The Investment Cost of Currency Crises in Emerging Markets: An Empirical Treatment from 1994-2015

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Abstract

Currency crises – large and sudden depreciations in the value of a country's currency – have been an unfortunate by-product of increased financial openness over the last half century. This study extends the already vast literature on the impact of currency crises by estimating how currency crises affect domestic investment in emerging markets. Specifically, the study uses panel data with fixed effects and various robust standard errors as well as a generalized method of moments estimator to investigate the impact of currency crises on domestic investment in a sample of 14 countries that experienced currency crises between 1994 and 2015 and 10 that did not. The results of the analysis initially indicate that, after controlling for a host of macroeconomic fundamentals, currency crises contribute significantly to dampened domestic investment. Ultimately, after controlling for banking crises, the study concludes that relatively severe, but not all, currency crises have a significant depressing effect on investment. The results further indicate that all currency crises should not be treated equally; those involving exceptionally large depreciations lead to an even greater decline in domestic investment.

JEL Classifications: E4, F3, F4, E42, F31, F32, F41, G01

Keywords: Currency Crises, Investment, Emerging Markets

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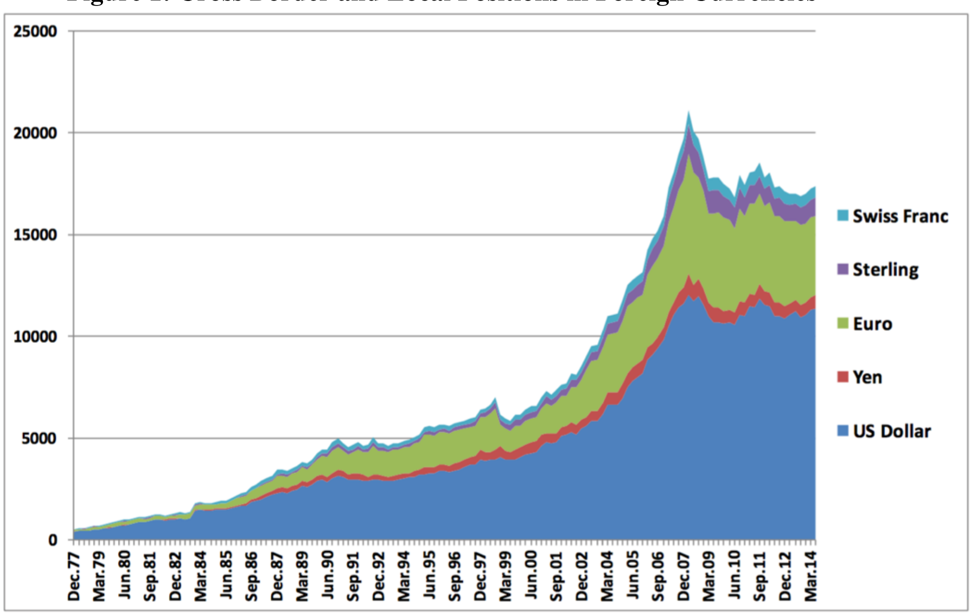
1. Introduction

Financial crises in emerging markets over the last half century have been frequent and vicious. Their onset is typically associated with a recession, a drawn-out credit crunch, and capital outflow. As emerging markets have liberalized their economic and monetary policy by abandoning pegged exchange rates, opening the capital account, and more, they have also become more vulnerable to financial panics. This study will focus on currency crises - episodes in which an emerging market's currency experiences a precipitous decline in its value - and how those crises impact domestic investment. A popular view in the academic literature is that emerging market firms suffer primarily from a decline in access to credit in the wake of currency crises. When firms in emerging markets need to borrow to invest, they typically cannot do so in domestic capital markets. As a result, they tap external markets and often borrow in a foreign currency (usually U.S. Dollars or Euros). The figure below shows the breakdown of emerging market foreign borrowing by currency denomination from 1977 to 2014 (Rey, 2014).

Figure 1: Cross Border and Local Positions in Foreign Currencies



This borrowing, which has grown rapidly since the 1970s, is commonly referred to as the "original sin." When the local currency rapidly loses its value, the cost of debt obligations soar in local currency terms, all while a domestic recession can hurt firms' revenues. As those two metrics move in opposite directions, firms' net worth plummets, often causing loan defaults and solvency issues (Aghion, Bacchetta, and Banerjee, 2003).

Arteta and Hale (2009) find that when a currency crisis hits, credit declines by about 25%. This study hypothesizes that this post-crisis credit leads to an important decline in domestic investment. The analysis will contribute to the existing literature by quantitatively analyzing the drop in domestic investment. Ultimately, a more complete understanding of how currency crises affect investment activity in emerging markets will help researchers, policy makers, and market participants assess the net impact of financial openness. In addition to measuring the size, if any, of investment decline due to currency crises, the analysis hopes to add a degree of nuance. Specifically, the study will test if currency crises of differing severity have distinct impacts on investment activity, and if the presence of other concurrent banking and sovereign debt crises impacts how currency crises drive investment.

Two general empirical techniques are used in the research: fixed effects and generalized method of moments estimators. The results produce three broad conclusions. First, after controlling for macroeconomic determinants of investment, currency crises maintain a substantial depressing effect on domestic investment. Second, when currency crises are especially severe, the impact on investment is even larger. Lastly, when other types of financial crises are added to the specification, the predictive power falls off for relatively mild currency crises. The relatively severe currency crises that remain significant are, however, more impactful than banking crises.

The rest of this paper will proceed as follows: section 2 will review the literature on this subject, section 3 will discuss the theoretical framework for the research, section 4 will be a discussion of the data used in the study, section 5 will develop the empirical methodology, section 6 will present the results, and section 7 will conclude with a general discussion of the results and proposals for future research.

2. Literature Review

There does not exist a deep literature on the impact of currency crises on domestic investment. There does, however, exist research on how currency crises impact other macroeconomic variables, particularly output, and on how domestic investment is impacted by a variety of economic events. Therefore, the contribution of this research will be to bridge these two, essentially disjoint, subsections of literature. Studying investment as opposed to output provides a more complete understanding of how economies suffer during crises. If a currency crisis hits, output may well remain high or recover quickly because a weak exchange rate helps exporters. However, if the economy does not also enjoy healthy investment activity, that export growth is unlikely to bolster productivity or real economic growth in the long run (Joyce and Nabar, 2007).

2.1. How Currency Crises in Emerging Markets Happen

Before discussing how currency crises impact investment, it is helpful to develop a grounding in the anatomy of currency crises. Currency crises can happen in a number of ways and under a number of exchange rate regimes. First, structural macroeconomic problems or exogenous shocks to an economy can prompt open market selling of a country's currency or large-scale capital flight from an economy, causing a rapid depreciation in the value of the currency. In an extreme case, this massive capital outflow is termed a sudden stop (Calvo, 2005). Importantly, this can happen even when a country's exchange rate is floating.

Alternatively, emerging market economies often experience rapid devaluation when they abandon a pegged exchange rate. A first-generation model of currency crises under fixed exchange rate regimes was provided by Krugman (1979). He explains that emerging market central banks defend an exchange rate peg by using foreign currency reserves to buy and sell the domestic currency in the open market when there is either excess supply or demand in the market. Often, excess supply exists because the price of a country's principal export (typically a commodity) has dropped or because excessive debt has been taken on by a government to fund a large current account deficit. In that case, the forward-thinking speculative community becomes convinced that the central bank can no longer successfully defend the peg. At that moment, they sell enough of the country's currency to deplete the foreign reserves of the central bank, taking away their only tool to defend the peg (Krugman, 1979).

That explanation of currency crises is expanded in a second generation model (Obstfeld, 1986). In the adapted view, currency crises are not always the result of unsustainable macroeconomic policy, but instead are self-fulfilling. Take, for example, investors in a country's sovereign debt. If those investors are buying sovereign debt issued to cover a large current account deficit, they might demand a very high yield on the debt because they are worried that the same current account deficit that they are funding is going to require a depreciation in the future to support exporters. If investors then buy the bonds with a relatively high interest rate, the government will start to accumulate a debt burden that it might not be able to pay without printing more money and devaluing the currency. It is in this way that investors who predict a currency crisis can eventually make it happen. Importantly, this explanation is highly regional. If a country is relatively vulnerable to a crisis because of a large current account deficit, huge external debt obligations, or the like, then investors who predict a crisis may end up creating that crisis. If a country, on the other hand, has sound macroeconomic fundamentals, then even a pessimistic investment community is unlikely to force a country to devalue their currency.

The third generation of currency crisis models studies how currency crises function in relation to stress in the banking system. For instance, Burnside, Eichenbaum, and Rebelo (2000) explain that prospective government debt resulting from guarantees to the financial system preceded the twin currency and banking crises in Korea and Thailand. In 2004, the same authors argue that implicit government guarantees of this sort can create a problem of moral hazard, wherein banks borrow recklessly from foreign creditors because they assume that the government will cover the debts if the banks are not able to. This results in twin crises when the banks experience solvency problems and a government cannot or will not bear the cost of a sufficiently large bailout (Burnside, Eichenbaum, and Rebelo, 2004). This is just one paper in a rich tradition of literature that investigates foreign borrowing and the role of expected government bailouts in precipitating crises. See, for instance, McKinnon and Pill (1996); Corsetti, Pesenti, and Roubini (1998), or Radelet and Sachs (1998).

