the fit of the model.

[4] In place of time fixed effects, I also estimated the model using GDP-weighted average of output growth in the US, European Union, and Japan as an explicit measure of global economic conditions. The results were nearly identical.

[5] Results presented in Tables 2.2 and 2.3 are robust to lagging the regressors two, three, and four quarters.

Table 2.2: Capital Flow Volatility, Growth, and Investment

Sample:	Emerging Markets		Advanced Economies	
Dependent Variable:	GDP[1]	Investment[1]	GDP[1]	Investment[1]
	(1)	(2)	(3)	(4)
Portfolio Inflows[2]	0.161***	0.571***	-0.006	-0.055
	(0.040)	(0.157)	(0.016)	(0.067)
Volatility, Portfolio Inflows[3]	-0.496***	-1.581***	-0.061	0.107
	(0.135)	(0.530)	(0.074)	(0.312)
Net FDI flows[2]	0.031	0.166	-0.0338	0.038
	(0.0287)	(0.112)	(0.027)	(0.112)
Net other flows[2]	0.173***	0.600***	-0.007	0.022
	(0.022)	(0.085)	(0.015)	(0.062)
Inflation[4]	0.001	-0.013	-0.633***	-2.187***
	(0.003)	(0.012)	(0.102)	(0.429)
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	749	749	353	353
R^2	0.478	0.384	0.775	0.598

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All regressors lagged one quarter. [1]Seasonally adjusted, log deviation from quadratic trend. [2]% of trend GDP. [3]12-month trailing standard deviation of AR(1) residuals, % of trend GDP. [4]Consumer prices, seasonally adjusted, log deviation from quadratic trend. See Appendix A for data sources and list of emerging and advanced economies included.

flows is indeed significantly associated with higher growth, as is the case for FDI and other flows. However the *volatility* of portfolio flows is negatively related to growth. Thus, after conditioning on other relevant variables, the relationship between capital flow volatility and output dicussed in Chapter 1 remains.

As a first step towards understanding the mechanism through which capital flow volatility affects growth I re-estimate (2.3) with investment as the dependent variable. The results are presented in regression 2 of Table 2.2. Once again, while the level of portfolio capital inflows is positively related to investment, the volatility of these capital flows offsets this effect. This suggests that the adverse impact of capital flow volatility on growth is due in part to a negative relationship with investment, as was the case in the model developed in Chapter 1.

In regressions 3 and 4 I estimate the model using data on the 11 small open high-income economies for which I have monthly capital flows data. I find no significant relationship between the volatility of portfolio capital flows and either output or investment. Not only are the coefficients on volatility in the right-hand two columns not statistically different from zero, the point estimates are an order of magnitude smaller than those for the emerging markets sample. These results suggest that the mechanism through which capital flow volatility affects output operates in emerging markets but not in advanced economies.

In the model of Section 1.3, capital flow volatility affected investment due to the presence of maturity mismatch and had no effect where mismatch was not present. Therefore, I expect that the volatility of capital flows that do not generate maturity mismatch will not dampen investment. I test this hypothesis in Table 2.3, where I divide portfolio inflows into its two components—portfolio equity and portfolio debt flows. Portfolio debt flows contain a mix of both long- and short-term debt, so that a portion of these flows will not be associated with maturity mismatch on the part of the domestic firms issuing the debt. However, by definition equity flows can never generate maturity mismatch. I therefore use this distinction in order to test the prediction of the model in Chapter 1 that financing that creates maturity mismatch generates a relationship between volatility and investment. While I imperfectly measure mismatch-generating flows, the contamination of the portfolio debt flows in my regression with foreign purchases of long-term bonds will work against my finding results consistent with the model's predictions.

The results of this exercise, presented in Table 2.3, suggest that the negative effects of capital flow volatility are indeed restricted to portfolio debt flows, which is significantly and negatively related to investment in all specifications. By contrast, the coefficient on equity flow volatility is generally not significantly different from zero and always much smaller than the coefficient on debt volatility. This is consistent with the model's prediction that uncertainty about the future availability of foreign financing dampens investment in the presence of maturity mismatch, but not when firms are able to fund themselves with liabilities that do not generate maturity mismatch.

The difference in the coefficients on the volatility of equity and debt in Table 2.3 also help to rule out a potential alternative explanation for the volatility-investment relationship I find in the data. Because economic conditions in high-income countries are major determinants of capital flows to emerging markets, periods of volatile capital inflows often coincide with periods of economic volatility in the US and Europe. The relationship observed in Table 2.2 between the volatility of total portfolio inflows and investment might therefore reflect not maturity mismatch, but rather uncertainty about demand for exports from the emerging markets in my data set.[6] If demand uncertainty rather than financial uncertainty were driving my results, however, the coefficients on equity and debt flows should be nearly identical. Both types of flows respond to economic conditions in high-income countries, so that the volatility of both types of flows capture an element of demand uncertainty. That the coefficients differ significantly, in both economic and statistical terms, suggests a channel of transmission other than demand uncertainty is at work.

Empirical work by Schmukler and Vesperoni (2006) and Fan et al. (2012) demonstrates

[6]For an overview of the challenges associated with distinguishing the impact of financial shocks from that of demand shocks, see Amiti and Weinstein (2011).

Table 2.3: Capital Flow Volatility, Investment, and Financial Development

Sample:	Emerging Markets		
Dependent Variable:	Investment[1]	Investment[1]	Investment[1]
	(1)	(2)	(3)
Portfolio Equity Inflows[2]	0.784***	1.217**	0.202
	(0.271)	(0.497)	(0.696)
Portfolio Debt Inflows[2]	0.444**	0.606**	0.764**
	(0.184)	(0.246)	(0.298)
Volatility, Equity Inflows[3]	-0.315	-2.621**	-1.477
	(0.762)	(1.127)	(1.125)
Volatility, Debt Inflows[3]	-3.162***	-4.256***	-6.397***
	(0.82)	(1.148)	(1.557)
Equity Flows*Market Cap[2,4]		-0.47	
		(0.396)	
Equity Volatility*Market Cap[3,4]		8.162***	
		(2.623)	
Debt Flows*Market Cap[2,4]		-0.353	
		(0.288)	
Debt Volatility*Market Cap[3,4]		3.451*	
		(2.04)	
Equity Flows*Credit[2,5]			0.697
			(0.682)
Equity Volatility*Credit[3,5]			4.872*
			(2.519)
Debt Flows*Credit[2,5]			-0.827*
			(0.428)
Debt Volatility*Credit[3,5]			7.043**
			(2.857)
Country Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Observations	749	749	749
R^2	0.393	0.411	0.411

Standard errors in parentheses; ** p<0.01, ** p<0.05, * p<0.1.
All regressors lagged one quarter. Additional controls included: net FDI inflows, net other inflows, inflation, trend market cap or credit (% GDP) [1]Seasonally adjusted, log deviation from quadratic trend. [2]% of trend GDP. [3]12-month trailing standard deviation of AR(1) residuals, % of trend GDP. [4]Quadratic trend of equity market capitalization, ,% GDP. [5]Quadratic trend of credit the to private sector, % GDP. See Appendix A for data sources and list of emerging economies included.

that the extent of maturity mismatch in the economy is closely related to its overall level of financial development. With this in mind, I employ two widely used measures of financial development, equity market capitalization and private credit (both as a share of GDP), as a proxies for the level of maturity mismatch. In particular, I use the quadratic trend of this variable to capture the underlying structural characteristic that I am interested in, rather than for example a stock price bubble or credit boom.

The results, in regressions 2 and 3 of Table 2.3, indicate that higher levels of financial development do indeed reduce the negative effects of portfolio debt flow volatility on investment. The negative impact of portfolio debt flow volatility is therefore less in more financially developed economies—those economies in which maturity mismatch is less severe. These results are consistent with the work of other researchers, including Alfaro et al. (2004) and Eichengreen et al. (2011), who have demonstrated that financial development amplifies the benefits associated with capital inflows. Moreover, this finding is consistent with a role for maturity mismatch in channeling shocks to capital flow volatility through to the real economy.

2.3 Evidence from Industry-Level Data

The previous section tested the predictions of the model of Chapter 1 regarding the relationship between financial uncertainty, as captured by capital flow volatility, and aggregate output and investment. However, the model also has a variety of implication for the relationship between capital flow volatility and the performance of different industries. In the model greater uncertainty regarding the future availability of lending induced the representative firm to cut back on long-term investment while leaving the level of short-term investment unchanged. As a result, I expect that the financial uncertainty generated by capital flow volatility will have a larger impact on industries characterized by greater mismatch between the maturity of their liabilities and the duration of their investment projects.

In this section, I therefore test whether capital flow volatility has a larger negative impact on industries with longer project durations, using a methodology based on that developed by Rajan and Zingales (1998). The Rajan-Zingales approach takes US data on industry-level characteristics as representative of the underlying technological or structural features of each industry, then looks at how the impact of a particular variable varies with those industry-level characteristics. Thus research into the effects of openness to capital flows has examined how firms with different degrees of dependence on external financing (the industry-level feature employed by Rajan and Zingales) respond to capital account liberalization (Gupta and Yuan, 2009; Levchenko et al., 2009), financial crisis (Kroszner et al., 2007; Tong and Wei, 2011), or fluctuations in capital inflows (Aizenman and Sushko, 2011). Other studies have employed modified versions of this technique, exploiting alternate sources of variation across industries such as liquidity needs (Raddatz, 2006), contract intensity (Nunn, 2007), and schooling intensity (Ciccone and Papaioannou, 2009). In each case, the authors take variation across industries in the US as indicative of the sector's fundamentals.

Here I take industry-level variation in the average time necessary for firms to complete investment projects in the US as representative of the variation in project duration dictated by industries' underlying technology and examine how the impact of capital flow volatility varies across industries which differ in this dimension. My focus on the maturity of investment projects contrasts with many existing empirical studies of maturity mismatch that rely on data from the liability side of firms' balance sheets (Schmukler and Vesperoni, 2006; Bleakley and Cowan, 2010; Fan et al., 2012). Using US project duration as a proxy for maturity mismatch in a given industry requires that the cross-industry variation in time-to-build in the US reflects underlying technical features of each industry that are constant across countries. This is the standard assumption made in studies employing the Rajan-Zingales approach.

In emerging markets where relatively few firms can fund themselves with long-term debt or equity, project duration clearly provides a reasonble measure of maturity mismatch. However, even where capital markets are more developed, this variable provides information regarding the degree of maturity mismatch in a given industry as long as some subset of firms in each industry are constrained in their ability to issue long-term debt and equity, for example small or young firms. In any case, to the extent that firms adjust their liability structure to reflect the length of time needed for their investments to mature, my estimates of the impact of project duration on the relationship between capital flow volatility and investment will be biased towards zero.

Data on the time needed to complete investment projects are relatively rare, particularly at the industry-level data.[7] Models featuring time to build generally demonstrate that their results are robust to a variety of investment lags (e.g. Bar-Ilan and Strange, 1996) or choose the project duration to match a calibration target such as the volatility of investment (e.g. Kydland and Prescott, 1982), rather than basing their parameter choice on any direct empirical evidence the parameter's empirical value. An exception is Koeva (2000), who compiles data on the duration of investment projects undertaken by US firms in 19 3-digit International Standard Industry Classification (ISIC) manufacturing industries. These data measure the time elapsed from the initiation of project planning

[7]For example, in discussing the available evidence on time-to-build, Kydland and Prescott (1982) cite a paper from 1960 (Mayer, 1960).

Table 2.4: Average Project Duration by Industry

ISIC Code	Description	Duration (months)
355	Rubber products	13
381	Metal products	14
362	Glass and stone products	18
369	Non-metallic mineral products	18
382	Machinery	18
390	Other manufacturing	18
323	Leather products	23
341	Paper products	23
352	Other chemical products	23
353	Petroleum refining	23
354	Petroleum and coal products	23
311	Food products	24
321	Textiles	24
383	Electrical machinery	24
385	Professional and scientific equipment	25
384	Transport equipment	28
331	Wood products	30
371	Iron and steel	37
372	Non-ferrous metals	37

Source: Koeva (2000)

to the time the project came on line. Project lengths in the sample range from just over a year for the construction of a light manufacturing facility producing metal or rubber products to more than three years for heavy industry such as mills engaged in the smelting and rolling of iron and steel (Table 2.4), with the average investment project taking just over two years to come on line. These findings are consistent with aggregate-level estimates by Boca et al. (2008) of the average time required for investment projects to become productive in a panel of approximately 1500 Italian manufacturing firms from 1985 to 1995.

To examine how the impact of capital flow volatility varies across industries with differing project durations, I estimate the following specification

$$\begin{aligned} y_{i,j,t} &= \beta_1 Flow_{i,t-1} + \beta_2 Vol_{i,t-1} \\ &+ (\beta_3 Flow_{i,t-1} + \beta_2 Vol_{i,t-1}) \times Duration_j \\ &+ VA\_share_{i,j,t-1} + X'_{i,t}\gamma + \alpha_i + \phi_j + \delta_t + \varepsilon_{i,j,t}, . \end{aligned} \tag{2.4}$$

The dependent variable $y_{i,j,t}$ represents the change in either log real value-added or log real investment, depending on the specification, in country i for industry j in year t. The variable $Duration_j$ multiplies both the level and the volatility of capital inflows and is the average project duration for industry j reported by Koeva (2000) measured in years.

As in the previous section, I measure capital flow volatility using the standard deviation of the residuals from an AR(1) regression of the level inflows, normalized by trend GDP. Following the literature, I control the industrial structure of the economy by including each industry's share of total value added in the previous year $VA_{share i,j,t-1}$, as well as a vector of country-level control variables $X_{i,t}$.

I obtained data on value added and investment at the three-digit ISIC level from INDSTAT4 datatase maintained by the United Nations Industrial Development Organization (UNIDO). The UNIDO data are compiled from national industrial surveys that cover both publicly listed and privately held firms. The inclusion of unlisted firms is important given that I expect capital flow volatiltiy to have the largest effects on firms unable to issue equity. The fact that the frequently used Worldscope data base excludes privately held firms is one reason why I do not follow other researchers (e.g. Schmukler and Vesperoni, 2006; Bleakley and Cowan, 2010; Fan et al., 2012) studying maturity mismatch who use firm-level data from Worldscope.

As the UNIDO data are in nominal terms, I deflate them using the aggregate GDP deflator (taken from the WDI), as is standard in the literature (e.g. Kroszner et al., 2007; Ciccone and Papaioannou, 2009; Gupta and Yuan, 2009; Levchenko et al., 2009; Rajan and Subramanian, 2011).[8] Since the use of industry-level data allows me to focus on the specific mechanism through which volatility affects investment, here I estimate the model using data not only for the emerging markets in my sample but also the small, open advanced economies.

Table 2.5 presents the results from estimating equation 2.4. The coefficients on the terms interacting the level of portfolio debt flows and time-to-build are positive, significantly so when the dependent variable is investment growth. This implies that debt flows benefit industries with longer project durations relatively more than those with shorter time-to-build. Therefore although the coefficient on the level of portfolio debt is significant and negative, the net impact of these capital flows on investment in industries with longer than average time-to-build will be positive.[9] This result is sensible given the close relationship between time-to-build, capital intensity, and reliance external financing.

Similarly, while the coefficient on portfolio debt volatility is significant and positive, the debt volatility-time-to-build interaction term carries a negative and statistically significant coefficient. Capital flow volatility more negatively affects industries in which projects take longer to complete, with the net effect of volatility negative where project durations

[8]Since industry-level deflators are not available for a broad set of countries, the alternate approach taken by Koren and Tenreyro (2007) is to use US industry-level deflators. I use the method most widely used in the literature.

[9]In the notation of equation 2.4, this net effect is given by $\beta_1 + \beta_3 \times Duration_j$. The unweighted mean value of duration across manufacturing industries is just over two years. Recall, however, that the data on US time-to-build are not used here as an accurate estimate of industry project durations in the countries. Rather, they provide a relative ranking of industries according to their time-to-build.

Table 2.5: Capital Flow Volatility and Project Duration

Sample:	Emerging & Advanced Economies	
Dependent Variable:	Value-Added[1]	Investment[1]
	(1)	(2)
Portfolio Equity Inflows[2]	-0.0873	-0.217
	(1.735)	(3.007)
Portfolio Debt Inflows[2]	-1.809**	-3.699***
	(0.908)	(1.387)
Volatility, Equity Inflows[3]	-1.889	21.38
	(10.13)	(15.68)
Volatility, Debt Inflows[3]	18.08***	33.78***
	(6.576)	(9.851)
Equity Flows*Time-to-Build[2,4]	0.064	0.177
	(0.852)	(1.464)
Equity Volatility*Time-to-Build[2,4]	1.444	-4.109
	(4.669)	(7.137)
Debt Flows*Time-to-Build[3,4]	0.496	1.698***
	(0.432)	(0.649)
Debt Volatility*Time-to-Build[3,4]	-9.083***	-19.45***
	(2.934)	(4.332)
Value-added Share	-1.021***	-0.476
	(0.205)	(0.325)
Industry Fixed Effects	Yes	Yes
Country Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Observations	3202	2347
R^2	0.092	0.098

Standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$. All regressors lagged one year. Additional controls included: net FDI inflows, net other inflows, inflation, GDP per capita. [1]Real growth, year-on-year. [2]% of trend GDP. [3]12-month standard deviation of AR(1) residuals, % of trend GDP. [4]Time-to-build measured in years. See Appendix A for data sources and a list of emerging and advanced economies included.

are above average. Why might value-added and investment in industries with relatively short project durations be positively related to capital flow volatility? This likely reflects the fact that these industries can more easily take advantage of surges in capital inflows that occur during periods of high volatility.

The results in Table 2.5 are consistent with maturity mismatch acting as a channel through which the financial uncertainty generated by capital flow volatility affects investment and output. The negative and significant coefficient on the interaction between portfolio debt flow volatility and project duration indicates that industries in which investments take longer to mature are more negatively affected by volatility. The coefficient on the interaction between time-to-build and equity flow volatility is not statistically different from zero and changes sign. Once again, this difference in the impact of the two different types of capital flows also suggests that my estimates of volatility's effects do not reflect factors such as demand uncertainty, which would be reflected in both types of capital flow volatility.

2.4 Conclusion

Data from a panel of 15 emerging markets and 11 advanced economies are consistent with a role for maturity mismatch in transmitting uncertainty shocks to capital flow volatility. In the emerging markets, capital flow volatility is associated with lower growth and investment, while this relationship does not hold in high-income small open economies. The volatility of portfolio debt flows, which can generate maturity mismatch, negatively affects output by dampening investment. By contrast, the volatility of equity flows, which do not generate maturity mismatch, is not significantly related to either output or investment. Moreover, the negative impact of portfolio debt flow volatility is mitigated by financial market development, one component of which is a longer yield curve and thus less widespread maturity mismatch.

The relationship between capital flow volatility and average project duration observed at the industry-level is also consistent with a role for maturity mismatch in transmitting shocks to capital flow volatility to the real economy. Industries in which investment projects require longer to complete are more negatively affected by increases in capital flow volatility. In industries where the average project takes only a year to complete, capital flow volatility has no impact on output or investment.

Chapter 3

Large Capital Inflows, Sectoral Allocation, and Economic Performance [1]

3.1 Introduction

The last 30 years have seen a sustained process of financial globalization, with countries around the world opening their capital account and joining the international financial markets. With the passing of time, both in academic and policy circles an initially benign view toward openness to international capital flows has given way to a more skeptical approach. The IMF's inclusion of capital controls in its recommended policy toolbox epitomizes the shift in thinking (Ostry et al., 2010; WEO, 2011). Not only are episodes of large capital inflows thought to set the stage for subsequent financial crises, but the impact of inflows on economic performance during tranquil times has also been called into question, for example in the context of the European Union (Giavazzi and Spaventa, 2010).

Figure 3.1 summarizes the experiences of Spain and Ireland, which are in many ways typical of the countries in the Eurozone periphery. Since the launch of the Euro, these countries have received large capital inflows (the first row of Figure 3.1), coinciding with rapid credit growth and consumption booms (second row). Moreover, these countries

[1] This chapter is joint work with Luca Fornaro and Dr. Gianluca Benigno The project was originally motivated by Luca Fornaro's and Gianluca Benigno's interest in empirically testing the model they developed in Benigno and Fornaro (2013). Other than brief passages in the chapter's introduction, all of the text was written by me. I carried out all of the empirical work, which I discussed with my co-authors, who assisted in interpreting results and provided general guidance on the direction of the paper. The model setup was suggested by Luca Fornaro. I derived all of the analytical results presented in the chapter.

experienced a shift of resources out of sectors producing tradable goods such as manufacturing and into the production of non-tradable goods, such as construction (third row of Figure 3.1). During the same period, the economies in Eurozone periphery saw a slow down in productivity growth (bottom row of Figure 3.1) . These developments have led some authors to draw a connection between episodes of large capital inflows and slowdowns in productivity growth, since capital inflows can trigger a movement of resource toward non-tradable sectors characterized by slow productivity growth (Benigno and Fornaro, 2013; Reis, 2013).

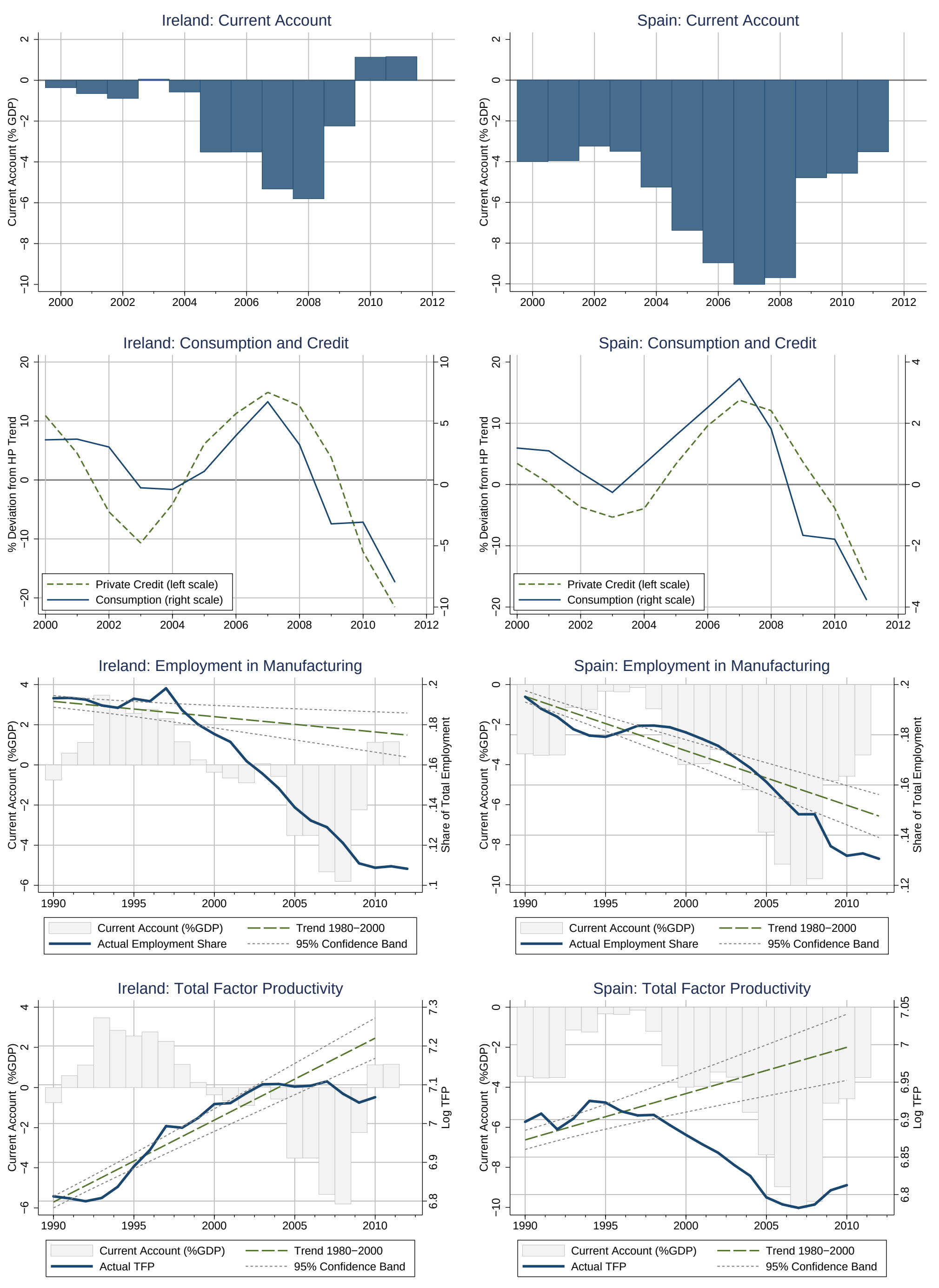
The consequences of large capital inflows have also raised concerns among policy-makers in emerging market economies. In the five years prior to the 2008 financial crisis, capital flows to these countries averaged 500 billion dollars per year, while after the crisis annual capital inflows averaged more than one trillion dollars annually. As in the European periphery, higher capital inflows to emerging markets coincided with consumption booms and exchange rate appreciation. The surge in inflows, memorably described by Brazilian President Dilma Rouseff as a "liquidity tsunami," led governments in countries ranging from Brazil to Korea to Indonesia to impose controls on capital inflows. More recently, the output growth in emerging markets has slowed, precisely as capital inflows have subsided. Once again, this experience raises the question of whether episodes of captial inflows negatively impact economic perfomance in the medium term.

This paper assesses whether the experience of Eurozone periphery countries represents an exception or rather the norm. To this end, we examine episodes of large capital inflows over the last 35 years in a group of 69 middle- and high-income countries. We find that while these episodes begin with an acceleration of growth, once the capital inflows subside growth slows significantly and aggregate productivity drops. However, we also find that the severity of the post-episode downturn is systematically related to the sectoral allocation of resources during the episode. Episodes in which investment shifts towards the tradables sector while capital inflows are high exhibit better growth performance once those inflows subside.

We use a model of a small open economy to interpret our empirical results. In an economy with two sectors, tradable and nontradable, we show that a permanent shock to productivity in the tradables sector, a fall in the world interest rate, and an increase in expected future productivity will all lead to a jump in capital inflows. Whereas the first of these three shocks will result in a shift of both labor and capital into the tradables sector, the latter two shocks result in labor moving into the production of notradable goods while investment shifts into nontradables.

The differences in sectoral allocation of labor across the episodes that we identify in the data can therefore be interpreted as an indication of the underlying cause of each episode.

Figure 3.1: Capital Inflows and Macroeconomic Performance in the Eurozone Periphery



Sources: IMF BoPS, WDI, PWT, UNIDO, ILO

In turn, the relationship between sectoral allocation of labor while capital inflows are rising and subsequent economic performance after inflows begin to fall may reflect the fact that large capital inflows generated by lower international interest rates or expected productivity gains expose the recipient economy to greater risk than do episodes that reflect increases in productivity which have already been realized.

Our finding that episodes of large capital inflows are typically followed by an economic downturn in the medium-term suggests that the concerns of policy-makers in emerging markets are warranted. Capital inflows that coincide with a shift in labor into the non-tradables sector merit particular caution. By contrast, where labor moves to the tradables sector, any downturn that follows the end of large capital inflows is likely to be relatively mild, thus weakening the case for policy intervention.

The paper begins by describing the data and methodology we use to identify episodes of large capital inflows in Section 2. In Section 3 we examine how key macroeconomic variables behave during and after inflows episodes, as well as how the sectoral allocation of resources changes. We then study the relationship between sectoral allocation during inflows episodes and post-episode performance. Section 4 introduces a model of a small open economy and analyzes the economy's response to shocks that generate capital inflows. We then interpret our empirical findings in light of the model's results. We discuss possible implications of our findings for policy-makers in countries that receive large capital inflows in Section 5.

3.1.1 Related Literature

This paper contributes to two areas of literature. First, in focusing on episodes of unusually large capital capital inflows, our work is related to the study of what have been called capital flow bonanzas or surges. Our methodology, taken from the literature on credit booms (Gourinchas et al., 2001; Tornell and Westermann, 2002; Mendoza and Terrones, 2008), identifies periods in which the **level** of capital inflows is unusually large. By contrast, the literature on surges examines the causes (Forbes and Warnock, 2012b) and consequences (Reinhart and Reinhart, 2009) of unusually large **changes** in capital inflows. The experience of Eurozone countries highlights the value of our approach. Capital inflows to Spain grew steadily, eventually exceeding 10 percent of GDP, but never jumped as in a surge.

Perhaps the closest paper to this work is Cardarelli et al. (2010), who also examine episodes in which the level of capital inflows is unusually high. Whereas they focus on policy responses to large capital inflows, we study the effects of such episodes on the sectoral allocation of resources. Using a different measure of capital inflows also allows us to examine episodes over a longer timespan. Importantly, our data include the large capital flows to the Eurozone periphery in the mid-2000s as well as recent capital flows to emerging markets, while Cardarelli et al. (2010) do not.

Second, our work contributes to research on how external factors interact with the sectoral allocation of production to affect economic performance. Rodrik (2008) documents that an undervalued exchange rate boosts economic growth and presents evidence that the reallocation of resources into the production of tradable goods generates this relationship. Analyzing the impact of sectoral allocation on aggregate productivity in more detail, McMillan and Rodrik (2011) show that a shift of productive resources into relatively less productive sectors have in many countries severely dampened aggregate productivity growth, even as resource allocation within sectors has improved. Our empirical findings are consistent with Rodrik's in that we show that large capital inflows are associated with both real exchange rate appreciation and a reallocation of resources out of the tradables sector, as well as a subsequent slowdown in both output and productivity.

Analyzing the experience of Southern Europe, Giavazzi and Spaventa (2010) also highlight the risks associated with capital inflows that are accompanied by reallocation into the nontradables sector. This paper takes the analysis further by systematically documenting the negative relationship between the shift into nontradables during episodes of large capital inflows and economic performance once those flows abate. Moreover, our model provides insights into why the pattern of sectoral reallocation differs across episodes.

3.2 Data and Methodology

3.2.1 Identifying Capital Inflows Episodes

As a measure of capital inflows into the economy we use the (negative of the) current account deficit less the increase in holdings of official reserves. All data on international capital flows are taken from the IMF's Balance of Payments Statistics (BoPS) data base. Such a broad measure of capital inflows may seem at odds with recent work on the subject, which has shown important differences in the behavior of private and public flows (Alfaro et al., 2011) as well as gross and net flows (Rothenberg and Warnock, 2011b; Forbes and Warnock, 2012b; Broner et al., 2013). However, our focus here is the impact of capital flows in recipient countries, meaning that the origins and drivers of those flows is of less importance for our analysis.

We do subtract reserve accumulation from our measure of capital inflows, however, in order to be able to differentiate between large capital inflows and the policy response to them.[2] The case of Brazil highlights the merits of our approach: during the four years after the 2008 financial crisis, Brazil received approximately 50 billion dollars in capital inflows, an average of 4.5 percent of GDP per year. At the same time, the country's foreign exchange reserves nearly doubled. This accumulation of assets by the monetary authorities meant that Brazil's current account deficit averaged only 2.5 percent of GDP during a time of large capital inflows, much discussed by policy-makers and the media as well as evident in the data.

Having selected our preferred inflows measure, we normalize by trend GDP in order to capture the size of the flows relative the economy.[3] Using trend GDP deals with the fact that a surge in capital inflows can boost the size of GDP. We then linearly detrend the normalized series because we observe in the data that numerous economies exhibit long-run trends in their current account balances, presumably for varying structural reasons. Most obviously, the neoclassical growth model predicts that capital-scarce economies will receive capital inflows that diminish in size as the economy converges to its steady-state level of capital. A downward trend in capital inflows is also consistent with models of convergence to a technological frontier (as in Krugman 1979 or Grossman and Helpman 1991). We are not interested in large capital flows that emerge in the course of a long-run trend, but rather on short- and medium-term jumps in capital inflows that occur along this transition path in response to shocks. Detrending the series allows us to identify precisely such events.

In order to identify periods of exceptionally large capital inflows, we follow a procedure commonly used in research on credit booms (Gourinchas et al., 2001; Mendoza and Terrones, 2008) which has more recently been applied to international capital flows (Cardarelli et al., 2010; Caballero, 2012). We calculate the long-run standard deviation of our detrended capital inflows measure for each country and flag years in which inflows rise more than one standard deviation above their trend.[4] These flagged country-years mark the existence of an episode of large capital inflows. An episode begins when the current account as a share of GDP first drops more than half a standard deviation below its trend

[2]Reinhart and Reinhart (2009) describe reserve accumulation less the current account balance as "the best indicator of capital flows," but ultimately use the current account balance in order to lengthen the period covered by their analysis. For an extended discussion of this measure of capital inflows and a survey of the research using it, see Miao and Pant (2012)

[3]Specifically, the capital inflows are measured in current US dollars and then normalized by the trend component of GDP in current US dollars. We extracted the trend component of GDP using a Hodrick-Prescott (HP) filter.

[4]Unlike Gourinchas et al. (2001) and Cardarelli et al. (2010) we take the trend over the entire sample period, rather than a country-year-specific expanding window tend. This is because our rationale for detrending differs substantially. Cardarelli et al. (2010) study policy responses to capital inflows and therefore detrend in order to determine whether contemporary policy-makers would have seen the inflows as unusually large. We detrend to determine whether the inflows are large relative to the long-run trajectory of the economy. This difference in motivation makes the long-run trend more appropriate than an expanding window.

level and ends when the current account again comes within half a standard deviation of its trend.[5]

Although for some countries balance of payments data extends as far back as the 1940s, the IMF Balance of Payments data cover substantially fewer countries prior to the early 1970s. We therefore restrict our attention to capital inflows episodes occurring between 1975 and 2010. We exclude from the analysis countries with a population that never exceeds one million as well as those with annual GDP that remains below one billion dollars throughout the period we study. This has the virtue of excluding several offshore financial centers where the relationship between capital flows and the real economy differs substantially from the typical economy. We also remove from our dataset major oil exporters and countries eligible to receive World Bank International Development Association (IDA) assistance.[6] The main determinants of the external balances of these groups—oil price movements and donors' willingness to provide foreign aid, respectively—play a far smaller role in the dynamics of capital inflows in most other economies.

We experimented with alternate methodologies for identifying episodes in order to verify that our results were robust to the use of different measures and thresholds. Thus, we identified episodes using two alternate measures of capital inflows: the raw current account as a share of GDP and the current account in constant US dollars normalized by population. We also raised the threshold for identifying episodes from one to 1.5 standard deviations, and lowered the exit and entry threshold from 0.5 to zero. The results discussed below are robust to these different methodologies.

3.2.2 Other Variables

Having identified episodes of large capital inflows, we are particularly interested in how these episodes end. Do inflows gradually taper off or do they stop abruptly? Does the economy experience a hard landing once inflows subside? Following the large literature on crises and sudden stops, we identify capital flow reversals and sudden stops using the methodology developed by Calvo et al. (2004).[7] In this classification scheme, a reversal occurs when the year on year change in capital inflows is at least two standard deviations below the mean. A sudden stop occurs when a reversal coincides with an output contraction Calvo et al. (2004). We deem a capital inflows episode to coincide

[5] In the terminology used by Mendoza & Terrones (2008) we set the entry and exit thresholds for the detrended current account equal to 0.5.