A final model describes the onset of currency crises as a result of interest rate arbitrage. Consider two hypothetical countries, A and B. Country B pegs their currency to the currency of country A. Additionally, in country A, the five year interest rate is 3% and in country B, the analogous rate is 8%. For the sake of the example, assume that transaction costs are negligible. In this case, investors can simply borrow money for five years in country A at 3%, convert the currency to that of country B, and earn the 8% return in country B. After five years, the investors can exchange their return from country B into the currency of country A to pay off the loan and earn a 5% profit. An issue emerges when investors execute this “carry trade” en masse. When a critical mass of investors want to exchange country B’s currency for country A’s currency, the central bank of country B will have to keep buying the currency to defend the peg. Once the central bank has insufficient reserves to perpetually buy up the domestic currency, the peg may be abandoned, making it more expensive for the investors to sell country B’s currency and buy country A’s currency. If the devaluation is sufficiently large, some of these investors may also default on their loan in country A because their investment return is not large enough to service their debt. This highly simplified example helps explain the structural macroeconomic issues that contributed to the Asian Financial Crisis of 1997-1998 (Levinson, 2014).

Eichengreen, Rose, and Wyplosz (1996) add that when a currency crisis hits one country, there is a tendency for that crisis to spread to “similar” countries - that is, countries that are tied to the initial victim by international trade flows and that are in similar macroeconomic circumstances. In that way, the bunches of currency crises in specific regions, most prominently including the 1997-1998 Asian Crisis that hit Korea, Indonesia, Malaysia, and Thailand, should not be surprising. Milesi-Ferrett and Razin (1998) contribute by empirically evaluating the importance of foreign reserves in predicting currency crises. They argue that the stage is set for a currency crisis in a developing country when foreign reserves are low (because of the reason outlined by Krugman [1979]) and external conditions are unfavorable (i.e. high interest rates and low-growth in the developed world).

2.2. Impact of Currency Crises on the Emerging Markets

A good deal of work has been done on the impact of currency crises on economic growth, which is intimately tied to domestic investment. Gupta, Mishra, and Sahay (2003) look at currency crises from 1970-1998 and make a number of interesting conclusions. First, they use a cross-sectional regression to say that output contraction following currency crises tends to be worse in large, developed economies than it does in smaller, developing economies. Secondly, they note that countries with relatively open capital accounts, that trade less with the world, and where the pre-crisis period sees a rapid increase in capital inflows are likely to see contraction in the wake of crises. They do conclude, rather surprisingly, that more than 40% of currency crises lead to more economic growth. That is likely because countries that rely heavily on exports, will see their goods become cheaper to foreign buyers in the wake of an exchange rate depreciation. The resulting increase in exports will help growth recover faster.

Hutchinson (2003) adds a temporal component to this research; he remarks that after currency crises, output tends to stay low for 1-2 years before recovery. He also finds that when the IMF steps in with a rescue plan, growth and credit do not recover in any meaningfully different way than when the IMF does not step in. Hutchinson and Noy (2006) add that when currency and banking crises happen at the same time, output falls off in an additive way - that is, output declines because of the currency crisis and because of the banking crisis, but there is not significant interaction between the two crises that accelerates contraction.

In addition, significant progress has been made in understanding the impact of currency crises on credit supply. Arteta and Hale (2009) are, by a significant margin, the leaders in this field. Their results were briefly touched upon in the introduction. They find that about a third of the decline in foreign credit after a currency crisis is due to supply decline (i.e. a “credit crunch”) and the other two thirds can be explained by a decline in demand for foreign credit. In the month of a depreciation, external corporate credit declined by 24.11%, and it declined by 26.30% in the first year post-depreciation. (Arteta and Hale, 2009)

2.3. Impact of other Financial Crises on Investment

Instead of looking at currency crises, Joyce and Nabar (2007) analyzed how sudden stops, an immediate reversal of capital flows out of a country, and banking crises simultaneously impact domestic investment. They found that, regardless of what specification was used, the crisis indicator was significant at 1%. Sudden stops, they concluded, were slightly more impactful than banking crises. This paper, therefore, extends that work by using similar analytical techniques to measure the impact of a different variety of financial crisis. An IMF report in 2005 added that investment is a fairly sticky variable, which is to say that in the wake of crises, investment tends to stay low for longer than growth or other variables. In fact, that 2005 report concluded that in many East Asian countries, investment had yet to fully recover from the crisis in 1997-1998. This study is focused on the severity of investment collapse as opposed to the length of investment collapse, but analyzing the latter would certainly be an interesting addition to this research.

Ksantini and Boujelbène (2014) analyze the impact of financial crises on investment, but choose not to distinguish between different types of financial crises. Even absent this distinction, they conclude that financial crises have statistically significant dampening effect on investment, but the coefficient on the crisis indicator is not very large in magnitude (only -0.044), calling into question the economic significance of the result.

3. Theoretical Framework

There are two tasks in the developing the theoretical framework of the research: deciding how to model the interest rate, and detailing how currency crises translate to investment decisions. Each of those tasks will be taken in turn, with a discussion of the merits to different approaches embedded within each subsection.

3.1. Open Economy vs. Closed Economy Framework

There are essentially two perspectives from which investment in emerging markets can be viewed: the open-economy framework or the closed-economy framework. The issue is if the supply schedule of funds is upward sloping (i.e. sensitive to the domestic interest rate) or perfectly flat (i.e. insensitive to the domestic interest rate). The "correct" choice is probably different for different countries depending on their level of investment openness. More open countries likely have supply schedules that are set more globally because there are fewer restrictions on foreign capital entering the country. Conversely, in closed economies where foreign investment is legally restricted or disincentivized, the supply schedule is likely to be upward sloping.

The first theoretical model is the open-economy model. An open economy model purports a global pool of capital that can be employed across borders and then invested by credit recipients. Importantly, this model assumes each individual country is small compared to the world. This means that increases in investment demand in a country only impact the amount of investment in that country, it does not impact the price of investment. The effect is a perfectly elastic supply schedule of funds in any one country. Therefore, the relevant interest rate is a global interest rate. It is certainly unreasonable to think that this model is perfectly reflective of reality. Most notably, country-specific risk factors subject different countries to higher interest rates through a "risk premium".

A closed-economy model would mean that the relevant interest rate that firms have to pay to invest is the domestic interest rate. This model implies that there is a tradeoff between savings and investment - that the domestic credit that is then used for investment comes from domestic deposits. This means that the savings-investment market would have a upward sloping investment supply curve (which is also the savings demand curve) and a downward sloping investment demand curve where the Y-axis variable is the domestic interest rate. This is the model that the analysis will proceed with. In addition to the theoretical justification, this decision is empirically motivated. When the three month London Interbank Offered Rate (LIBOR) is included as a regressor to proxy a global interest rate, it is consistently insignificant across different specifications. Additionally, this choice is in keeping with the literary tradition of Joyce and Nabar (2007) and Ksantini and Boujelbène (2014).

3.2. How Currency Crises Impact Investment

The theoretical underpinnings of how currency crises impact firm decision making and investment activity draws from the "original sin" thesis discussed previously. When the net worth of firms drops rapidly, those firms tend to demand less credit to finance long-term investments. When a recession accompanies a currency crisis, many firms will see inventories rise drastically, and will therefore have less need to rapidly expand production. The decreased demand for investable funds makes firms less likely to access domestic and international capital markets.

The most basic supply effect argument involves a mark-up of the risk premium in the country experiencing the crisis. When domestic firms experience rapid declines in net worth, many will also experience solvency problems and will be unable to service their debts. Lenders to firms in the emerging market, noting the generally higher risk of default among borrowers, are likely to raise the price of borrowing to offset the increased risk that they are taking by lending (Hale and Arteta, 2009). As external creditors begin to reassess risk within a country, marginal lenders who are unwilling to shoulder hefty risk leave the market. The result is fewer willing lenders in the market and a shift in the supply curve up and to the left. In this way, some simple supply and demand economics can help explain a decline in debt issuance, and because a lot of emerging market investment relies on foreign credit, investment is likely to decline as well. Moreover, when a crisis hits, the banking sector may experience significant stress. The number of non-performing loans on the balance-sheets of domestic financial intermediaries goes up. That leaves domestic banks less able to issue new debt or equity, which means that domestic firms cannot access local sources of funding as an easy replacement for foreign financing. Sometimes, domestic financial institutions will be able to clean up their balance-sheets privately, but this might require government intervention. If a crisis happens in a market where the government (or an international institution like the IMF) is more likely to intervene, the drop off in investment might be milder. Otherwise, if finance-hungry firms try to shift out of external financing and into internal financing, they may find themselves without lenders willing to finance potential investment.

4. Data

The next task is to describe the data used to test the theoretical framework. This section will cover four things: the currency crisis variable, the investment variable, the variables in the control vector, and the variables required for robustness testing. Included will be details of how the variable was constructed, the source of the data, and some summary statistics of the series.