[6] The main criterion for IDA eligibility is a PPP-adjusted per-capita GDP of less than US $1,195. The IDA provides grants as well as concessional lending to eligible countries.

[7] Rothenberg and Warnock (2011b) and Forbes and Warnock (2012b) use this approach to identify both surges and sudden stops in gross capital flows.

with a reversal or sudden stop if one of these events occurs at any point during the episode or in the year immediately after the episode end.

Several authors have suggested a link between aggregate productivity and capital inflows (Aoki et al., 2010) as well as closely related variables such as the real exchange rate (Rodrik, 2008). In order to further explore these links we calculate total factor productivity (TFP) for a broad sample of countries over an extended time period using data on output and investment obtained from the Penn World Tables (Heston et al., 2013). We estimate initial capital stock using the method described in Klenow and Rodrguez-Clare (1997) and calculate capital stock for subsequent years using the annual values of investment obtained from the Penn World Tables. In calculating TFP, we use employment data from the International Labor Organization's LABORSTA data set rather than the labor force data provided by the Penn World Tables. This ensures that fluctuations in TFP around episodes of large capital inflows are not the result of changes in the unemployment rate. We calculate aggregate total factor productivity using standard growth accounting (e.g. as in Benhabib and Spiegel, 2005). This allows us to measure TFP in nearly all of the 69 countries in which we observe episodes of large capital inflows.

Macroeconomic data are from the standard sources, including the IMF International Financial Statistics (IFS) and the World Bank World Development Indicators (WDI). We also analyze international liquidity conditions at the time of capital inflows episodes, taking movements of the effective Federal Funds rate, obtained from the Federal Reserve Economic Database (FRED) as a proxy for changes in the rates attached to international lending. We calculate real rates by subtracting from the nominal rate inflation during the previous year, which we use as a proxy for expected inflation. As a measure of the risk appetite of major international investors, we use the the spread between top-rated corporate bonds in the US (those rated Aaa by Moody's) and medium-grade corporate bonds (rated Baa), which "are subject to substantial credit risk" (Moody's, 2013).[8]

We obtain data on manufacturing sector employment, value-added, and investment from the UNIDO INDSTAT2 database. As the UNIDO data are in nominal terms, we deflate them using the aggregate GDP deflator (taken from the WDI), as is standard in the literature (e.g. Kroszner et al., 2007; Ciccone and Papaioannou, 2009; Gupta and Yuan, 2009; Levchenko et al., 2009; Rajan and Subramanian, 2011).[9] Appendix C provides detailed descriptions of which data were drawn from which source.

[8]The VIX index provides a more explicit measure of risk appetite; however, the VIX is available only since the early 1990s, whereas corporate bond spreads are available the point where our sample begins in the mid-1970s.

[9]Since industry-level deflators are not available for a broad set of countries, the alternate approach taken by Koren and Tenreyro (2007) is to use US industry-level deflators. We use the method most widely used in the literature.

3.2.3 Descriptive Statistics

Our baseline methodology identifies 141 episodes of large capital inflows occurring between 1975 and 2010, of which 38 took place in advanced economies and 68 in emerging markets (A full list of these episodes is provided in Appendix C).[10] Reassuringly, our methodology captures well known examples of large capital inflows such as the lead-up to well-known crises in Latin America in the early 1980s, Scandinavia in the early 1990s, East Asia in the late 1990s, and the Eurozone periphery in the mid-2000s. We also pick up less well-known episodes that did not end in crisis, such as inflows to Canada in the early 1990s. Importantly, the episodes we identify include the large capital inflows to emerging markets such as Brazil, Indonesia, and Turkey following the 2008 crisis. The number of episodes we identify is consistent with the the findings of Reinhart and Reinhart (2009), who identify 207 capital flow "bonanzas" in middle- and high-income countries between 1980 and 2007, of which 112 last more than one year.

The average episode duration was just under four years. Table 3.1 gives the average current account deficit (as a share of trend GDP), number of episodes, and average duration of episodes in major regions over the four decades covered by our analysis. Overall, the incidence of episodes of large capital inflows rises over time, with 36 percent of all episodes taking place after 2000. This pattern reflects the fact that governments have consistently liberalized controls on capital inflows since the 1970s (as documented by, for example, Chinn and Ito, 2006). The share of episodes in the advanced economies fell throughout the 1970s, 80s, and 90s, but rose to nearly 18 percent in the 2000s as the countries of the Eurozone periphery received large capital inflows, reflecting the launch of the Euro as well as the accession of Eastern European economies. While the share of episodes occurring in Latin America during in the 1970s was high, more recently it has seen around one fifth of all episodes. Similarly, Asia has consistently played host to roughly one fifth of episodes. In both the 1990s and 2000s, a third of episodes have occurred in Eastern European countries. This means that the region played host to more episodes than any other during the 2000s.

The average duration of episodes has fallen slightly over time from just over 4 years to around 3.5. The size of the current account relative to the economy during these episodes is substantially larger in most emerging markets in all regions than in the advanced economies. While the average current account deficit has fallen over time in the advanced economies, Latin America, and of course Asia, it has risen substantially in Eastern Europe. Note that in Asia during the 2000s the average current account balance

[10]We define emerging markets broadly, including in this category countries in either the JPMorgan Emerging Market Bond Index (EMBI) or the S&P/International Finance Corporation Emerging Markets Database Investable Index (S&P IFCI Index). Advanced economies are the high-income members of the OECD.

Table 3.1: Capital Inflows Episodes: Summary Statistics

	Decade of Episode Start				
	1970s	1980s	1990s	2000s	Total
Advanced Economies					
Number of Episodes	12	11	4	9	36
Ave.Duration	4.08	4.91	6.5	4.11	4.61
Ave.CA(%GDP)	-4.49	-4.32	-0.75	-3.48	-3.77
Latin America					
Number of Episodes	5	10	6	6	27
Ave.Duration	3.8	3.9	4	3.5	3.81
Ave.CA(%GDP)	-8.05	-7.73	-5.87	-7.09	-7.23
Africa					
Number of Episodes	4	2	1	5	12
Ave.Duration	5	3.5	2	4.4	4.25
Ave.CA(%GDP)	-13.02	-5.41	-8.32	-5.26	-8.12
E.Europe					
Number of Episodes	1	1	12	16	30
Ave.Duration	3	5	3.08	3.44	3.33
Ave.CA(%GDP)	-4.72	-5.16	-5.7	-10.01	-7.95
Asia					
Number of Episodes	1	7	6	10	24
Ave.Duration	4	3.29	3.33	3	3.21
Ave.CA(%GDP)	-6.58	-8.31	-6.07	2.32	-3.25
Middle East & N.Africa					
Number of Episodes	2	2	3	5	12
Ave.Duration	5.5	4.5	2.33	3.6	3.75
Ave.CA(%GDP)	-11.03	-7.05	-8.12	-8.53	-8.6
Total					
Number of Episodes	25	33	32	51	141
Ave.Duration	4.24	4.15	3.63	3.59	3.84
Ave.CA(%GDP)	-7.18	-6.46	-5.49	-5.49	-6.01

Sources: IMF BoPS, Authors' Calculations

even during these episodes was over four percent of GDP. This happens for two reasons. First, because we measure capital inflows by subtracting the change in official reserves from the current account balance, our method will flag countries receiving substantial capital inflows while nonetheless running a current account surplus due to the authorities' purchases of foreign reserves. Second, our methodology looks at the deviation of our inflow measure from its long-run trend.

Table 3.2 examines the relationship between the capital inflows episodes that we identify, capital flow reversals, and sudden stops. Of the episodes of unusually large capital inflows that we study, 107 (76 percent) end in a reversal as defined by Calvo et al. (2004). Just over 40 percent inflows episodes coincided with a sudden stop.[11] Although emerging mar-

[11]Recall that according to Calvo et al. (2004) and others (Rothenberg and Warnock, 2011b; Forbes and Warnock, 2012b), a reversal occurs when the year on year change in capital inflows is at least two

Table 3.2: Capital Inflows Episodes, Reversals, & Sudden Stops

	Advanced Economies	Emerging Economies	Other Economies	Total
Total Episodes:	38	68	35	141
Of which:				
Ending in Reversal	33	47	27	107
(% of Group Total)	(86.8)	(69.1)	(77.1)	(75.9)
Of which:				
Ending in Sudden Stop	21	28	8	57
(% of Group Total)	(55.3)	(41.2)	(22.9)	(40.4)

Sources: IFS, WDI, Authors' Calculations

kets experienced more episodes of large capital inflows than advanced economies, Table 3.2 suggests that these are less likely to end abruptly. Episodes in advanced economies ended in a reversal nearly 90 percent the time and a sudden stop in 55 percent of cases. For emerging markets, large capital inflows reversed sharply in 70 percent of episodes and led to a sudden stop just over 40 percent of the time.

3.3 Event Analysis

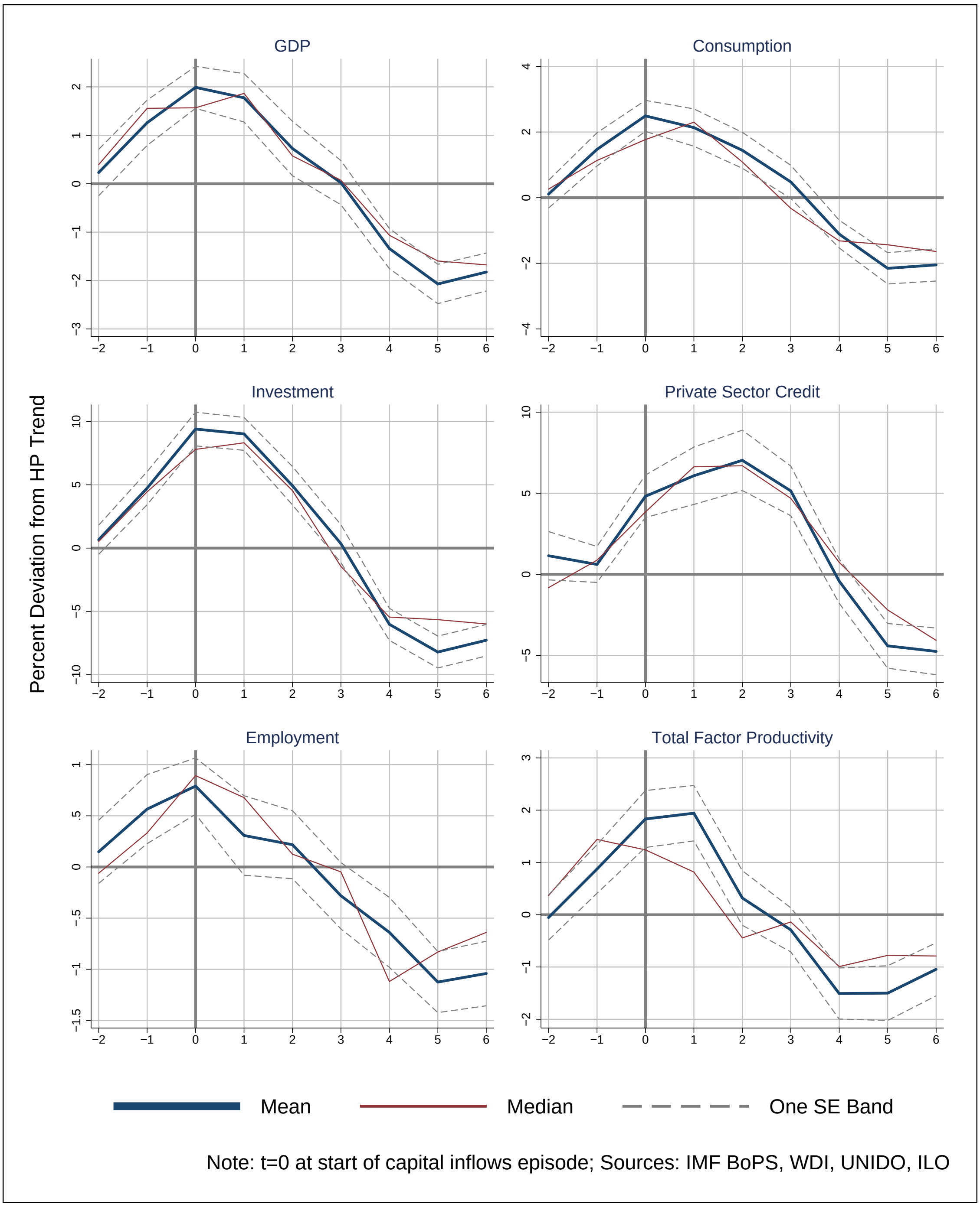
3.3.1 Behavior of Macroeconomic Indicators

We now examine in more detail the behavior of several macroeconomic variables during eight-year event windows that begin two years before the start of each inflows episode. In general this window captures the point at which the variables first diverge from their trend level as well as the trough of the post-boom drop. As is standard in much of the literature (e.g. Gourinchas et al., 2001; Mendoza and Terrones, 2008; Cardarelli et al., 2010), we look at how these variable move relative to their HP trend. Figure 3.2 makes clear that output, consumption, and investment are on average equal to their trend values three years before the peak of an episode. Output and consumption rise between two and three percent above trend through the peak of the episode and then fall to two percent below trend in the subsequent three years. Similarly investment and credit to the private sector rise to 10 percent above trend, then drop to five percent below. The pattern is similar for total employment and total factor productivity, with these variables rising above trend as capital flows increase, then dropping significantly after the flows begin to wane.

Figure 3.3 examines the path of external variables during episodes of large capital inflows. Confirming that we have indeed identified episodes of large inflows, the current account

standard deviations below the mean. A sudden stop occurs when a reversal coincides with an output contraction Calvo et al. (2004).

Figure 3.2: Capital Inflows Episodes and Macroeconomic Performance



deficit goes from an average of just under two percent of GDP prior to start of the episode to between five and six percent in the first two years after the start of the episode, before returning to its original level after five years. Large capital inflows also coincide with a six percent appreciation of the real exchange rate (represented by a rise in the index plotted in Figure 3.3). The real exchange rate remains above its trend value for approximately four years, which is the average duration of the episodes in our sample.

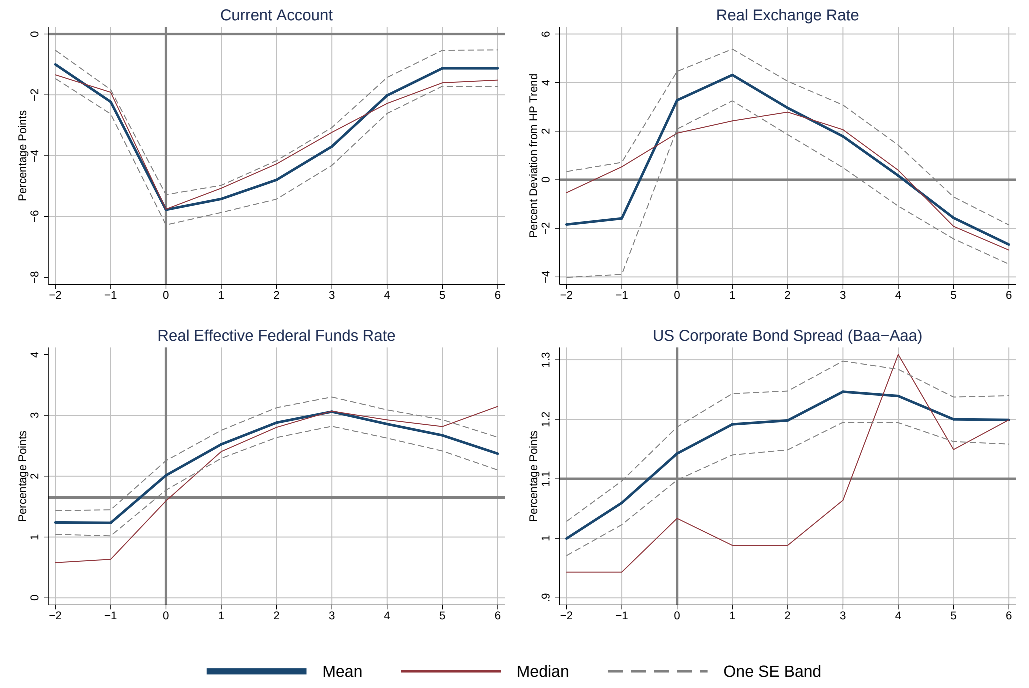
Next we look at international liquidity conditions during periods of large capital inflows, as captured by two measures of financial financial conditions in the US. First, we take take the US real interest rate as a proxy for the international interest rate. When the typical episode begins, the real effective federal funds rate is on average around 1.4 percent, significantly below its average value of 1.65 during the period we analyze (this is plotted in the bottom left panel of Figure 3.3). The US interest rate then rises, peaking three years after the start of the episode. This is just before the point at which the average episode ends.

Second, we test whether prevalent attitudes towards risk in major financial markets vary around the episodes that we identify, taking corporate bonds spreads in the US as a measure of risk appetite. In the two years before the start of an episode, bond spreads are below their long term average of 1.1 percentage points (again plotted in Figure 3.3). Episodes tend to coincide with rising spreads, which peak between three and four years after the start of an episode. The median spread, however, diverges substantially from the mean, spiking sharply four years after the start the episode. Given that the typical episode ends after three years, this suggests that the end of large capital inflows is associated with a drop in risk appetite on the part of US investors. The low levels of interest rates and corporate bond spreads at the start of the episodes we identify indicate that an increase in the supply of international lending, as opposed to changes in domestic fundamentals in the recipient country, plays a role in generating large capital flows.

There are two points worth mentioning with regard to the findings just discussed. First, these patterns hold for both emerging markets and advanced economies as well as overall. The size of the fluctuations in emerging markets is larger, however, consistent with the well-documented fact that emerging economies are more volatile in general (Lucas, 1988; Neumeyer and Perri, 2005; Koren and Tenreyro, 2013). Second, the behavior of these macroeconomic variables is consistent with the literature on sudden stops, which has for example consistently found that productivity drops when capital flows come to a halt. However, it is worth recalling that only 40 percent of inflows episodes end in a sudden stop.

Next we turn our attention to the sectoral allocation of production during episodes of large capital inflows. We examine three measures of sectoral allocation: the shre of

Figure 3.3: Capital Inflows Episodes and the External Sector

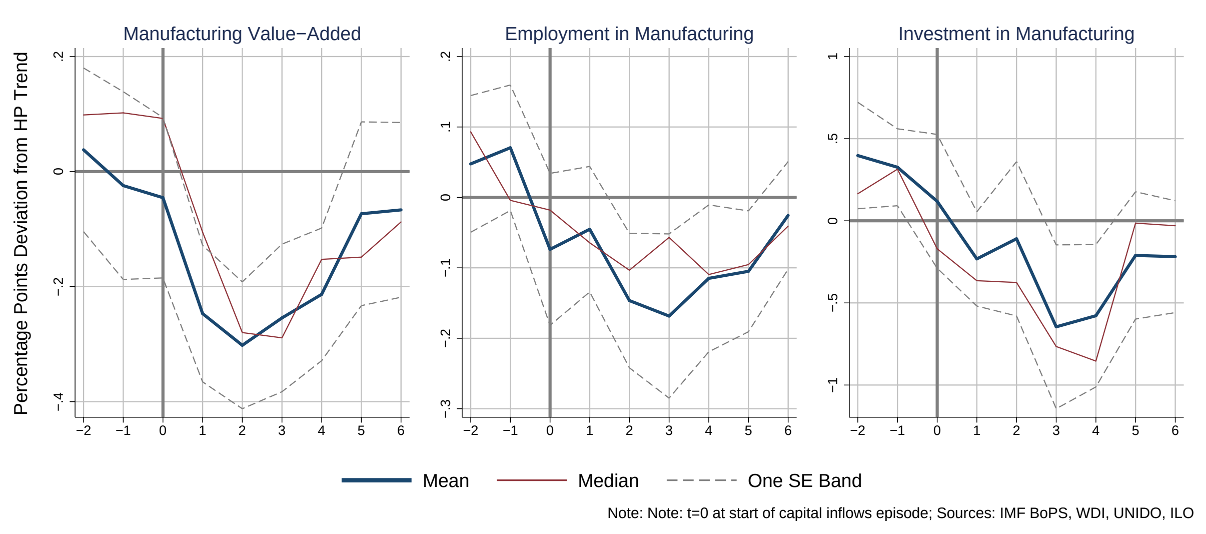


Note: t=0 at start of capital inflows episode; Sources: IMF BoPS,WDI,FRED

manufacturing in total value-added, employment in the manufacturing sector as a share of total employment, and investment in the manufacturing sector as a share of total investment. The value-added share is a commonly used measure of sectoral allocation, while we look at the use of factors of production in order to study in more detail the sources of that reallocation. We use manufacturing as a proxy for the tradables sector in order to maximize the number of capital inflows episodes included in the analysis, since data on agriculture and mining (the other components of tradables) are less widely available. We detrend the sectoral shares because these exhibit clear time trends in nearly all countries in the sample. In advanced economies, the sectoral shares of tradables and manufacturing are steadily falling over time, reflecting a structural shift towards services. By contrast, the importance of tradables and manufacturing rises steadily over time in most emerging and developing economies. Here we detrend using an HP filter for the sake of consistency, but the results are almost identical with linear or quadratic detrending.

In the left-hand panel of Figure 3.4, we plot the movement of the share of manufacturing in total value added. The share is typically very close to trend when the episodes starts, then falls by 0.3 percentage points during the first three years of the boom, indicating a shift in production towards the nontradables sector. The change in sectoral allocation is then gradually reversed, during what are typically the years after the end of the episode. Looking at how the allocation of inputs changes during the episodes we identify, we find some evidence of a drop in the shares of employment and investment in manufacturing.

Figure 3.4: Capital Inflows Episodes and Sectoral Allocation



Although both the mean and median values of the sectoral shares show a clear drop below trend during episodes of large capital inflows, the magnitudes of the shifts are relatively small—0.15 percentage points for employment and slightly above -0.6 percentage points in the case of investment. However, the detrended sectoral shares are not particularly volatile variables, with the mean absolute deviation from trend for employment only 0.5 percentage points and 1.5 percentage points for investment in the countries in our sample.

The patterns discussed here indicate that the four Eurozone periphery countries discussed in the introduction are typical of countries experiencing unusually large capital inflows, rather than exceptional cases. The start of episodes of large capital inflows generally coincides with an rise in output, and expansion of credit, and an acceleration in productivity growth. As capital inflows subside, these variables all drop below trend—a post-episode downturn. In addition, the share of resources dedicated to the production of tradable goods tends to fall during episodes of large capital inflows, rising back towards its trend level once the episode has finished.

3.3.2 Sectoral Reallocation and Economic Performance when Capital Flows Fall

The patterns just discussed raise the question of how these various macroeconomic variables co-move. In Table 3.3 we begin our analysis of these co-movements by examining the bivariate correlations between economic conditions in the three-year period prior to the peak of the capital inflows episodes and macroeconomic performance in the three years after capital flows begin to fall.[12] The episode peak is defined as year with the largest annual capital inflows during the episode. We find that a larger initial credit boom is strongly and significantly associated with lower output, consumption, investment, and employment. Similarly, episodes with greater real exchange rate appreciation are typically followed by a deeper slump.

In Table 3.3 we once again use the manufacturing sector as a proxy for the tradables sector of the economy. Thus, a fall in the share of manufacturing in the years before the episode peak represents a shift of resources away from the tradables sector and into the production of nontradables. Many researchers have used sectoral share of output or value-added as a measure of resource allocation (e.g. Rodrik, 2008; Giavazzi and Spaventa, 2010). The final three columns of Table 3.3 reveal a more nuanced picture.

Table 3.3: Bivariate Correlations,
Sectoral Reallocation and Macroeconomic Performance

	Pre-Peak Averages:				
Post-Peak	Private	Real	Manufacturing Share of Total		
Averages:	Credit[1]	Exchange Rate[2]	Value-Added[3]	Employment[3]	Investment[3]
GDP[1]	-0.426	-0.223	0.228	0.028	0.205
	(0.000)	(0.050)	(0.020)	(0.795)	(0.070)
Consumption[1]	-0.246	-0.195	0.204	-0.122	0.222
	(0.008)	(0.089)	(0.039)	(0.261)	(0.051)
Investment[1]	-0.469	-0.225	0.195	0.073	0.199
	(0.000)	(0.050)	(0.049)	(0.504)	(0.082)
Employment[2]	-0.303	-0.412	0.422	0.154	0.099
	(0.003)	(0.000)	(0.000)	(0.168)	(0.415)

Notes: p-values in parenthesis. Pre- and post-peak averages are mean values 3 years before and after the year capital inflows peak. [1]Real per capita terms; log deviation from HP trend. [2]Log deviation from HP trend. [3]Percentage points deviation from HP trend. See Appendix C for data sources.

We do find that manufacturing value-added share is positively and significantly associated with the four macroeconomic indicators. However, when we look at the allocation of inputs, the share of employment is never significantly related to post-episode performance. By contrast, the share of investment going to the manufacturing sector during the boom period is significantly associated with better economic performance along three of the four dimensions once capital flows start to dry up. The correlations in Table 3.3 change very little when the sample is restricted either to advanced economies or to emerging markets, indicating that the results are not driven by patterns in either of these subgroups.

Next we examine whether these unconditional relationships remain once we control for other relevant factors. In Table 3.4 we estimate the following model in order to study in more detail the relationship between credit, external factors, and sectoral allocation dur-

[12]These results are robust to expanding the window length, although this forces us to drop several episodes near the end of the sample period.

ing the boom years of an episode of large capital inflows and macroeconomic performance in the years when capital inflows are falling:

$$\begin{aligned} y_{i,post} &= \alpha + \beta_1 CREDIT_{i,post} + \beta_2 CREDIT_{i,pre} \\ &\quad + \beta_3 FED\_FUNDS_{i,post} + \beta_4 FED\_FUNDS_{i,pre} \\ &\quad + \beta_5 MANUF\_EMP_{i,post} + \beta_6 MANUF\_EMP_{i,pre} \\ &\quad + \beta_7 MANUF\_INV_{i,post} + \beta_8 MANUF\_INV_{i,pre} + \varepsilon_{i,post}, \end{aligned}$$

Where the dependent variable $y_{i,post}$ is the average of a measure of economic performance after capital inflows have peaked and begun to fall during episode i. The dependent variables we consider are the average values of GDP, Investment, Employment, and TFP (all HP detrended) during the three years after capital inflows reach their peak, as well as the length of time after the peak of capital inflows that GDP is below its trend value.

The variable $CREDIT_{i,post}$ is the average value of HP-detrended real credit to the private sector in the three years after capital inflows have peaked in episode i, while $CREDIT_{i,pre}$ is average credit in the three years before capital inflows reach their peak for episode i. Similarly, the other independent variables represent the pre- and post-peak averages of the US effective Federal Funds rate ($FED\_FUNDS_{i,t}$), the share of manufacturing in total employment ($MANUF\_EMP_{i,t}$), and manufacturing investment as share of total investment ($MANUF\_INV_{i,t}$), where the sectoral shares are measured as the deviation from their HP trends. By controlling for their contemporaneous values we ensure that we are in fact capturing the relationship between the independent variables value prior to the peak and economic performance afterward.[13] This specification is not intended to identify causal relationships, but rather to determine whether the bivariate relationships discussed are robust.

The results in Table 3.4 confirm that a larger boom in credit during the years in which capital flows are rising is associated with a longer post-peak recession as well as lower output, investment, employment, and productivity during the period of falling inflows. By contrast, looser credit conditions in the three years after inflows peak are positively related to macroeconomic performance. While international liquidity conditions during the expansionary phase of the inflows episodes, as proxied by the real Fed Funds rate, are not significantly related to post-peak economic performance, lower US interest rates do coincide with higher GDP in the years after the episode peak, as well as with shorter post-peak downturns.

[13] Controlling for the post-peak values of these variables also helps to control for the degree of factor market flexibility in each economy. It may be the case that countries with greater labor market flexibility fare better once capital inflows fall, flexibility might also mean that the economy exhibits more reallocation of labor and capital during the period of growing capital inflows, which we refer to as the length of the downturn.

Table 3.4: Regression Results,
Episode Characteristics and Economic Performance

Dependent Variable: (Post-Peak)	Downturn Length (1)	GDP[1] (2)	Investment[1] (3)	Employment[2] (4)	TFP[2] (5)
Private Credit,[1]	0.0602**	0.132***	0.380***	0.0258	0.0848***
Post-Peak	(0.026)	(0.031)	(0.089)	(0.033)	(0.023)
Private Credit,[1]	0.0540**	-0.0897***	-0.369***	-0.044	-0.0612**
Pre-Peak	(0.026)	(0.026)	(0.096)	(0.038)	(0.029)
Fed Funds Rate,[3]	0.279***	-0.181*	-0.297	0.0212	-0.0179
Post-Peak	(0.096)	(0.094)	(0.304)	(0.132)	(0.112)
Fed Funds Rate,[3]	0.0874	-0.0651	0.293	-0.0642	-0.084
Pre-Peak	(0.179)	(0.156)	(0.588)	(0.207)	(0.164)
Manuf. Employment,[4]	-1.082*	2.035***	7.461***	1.398**	1.688***
Post-Peak	(0.578)	(0.483)	(1.664)	(0.646)	(0.622)
Manuf. Employment,[4]	-1.177***	0.439	3.270**	1.680***	-0.468
Pre-Peak	(0.383)	(0.416)	(1.593)	(0.446)	(0.364)
Manuf. Investment,[4]	-0.301**	-0.185	-0.962	0.0651	-0.366**
Post-Peak	(0.121)	(0.158)	(0.683)	(0.268)	(0.178)
Manuf. Investment,[4]	-0.126	-0.0619	-0.652	-0.16	-0.00243
Pre-Peak	(0.151)	(0.269)	(0.772)	(0.368)	(0.207)
Observations	66	66	64	65	65
R-squared	0.409	0.66	0.701	0.309	0.518

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Pre- and post-peak values are averages for 3 years before and after the year capital inflows peak. [1]Real, per capita terms; log deviation from HP trend. [2]Log deviation from HP trend. [3]Percentage points. [4]Share of total; percentage points deviation from HP trend. See Appendix C for data sources.

The conditional relationship between macroeconomic performance and the sectoral allocation of labor and capital differs from the patterns we observed in the bivariate correlations. The share of employment in manufacturing during the pre-peak period is now significantly associated with a shorter post-peak downturn as well as higher investment and employment in the years when capital inflows are falling. The coefficient on pre-peak labor allocation is also positive, but not significant. As would be expected given the relatively high average productivity of the manufacturing sector, a shift of labor into the manufacturing sector in the post-peak period is always positively and significantly related to economic performance. By contrast, Table 3.4 shows no systematic relationship between the share of total investment allocated to manufacturing in the pre-peak period and post-peak economic performance, as measured by growth, investment, or employment. A higher share of investment in manufacturing during the post-peak period is however associated with a shorter downturn.

Putting these coefficients in perspective, during the mid-2000s employment in the tradables sector in Ireland ran 0.3 percentage points below its HP trend. According to the results in 3.4, this reallocation of labor is typically associated with the post-inflow recession lasting four months longer, with investment lower by 1.5 percent and employment 0.5 percent lower each year. Like the Eurozone periphery, countries in Eastern Europe received large capital inflows during the mid-2000s. In these countries (Poland, Hungary, Bulgaria, and the Baltic Republics) the share of the labor force in manufacturing actually rose to between 0.6 and 0.9 percentage points above its trend. Our results imply this reallocation would typically coincide with a post-episode downturn shorter by nine months or a year, investment two or three percent higher, and employment between one and 1.5 percent higher.

These findings suggest that once we control for the size of the credit boom during episodes of capital inflows and for international liquidity conditions, the sectoral allocation of labor is significantly related to economic performance in the post-boom period. These findings are consistent with the analysis of Giavazzi and Spaventa (2010), who show that the use of external borrowing to finance the expansion of nontradables production can render the current account position unsustainable. However, our results indicate the allocation of labor is more informative regarding post-episode performance than the sectoral allocation of investment. To understand why this might be the case, in the next section we model a small open economy and examine its responses to shocks that produce an episode of capital inflows.

3.4 A Model of Capital Inflows and Sectoral Allocation

In the previous section, we found evidence that the share of labor in the tradables sector during episodes of large capital inflows is correlated with the severity of the post-episode downturn, while the sectoral allocation of investment was not. We now present a model of a small open economy in which an increase in net borrowing, that is, an increase in capital inflows, may occur for three reasons. In the first scenario we consider, an increase in future productivity prompts households to increase borrowing in order to smooth consumption of their increased lifetime wealth. Second, we analyze the economy's response to a fall in the rate at which agents can borrow from abroad. Third, we consider a immediate and permanent increase in the productivity of the tradables sector.

In all three cases, the increase in capital inflows is accompanied by a rise in aggregate consumption and investment as well as a shift of investment into the tradables sector. However, we show that the immediate reallocation of labor depends on the type of shock hitting the economy. Both an increase in future productivity and a fall in the interest rate generate a rise in the share of labor allocated to the nontradables sector. By contrast, a permanent increase in tradables productivity prompts a shift of labor into the tradables sector.

3.4.1 Model Environment

In order to analyze the relationship between capital inflows, the sectoral allocation of resources, and macroeconomic outcomes we study a two-period model of a small open economy in which there are two sectors, one producing a tradable goods and the other producing a non-tradable good, indexed by $i = T, NT$, respectively. A representative household maximizes utility from consumption while inelastically supplying L units of labor each period. Lifetime utility is given by

$$\log C_0 + \beta \log C_1 \tag{3.1}$$

where $0 < \beta < 1$ is the subjective discount factor. Aggregate consumption C_t is a Cobb-Douglas aggregate of tradable and non-tradable goods

$$C_t = (C_t^T)^{\omega}(C_t^N)^{1-\omega}$$

With ω the share of consumption expenditure devoted to tradable goods. The household faces the following flow budget constraints

$$\begin{aligned} C_0^T + P_0 C_0^N + B_0 &= W_0 L_0 + \Pi_0 \\ C_1^T + P_1 C_1^N &= R B_0 + W_1 L_1 + \Pi_1 + Y_2. \end{aligned} \tag{3.2}$$

We give the household an endowment Y_2 in the second period in order to ensure that the economy is a net borrower from abroad during the first period. The price of tradable goods is normalized to one, while the price of nontradable goods in terms of tradables is given by P_t. The household purchases B_0 riskless bonds in the first period, which pay a return R given by the exogenous world interest rate. We assume that $\beta R < 1$ so that household are relatively impatient and borrow in the first period. We also assume labor is perfectly mobile across sectors, so that the household's total wage income is given by $W_t L$. All firms are owned by the representative household, which receives dividends Π_t each period.

The household's optimal mix of tradables and nontradables consumption is defined by

$$P_t = \frac{1-\omega}{\omega} \frac{C_t^T}{C_t^N}, \tag{3.3}$$

while the household divides consumption over time according to a standard Euler equation

$$\frac{1}{C_0^T} = R\beta \frac{1}{C_1^T}. \tag{3.4}$$

A large number of firms produce tradable and nontradable goods using labor and capital in a Cobb-Douglas production process given by

$$Y^i = (K^i)^\alpha (A^i L^i)^{1-\alpha}$$

for $i = T, N$. Each period firms maximize profits,

$$\Pi^i = P^i Y^i - WL^i - R^k K^i,$$

Where R^k is the rental rate for capital and W is the wage. In the first period, firms chose both labor input L_0^i and investment, I_0^i, while in the second period, firms only decision variable is labor. Since the initial capital stock K_0^i is exogenously given, we normalize it to one and assume that capital fully depreciates so that $I_0^i = K_1^i$ in both sectors. Moreover, we assume that firms use only tradable goods in the production of capital goods, a realistic assumption given that most investment goods used in the production of nontradables like services and housing, such as office equipment and construction machinery, are tradable.