4.1. Currency Crises

Currency crises are deliberately defined in a way that makes them rare. Krugman (2001) as well as Hale and Arteta (2009) note that firms are unlikely to change behavior when currency fluctuations are minor in magnitude. Monthly data on the broad real effective exchange rate (normalized to 100), is provided by the Federal Reserve Economic Data (FRED) service of the

St. Louis Fed. The series provides monthly observations on twenty countries from January, 1994 until September, 2015. In the 5460 observations, the average percentage monthly change in the real exchange rate was .0819% and the standard deviation of exchange rate changes was 3.29%. Therefore, a move three standard deviations worse than the mean is at least a 9.78% depreciation, so it is natural to define a currency crisis to be any drop of 10% or more in a single month. 60 of the 5460 months in the dataset (1.10%) qualify as a currency crisis under this definition. There are a variety of definitions employed throughout the literature, but this conforms with the work or Arteta and Hale (2009). Following the lead of Arteta and Hale (2009), the study considers consecutive months of large depreciations to be part of the same currency crisis. Specifically, the currency crisis indicator is only allowed to take on a value of 1 after three months of the indicator taking on a value of 0 (i.e. only after three consecutive months without a crisis).

Additionally, the study wants to measure firms' response to crises, which means the timing of the crisis within a year is important. Therefore, if a crisis begins in the first half of a year, t, then it is considered to be of that year, but if it begins in the second half of a year, t, then it is considered to be of the year t+1. For instance, Brazil experiences a currency crisis in October, 2002, but a change in investment is more likely to appear in 2003 than in 2002 because there are only two additional months in 2002 in which behavior can be changed. Finally, Argentina and Venezuela both experience crises in 2016, but because there is no investment data for this past year, those crises are not included in the analysis. After these adjustments are made, there are 35 emerging market currency crises across 14 different markets that occur between 1994 and 2015.

Even though currency crises are deliberately defined in a way that makes them rare, it is still somewhat surprising that the 35 crises are concentrated in only 14 countries. 11 of the 14 crisis countries can be classified into three broad geographical groups: Southeast/East Asia (Indonesia, Korea, Thailand, Malaysia), Latin America (Argentina, Brazil, Mexico, Venezuela), and Eastern Europe (Russia, Romania, Bulgaria). It is reasonable to hypothesize that those regions had distinct policy and macroeconomic similarities, such as trade relationships, that caused crises to spread regionally (i.e. the 1997-1998 Asian Crisis, the wave of Latin American crises in 2002-2003, and the seven Eastern European crises that happened in the mid-late 1990s) and made those regions more susceptible to crises. The instances of currency crises are summarized in table 1.

Table 1: Instances of Currency Crises

Country	Year of Crisis
Algeria	1994
Argentina	2002
Brazil	1999, 2003*, 2009*
Bulgaria	1994, 1996, 1997*
Indonesia	1998, 2000*, 2009*
Korea	1998*, 2009*
Malaysia	1998
Mexico	1995*, 2009*
Romania	1996*, 1997
Russia	1995*, 1999*, 2015*
South Africa	1999*, 2002*, 2009*
Thailand	1998
Turkey	1994, 2001, 2003*
Venezuela	1994, 1996, 2002, 2003, 2004, 2010, 2013

Note: * indicates that a crisis happened in July-December of the previous year

4.2 Investment

Data on aggregate domestic investment is obtained from the World Bank's World

Development Indicators dataset. The dataset is extraordinary, providing yearly observations on all 14 countries that experience a currency crisis as well as the ten countries in the sample that did not. The ten non-crisis countries were chosen to provide additional data-points and minimize the impact of idiosyncratic country effects through diversification. The countries were also chosen with geographic diversity in mind, so as not to introduce too much regional idiosyncrasy. The World Bank calls the investment variable "Gross Capital Formation," but the same series was previously referred to as "Gross Domestic Investment." Gross Capital Formation includes "outlays on additions to the fixed assets of the economy plus net changes in the level of inventories," including land improvements, capital expenditures, private residential construction, commercial buildings, and industrial buildings. Importantly, the gross capital formation variable is scaled by GDP to get a more accurate picture of how economies shift in and out of investment relative to other forms of spending when currency crises hit. A few summary statistics on domestic investment as a percentage of GDP across all 24 countries in the sample are shown in table 2.

Table 2: Domestic Investment (% of GDP)

Mean	29.694
Standard Deviation	6.656
Minimum	.299
Maximum	46.876
Observation	522

For a few countries with prominent currency crises, plots were generated of domestic investment over time, the goal of which was to identify (albeit, without controlling for the other relevant macroeconomic indicators to be discussed later) if crisis years tend to be associated with precipitous declines in investment. Thailand's investment trend is shown in figure 2, and Mexico's is shown in figure 3.

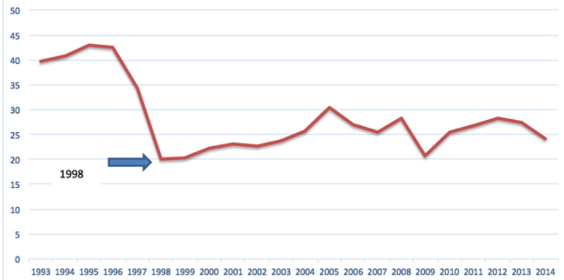


Figure 2: Thailand Gross Capital Formation (% GDP) (Crisis Years: 1998)

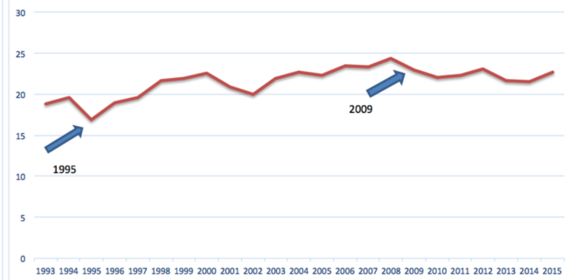


Figure 3: Mexico Gross Captial Formation (% GDP) (Crisis Years: 1995, 2009)

It certainly appears as though the association is strong for Thailand, but it is not as strong for Mexico, where investment appears to remain relatively stable over time even if the Mexican Crisis of 1994-1995 was associated with a mild decline in investment. Additionally, it is important to note even in a country, Thailand for instance, where a currency crisis clearly happens at the same time as investment collapse, a currency collapse does not explain every collapse in investment. Thai investment collapses in conjunction with their 1998 currency crisis (part of the larger Asian Financial Crisis), but when investment collapses in 2009 (likely associated with the 2008-2009 subprime crisis), there is not concurrent depreciation of the Baht. Summary statistics on investment change where year-over-year change is given in percentage terms is show in table 3.

Table 3: Year over Year Investment Change

	All Years	Crisis Years	Non-Crisis Years
Mean	6.524	71.195	1.876
Standard Deviation	126.448	487.821	13.029
Minimum	-98.100	-98.100	-36.736
Maximum	2869.726	2869.726	108.523
Observation	522	35	487

$$\boldsymbol{\Delta Investment_{YoY}}\,(\%) = \frac{\boldsymbol{Investment_t - Investment_{t-1}}}{\boldsymbol{Investment_{t-1}}} * 100$$

The initial outcome here is troubling. In percentage terms, the results say that in a year where a currency crisis occurs, investment increases by an average of 71.19%, whereas in a year without a currency crisis, investment increases by only 1.88%. The source of the issue is, unsurprisingly, an outlier. In 1996, investment in Bulgaria was only .2986% of GDP, the lowest in any year across all countries in the sample. When investment jumped in 1997 to just 8.869% of GDP, the increase was 2869.73%. There are a couple of ways to correct this. First, the outlier can be removed from the sample. In that case, the average investment percentage change in the year of a currency crisis drops to -11.11% and the standard deviation of that subset of data drops to 29.56 from 487.82. Second, the outlier can be included in the sample, but the median can be used as the metric instead of the mean. The median percentage investment change in all years is 1.11%, the median percentage investment change in a non-crisis year is 1.56%, and the median percentage investment change in a crisis year is -9.26%. [1] These results conform much better with the hypothesis that currency crises are associated with a collapse in investment.

4.2. Control Vector

The control vector in the analysis has five variables: the real interest rate, foreign direct investment, total debt service, lagged GDP growth, and lagged investment (i.e. the lagged dependent variable). These variables are the five that remained after a much larger set of macroeconomic variables were tested. The variables that ultimately did not merit inclusion in the control vector showed consistent statistical insignificance across the vast majority of empirical specifications. Some of the variables that were ultimately discarded were total trade (sum of imports and exports), the 3m LIBOR rate, inflation, and the value of the JP Morgan Emerging Market Bond Index. No discussion is necessary on lagged investment because it is the same data as that for investment.

4.3.A. The Real Interest Rate

The real interest rate is defined as a country's nominal, risk-free interest rate less

[1] This discussion is only meant to give context on how investment tends to perform in crisis years versus non-crisis years – none of the adjustments were made to the dataset before use in the model

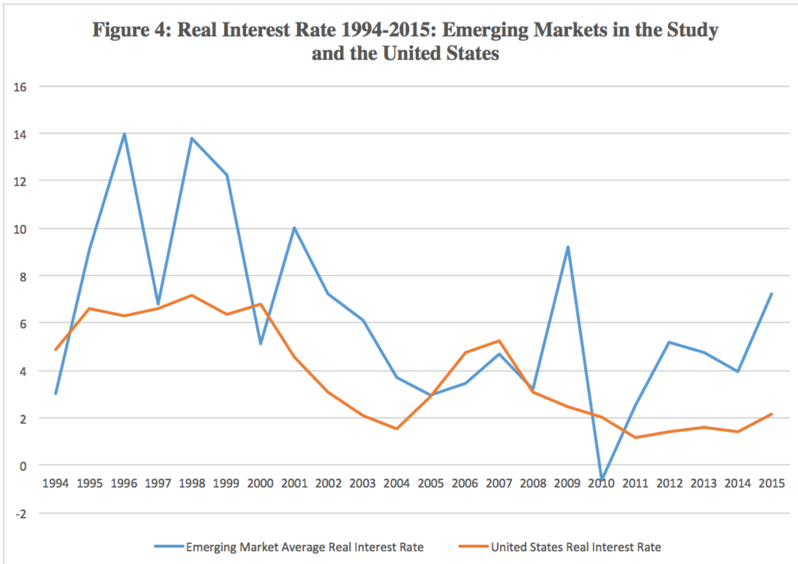
inflation. As explained in greater detail in section three of this paper, the principal motivation for including the real interest rate in the control vector is to get an accurate gauge of how the price of investing fluctuates over time within each individual country. The data was gathered from Bloomberg. A few summary statistics on the real interest rate across all countries are provided in table 4.