Capital and labor can move freely between sectors, so that in equilibrium wages and returns to capital are equal across sectors. Moreover, by an arbitrage argument the rental rate of capital, R^K, will be equal to the international interest rate R. Firms optimal choices of labor and capital therefore satisfy

$$W_0 = (1-\alpha)(A_0^T)^{1-\alpha}(L_0^T)^{-\alpha} = (1-\alpha)P_0(A_0^N)^{1-\alpha}(L_0^N)^{-\alpha} \quad (3.5)$$

$$W_1 = (1-\alpha)(A_1^T)^{1-\alpha}(K_1^T)^{\alpha}(L_1^T)^{-\alpha} = (1-\alpha)P_1(A_1^N)^{1-\alpha}(K_1^N)^{\alpha}(L_1^N)^{-\alpha} \quad (3.6)$$

$$R = \alpha(A_1^T L_1^T)^{1-\alpha}(K_1^T)^{\alpha-1} = \alpha P_1(A_1^N L_1^N)^{1-\alpha}(K_1^N)^{\alpha-1} \quad (3.7)$$

Equilibrium requires market clearing in the nontradable goods market. Since these goods cannot be borrowed from abroad, consumption must equal production in each period,

$$C_t^N = Y_t^N. \quad (3.8)$$

Thus the market clearing conditions for tradable goods are

$$C_0^T + K_1^T + K_1^N + B_0 = Y_0^T \quad (3.9)$$

$$C_1^T = RB_0 + Y_1^T + Y_2 \quad (3.10)$$

while labor market clearing requires that in each period

$$L^T + L^N = L. \quad (3.11)$$

We assume that total labor supply L is constant over time.

3.4.2 Shocks, Capital Flows, and Sectoral Allocation

In this section we analyze the economy's response to three types of shocks: A rise in expected future tradables sector productivity, a fall in the interest rate, and an immediate, permanent increase in tradables sector productivity.[14] We show that the immediate shift in the allocation of resources generated by the first two shocks are qualitatively identical, with labor moving into the nontradables sector while investment in nontradables increases. By contrast, a permanent rise in productivity shifts both labor and capital into the tradables sector . These results suggest that the relationship between the reallocation of labor and the severity of the post-episode downturn may reflect the differences in the causes of capital inflows episodes.

A Rise in Future Tradables Sector Productivity

We first consider an anticipated shock to second-period productivity in the tradables sector, A_1^T. This change in agents' expectations regarding future productivity will cause an episode of capital inflows as well as a reallocation of both labor and capital into the tradables sector. We begin by analyzing in detail firms' response to this shock, then discuss the changes in the behavior of households.

Firms respond to the shock by increasing investment to take advantage of the higher productivity of capital in the future. To see this, first note that combining the optimality condition for labor and the $t = 1$ production function expresses output as a linear function of capital

$$Y_1^i = \left(\frac{(1-\alpha)A_1^i}{W_1}P_1^i\right)^{\frac{1-\alpha}{\alpha}} K_1^i \qquad \text{for } i = \{T, N\}.$$

The condition for optimal investment thus allows us to write future output as

$$Y_1^i = RK_1^i \tag{3.12}$$

and to pin down wages as a function of the interest rate and productivity in the tradables sector

$$W_1 = (1-\alpha)A_1^T R^{\frac{-\alpha}{1-\alpha}}.$$

Combining the optimality conditions for labor and capital shows that the capital-labor ratios in both sectors, and therefore the aggregate capital-labor ratio, are a linear function of the factor price ratio

$$\frac{K_1^i}{L_1^i} = \frac{\alpha}{1-\alpha}\frac{W_1}{R} = \frac{K_1}{L}, \tag{3.13}$$

[14] We do not study shocks to productivity in the nontradables sector since productivity in this sector has been shown to change relatively little.

Where $K_1^T + K_1^N = K_1$. Substituting for wages gives us the aggregate capital stock as a function of the interest rate, the total labor force, and productivity in the tradables sector,

$$K_1 = \alpha R^{\frac{-1}{1-\alpha}} A_1^T L. \tag{3.14}$$

This expression makes clear that a rise in second-period tradables productivity will result in an increase in aggregate investment at time $t = 0$.

For the household, higher productivity in the future represents a positive shock to lifetime wealth. Motivated by consumption smoothing, households boost not only future consumption but also their current consumption, which they divide between tradable and nontradable goods according the the intratemporal optimality condition (3.3). In Appendix D we show formally that current consumption of tradable goods C_0^T will rise. Although a higher relative price of nontradables P_0 dampens the increase in the consumption of nontradables somewhat, it nonetheless rises (again see Appendix D for details). Since capital is fixed and consumers cannot import nontradables from abroad, this requires that the share of labor employed in the nontradables sector L_0^N grow larger. Thus higher future productivity in the tradables sector produces an immediate reallocation of labor into the nontradables sector and a drop in tradables production Y_0^T, both in absolute terms and as a share of total output.

Re-writing the market clearing condition for tradables at $t = 0$ gives first-period borrowing as a function of tradables production, consumption, and aggregate investment (recall that $K_1 = K_1^T + K_1^N = I_0^T + I_0^T$):

$$B_0 = Y_0^T - C_0^T - K_1$$

Consumption of tradable goods and aggregate investment both rise when future productivity increases, while production of tradable goods falls. As a result, an increase in future productivity will result in an increase in borrowing B_0, or said differently, higher capital inflows.

Since borrowing must be repaid with tradables, this implies that second-period tradables production must rise by more than the increase in second-period tradables consumption (it is clear from the Euler equation 3.4 that C_1^T rises). By contrast, market clearing for nontradables requires that any increase in consumption be matched one-for one by an increase in production. As a result,

$$0 < \Delta \frac{C_1^T}{C_1^N} < \Delta \frac{Y_1^T}{Y_1^N}$$

Since we are able to express $t = 1$ output as a linear function of capital (3.12), the ratio of sectoral capital stocks will equal the ratio of tradables output to nontradables output and therefore

$$\Delta \frac{K^T}{K^N} = \Delta \frac{Y^T}{Y^N} > 0.$$

Thus an increase in the future productivity in the tradables sector will result in an increase in the share of total investment that is allocated the tradables sector in the first period.

A Fall in the Interest Rate

In our second experiment, we analyze the consequences of a fall in the interest rate on external borrowing R. The economy's response to this shock is qualitatively identical to that of an increase in future productivity, with both labor and capital shifting into the tradables sector. Firms respond the the fall in the price of capital by increasing aggregate investment, while households respond the drop in borrowing costs by shifting more of their consumption into the present. Higher investment demand combined with greater demand for nontradables by consumers results in an increase in capital inflows (See Appendix D for the mathematical proof of these results).

Once again, although the price of nontradable goods rises this effect does not outweigh positive effect of the interest rate shock on demand for nontradables, and consumption of both goods rises. Increased demand for nontradables results in the reallocation of labor into the nontradable sector.

The shift in consumption towards the present in response to the change in intertemporal prices means that demand for both tradables and nontradables will fall in the future. Since nontradables cannot be exported to service debt, this results in a drop in future nontradables production. The lower the cost of capital prompts firms in both sectors to boost their capital labor ratios (equation 3.13). Rewriting the production function in terms of the capital labor ratio gives

$$Y_1^N = (A_1^T)^{1-\alpha} \left(\frac{K_1^N}{L_1^N} \right)^{\alpha} L_1^N$$

Since nontradables production falls and the capital-labor ratio rises, this expression makes clear that the sector's use of labor L_1^N will fall. The shift of workers into tradables production, combined with the higher optimal capital labor ratio, results in an increase in investment in the tradables sector. Thus as was the case with a rise in expected future productivity, a drop in interest rates will cause an immediate shift of labor into the nontradables sector as well as reallocation of investment towards the tradables sector.

A Permanent Increase in Tradables Productivity

Third and finally, we consider what happens when productivity rises in the first period and remains high in the future. As with the other two shocks we have analyzed, the change in sectoral productivity will result in a reallocation of investment into the tradables sector. However, in this scenario the immediate impact of the shock is a shift of labor into the tradables sector.

Since the rise in productivity is permanent, firms respond by increasing aggregate investment in order to take advantage of the higher productivity in the future. Consumption demand also increases as households respond to the increase in their lifetime wealth by boosting total consumption, in particular their consumption of tradables. As a result, the economy experiences a rise in capital inflows.

Unlike in the previous case, the immediate rise in productivity in the tradables sector creates an incentive for firms to shift labor away from nontradables production. Consumers' desire to divide their increased consumption between the two goods is outweighed by an increase in the price of nontradables, and consumption of nontradables actually falls (once again, a mathematical proof of these results is found in Appendix D). Since the current capital is fixed, the share of labor employed in the production of nontradables falls. Thus the sectoral allocations of labor and capital move in opposite directions in response to an immediate and permanent increase in tradables productivity, making this case qualitatively different from the previous two shocks we considered.

3.4.3 Implications of Model Results

Our analysis of a two-sector small open economy therefore helps us interpret the patterns observed in the data. Episodes of large capital inflows that coincide with the reallocation of labor into the nontradables sector are generated by either a fall in international interest rates or by a rise in expectations regarding future productivity. By contrast, a positive shock to tradables productivity which has already been realized drives those episode in which labor moves into the tradables sector. That three different types of shocks result in a shift in investment towards tradables is consistent with our finding that the extent of investment reallocation during the period of capital inflows is unrelated to subsequent economic performance. Likewise, the absence of a relationship between US interest rates and post-episode performance is consistent with the identical responses produced by interest rate shock and anticipated productivity shocks in the model

It is striking that both exceptionally low interest rates on foreign borrowing and anticipated productivity gains have been mentioned as factors contributing to economic imbalances and recession in the Eurozone periphery (Giavazzi and Spaventa (2010) discuss both factors, while Benigno and Fornaro (2013) highlight the role of low interest rates). Capital inflows generated by these two types of shock involve clear risks. The interest rate at which countries can borrow from abroad can rise suddenly and dramatically, as occurred in the Eurozone in 2011. Moreover, expected increases in future productivity may not in fact be realized, instead reflecting what Chen et al. (2013) refer to as "over-optimistic expectations of convergence" in the case of the Eurozone. In this case, capital inflows leave the country with a larger external debt burden but without the increased capacity to service those debts that was expected when they were incurred. An increase in tradables sector productivity that has already been realized will also result in large capital inflows, but these reflect improved domestic fundamentals rather than expectations of improvement that may prove incorrect.

3.5 Conclusion

This paper has analyzed the experiences of 69 middle- and high-income countries that underwent episodes of large capital inflows between 1975 and 2010. A large majority of these episodes end in a sharp reversal of capital inflows, but only about half of these reversals are sudden stops in which output contracts. Nonetheless, our event study shows that in the typical episode output rises initially but then drops below trend as capital inflows subside. Aggregate productivity follows a similar path, remaining below its trend level for more than three years after the episode ends. The episodes that we identify typically begin in years when US interest rates are below average and when risk appetite in US financial markets is higher than average, suggesting that supply factors drive a significant share of the episodes in our sample.

Large capital inflows also coincided with a shift of both labor and capital into the production of nontradables. Our regression analysis revealed that post-episode economic performance was significantly and negatively related not only to the size of the credit boom generated by capital inflows, but also the extent to which labor moves into the nontradables sector. By contrast, international liquidity conditions and the allocation of investment were uninformative regarding the severity and length of the post-boom downturn.

In order to interpret these results, we built a model of a two-sector small open economy and examined its response to three types of shocks, all of which generate an increase in capital inflows. This exercise showed that the extent of labor reallocation during inflows episodes is potentially informative about the drivers of capital inflows, with only positive productivity shocks that have already been realized capable of generating a shift in labor into the tradables sector.

To the extent that capital inflows driven by low interest rates on external borrowing or expected but not yet realized productivity gains expose the recipient economy to greater risk than inflows generated by productivity improvements that have already occurred, this result is consistent with the empirical relationship between labor reallocation and the severity of the post-episode downturn. Our findings therefore indicate that policy-makers should monitor the sectoral allocation of labor during periods of exceptionally large capital inflows. A shift in employment into the production of nontradable goods may signal increased risk of a hard landing. We leave an analysis of the appropriate policy response for future work.

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Appendix A

Data Appendix: Capital Flows Data

A.1 Capital Flows Data

Table A.1: Sources of Monthly Capital Flows Data, Advanced Economies

Country	Definition	Source
Austria	"Portfolio investment, liabilities" from balance of payments	Oesterreichische Nationalbank
Belgium	"Portfolio investment, liabilities" from balance of payments	National Bank of Belgium
Canada	"Portfolio investment, liabilities" from balance of payments	Statistics Canada
Denmark	"Portfolio investment, liabilities" from balance of payments	Danmarks Nationalbank
Finland	"Portfolio investment, liabilities" from balance of payments	Bank of Finland
Greece	"Portfolio investment, liabilities" from balance of payments	Bank of Greece
Italy	"Portfolio investment, liabilities" from balance of payments	Banca D'Italia
Norway	"Portfolio investment in Norway" from balance of payments	Statistics Norway
Sweden	"Portfolio investment, liabilities" from balance of payments	Statistics Sweden
Portugal	"Portfolio investment, liabilities" from balance of payments	Banco de Portugal
Spain	"Portfolio investment, liabilities" from balance of payments	Banco de España

Table A.2: Sources of Monthly Capital Flows Data, Emerging Markets

Country	**Definition**	**Source**
Brazil	"Portfolio investment, liabilities" from balance of payments	Banco Central do Brasil
Bulgaria	"Portfolio investment, liabilities" from balance of payments	Bulgarian National Bank
Chile	"Portfolio investment, liabilities" from balance of payments	Banco de Chile
Colombia	Change in value of securities held by foreigners	Bolsa de Valores de Colombia
Czech Republic	"Portfolio investment, liabilities" from balance of payments	Ceska Narodni Banka
Hungary	"Portfolio investment, liabilities" from balance of payments	Magyar Nemzeti Bank
India	Net investment in equity and debt by foreign institutional investors	Securies and Exchange Board of India
Indonesia	Net shares transacted by foreign investors	Jakarta Stock Exchange
Korea	"Portfolio investment, liabilities" from balance of payments	Bank of Korea
Malaysia	Foreign Holdings of Malaysian Debt Securities	Bank Negara Malaysia
Mexico	Change in value of securities held by foreigners	Bolsa Mexicana de Valores
Philippines	Portfolio investment, liabilities" from balance of payments	Bangko Sentral ng Pilipinas
Poland	"Portfolio investment, liabilities" from balance of payments	Narodowy Bank Polski
South Africa	Net stocks bought by foreigners on Johannesburg Stock Exchange	Johannesburg Stock Exchange
Thailand	'Portfolio investment, liabilities" from balance of payments	Bank of Thailand
Turkey	"Portfolio investment, liabilities" from balance of payments	Central Bank of the Republic of Turkey

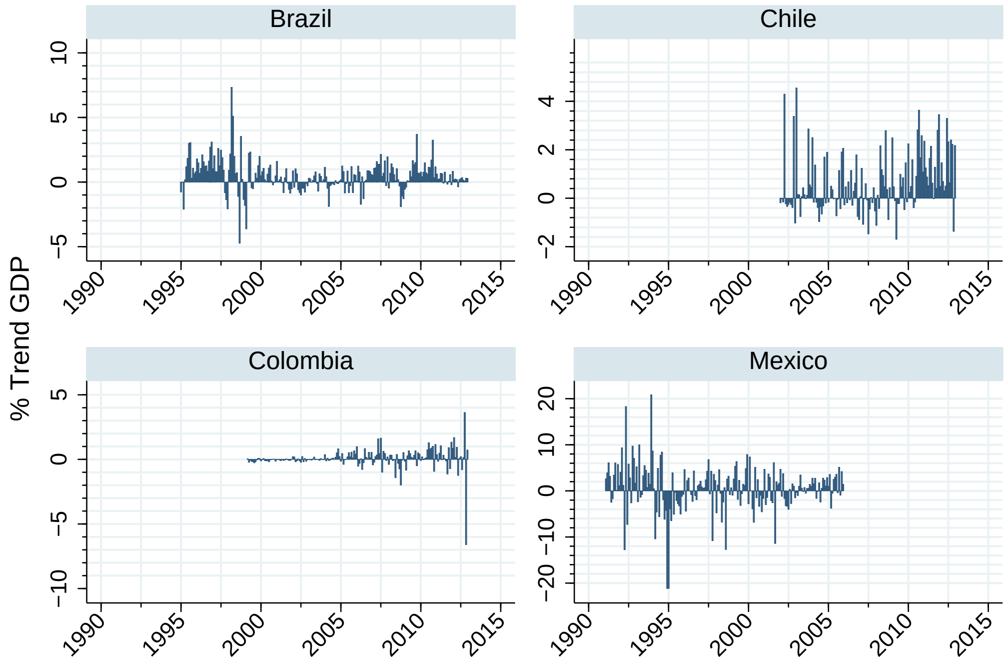
Table A.3: Data Sources: Macroeconomic Data

Variable	Source
Gross Porfolio Inflows	IMF Balance of Payments Statistics
Gross Porfolio Equity Inflows	IMF Balance of Payments Statistics
Gross Porfolio Debt Inflows	IMF Balance of Payments Statistics
Net FDI Inflows	IMF Balance of Payments Statistics
Net Other Inflows	IMF Balance of Payments Statistics
Real GDP	IMF International Financial Statistics
Investment	IMF International Financial Statistics
Consumer Price Index	IMF International Financial Statistics
Equity Market Capitalizaiton	WDI
Private Sector Credit	WDI

Table A.4: Coverage: Capital Flow Volatility Data

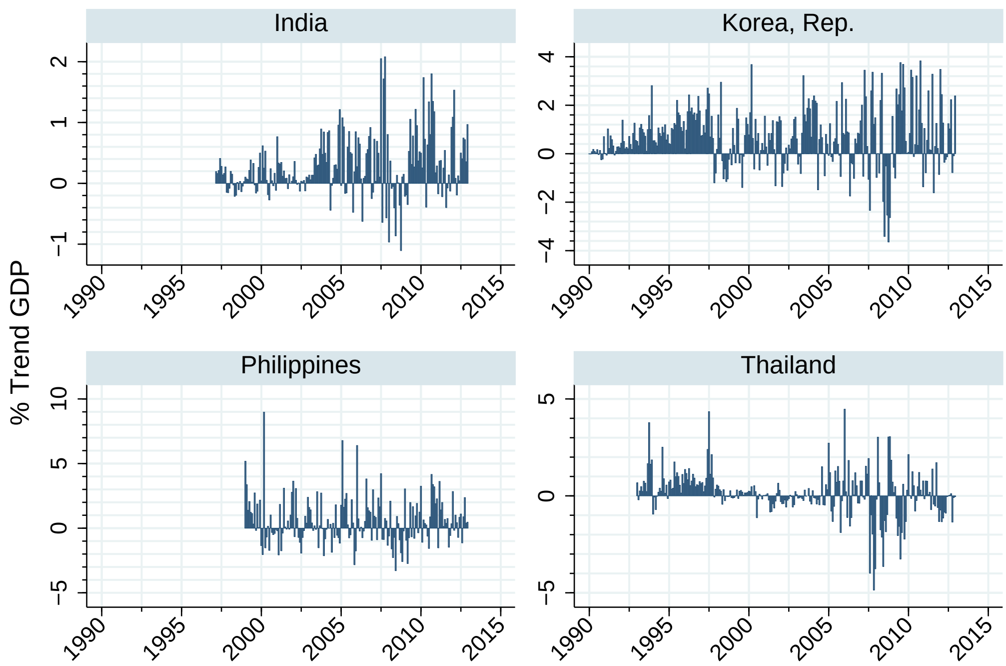
	Total Portfolio		Portfolio Equity		Portfolio Debt	
	Start Date	End Date	Start Date	End Date	Start Date	End Date
Austria	Dec-92	Dec-05	–	–	–	–
Belgium	Dec-02	Dec-12	–	–	–	–
Denmark	Dec-99	Dec-12	Dec-99	Dec-12	Dec-99	Dec-12
Italy	Dec-97	Dec-12	Dec-97	Dec-12	Dec-97	Dec-12
Norway	Dec-94	Dec-04	Dec-94	Dec-04	Dec-94	Dec-04
Sweden	Dec-07	Dec-12	Dec-07	Dec-12	Dec-07	Dec-12
Canada	Jan-89	Dec-12	Jan-89	Dec-12	Jan-89	Dec-12
Finland	Dec-96	Dec-12	Dec-96	Dec-12	Dec-96	Dec-12
Greece	Dec-00	Dec-12	–	–	–	–
Portugal	Dec-96	Dec-12	Dec-96	Dec-12	Dec-96	Dec-12
Spain	Jan-00	Dec-12	Jan-00	Apr-08	Jan-00	Apr-08
Turkey	Dec-92	Dec-12	Dec-92	Dec-12	Dec-92	Dec-12
South Africa	Jun-98	Dec-12	Jun-98	Dec-12	Jun-98	Dec-12
Brazil	Dec-95	Dec-12	Dec-95	Dec-12	Dec-95	Dec-12
Chile	Sep-02	Dec-12	Sep-02	Dec-12	Sep-02	Dec-12
Colombia	Nov-99	Dec-12	Nov-99	Dec-12	Dec-98	Dec-12
Mexico	Dec-91	Dec-05	Dec-91	Dec-05	Dec-91	Dec-05
India	Nov-97	Dec-12	Nov-97	Dec-12	Apr-96	Dec-12
Indonesia	–	–	–	–	Dec-01	Dec-12
Korea, Rep.	Dec-90	Dec-12	Dec-90	Dec-12	Dec-90	Dec-12
Malaysia	–	–	Jan-06	Dec-12	Dec-99	Dec-12
Philippines	Dec-99	Dec-12	Dec-99	Dec-12	Dec-93	Dec-12
Thailand	Dec-93	Dec-12	Dec-93	Dec-12	Dec-98	Dec-12
Bulgaria	Dec-98	Dec-12	Dec-98	Dec-12	Dec-03	Dec-12
Czech Republic	Dec-03	Dec-12	Dec-03	Dec-12	Dec-95	Jul-04
Poland	Dec-98	Dec-12	Dec-98	Dec-12	Dec-98	Dec-12

Figure A.1: Portfolio Capital Inflows: Latin America



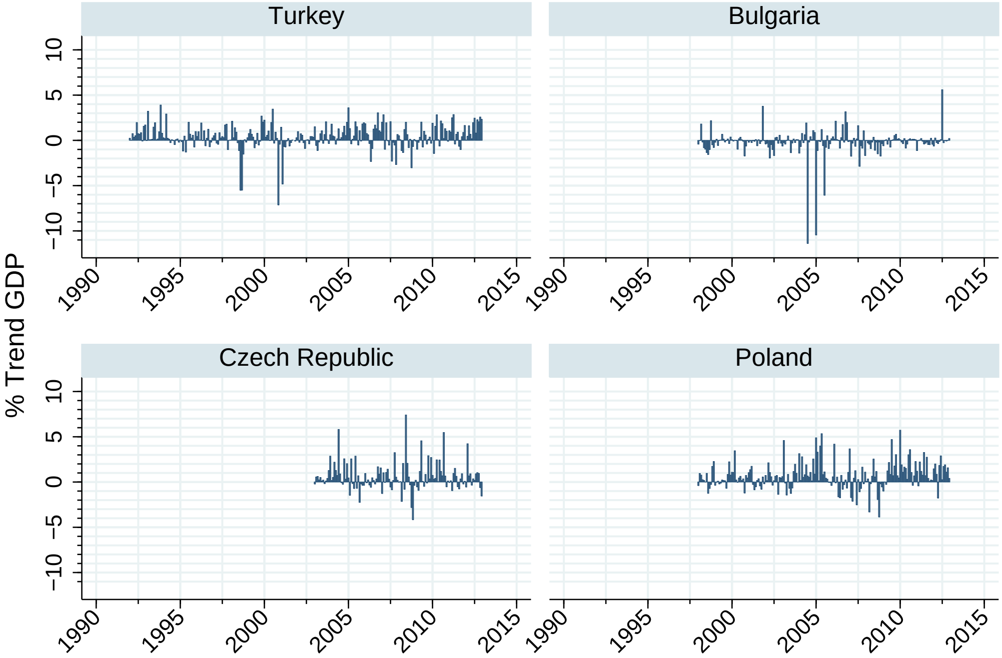
Source: IMF Balance of Payments and nat'l sources

Figure A.2: Portfolio Capital Inflows: Asia



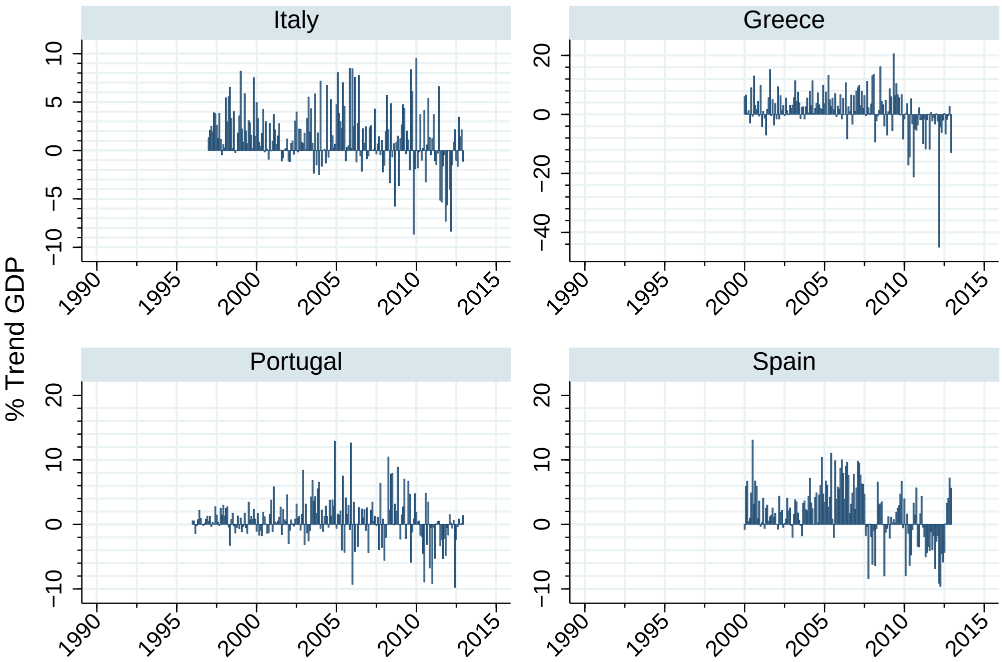
Source: IMF Balance of Payments and nat'l sources

Figure A.3: Portfolio Capital Inflows: E.Europe



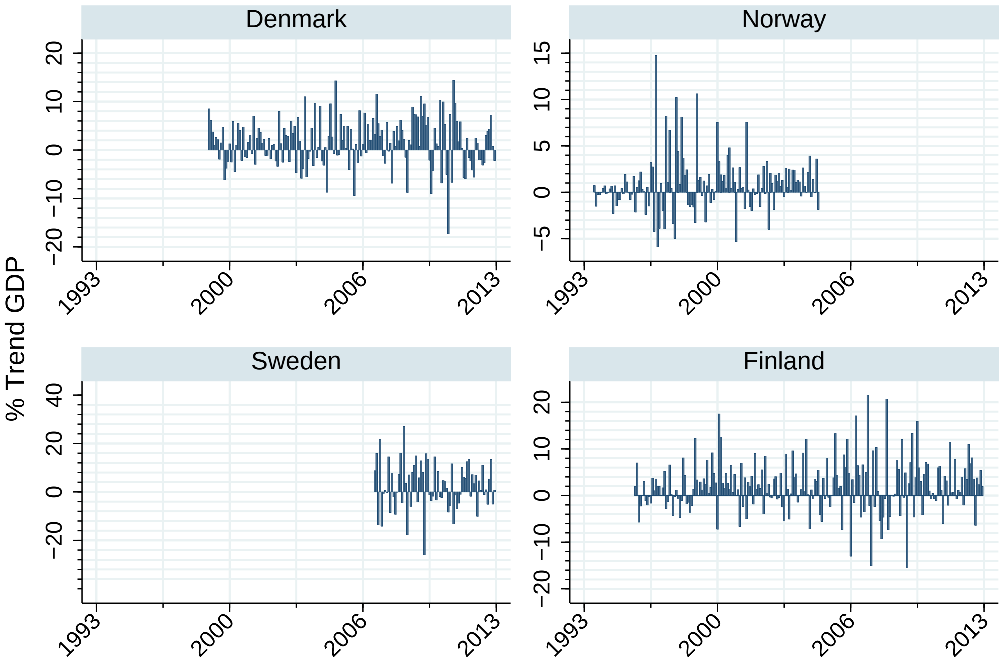
Source: IMF Balance of Payments and nat'l sources

Figure A.4: Portfolio Capital Inflows: S.Europe



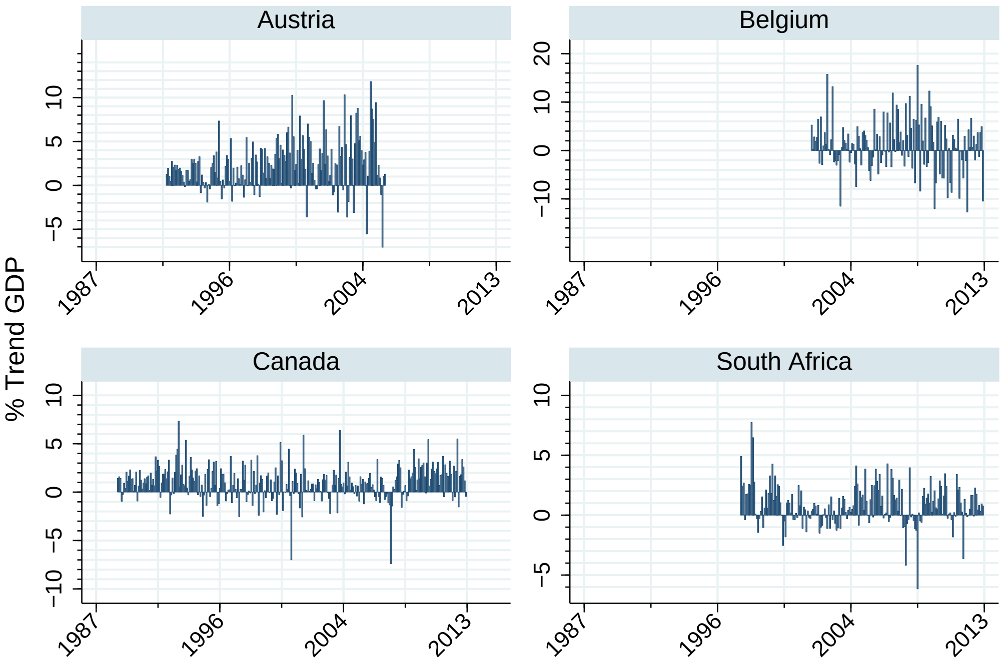
Source: IMF Balance of Payments and nat'l sources

Figure A.5: Portfolio Capital Inflows: Scandinavia



Source: IMF Balance of Payments and nat'l sources

Figure A.6: Portfolio Capital Inflows: Other



Source: IMF Balance of Payments and nat'l sources

A.2 Comparison with IMF Balance of Payments Data

Since the data were collected in order to construct a measure of the volatility of capital flows rather than their level, it is not crucial that the monthly flows sum precisely to the relevant quarterly number in the balance of payments. Nonetheless, comparing the data gathered with IMF balance of payments data does give some sense of what is being measured for each country. Table A.5 demonstrates that quarterly totals of the monthly data collected are highly correlated with corresponding lines from the balance of payments, with the overall correlation 0.73 for equity flows and 0.96 for debt flows.[1]

Table A.5: Correlations: Collected Data vs. IMF Data

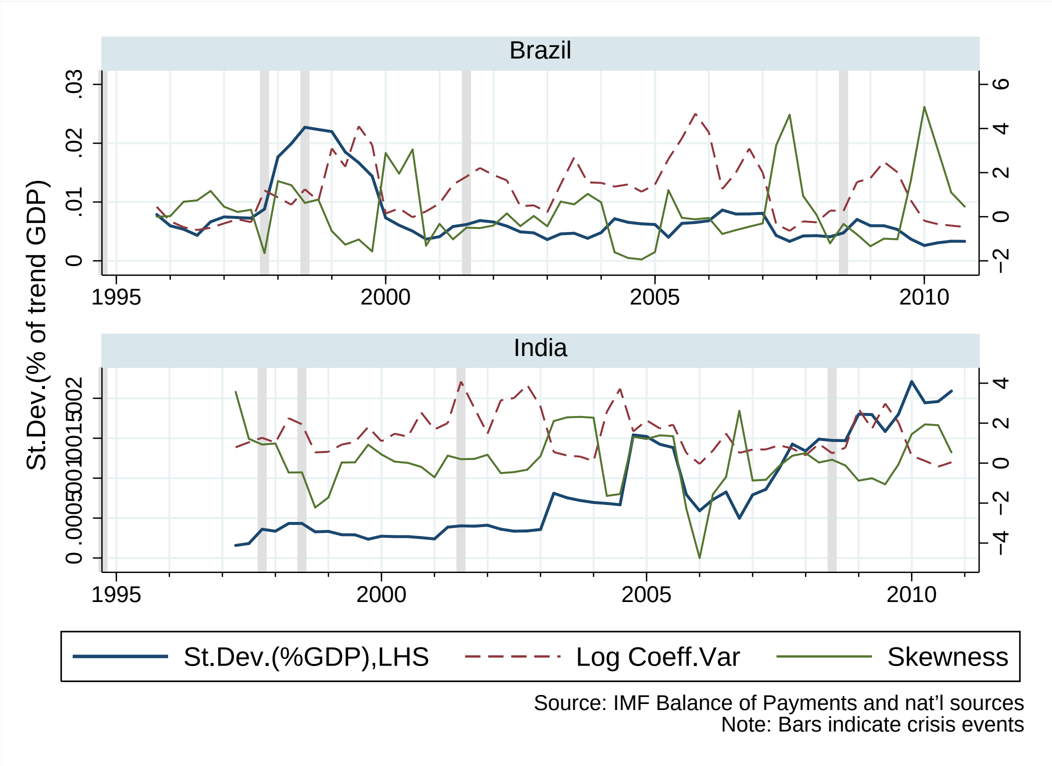
Country	Portfolio Equity Inflows	Portfolio Debt Inflows
Turkey	1.0000 ***	1.0000 ***
S.Africa	0.8567 ***	0.7556 ***
Brazil	0.9842 ***	0.9798 ***
Chile	0.7718 ***	0.9995 ***
Colombia	0.5234 ***	0.3760 ***
Mexico	0.3710 ***	0.5833 ***
India	1.0000 ***	1.0000 ***
Indonesia	0.8734 ***	—
Korea	1.0000 ***	1.0000 ***
Philippines	1.0000 ***	1.0000 ***
Thailand	0.8025 ***	0.1578
Bulgaria	0.9994 ***	0.9985 ***
Czech Rep	0.9998 ***	0.9999 ***
Hungary	0.9495 ***	—
Poland	0.9998 ***	0.9998 ***
Overall	0.6991 ***	0.9279 ***

Source: IMF Balance of Payments Data, nat'l sources

One possible source of divergence between the financial market data and balance of payments data stems from the classification of stock purchases as either FDI or portfolio equity. In the balance of payments, purchases of equity shares greater than 10 percent are classified as FDI, and once a foreign investor has acquired a share larger than this threshold, all subsequent equity purchases by that investor are deemed to be FDI regardless of the size of the transaction. Where financial market data are used, all stock purchases are classified as portfolio equity investment.