Table 4: Real Interest Rate - All Countries

Mean	6.313%
Standard Deviation	14.032
Minimum	-70.432
Maximum	93.937
Observation	461

There are couple of noteworthy pieces of information embedded in the summary statistics. First, the maximum and minimum real interest rates occurred in Bulgaria in 1996 and 1997, respectively. Perhaps not coincidentally, 1996 and 1997 were two of the three years in which Bulgaria experienced a currency crisis, and outside those two years, the Bulgarian real interest displays a fairly consistent trend. Despite this otherwise consistent behavior, Bulgaria has the most volatile interest rate of any country in the study, measured by the standard deviation of the yearly interest rate average over the sample of observations in the dataset. The Bulgarian real interest rate has a standard deviation of 26.072 from 1994 to 2014. The least volatile interest rate can be found in the Czech Republic, where there has not been a currency crisis since at least 1994. The standard deviation of the Czech real interest rate is 1.607.

Although the real interest rates in the developed world and emerging world tend to move in the same direction, the latter is typically much higher and more volatile than the former. The standard deviation of the real interest rate in the United States, for instance, was just 2.125 from 1994 until 2015, making the U.S. more volatile than only the Czech Republic. In addition, the real rate in the United States peaks in 1998 at 7.191%. In the same year, the average real interest rate among the emerging markets in the study was 13.774%. Figure 4 shows the average real interest rate across the emerging markets in this study against the real rate in the United States between 1994 and 2015.



The final thing that is worth pointing out is that there are only 461 real interest rate observations (87.31% of total possible observations). Two countries, Saudi Arabia and Turkey, are missing all of their observations and two others, Poland and Ecuador, have their observations truncated in 2006. A few other countries are missing one or two observations at the beginning or end of the series. It is unclear what the exact source of the missing data is, but it can sometimes be difficult to accurately calculate data if economies are closed off or if macroeconomic reporting on prices, nominal interest rates, etc. is lackluster. Ultimately, while the study would certainly benefit from recovering the missing observations, a critical mass of data still exists such that the analysis can proceed with confidence.

4.3.B. Foreign Direct Investment

Data on foreign direct investment (FDI) is gathered from the World Bank's World Development Indicators database. FDI is defined to be the total inflow of foreign investment capital designed to acquire a lasting management interest (10% or more) in an enterprise operating in the destination country minus total disinvestment. The data is scaled by GDP. Often, FDI provides foreign funding and stimulus needed to fuel domestic investment (Joyce and Nabar, 2007). Summary statistics on FDI are provided in table 5.

Table 5: FDI (% of GDP) - All Countries

Mean	3.344%
Standard Deviation	4.010
Minimum	-2.757
Maximum	30.995
Observation	524

Over the period of interest, the country with the highest average FDI as a share of GDP was, by a wide margin, Singapore with 16.102%. The country with the lowest average FDI as a share of GDP was South Korea with only .976%. FDI is also one of the most complete variables – missing only four of the 528 possible observations (two from both Algeria and Venezuela).

<u>4.3.C. Total Debt Service</u>

Data on total debt service (referred to most commonly as just "debt") also comes from the World Bank's World Development Indicators Database. Debt is the sum of principal and interest payments that sovereigns pay in currency, goods, or services on long-term debt, interest on short-term debt, and repayments to the International Monetary Fund. Debt is then scaled by Gross National Income. Debt is important in the analysis because it has the ability to impact the pool of capital available for the private sector to fund investment. As such, private sector borrowers may have a harder time accessing debt financing at the prevailing interest rate if the government in that country carries a larger debt burden (Joyce and Nabar, 2007). At 9.902% of GNI, Bulgaria has the highest average debt service. India, with an average of just 2.629% of GNI, has the lowest average debt service. Debt service is the least complete variable in the study. In fact, nine countries: Argentina, Chile, the Czech Republic, South Korea, Poland, Russia, Saudi

Arabia, Singapore, and Venezuela have no observations on the variable. In all, only 60.42% of the total possible observations are in the study. The variable is still included in the analysis because it has significant theoretical value and because other literature in the field (see, for instance, Joyce and Nabar [2007] or Arteta and Hale [2009]) includes some measure of debt service as a control variable. However, this empirical limitation should be kept in mind when interpreting the results. Summary statistics on debt are shown in table 6.

Table 6: Total Debt Service (% of GNI) – All Countries

Mean	6.169%
Standard Deviation	3.510
Minimum	.093
Maximum	20.332
Observation	319

4.3.D. Lagged GDP Growth

The final control variable in the study is lagged GDP growth. Again, the data comes from the World Bank's World Development Indicators database. The data is an annual percentage, and GDP is defined as the sum of gross value added by domestic producers plus product taxes less subsidies not included in product value. The thinking here is that there might be a flexible accelerator – that is, if GDP grows in year t, investment might pick up in response in year t+1 (Joyce and Nabar, 2007). Summary statistics are provided in table 7.

Table 7: Annual GDP Growth (%) - All Countries

Mean	3.852%
Standard Deviation	4.013
Minimum	-13.127
Maximum	33.736
Observation	528

Although some countries certainly experience a year (or several years) of negative growth, there is no country that has averaged negative growth over the sample period. Russia has the weakest average expansion in output at 1.935% and India has the strongest at 6.695%. Moreover, GDP growth is the only control variable that is missing no observations.

4.3.E. Multicollinearity

Multicollinearity occurs when two or more independent variables are highly correlated with each other, making one or more variable redundant. To test for the presence of multicollinearity, the correlation matrix between the five control variables was generated. The results can be found in table 8.

Table 8: Multicollinearity – Control Vector Correlation Coefficients

	Real Interest Rate	FDI	Debt	Lagged Growth	Lagged Investment
Real Interest Rate	1.000				
FDI	-.059	1.000			
Debt	.014	.264	1.000		
Lagged Growth	-.075	.093	-.159	1.000	
Lagged Investment	-.100	.019	-.031	.212	1.000

The results suggest that multicollinearity is not at all a problem. The largest correlation coefficient between two distinct variables in absolute value terms is .264 (between FDI and Debt), which is far from concerning correlation.

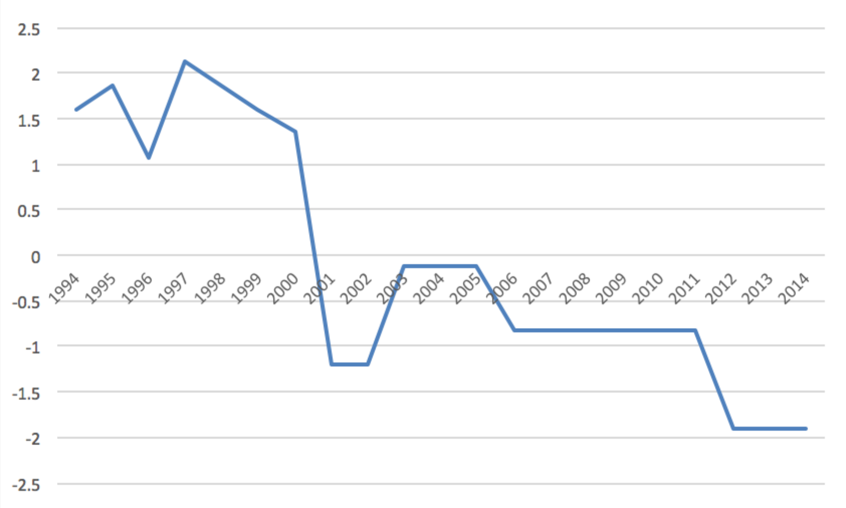
4.3. Variables for Robustness Tests

There are three variables that will be needed for robustness checks of the models in the analysis: a variable on capital account openness, an indicator for banking crises, and an indicator for sovereign debt crises. Each will be taken in turn. Details of how these variables will be incorporated in the model can be found in section 5 on the empirical methodology. Some of the robustness testing will also disaggregate currency crises by severity tier, but this just involves a separation of the currency crisis indicator defined previously, not a unique variable.