[1] The relevant balance of payments lines are "portfolio liabilities, equity" and "portfolio liabilities, debt."

Figure A.7: Alternative Volatility Measures



A.3 Alternate Volatility Measures

This paper measures capital flow volatility using the standard deviation of capital inflows normalized by GDP. The literature on capital flow volatility suggests two alternative measures: the coefficient of variation (standard deviation of monthly capital flows normalized by their mean monthly value) and skewness (the centered third empirical moment divided by the cube of the standard deviation).[2] Each of these methods for measuring capital flow volatility has advantages and disadvantages. If the mean level capital flows over of some time periods is near zero, the coefficient of variation will take on extremely large values. Moreover, measures such as the coefficient of variation and the skewness provide no information about how the volatility compares to the size of the economy.

Figure A.7 illustrates this point with data for two of the largest emerging markets in the sample. In both India and Brazil, the volatility of monthly capital inflows relative to the size of the economy has changed substantially over time. This important change is not reflected in the coefficient of variation or in the skewness—a potentially important shortcoming. I am interested in the impact of capital flow volatility on variables such as growth and investment, and this impact presumably depends on the size of capital flow

[2]The standard deviation normalized by GDP is employed by Broner & Rigobon 2004; Knill 2005; Becker & Noone 2009; and Neumann, Penl, & Tanku 2008). The coefficient of variation is used by Alfaro, Kalemli-Ozcan, & Volosovych 2007 and Levchenko & Mauro 2007). Finally, Ranciere, Tornell, & Westermann (2008) use skewness.

fluctuations relative to the size of the economy. Therefore this paper uses the standard deviation of monthly net capital inflows as a share of GDP to measure capital flow volatility in the main analysis, then re-run the baseline regressions using both the coefficient of variation and skewness as a robustness check (these results are available from the author on request).

A.4 Cyclical Properties of Capital Flow Volatility

Table A.6: Correlations of Capital Flow Volatility (%GDP) with Real GDP (SA and HP-Filtered): Emerging Markets

Total Portfolio Inflows: Lagging/Leading Correlations with HP-Filtered Output (quarterly frequency)	Lag Length						
	-3	**-2**	**-1**	**0**	**1**	**2**	**3**
Turkey	-0.3504*	-0.3199*	-0.154	0.060	0.2550*	0.4841*	0.5522*
	(0.002)	(0.006)	(0.188)	(0.606)	(0.027)	(0.000)	(0.000)
S.Africa	0.045	0.012	0.006	0.073	0.2504*	0.4611*	0.6410*
	(0.755)	(0.934)	(0.969)	(0.601)	(0.071)	(0.001)	(0.000)
Brazil	-0.2744*	-0.2834*	-0.2246*	0.054	0.049	0.060	0.013
	(0.032)	(0.026)	(0.077)	(0.671)	(0.704)	(0.645)	(0.919)
Chile	-0.180	-0.2506*	-0.2842*	-0.3091*	-0.3234*	-0.3472*	-0.3360*
	(0.180)	(0.058)	(0.029)	(0.016)	(0.012)	(0.007)	(0.009)
Colombia	0.4455*	0.4498*	0.3929*	0.2963*	0.3147*	0.3644*	0.3888*
	(0.001)	(0.001)	(0.004)	(0.033)	(0.025)	(0.009)	(0.006)
Mexico	-0.2488*	-0.155	-0.024	0.161	0.3271*	0.4973*	0.5590*
	(0.062)	(0.246)	(0.858)	(0.219)	(0.011)	(0.000)	(0.000)
India	0.069	0.078	0.113	0.168	0.2367*	0.2888*	0.2948*
	(0.611)	(0.567)	(0.404)	(0.211)	(0.079)	(0.033)	(0.031)
Korea	-0.2368*	-0.2541*	-0.2579*	-0.2090*	-0.163	-0.104	-0.041
	(0.033)	(0.021)	(0.019)	(0.056)	(0.140)	(0.351)	(0.716)
Philippines	-0.102	-0.073	-0.082	-0.051	0.034	0.123	0.225
	(0.505)	(0.629)	(0.584)	(0.728)	(0.822)	(0.416)	(0.137)
Thailand	-0.158	-0.149	-0.067	0.046	0.157	0.2128*	0.2362*
	(0.195)	(0.218)	(0.577)	(0.700)	(0.191)	(0.077)	(0.051)
Bulgaria	0.139	0.095	0.063	0.053	0.013	-0.043	-0.099
	(0.340)	(0.513)	(0.659)	(0.707)	(0.926)	(0.767)	(0.499)
Czech Rep	-0.4098*	-0.3240*	-0.186	-0.015	0.119	0.254	0.3412*
	(0.027)	(0.081)	(0.316)	(0.934)	(0.525)	(0.176)	(0.070)
Poland	0.182	0.075	-0.059	-0.2364*	-0.2512*	-0.2781*	-0.2743*
	(0.211)	(0.605)	(0.682)	(0.092)	(0.075)	(0.051)	(0.057)
Overall	-0.0995*	-0.0890*	-0.054	0.005	0.054	0.1008*	0.1165*
	(0.004)	(0.010)	(0.119)	(0.884)	(0.113)	(0.004)	(0.001)

Source: IMF, national sources. P-values in parentheses.

Table A.7: Correlations of Capital Flow Volatility (%GDP) with Real GDP (SA and HP-Filtered): Advanced Economies

Total Portfolio Inflows							
Lagging/Leading Correlations with HP-Filtered Output							
(quarterly frequency)	Lag Length						
	-3	**-2**	**-1**	**0**	**1**	**2**	**3**
Belgium	-0.185	-0.293	-0.3908*	-0.4134*	-0.3106*	-0.140	0.039
	(0.320)	(0.104)	(0.025)	(0.015)	(0.074)	(0.430)	(0.828)
Denmark	-0.113	-0.187	-0.192	-0.245	-0.318	-0.4560*	-0.5794*
	(0.618)	(0.393)	(0.370)	(0.237)	(0.122)	(0.022)	(0.002)
Canada	-0.033	0.019	0.050	0.071	0.121	0.160	0.172
	(0.765)	(0.861)	(0.649)	(0.515)	(0.266)	(0.142)	(0.114)
Finland	0.165	0.174	0.144	0.094	0.098	0.149	0.2243*
	(0.228)	(0.199)	(0.287)	(0.484)	(0.464)	(0.266)	(0.091)
Portugal	-0.2715*	-0.2876*	-0.2808*	-0.2413*	-0.198	-0.137	-0.062
	(0.045)	(0.032)	(0.034)	(0.068)	(0.136)	(0.304)	(0.642)
Spain	0.238	0.3227*	0.3849*	0.4018*	0.3957*	0.3419*	0.2672*
	(0.116)	(0.031)	(0.009)	(0.006)	(0.008)	(0.025)	(0.087)
Overall	0.087	0.077	0.060	0.029	0.019	0.017	0.025
	(0.137)	(0.186)	(0.302)	(0.618)	(0.736)	(0.767)	(0.660)

Source: IMF, national sources. P-values in parentheses.

Appendix B

Mathematical Appendix to Chapter 1

This mathematical appendix has two section. In the first section, I discuss the solvency constraints that firms face in the model of Section 1.3.1. The second section formally derives the results that are discussed in Section 1.3.1. Whereas in Section 1.3.1 I set the liquidation value of long-term investments equal to one in order to highlight that irreversibility does not drive my results, here I denote the liquidation value $\phi \in [0, 1]$ as in Section 1.3.2. This more general specification nests that of Section 1.3.1.

B.1 Solvency Constraints in the Model of Long-Term Investment

In the model of Section 1.3.1 the entrepreneur's borrowing in each period to a solvency constraint. Borrowing in the intermediate period (D_2) cannot be greater than the present value of his final period resources:

$$D_2 \leq \frac{R(I_0 - L_1) + y_2}{1 + r}$$

As discussed in detail in Section 1.3.1 and proved in Section B.2 of this Appendix, the entrepreneur's optimal second-period borrowing and liquidation will be fully determined by his initial borrowing and by the realized value of the borrowing constraint. If the borrowing constraint is sufficiently low, he will liquidate just enough to service his debts; otherwise he will borrow the precise amount needed to roll over his debts. As a result, the

$t = 1$ solvency constraint can be written as an upper bound on initial period borrowing:

$$D_1 \leq \frac{1}{rR}\left[R(y_0 + \kappa_2^{min}) + (1+r)(y_1 - \kappa_2^{min}) + y_2\right] \tag{B.1}$$

Where κ_2^{min} is the lowest possible value of the second-period borrowing constraint. Likewise, the entrepreneur cannot borrow more in the first period than his resources in the worst-case scenario at time $t = 1$, so that first period borrowing to finance investment in long-term projects must satisfy

$$(1+r)D_1 \leq \kappa_2^{min} + I_0 + y_1,$$

which simplifies to:

$$D_1 \leq \frac{1}{r}\left(y_0 + y_1 + \kappa_2^{min}\right) \tag{B.2}$$

A complete cutoff in foreign lending is a possibility, so that $\kappa_2^{min} = 0$. Even so, comparing the ceilings on D_1 in (B.1) and (B.2) to the level of D_1 below which the borrowing constraint binds ($(1+r)D_1 > y_1 + \kappa_2$) makes clear that (B.1) and (B.2) and are not so tight as to prevent the entrepreneur from borrowing an amount large enough that he risks being forced to prematurely liquidate part of his long-term project. Moreover, for realistic values for the world interest rate and for the return on long-term projects, these solvency constraints will not bind in the neighborhood of the solution to the entrepreneur's problem.

B.2 Solving the Model of Long-Term Investment

In this section, I formally derive the results discussed in Section 1.3.1.

Proposition B.2.1 *The non-negativity constraint on dividends does not bind in the final period:* $\lambda_2 = 0$

Proof λ_t is the shadow value of the firm's net worth. Since the firm ceases to exist after three periods, the value of the firm's net worth in the final period is simply its value in terms of consumption, and the shadow value will be zero at $t = 2$.

Proposition B.2.2 *Firms will never pay dividends in the first period.*

Proof Bearing in mind Proposition B.2.1, (1.5) becomes

$$1 + \lambda_0 = \beta^2 R + E_0[\zeta_1^{(2)}]$$

Since $\beta^2 R > 1$ by assumption (domestic investments are profitable if not liquidated) and $\zeta_1^{(2)} \geq 0$ by definition, it must be the case that $\lambda_0 > 0$ and $d_0 = 0$.

Proposition B.2.3 *If the borrowing constraint does not bind, there will be no liquidation*

Proof When the borrowing constraint does not bind ($\mu_1 = 0$), the condition for optimal liquidation (1.8) becomes

$$\zeta_1^{(1)} - \zeta_1^{(2)} = \beta[R - \phi(1 + r)]$$

The right-hand side of this equation will be strictly greater than zero since $R > (1 + r)^2$ and $\phi \leq 1$ by assumption. Since $\zeta_1^{(1)}$ and $\zeta_1^{(2)}$ are associated with lower and upper bounds, respectively, on liquidation they will not simultaneously be non-zero. Therefore, $\zeta_1^{(2)}$ cannot be non-zero when the borrowing constraint does not bind, meaning that the upper bound on liquidation will not bind. Consequently, this equation implies that $\zeta_1^{(1)} > 0$ when the borrowing constraint does not bind.

Proposition B.2.4 *If the borrowing constraint binds, the non-negativity constraint on liquidation will not bind*

Proof If the borrowing constraint binds, the second-period Euler equation (1.7) shows that $\lambda_1 > 0$ and thus $d_1 = 0$. Moreover, from the complementary slackness condition, $D_2 = \kappa_2$. Substituting into the borrowing constraint gives the optimal level of liquidation when the borrowing constraint binds:

$$L_1 = \phi^{-1}[(1 + r)D_1 - y_1 - \kappa_2] \tag{B.3}$$

The right-hand side of this equation would be zero only if the realized value of κ_2 was exactly $\phi^{-1}[(1 + r)D_1 - y_1]$. Since κ_2 is a continuous variable, this is a zero probability event. Therefore, $L > 0$ when the borrowing constraint binds and $\zeta_1^{(1)} = 0$ in this situation.

Proposition B.2.5 *The upper bound on liquidation will never bind*

Proof It was already shown in the proof of Proposition B.2.3 that $\zeta_1^{(2)} = 0$ when the borrowing constraint does not bind. If the borrowing constraint does bind, if the upper bound on liquidation were to bind, B.3 (along with Proposition B.2.2 and the $t = 1$

budget constraint) would imply that $\kappa_2 = (1 + r - \phi)D_1 - \phi y_0 + y_1$. Once again, with κ_2 a continuous variable, this is a zero probability event.[1]

Before proceeding to the solution, I make an additional simplifying assumption, without loss of generality. If the borrowing constraint does not bind, with $\beta(1 + r) = 1$ (1.7) implies that $\lambda_1 = 0$ and thus the firm will pay out dividends. This is because the firm can exhaust the borrowing constraint borrowing at rate $(1 + r)$, use the funds to pay dividends, and then pay the money back in the final period. However, agents receive no real welfare gain from this strategy—in terms of utility, they are indifferent between using additional borrowing to pay dividends and paying no dividends in the second period. For simplicity, I assume that the firm does not engage in this type of borrowing. This has no effect on the level of optimal investment, which is the focus of my analysis.

Thus, when the borrowing constraint does not bind

$$D_2 = (1 + r)D_1 - y_1.$$

The right-hand side of this expression also defines $\underline{\kappa}_2$, the minimum value of the borrowing constraint κ_2 for which it will not bind.

I am now able to solve the model. When the borrowing constraint binds, the condition for optimal liquidation (1.8) gives

$$(1 + \lambda_1) = \frac{\beta R}{\phi}$$

Substituting this into the second-period Euler equation allows me to write the Lagrange multiplier in terms of exogenous parameters:

$$\mu_1 = \beta\left[\frac{R}{\phi} - (1 + r)\right] \tag{B.4}$$

Combining the two Euler equations (1.6 and 1.7) and the condition for optimal borrowing gives

$$\beta^2 R = \beta(1 + r)E_0[\beta(1 + r) + \mu_1]$$

[1]A looser but more intuitive explanation is the following: Liquidation takes place only when the borrowing constraint binds, and thus when $d_1 = 0$. Since $(1 + r)\phi < R$, it is never profitable to liquidate investments in order to purchase foreign bonds. Therefore, the only motivation for liquidation is to service outstanding debts. Under these circumstances, if the feasibility constraint $L_1 \leq I_0$ were to bind, it would mean that the firm was unable to service its debts. I assume that lenders enforce solvency constraints on borrowers, and will not lend amounts that introduce the possibility of default. Therefore, it will always be the case that $\zeta_1^{(2)} = 0$.

Simplifying, substituting from (B.4) and noting that $F(\underline{\kappa}_2)$ is the probability that the borrowing constraint will bind, I get

$$R = (1+r)^2 + (1+r)F(\underline{\kappa}_2)\left[\frac{R}{\phi} - (1+r)\right]$$

Or simply:

$$F(\underline{\kappa}_2) = \frac{R - (1+r)^2}{\frac{R(1+r)}{\phi} - (1+r)^2}$$

Which pins down optimal initial borrowing D_2^*. This is the result obtained in Section 1.3.1.