4.4.A. Capital Account Openness

The measure of capital account openness in the study is given by the Chinn-Ito Index. The index is based on a set of binary dummy variables that measure a country's openness to capital flows including, but not limited to: exchange rate regime, trade openness, corruption measures, and foreign exchange reserves. A full discussion on the construction of the Chinn-Ito Index can be found in *The Journal of Development Economics* (Chinn and Ito, 2006). The data has been updated through 2014. The Chinn-Ito Index has data on 182 different countries, including all 24 in this study. The Index is centered around an average value of 0 and the standard deviation across all 182 countries from 1970 to 2014 is 1.529. It is worthwhile to note that over the course of the study, Algeria and India had the two most closed off capital account, both with an average score of -1.189, and Singapore was the most open with an average score of 2.288. The variability of capital account openness is significantly different within countries as well. Algeria, for instance, has the same score for every year of this study. Mexico, Singapore, and South Africa have each had the same score for all but two years. Argentina, on the other hand, has been highly variable. In fact, Argentina has, almost monotonically, become more closed off over time. Figure 5 shows Argentina's Chinn-Ito Index score over time.

Figure 5: Argentina Chinn-Ito Index Score - 1994-2014



The Index is also quite complete. As mentioned previously, the data is missing every country's observation in 2015, but beyond that it is missing only four observations, meaning that the Index has 500 of 528 possible observations (94.70%).

4.4.B. Banking Crises

A portion of the study will also control for banking and sovereign debt crises. The data on instances of banking crises comes from Reinhart and Rogoff (2009). As such, this study defines banking crises as they do. In particular, Reinhart and Rogoff mark a banking crisis by one of two events: either a bank run that leads to the closure, merger, or takeover by the public sector of one or more financial institution, or, in the absence of a bank run, the closure, merger, takeover, or large-scale government assistance of an important financial institution that precedes a similar process for other financial institutions (Reinhart and Rogoff, 2009). The banking crisis variable will take on a value of 1 if a crisis occurred in country i and year t, and 0 otherwise.

Table 9: Instances of Banking Crises

Country	Year of Banking Crisis
Argentina	1995, 2001*
Brazil	1995
Bulgaria	1994
Colombia	1998
Ecuador	1996
Indonesia	1998*
Korea	1998*
Malaysia	1998*
Mexico	1995*
Philippines	1998*
Russia	1995, 1999*
Thailand	1997*
Turkey	1994

Note: * indicates that a crisis happened in July-December of the previous year

Importantly, the data of Reinhart and Rogoff only goes until 2008, but includes the Global Financial Crisis of 2008. In the countries and period of this study, there are 15 total banking crises. In a manner similar to currency crises, the study independently verified, mainly through news reporting, when the onset of the banking crises happened within each year. If a banking crisis happened between January and June of year t it is considered to be of year t, and if it happened in July or later is considered to be of year t+1. The reasoning is the same as the reasoning used to justify this coding of currency crises. The banking crises in the study can be found in table 9.

Across all countries from 1994-2008 there were 56 total banking crises, 47 of which happened in middle or low income countries. It appears, therefore, that banking crises are a slightly more frequent tormentor of the emerging (and developed) world than currency crises.

4.4.C. Sovereign Debt Crises

The second type of financial crisis that the study will control for in a robustness check is sovereign debt crises. Like banking crises, the data on sovereign debt events comes from Reinhart and Rogoff (2008). This study, therefore, adopts the same definition of a sovereign "default" that Reinhart and Rogoff do. Reinhart and Rogoff code both full defaults and partial defaults/rescheduling agreements – meaning that a sovereign debt crisis can occur when a country refuses to pay back any amount of its external debt obligations or just tries to change the schedule of payments. Just like currency and banking crises, sovereign debt crises will be coded with a dummy variable that takes the value of 1 if a sovereign defaulted in that year, and 0 otherwise. Additionally, like the other two varieties of crises, those that take place in the second half of a year are considered to be of the next year. In a fashion similar to banking crises, this study verified the first announcement of sovereign default or the beginning of restructuring agreements through news sources to put the crises in the proper year. Data on the instances of sovereign default only go until 2008.

It is important to note that because sovereign debt crises are coded with a dummy variable, no distinction is made between the different varieties of sovereign default. A country that refuses to pay back the entirety of its debt obligation and a country that renegotiates only a tiny portion are treated the same. That is a limitation that the reader may want to keep in mind. The instances of sovereign debt crises are listed table 10.

Table 10: Instances of Sovereign Debt Crises

Country	Year of Sovereign Debt Crisis
Argentina	2002*
Ecuador	2000*, 2009*
Indonesia	1999*, 2000, 2002
Nigeria	2002*, 2005*
Russia	1999*
South Africa	1994*
Venezuela	1995, 2005*

Note: * indicates that a crisis happened in July-December of the previous year

In countries and years in the study, there are 12 instances of a sovereign debt crisis. Indonesia is the most consistent offender, defaulting three times in a span of 4 years. In all countries during the time span of the study, there are only 18 total sovereign defaults – all of which are in the emerging world. The era of sovereign default in emerging markets, if there ever was one, seems to have been the 1980s. From 1980-1989, there were 43 instance of sovereign default (Reinhart and Rogoff, 2008). The correlation between currency and banking crises is the highest at .367, the correlation between currency and debt crises is only .164, and the correlation between banking and debt crises is just .127. None of these correlation coefficients suggest multicollinearity strong enough to cause concern when multiple crisis indicators are used in the same specification.

5. Empirical Methodology

This section of the paper is dedicated to explaining the econometric tools used to translate the data into meaningful results.

5.1. Pooled OLS and the Fixed Effects Approach

The study first uses a fixed effects estimator to determine the significance of the currency crisis indicator and the other independent variables on domestic investment. The variables in the study are defined as follows:

$\boldsymbol{I_{it}}$: Domestic investment as a percentage of GDP in country i and year t

$\boldsymbol{C_{it}}$: Indicator with value 1 if a currency crisis occurred in country i and year t, 0 otherwise

$\boldsymbol{X_{it}}$: A vector containing control variables in county i and year t

$\boldsymbol{u_i}$: Time invariant factors that impact investment in country i

$\boldsymbol{\varepsilon_{it}}$: Error term of a regression in country i and year t.

Arriving at the fixed effects specification requires starting with a pooled ordinary least squares (OLS) regression. In the context of this study, that pooled OLS is:

$$(1)\ \ I_{it} = \beta_0 + \beta_1 C_{it} + \beta_2 X_{it} + u_i + \varepsilon_{it}$$

In the pooled OLS regression, the most important coefficient is β_1, the coefficient on the crisis indicator. The issue with the pooled OLS regression is that there is a significant possibility that the independent variables (the X_{it} vector) are correlated with either the error term or the country-specific, time invariant factors. This causes omitted variables bias, which can cause the observed impact of independent variables to be too strong, because it is systematically capturing a confounding factor.

To remedy this potential issue, the analysis requires a specification that controls for idiosyncratic factors within a country that might impact investment. To arrive at that estimator, a new equation is constructed where the regressors are the arithmetic means over time for each variable in equation (1). Now, none of the regressors have a time component.[2] This new equation is then subtracted from equation (1). The idiosyncratic term, u_i, does not depend on t, so when the mean over time is taken, it is still u_i. As a result, the subtraction of the equations eliminates that term. This produces equation (2), the fixed effects estimator:

$$(2)\ \tilde{I}_{it} = \beta_1 \tilde{C}_{it} + \beta_2 \tilde{X}_{it} + \tilde{\varepsilon}_{it}$$

A variable with a tilde, say $\tilde{C}_{it}$, just represents this process of subtracting away the variable's mean over time, i.e. $C_{it} - \bar{C}_i$. This simple manipulation eliminates the impact of unobserved, country specific factors on the outcome.

5.2. Heteroscedasticity

Heteroscedasticity in panel data occurs when the distribution of disturbance terms is different across panels. More specifically, it is possible that the disturbance terms are homoscedastic within some subsets of panels, but are different across those subsets – a condition known as groupwise heteroscedasticity. In this way, heteroscedasticity can cause standard error estimates to be biased and lead to incorrect interpretation of regression results. A modified Wald test statistic for groupwise heteroscedasticity in fixed effects models is used to detect if this problem exists in the data (Greene 598, 2000). Formally, the null hypothesis of homoscedasticity says:

$$(3)\ \sigma_i^2 = \sigma^2 \text{ for } i = 1, \dots, N_g$$

[2] In this transformation, the new equation that is subtracted from equation (1) is $\bar{I}_i = \beta_0 + \beta_1 \bar{C}_i + \beta_2 \bar{X}_i + \bar{u}_i + \bar{\varepsilon}_i$, where the bar indicates a mean over time.

where σ_i^2 is the variance of the errors in country i across time and N_g is the number of panels. This modified Wald test returned a test statistic that led to a strong rejection of the null hypothesis, indicating presence of groupwise heteroscedasticity.

A common fix for groupwise heteroscedasticity is to employ a Huber-White estimator (also known as a sandwich estimator) to obtain HC (heteroscedasticity consistent) standard errors. The Huber-White estimator is equivalent to running a standard fixed effects regression and clustering the standard errors by country. Employing this method would be sufficient to solve this issue; however, as will be shown in subsequent subsections of the paper, HC standard errors are not robust against other issues that occur in the data.

5.3. Autocorrelation

Autocorrelation (also called temporal correlation or serial correlation) is correlation between the residuals within a panel over time. Essentially, the residual in period t influences the residual in period t+1 (and perhaps more, if the autocorrelation is significant for multiple time periods). Autocorrelation causes the standard errors of the estimates to be too low, and as a result, conclusions on the significance of regressors are overly-optimistic.

The most common test for autocorrelation is the Durbin Watson test, but that test is not valid across multiple panels. Therefore, to detect the presence of autocorrelation in the dataset, a Wooldridge (2002) test was run. The Wooldridge test uses a first differences model that eliminates the country-specific, time invariant characteristics that influence investment. The test uses the residuals from that first differenced equation and the lagged residuals from the first differenced equation to come up with a test statistic. The test was run for the data in this study, and probability of the test returning a test statistic as or more extreme than what was generated if there was actually no autocorrelation was negligible – implying that the model needs to account for autocorrelation.

The first remedy for autocorrelation is to include a lagged dependent variable on the right hand side of the specification to account for the possibility that investment is "sticky", or takes some time to come online. If investment is indeed "sticky", not including a lag of the dependent variable might well lead to the omitted variables bias that is causing the errors to be serially correlated. However, as noted earlier, this technique makes the standard errors inconsistent. When that lag is included, the Wooldridge test statistic declines marginally, but the test still suggests that autocorrelation is present.

Another common correction for autocorrelation is to use Newey and West standard errors. Newey and West (1987) developed a weighted HAC (heteroscedasticity and autocorrelation consistent) estimator that produces standard errors robust against both heteroscedasticity and autocorrelation. Their work builds on the robust standard errors developed by White (1980) that produced consistent estimates in the presence of heteroscedasticity only. The issue with Newey-West standard errors is that they adjust standard errors in the context of pooled OLS, which means that the chance that the control variables are correlated with the error or the country-specific effects remains. Therefore, the study requires a better solution to control for autocorrelation.

5.4. Cross-Sectional Dependence (Spatial Correlation)

Cross-sectional (spatial) dependence occurs when the disturbance terms across various panels are correlated. In particular, when i and j are different panels, cross-sectional dependence implies:

$$(4)\ \rho_{ij} = \rho_{ji} = corr(\varepsilon_{it}, \varepsilon_{jt}) \neq 0$$

This issue is common in macroeconomic or financial panels with relatively long time frames (Reyna, 2007). Moreover, De Hoyos and Sarafidis (2006) suggest that this problem may only become more common in macroeconomic studies because financial and economic integration is making different countries susceptible to the same unobserved phenomena. If the dependence is caused by unobserved factors that are correlated with the disturbance terms across panels, but uncorrelated with the regressors, then the estimates of the parameter coefficients in the fixed effects will be consistent, but the statistical significance will be incorrect because of biased standard errors (De Hoyos and Sarafidis, 2006).

The Pesaran test was used to determine if cross-sectional dependence was present in the data. Pesaran (2004) built on the work Breusch and Pagan (1980) to provide a test for cross-sectional dependence in both balanced and unbalanced panel data using pairwise correlation coefficients from within-panel OLS regressions. Under the null hypothesis of no cross-sectional dependence, the test statistic converges to a normal distribution as N goes to infinity and for a sufficiently large time-series. The Pesaran test statistic was significant at the 5% level, suggesting that cross-sectional dependence is present in the data.

The study employs two corrections for cross-sectional dependence. The first is to use Driscoll Kraay standard errors, which are robust against autocorrelation, heteroscedasticity, and cross-sectional dependence. Driscoll and Kraay (1998) build on the work of Newey and West (1987). The strategy of Driscoll and Kraay (1998) is to take averages of the product between independent variables and the residuals, and then to use these values in a weighted HAC estimator to produce standard errors that are now have the added feature of being robust against cross-sectional dependence (Vogelsang, 2011). Because all three issues are present in this study's data, Driscoll Kraay standard errors are preferable to either Huber White standard errors or Newey West standard errors. For a full mathematical treatment of Driscoll Kraay standard errors, see either Driscoll and Kraay (1998) or Hoechle (2007).

Secondly, while the Pesaran test suggests the presence of cross-sectional dependence, it does not give any insight into how strong the dependence is or between which panels it exists. Therefore, the study posits that it is far more likely that cross-sectional dependence is present between countries that share similar features. For instance, shared economic policies related to capital openness and financial regulation as well as similar trade flows make it much more likely for say, Korea and Thailand, to have some cross-sectional dependence than for Korea and Argentina to have a similar correlation. More on these similarities can be found in Burnside, Eichenbaum, and Rebelo (2000). Therefore, the study uses two methods of clustering variables, one group for geography and one for capital account openness. Clustering the countries allows for cross-sectional correlation *within* clusters, but not *across* clusters. This adjustment does not change the estimates of the parameters in the model (i.e. the economic significance of the variables is unchanged), but it does change the calculation of the standard errors – creating a more accurate estimation of the parameters' statistical significance. The regional designation of each country can be found in table 11.

Table 11: Countries in the Study by Region

Region	**Countries**
Latin America	Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Venezuela
Asia	Indonesia, Korea, Malaysia, Philippines, Thailand, Singapore
Eastern Europe	Bulgaria, Czech Republic, Poland, Romania, Russia
Other	Algeria, India, Nigeria, Saudi Arabia, South Africa, Turkey

The variable on geography separates the countries in the sample into four groups: Asia, Eastern Europe, Latin America, and other – which captures the countries, mostly from Africa and the Middle East, that don't fit into any other category. The rationale here is that trade flows and economic/financial policies are likely to share similarities within regions.

The variable on capital account openness is based on the Chinn-Ito index of Capital Account Openness (see section 4.4.A for a more complete description of the variable). The index is used to partition the countries in the study into three groups of capital account openness: closed, semi-open, and open. To classify each country, an average of their openness score over the 22 years of data was calculated, and that was compared to the distribution of averages among all 182 countries in the Chinn-Ito index over the same period. Because countries tend to be distributed more frequently in the middle of the openness distribution, closed countries were defined as those below the 40th percentile on the openness index, semi-open countries were defined as those between the 40th and 60th percentile, and open countries were defined as those above the 60th percentile. The categorization of each country can be found in the table 12.

Table 12: Countries in the Study by Capital Account Openness Tier

Openness-Tier	Countries
Closed	Algeria, India, Nigeria, South Africa, Turkey
Semi-Open	Argentina, Brazil, Bulgaria, Chile, Colombia, Ecuador, Korea, Malaysia, Philippines, Poland, Romania, Russia, Thailand, Venezuela
Open	Czech Republic, Indonesia, Mexico, Saudi Arabia, Singapore

There are some limitations of this approach that warrant recognition. First, the openness tiers are hard cutoffs. One would expect a country in the 41st percentile to be more similar to a country in the 39th percentile than one in the 59th percentile, but cross-sectional dependence is allowed for the latter and disallowed for the former. Second, because the openness-tiers need to be nested within the panels to cluster the standard errors, each country has to be assigned to exactly one tier. This does not allow for the possibility that a country can become more open or closed over time. A good example of a country in which this may be an issue is Argentina (see figure 5 in section 4.4.A), which would have been classified as open from 1994 until 2000, but became very closed in 2001. Argentina became semi-open from 2003-2005, but was closed again from 2005-2014. These fluctuations over time ultimately land Argentina in the semi-open tier, but it is clear that this designation has not always been appropriate. These limitations should be kept in mind when interpreting the results with these clustered standard errors.

5.5. Endogeneity

Some macroeconomic panel data models suffer from a problem of endogeneity. In this study, that would mean that currency crises are not causing collapses in investment, but rather investment collapse is causing a currency crisis. To consider how the causality might work in this direction, consider again the second-generation model of self-fulfilling currency crises (see section 2.1). If investors in a country think that a currency depreciation is likely, they might anticipate lower returns in purchasing power terms, leading to less investment and demand for the local currency. To defend a peg, the government would then counter by keeping short-term interest rates relatively high. If rates stay high for long enough, output will fall off and the government will experience depressed cash inflows. If the government has a substantial debt burden to cover and can no longer make interest and/or principal payments using tax revenues, they might eventually be forced to devalue the currency by printing money to make good on their obligations, or else default. This kind of endogeneity is problematic because it would make the currency crisis indicator correlated with the error term in the standard linear specification.

To remedy this potential issue, an Arellano-Bond General Method of Moments specification will be estimated. The benefit of an Arellano-Bond estimator is two-fold. First it addresses the final issue with the fixed effects estimator. The potential problem is that the lagged dependent variable, which is included as a regressor, might be correlated with the country-specific, unobserved effects. This would essentially bias the standard errors in a manner similar to the inclusion of those unobserved effects (previously denoted as u_i). This issue is most likely to come about in datasets with many panels and few time periods, and this dataset does not have that feature. For this reason, the analysis continues to use the fixed effects specification with high confidence, but also uses the Arellano-Bond estimator as a contingency. To see how the dynamic panel estimator corrects this issue, consider the linear specification of the study, but with lagged investment listed explicitly on the right hand side, and including the country-specific fixed effects:

$$(5)\ I_{it} = \beta_1 I_{i,t-1} + \beta_2 C_{it} + \beta_3 X_{it} + u_i + \varepsilon_{it}$$

Now take a first difference of equation (5) to get

$$(6)\ \Delta I_{it} = \beta_1 \Delta I_{i,t-1} + \beta_2 \Delta C_{it} + \beta_3 \Delta X_{it} + \Delta\ \varepsilon_{it}$$

Notice that the country-specific, fixed effects, u_i, have been eliminated by first-differencing. Arellano-Bond then uses past levels of the lagged dependent variable as instruments for the dependent variable. This method makes the endogenous variables, including the lagged dependent variable, "predetermined", and therefore uncorrelated with the idiosyncratic error (Mileva, 2007).