Appendix C

Data Appendix: Capital Inflows Episodes

Table C.1: Data Sources

Variable	**Source**
Current Account	IMF Balance of Payments Statistics
Reserves	IMF Balance of Payments Statistics
Effective Fed Funds Rate	FRED
Baa-Aaa Corporate Bond Spread	Global Financial Data
Real Exchange Rate	WDI
Output	WDI
Consumption	WDI
Investment	WDI
Credit to the Private Sector	WDI
Tradables Value-Added	WDI
Nontradables Value-Added	WDI
Total Employment	ILO LABORSTA
Manufacturing Employment	UNIDO INDSTAT2
Manufacturing Investment	UNIDO INDSTAT2
TFP	Penn World Tables

Table C.2: Capital Inflows Episodes in Advanced Economies

Country	**Start Year**	**Peak Year**	**End Year**	**Average Current Account (%GDP)**
United Kingdom	1988	1988	1992	-3.7
Austria	1976	1976	1981	-4.25
Austria	1994	1994	2001	-1.91
Belgium	2008	2008	2009	-1.49
Denmark	1979	1979	1982	-4.05
France	1981	1981	1982	-1.42
France	2005	2005	2011	-1.28
Germany	1979	1979	1981	-1.23
Germany	1991	1991	2001	-1.02
Italy	1980	1980	1982	-2.37
Italy	1991	1991	1992	-2.61
Netherlands	1978	1978	1981	0.38
Netherlands	1998	1998	2002	2.53
Norway	1976	1976	1977	-11.51
Norway	1986	1986	1988	-4.79
Norway	2009	2009	2010	11.15
Sweden	1979	1979	1982	-2.96
Sweden	1989	1989	1997	-0.54
Canada	1975	1975	1981	-3.73
Canada	1989	1989	1994	-3.76
Canada	2009	2009	2011	-3.2
Japan	1979	1979	1982	-0.27
Japan	2009	2009	2011	2.99
Finland	1986	1986	1992	-4.18
Greece	1976	1976	1982	-3.91
Greece	2006	2006	2009	-14.5
Ireland	1979	1979	1982	-12.82
Ireland	2005	2005	2009	-4.64
Portugal	1975	1975	1976	-5.68
Portugal	1981	1981	1983	-11.14
Portugal	2003	2003	2009	-10.44
Spain	1975	1975	1976	-3.87
Spain	1980	1980	1982	-2.83
Spain	2005	2005	2008	-9.94
Australia	1989	1989	1995	-4.82
New Zealand	1982	1982	1987	-7.97

Source: IMF, Authors' Calculations

Table C.3: Capital Inflows Episodes in Emerging Markets (1)

Country	**Start Year**	**Peak Year**	**End Year**	**Average Current Account (%GDP)**
Turkey	1975	1975	1977	-4.72
Turkey	2006	2006	2011	-6.32
South Africa	1981	1981	1984	-3.6
South Africa	2006	2006	2011	-5
Argentina	1980	1980	1983	-4.69
Argentina	1997	1997	2001	-4.27
Brazil	1979	1979	1982	-6.02
Brazil	1997	1997	2001	-4.28
Brazil	2009	2009	2011	-2.07
Chile	1981	1981	1984	-12.63
Colombia	1981	1981	1985	-6.78
Colombia	1994	1994	1998	-6.03
El Salvador	1978	1978	1979	-4.55
El Salvador	1981	1981	1982	-5.74
El Salvador	2004	2004	2008	-5.09
Mexico	1980	1980	1982	-7.25
Mexico	1992	1992	1994	-7.96
Peru	1981	1981	1982	-8.96
Peru	1986	1986	1988	-7.71
Uruguay	1979	1979	1982	-6.92
Uruguay	2009	2009	2011	-2.51
Lebanon	2009	2009	2010	-21.07
Egypt, Arab Rep.	1979	1979	1985	-5.71
Egypt, Arab Rep.	1998	1998	2000	-2.27
Egypt, Arab Rep.	2008	2008	2010	-1.69
India	1985	1985	1990	-2.18
India	2009	2009	2011	-2.9
Indonesia	1982	1982	1983	-7.33
Indonesia	1995	1995	1997	-4.13
Indonesia	2008	2008	2011	0.73
Korea, Rep.	1979	1979	1982	-6.58
Korea, Rep.	1996	1996	1997	-3.48
Korea, Rep.	2008	2008	2010	2.17
Malaysia	1981	1981	1983	-12.46
Malaysia	1994	1994	1997	-7.94
Pakistan	1993	1993	1996	-5.87
Pakistan	2008	2008	2009	-6.32
Philippines	1981	1981	1983	-8.83
Thailand	1994	1994	1997	-7.73
Thailand	2009	2009	2011	4.34
Vietnam	1996	1996	1998	-7.24
Vietnam	2008	2008	2010	-7.96
China	1985	1985	1986	-3.59
China	2009	2009	2011	4.07

Source: IMF, Authors' Calculations

Table C.4: Capital Inflows Episodes in Emerging Markets (2)

Country	**Start Year**	**Peak Year**	**End Year**	**Average Current Account (%GDP)**
Morocco	1976	1976	1982	-12.61
Morocco	2008	2008	2011	-5.92
Tunisia	1976	1976	1977	-9.51
Tunisia	1984	1984	1986	-7.22
Tunisia	1992	1992	1993	-8.32
Tunisia	2009	2009	2011	-4.93
Bulgaria	1986	1986	1990	-5.16
Bulgaria	2005	2005	2008	-21.57
Russian Federation	1996	1996	1998	1.12
Russian Federation	2008	2008	2011	5.47
Ukraine	1994	1994	1998	-2.59
Ukraine	2008	2008	2011	-4.91
Czech Republic	1996	1996	1997	-7.23
Slovak Republic	1996	1996	1998	-8.14
Slovak Republic	2006	2006	2008	-6.28
Estonia	2004	2004	2008	-13.71
Latvia	2006	2006	2008	-23.33
Hungary	1994	1994	1996	-6.15
Hungary	2002	2002	2004	-7.86
Lithuania	1996	1996	1999	-10.09
Lithuania	2007	2007	2008	-17.51
Slovenia	1998	1998	2000	-2.01
Slovenia	2004	2004	2008	-4.22
Poland	1991	1991	1993	-3.8
Poland	1999	1999	2000	-6.39
Poland	2008	2008	2010	-5.68

Source: IMF, Authors' Calculations

Table C.5: Capital Inflows Episodes: Other Economies

Country	**Start Year**	**Peak Year**	**End Year**	**Average Current Account (%GDP)**
Costa Rica	1978	1978	1981	-15.22
Costa Rica	2008	2008	2011	-5.26
Dominican Republic	1978	1978	1982	-7.54
Dominican Republic	2008	2008	2011	-8.1
Guatemala	1980	1980	1982	-5.09
Guatemala	1992	1992	1995	-5.39
Paraguay	1981	1981	1988	-7.45
Paraguay	1996	1996	1997	-7.29
Jamaica	1981	1981	1985	-10.98
Jamaica	2007	2007	2008	-19.52
Cyprus	1977	1977	1980	-16.34
Cyprus	1991	1991	1992	-8.8
Cyprus	2007	2007	2010	-11.85
Israel	1982	1982	1984	-8.4
Israel	2009	2009	2011	2.8
Jordan	1982	1982	1987	-5.7
Jordan	1992	1992	1993	-13.3
Jordan	2005	2005	2010	-10.81
Sri Lanka	1980	1980	1983	-11.55
Sri Lanka	2008	2008	2011	-5.39
Singapore	1980	1980	1982	-12.22
Singapore	2001	2001	2002	11.26
Singapore	2009	2009	2011	23.24
Botswana	1978	1978	1982	-18.48
Botswana	2009	2009	2010	-1.74
Mauritius	1976	1976	1981	-11.45
Mauritius	2005	2005	2011	-8.71
Belarus	1997	1997	1998	-6.91
Belarus	2008	2008	2011	-11.77
Albania	1990	1990	1991	-8.69
Albania	2008	2008	2009	-17.11
Croatia	1995	1995	1999	-7.52
Croatia	2008	2008	2009	-7.87
Macedonia, FYR	2002	2002	2004	-6.56
Macedonia, FYR	2008	2008	2009	-10.92

Source: IMF, Authors' Calculations

Appendix D

Mathematical Appendix to Chapter 3

D.1 Analytical Solution of the Model

We start with a system of 19 equations, which have already been described in the text: four production functions, two intratemporal optimality conditions (3.3), the Euler equation (3.4), labor demand for the two sectors in both periods (3.5 and 3.6), optimal investment for both sectors in the first period (3.7), two labor market clearing conditions (3.11), the two nontradable goods market clearing conditions (3.8), and the two tradable goods market clearing conditions (3.9 and 3.10). The system is solved by the optimal values of consumption, output, and employment in the tradable and nontradables sectors in both periods, as well as equilibrium wages and prices in both periods, optimal borrowing, and finally optimal investment in the two sectors in the first period.

We eliminate borrowing B_0 by combining the tradable goods market clearing conditions (3.9 and 3.10) into an intratemporal budget constraint. Market clearing in the nontradables sector (3.8) allows us to eliminate nontradables output Y_t^N, while wage equalization due to free movement of labor between sectors (3.5) lets us eliminate first-period wages W_0. As discussed in the text, we can express second-period output as a linear function of capital (3.12) and write second-period wages W_1 and aggregate capital stock K_1 as functions of exogenous parameters. In addition, combining the optimality conditions for labor and capital allows us to write the relative price of nontradables at $t = 1$ as a function of the ratio of the exogenous sectoral productivities.

$$P^N = \left(\frac{A^T}{A^N}\right)^{1-\alpha}. \tag{D.1}$$

This leaves us with 11 unknowns: consumption in both sectors and time periods; investment and labor for both sectors at $t = 1$; tradables output in both periods; and first-period prices. The remaining 11 equations are

$$
\begin{aligned}
C_0^N = (A_0^N L_0^N)^{1-\alpha} \quad &and \quad C_1^N = RK_1^N \\
Y_0^T = (A_0^T L_0^T)^{1-\alpha} \quad &and \quad Y_1^T = RK_1^T \\
P_t^N = \frac{1-\omega}{\omega}\frac{C_t^T}{C_t^N} \quad &for \quad t = 0, 1
\end{aligned}
$$

$$
\begin{aligned}
C_0^T + R^{-1}C_1^T + K_1^T + K_1^N &= Y_0^T + R^{-1}\left(Y_1^T + Y_2\right) \\
C_1^T &= R\beta C_0^T \\
L_t^T + L_t^N &= L \text{ for } t = 0, 1 \\
L_0^N &= P^{1/\alpha}\left(\frac{A_0^N}{A_0^T}\right)^{\frac{1-\alpha}{\alpha}} L_0^T
\end{aligned}
$$

Further substitution leaves three unknowns: first-period values of tradables output and consumption as well as the relative price of nontradables. The remaining four equations consist of a modified intratemporal optimality condition

$$
C_0^T = \left(\frac{\omega}{1-\omega}\right)\left(\frac{A_0^N}{A_0^T}\right)^{\frac{1-\alpha}{\alpha}} P^{\frac{1}{\alpha}} Y_0^T,
$$

An expression derived from labor-market clearing

$$
(Y_0^T)^{\frac{1}{1-\alpha}}\left((A_0^N)^{\frac{1-\alpha}{\alpha}}(A_0^T)^{\frac{-1}{\alpha}} P_0{}^{\frac{1}{\alpha}} + (A_0^T)^{-1}\right) = L, \tag{D.2}
$$

and a linear relationship between first-period tradables consumption and output, derived from the Euler equation and the intertemporal budget constraint

$$
C_0^T = \left[1 + \beta + \frac{1-\omega}{\omega}\frac{\beta}{P_1}\right]^{-1}\left(Y_0^T + R^{-1}Y_2\right) \tag{D.3}
$$

Since the price of nontradables P_1 is increasing in tradables-sector productivity, the share of first-period tradables production allocated for consumption (which I will call γ) rises when future productivity increases.

Thus the price of nontradables can be written in terms of tradables output

$$
P_0^{1/\alpha} = \gamma\left(1 + R^{-1}\frac{Y_2}{Y_0^T}\right)
$$

Substituting this into the modified labor-market clearing condition (D.2) and simplifying gives

$$\left(\frac{1-\omega}{\omega}\right)\gamma(A_0^N)^{\frac{(1-\alpha)^2}{\alpha}}(A_0^T)^{-\left(\frac{(1-\alpha)^2}{\alpha}+1\right)}\left[(Y_0^T)^{\frac{1}{1-\alpha}}+R^{-1}Y_2(Y_0^T)^{\frac{\alpha}{1-\alpha}}\right] \tag{D.4}$$

$$+(A_0^T)^{-1}(Y_0^T)^{\frac{1}{1-\alpha}}=L. \tag{D.5}$$

This expresses first-period tradables production as an implict function of the model's exogenous parameters.

D.2 An Increase in Future Tradable Sector Productivity

Here we show that an increase in agent's expectations regarding the future productivity of the tradables sector A_1^T will cause households to increase their current consumption of tradable goods. Since first period productivity is not changing, in what follows we set both A_0^T and A_0^N equal to one to conserve notation.

From the optimal value of second-period prices (D.1) and the consumption function (D.3), it is clear that an increase in future productivity will increase γ, the share of first period tradables production that households consume. Implicitly differentiating (D.5) with respect to γ gives

$$\frac{\partial Y_0^T}{\partial \gamma}=\frac{-\left(\frac{1-\omega}{\omega}\right)\left[(Y_0^T)^{\frac{1}{1-\alpha}}+R^{-1}Y_2(Y_0^T)^{\frac{\alpha}{1-\alpha}}\right]}{\left(\frac{1-\omega}{\omega}\right)\gamma\left[\frac{1}{1-\alpha}(Y_0^T)^{\frac{1}{1-\alpha}-1}+R^{-1}Y_2\frac{\alpha}{1-\alpha}(Y_0^T)^{\frac{\alpha}{1-\alpha}-1}\right]+(Y_0^T)^{\frac{1}{1-\alpha}-1}}<0$$

Since capital is fixed at $t=1$ an fall in tradables production implies a fall in the production and therefore consumption of nontradable goods. The modified labor market clearing condition (D.2) shows that a fall in Y_0^T requires that the current price of nontradables P_0 rise. From the intratemporal optimality condition, this shows that $t=1$ consumption of tradables C_0^T will also rise.

D.3 A Fall in the Interest Rate

We now show that a fall in the interest rate R at which agents in the model economy borrow from abroad increases current consumption of both tradable and nontradable goods and leads to an immediate reallocation of labor into the nontradables sector as well as an increase in in the share of investment allocated to the tradables sector. Once again, we set $A_0^T = A_0^N = 1$ to economize on notation.

Implicit differentiation of (D.5) with respect to R gives:

$$\frac{\partial Y_0^T}{\partial R} = \frac{\left(\frac{1-\omega}{\omega}\right)\gamma R^{-2} Y_2 (Y_0^T)^{\frac{\alpha}{1-\alpha}}}{\left[1+\left(\frac{1-\omega}{\omega}\right)\gamma\right]\frac{1}{1-\alpha}(Y_0^T)^{\frac{1}{1-\alpha}-1} + \left(\frac{1-\omega}{\omega}\right) R^{-1} Y_2 \frac{\alpha}{1-\alpha}(Y_0^T)^{\frac{\alpha}{1-\alpha}-1}} > 0$$

So that a fall in R will result in a fall in Y_0^T. Intuitively, the fall in the interest rate induces the household to shift consumption into the first period, optimally dividing the higher consumption between tradables and nontradables. Higher consumption of nontradables requires an immediate increase in nontradables production. Since capital is fixed, this requires that labor shift into the nontradables sector (an increase in L_0^N and a fall in L_0^T) and tradables production must fall.

Looking at the the modified labor-market clearing condition (D.2) it is clear that lower Y_0^T implies that the price of nontradables P_0 increase in response to the lower interest rate. Since both the quantity of nontradables consumed and their price have increased, from the intratemporal optimality condition (3.3), we know that tradables consumption will also rise.

To see what happens in the second period, combine the Euler equation and the consumption function (D.3) to get

$$C_1^T = \beta\gamma[RY_0^T + Y_2]$$

Since nontradables output falls when the interest rate drops, this shows that consumption of tradables in the second period will fall. Since second-period prices depend only on the ratio of sectoral productivity, we see from the intratemporal optimality condtion (3.3) that the ratio of tradable to nontradable consumption in the second-period will not respond to changes in the interest rate, and therefore nontradables consumption C_1^N and output Y_1^N will also fall.

From 3.13 and 3.14 we know that a fall in the interest rate will increase the capital-labor ratio in both sectors. Rewriting the production function for nontradables in terms of the capital-labor ratio gives

$$Y_1^N = (A_1^N)^{1-\alpha}\left(\frac{K_1^N}{L_1^N}\right)^{\alpha} L_1^N$$

We know that the capital labor ratio will rise while output falls in response to a drop in the interest rate. Therefore labor allocated to the nontradables sector L_1^N falls. Labor market clearing requires that L_1^T rise. In order to maintain equal capital labor ratios across sectors, capital dedicated to to the production of tradable goods must rise when the interest rate falls. Therefore when the interest rate rises, the share of investment allocated to tradables will rise.

D.4 A Permanent Rise in Productivity in the Tradables Sector

Here we prove that an increase in the productivity of the tradables sector which is permanent will lead to an immediate increase in the production of tradable goods. Since we are considering a permanent increase in tradables sector productivity, $A_0^T = A_1^T$ and we will express these simply as A^T. We also set A_0^N equal to unity to simplify notation. Using the definition of γ, the expression for Y_0^T becomes

$$\frac{\left(\frac{1-\omega}{\omega}\right)\left[(Y_0^T)^{\frac{1}{1-\alpha}} + R^{-1}Y_2(Y_0^T)^{\frac{\alpha}{1-\alpha}}\right]}{\left[(1+\beta)(A^T)^{\frac{(1-\alpha)^2}{\alpha}+1} + \frac{1-\omega}{\omega}\beta(A_1^N)^{1-\alpha}(A^T)^{\frac{(1-\alpha)^2}{\alpha}+\alpha}\right]} + (A^T)^{-1}(Y_0^T)^{\frac{1}{1-\alpha}} = L.$$

Calling the denomintor of the first term on the left-hand side of the expresion ψ, note that $\partial\psi/\partial A^T > 0$. Thus we get

$$\frac{\partial Y_0^T}{\partial A^T} = \frac{\left(\frac{1-\omega}{\omega}\right)\left[(Y_0^T)^{\frac{1}{1-\alpha}} + R^{-1}Y_2(Y_0^T)^{\frac{\alpha}{1-\alpha}}\right]\frac{\partial\psi}{\partial A^T} + (A^T)^{-2}(Y_0^T)^{\frac{1}{1-\alpha}}}{\left(\frac{1-\omega}{\omega}\right)\gamma(A_0^T)^{-\left(\frac{(1-\alpha)^2}{\alpha}+1\right)}\left[\frac{1}{1-\alpha}(Y_0^T)^{\frac{1}{1-\alpha}-1} + R^{-1}Y_2\frac{\alpha}{1-\alpha}(Y_0^T)^{\frac{\alpha}{1-\alpha}-1}\right] + (A^T)^{-1}(Y_0^T)^{\frac{1}{1-\alpha}-1}}$$
$$> 0$$

The fact that capital is fixed in the first period, along with labor market clearing, means that the increase in tradables production requires a fall in the production of nontradables and an immediate shift of labor into tradables. Since a permanent increase in tradables productivity increases both γ and Y_0^T, it is clear from the consumption function (D.3) that current consumption of tradables will rise as well.