The second benefit is that the Arellano-Bond estimator can specify endogenous variables in the model and use previous values of those variables to make them predetermined as well. The study can thus run a separate specification in which the crisis indicator is treated as endogenous, and make sure the results are robust against the concern of reverse causality that was just discussed.

There is a tradeoff that comes from using the Arellano-Bond estimator. The estimator's robust standard errors correct against heteroscedasticity, but fail to do so against autocorrelation and cross-sectional dependence, both of which are present in the data. This is part of the reason why the study is choosing to use the Arellano-Bond estimator in conjunction with a fixed effects estimator - neither model is perfect, both force the study to make a tradeoff between different standards of robustness. Autocorrelation can be corrected within the Arellano-Bond estimator, but that comes at a price. In the context of this study, it takes three lags of the dependent variable in order to get rid of autocorrelation. As a result, the study will estimate the Arellano-Bond model with both a single lag (and some autocorrelation) and three lags (and no autocorrelation). The analysis will proceed by using the Arellano-Bond estimator as a complement to the fixed effects specification, but these limitations should be kept in mind when interpreting the results.

5.6. Robustness Specifications

Lastly, it is important to ensure that the results are robust across different specifications. To that end, the study will run test two different specifications of the fixed effects and Arellano-Bond estimators described above. The first additional specification will control for the presence of other types of financial crises. In particular, the fixed effects specification will be tested with two dummy variables, one for banking crisis and one for sovereign debt crisis, that are equal to 1 in the first year of a crisis and equal to 0 otherwise. A growing literature on twin and triple crises suggests that the simultaneous onset of different varieties of financial crises may play a big role in the deterioration of macroeconomic fundaments (Hutchinson [2002] and Bauer [2007]). Therefore, an analysis of the particular role that currency crises play in investment changes should control for the presence of these other crises. A more detailed discussion on the construction of these variables can be found in the data section of this paper. If S_{it} and K_{it} represent dummies for sovereign debt and banking crises in country i and year t, respectively, the fixed effects specification in the robustness test is:

$$(7)\ \tilde{I}_{it} = \beta_1 \tilde{C}_{it} + \beta_2 \tilde{X}_{it} + \beta_3 \tilde{S}_{it} + \beta_4 \tilde{K}_{it} + \tilde{\varepsilon}_{it}$$

The second robustness test will be to break the currency crises in the sample into different severity tiers. Up until this point, currency crises have been defined as a 10% or larger single month depreciation in a country's real exchange rate. This robustness test will define a mild currency crisis as one in which that real exchange rate declines by between 10% and 20% in the month of the crisis, a medium currency crisis as one in which the real exchange rate declines by between 20% and 30% in the month of the depreciation, and a severe currency crisis as one in which the real exchange rate declines by more than 30% in the month of the crisis. If a currency crisis happens over the course of multiple months, the most severe month determines which tier it is placed in. Dummy variables are used to assign each crisis to a severity tier. The classification of each crisis by severity tier can be found in table 13.

Table 13: List of Currency Crises by Severity Tier

Severity Tier	Country and Year of Crisis
Mild	Brazil (2003), Brazil (2009), Bulgaria (1994), Indonesia (2000), Indonesia (2009), Korea (2009), Malaysia (1998), Mexico (2009), Romania (1996), Romania (1997), Russia (1995), Russia (2015), South Africa (1999), South Africa (2002), South Africa (2009), Thailand (1998), Turkey (2001), Turkey (2003), Venezuela (1994), Venezuela (2002), Venezuela (2004)
Medium	Algeria (1994), Brazil (1999), Bulgaria (1996), Bulgaria (1997), Korea (1998), Mexico (1995), Turkey (1994), Venezuela (1996), Venezuela (2003), Venezuela (2013)
Severe	Argentina (2002), Indonesia (1998), Russia (1999), Venezuela (2010)

Define $CMed_{it}$ and $CSev_{it}$ to be dummy variables that indicate that a medium currency crisis and a severe currency crisis occurred in country i in year t, respectively. All other variables are defined as previously. Then consider the following specification:

$$(8)\ \tilde{I}_{it} = \beta_1 \tilde{C}_{it} + \beta_2 \widetilde{CMed}_{it} + \beta_3 \widetilde{CSev}_{it} + \beta_4 \tilde{X}_{it} + \tilde{\varepsilon}_{it}$$

Now take the partial derivative of the investment variable with respect to the aggregated crisis indicator and the medium crisis indicator, respectively.

$$(9)\ \frac{\partial \tilde{I}_{it}}{\partial \tilde{C}_{it}} = \beta_1$$

$$(10)\ \frac{\partial \tilde{I}_{it}}{\partial \widetilde{CMed}_{it}} = \beta_1 + \beta_2$$

Note that equation (10) contains β_1 on the right hand side because medium crises are still included in the aggregated crisis indicator. Next, subtract equation (9) from equation (10) to get:

$$(11)\ \frac{\partial \tilde{I}_{it}}{\partial \widetilde{CMed}_{it}} - \frac{\partial \tilde{I}_{it}}{\partial \tilde{C}_{it}} = \beta_1 + \beta_2 - \beta_1 = \beta_2$$

Equation (11) says that the extra impact of a crisis being of medium severity, relative to mild crises, is given by the coefficient β_2. An analogous analysis shows that the extra impact of a crisis being severe, relative to mild crises, is given by β_3. To test whether there is any statistically significant difference between medium and severe crises, an F-test will be run between β_2 and β_3.

Before moving on to discuss the results, it is appropriate to do a brief comparison between the fixed effects model with Driscoll Kraay standard errors and the Arellano-Bond estimator, as results from those two models will be repeatedly compared. The advantage of fixed effects with Driscoll and Kraay standard errors is that the problems of heteroscedasticity, autocorrelation, and cross-sectional dependence are all corrected. The drawback is that it doesn't solve endogeneity and the lagged dependent variable may still be correlated with the unobserved, idiosyncratic effects. The benefit of the Arellano-Bond specification is that it solves for both of the issues unsolved by the Driscoll Kraay technique, but does not solve for cross-sectional dependence and only solves for autocorrelation with the introduction of two additional lags of the dependent variable. Neither model dominates the other econometrically, so forming a complete picture of how currency crises impact investment requires the consideration of both approaches.

6. Results

The presentation and discussion of the empirical results will begin with the simpler models such as pooled OLS and will progress to greater degrees of complexity with regards to different types of modeling, standard error computation, clustering techniques, and robustness tests. The most important result in each model is the coefficient on the crisis indicator. That coefficient can be interpreted as an X percentage point short-run change in investment as a result of a crisis. If the currency crisis indicator is significant at the 10% level, that result will also be discussed as a percentage of the standard deviation of the investment (as a percentage of GDP) variable to understand how large the predicted move is in the context of typical investment volatility (Joyce and Nabar, 2007). Additionally, the long-run change in domestic investment after a currency crisis will be reported if the currency crisis indicator is significant. All of the specifications used are partial adjustment models, so the long-run change in investment as a share of GDP can be computed by dividing the short-run change by one minus the coefficient of the lagged dependent variable (Joyce and Nabar, 2007).[3] The long-run change will help crystalize how currency crises impact emerging markets over a more economically meaningful period of time, not just in the immediate wake of the crisis.

6.1. Pooled OLS with Clustered Standard Errors Results

The analysis begins with a pooled OLS regression with heteroscedastic and autocorrelation robust standard errors. The coefficients are displayed with the standard errors reported in the parentheses underneath. The results of that regression can be found in table 14.

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[3] $(Long\ Run) = \frac{(Short\ Run)}{(1-Lag)}$ where Lag is the coefficient on lagged investment in the relevant specification.

Table 14: Pooled OLS Regression with Clustered SEs

	Coefficients
Crisis Indicator	-3.167**
	(1.235)
Real Interest Rate	-.027
	(.030)
FDI	.093
	(.070)
Total Debt Service	-.102*
	(.056)
Lagged GDP Growth	.051
	(.058)
Lagged Investment	.874***
	(.058)
Observations	283
Overall R-Squared	.845

Note: ***=1% significance, **=5% significance, *=10% significance

There are some details of these results that are encouraging, and others that are troubling. Let's start by recognizing that the currency crisis indicator is the most negative coefficient in the regression and is significant at the 5% level. The regression suggests that in the wake of a currency crisis, a country should expect investment as a share of GDP to decline by 3.167 percentage points (47.60% of investment standard deviation).[4] The long-run impact on investment as a share of GDP is 25.14 percentage points (377.70% of investment standard deviation).

It is important to note that the interest rate variable is statistically insignificant. The variable is mildly negative, which the theoretical framework of this study suggests, but only becomes significant at the 38% level. This result flies in the face of the kind of classical macroeconomic theory that was employed earlier in this paper. However, a more Keynesian analysis that emphasizes other determinants of investment return might not be as quick to challenge this result.

[4] The standard deviation of investment that every significant short and long-run adjustment is divided by to provide context is 6.656 – see Table 2 in Section 4.2

However, the pooled OLS model, as noted earlier, has some significant flaws. Namely, the pooled OLS assumes that there is no correlation between the independent variables and the time-dependent factors that are not explicitly controlled for, and it assumes no correlation between the independent variables and the idiosyncratic factors in each country that do not vary over time. The analysis going forward will solve this problem and, therefore, address the causal relationship between currency crises and investment collapse more effectively.

6.2. Fixed Effects Estimator Results

To remedy the issues with pooled OLS, the next regression run is a fixed effects specification. To help ensure that the study captures the relevant factors that explain investment activity, the fundamental control variables discussed in the data section of this paper are included in the regression. The results of the fixed effects specification are more supportive of the notion that currency crises cause investment collapse. All the variables, including the crisis indicator, are significant at the 1% level. The coefficient of -3.144 (47.24% of investment standard deviation) still suggests that currency crises are highly predictive of investment collapse. The long-run predicted decline in investment is 10.41 percentage points (156.40% of investment standard deviation). Importantly, in addition to becoming significant at the 1% level, the real interest rate variable becomes slightly more negative, which conforms much better with the theoretical framework of the analysis. The overall R-squared of the specification is also very high. 82.9% of the variation in investment can be explained by variation in the model's parameters. That inspires confidence that most big macroeconomic determinants of investment have been included in the model either directly or indirectly. Table 15 shows the results of the fixed effects estimator.

Table 15: Fixed Effects Estimator

	Coefficients
Crisis Indicator	-3.144***
	(.714)
Real Interest Rate	-.037***
	(.014)
FDI	.246***
	(.072)
Total Debt Service	-.245***
	(.060)
Lagged GDP Growth	.127***
	(.049)
Lagged Investment	.698***
	(.034)
Observations	283
Overall R-Squared	.829

Note: ***=1% significance, **=5% significance, *=10% significance

The issues with the fixed effects model, namely heteroscedasticity, autocorrelation, and cross-sectional dependence, can all be solved through different standard error computational techniques. Table 16 shows the results of a fixed effects regression using Huber-White (HC) and Driscoll-Kraay (robust against all three) standard errors.

Table 16: Fixed Effects Estimator with Different Robust Standard Errors

	Huber-White SEs	*Driscoll Kraay SEs*
Crisis Indicator	-3.144**	-3.144**
	(1.316)	(1.515)
Real Interest Rate	-.037	-.037*
	(.034)	(.020)
FDI	.246***	.246**
	(.069)	(.093)
Total Debt Service	-.245*	-.245***
	(.122)	(.085)
Lagged GDP Growth	.127**	.127*
	(.057)	(.065)
Lagged Investment	.698***	.698***
	(.049)	(.078)
Observations	283	283
Overall R-Squared	.8293	.8293

Note: ***=1% significance, **=5% significance, *=10% significance

The most important result is that after the Driscoll Kraay standard error adjustment, every independent variable is significant at at least the 10% level. Moreover, the crisis indicator remains significant at the 5% level even though the standard error increases by about 0.2. The economic significance of the indicator (and of all independent variables) is unchanged because all that is being adjusted are the standard errors (as a result, the long-run impact is also unchanged). Interestingly, the real interest rate variable is significant only at the 30% level when the model is only robust against heteroscedasticity, but when the model accounts for autocorrelation and cross-sectional dependence, that same variable becomes significant at the 8% level. Similarly, total debt service goes from being significant at the 7% level in the Huber-White case to significant at the 1% level in the Driscoll-Kraay case. In both cases, the overall r-squared figure is unchanged from the unadjusted fixed effects specification.

Finally, the model is re-run with standard errors clustered first by region and second by capital account openness tier. Despite its theoretical merit, the latter approach suffers from some empirical deficiencies that can be found in section 5.4. The results of these specifications are detailed in table 17.

Table 17: Fixed Effects - SEs Clustered by Region and Capital Account Openness Tier

	Region	***Openness Tier***
Crisis Indicator	-3.144*	-3.144
	(1.150)	(1.936)
Real Interest Rate	-.037	-.037
	(.038)	(.039)
FDI	.246***	.246**
	(.038)	(.048)
Total Debt Service	-.245	-.245
	(.130)	(.234)
Lagged GDP Growth	.127	.127
	(.087)	(.056)
Lagged Investment	.698***	.698**
	(.023)	(.043)
Observations	283	283
Overall R-Squared	.8293	.8293

Note: ***=1% significance, **=5% significance, *=10% significance

Neither of these approaches account directly for heteroscedasticity or autocorrelation, although the lagged dependent variable continues to be included as a regressor to partially address autocorrelation. Heteroscedasticity is not explicitly addressed because the method of adjusting for heteroscedasticity previously was to use Huber-White standard errors, which is essentially clustering by each individual country.

These results do not inspire much confidence in the hypothesis that currency crises have a significant depressing effect on domestic investment. When standard errors are clustered by region, the currency crisis indicator remains significant at the 10% level. That is, however, the only supportive result. In that model, the real interest rate is statistically insignificant; indeed, it is the *least* significant independent variable. In both models, the most significant variable is lagged investment. In fact, there has yet to be a specification in which lagged investment is not significant at the 1% percent level, suggesting that investment remains fairly sticky regardless of how the model is specified. When standard errors are clustered by capital account openness tier, the standard error of the currency crisis indicator explodes to 1.936, and crisis indicator becomes significant only at the 25% level. The only variables significant in this specification are foreign direct investment and lagged investment. Of course, this specification is only one of many, and it is relatively flawed. However, the results, at a minimum, demonstrate that the encouraging results of previous specifications are not beyond questioning. The coefficients and the long-run effect is unchanged from the previous two tables.

6.3.Arellano-Bond Estimator (GMM) with Clustered Standard Error Results

As already noted, the Arellano-Bond estimator is used for two purposes. The first is because the technique of Arellano-Bond eliminates the possibility that the lagged dependent variable is correlated with error term, and the second is because it allows the analysis to produce results under the assumption that currency crises are endogenous. Recall from section 5.5 that the two different specifications of the Arellano-Bond estimator are required – one with a single lag of the dependent variable and one with three lags. The latter rids the model of autocorrelation (the estimator is not otherwise robust against autocorrelation), but comes at the cost of two additional lags that also change the economic and statistical significance of the other independent variables. The results from these two models are displayed in table 18, once again with the clustered (by country) standard errors in parentheses under the coefficients. The table also reports the result of the Arellano-Bond test for zero autocorrelation in first-differenced errors. The test returns a z-score under the null hypothesis of no autocorrelation, and the table shows the probability that the z-score is as or more extreme than observed if the null hypothesis is true. The specifications in table 18 continue to assume that currency crises are exogenous events.

Table 18: GMM Estimator with Clustered SEs and Exogenous Currency Crises

	1 Lag	*3 Lag*
Crisis Indicator	-2.594*	-2.136*
	(1.391)	(1.243)
Real Interest Rate	-.059*	-.021
	(.032)	(.031)
FDI	.332***	.379***
	(.058)	(.037)
Total Debt Service	-.357***	-.400***
	(.136)	(.126)
Lagged GDP Growth	.068	.067
	(.058)	(.052)
Lagged Investment	.597***	.617***
	(.048)	(.058)
Lagged Investment (2)	-	-.197***
		(.050)
Lagged Investment (3)	-	.137***
		(.053)
Autocorrelation P-Value	.023	.204
Observations	256	231

Note: ***=1% significance, **=5% significance, *=10% significance

The results prompt a few interesting observations. First, in both specifications, the currency crisis indicator is significant at the 10% level. Moreover, in both the specification with one lagged dependent variable and the specification with three, the indicator is economically predictive – the results suggest that domestic investment can be expected to decline by 2.594 (38.97% of investment standard deviation) and 2.136 (32.09% of investment standard deviation) percentage points, respectively, as a result of a currency crisis. In the long-run, the models predict investment decline after a currency crisis of 6.44 (96.75% of investment standard deviation) and 5.58 (83.83% of investment standard deviation) percentage points, respectively.

When only one lag is used, the real interest rate variable is significant at the 10% level, but when the two additional lags are added, the variable becomes less economically significant and statistically significant at only the 51% level. Additionally, while the second and third lag in the second specification are each statistically significant at the 1% level, they both have fairly little economic significance. The first lag in each suggests that for every 1 percentage point change in investment as a share of GDP in period t, there is about a .6 percentage point change in investment as a share of GDP in the same direction in period t+1. However, the second lag has a mildly negative coefficient, suggesting that an increase (decrease) in investment as a share of GDP in period t will result in a decrease (increase) in investment as a share of GDP in period t+2. The only argument for that coefficient being reasonable is that investment in a given country displays a mean-reverting tendency – that is, if it increases now, it can be expected to fall back down because deviations from the norm are unsustainable. However, even if that is accepted as a plausible argument, it does not explain why the third lag is now positive and slightly smaller in absolute value terms.

All this leads the study, on this point, to favor the Arellano-Bond estimator that uses just the first lag. The next point is just a quantitative demonstration of the problem involving autocorrelation described earlier. In the estimator with a single lag, the probability of seeing the observed results (with respect to autocorrelation) if autocorrelation is actually not present is just 2.23%, leading to a rejection of the null hypothesis. In the second estimator, that same probability is 20.4% percent, leading to no rejection of the null hypothesis. Finally, the estimator also produces a Wald statistic for a test whose null hypothesis is simply that all coefficients except the constant are zero. In both specifications, that null hypothesis is strongly rejected.

The same estimators are re-estimated assuming that currency crises are endogenous – that is, there is a feedback effect between investment and the crisis indicator. The results of these tests are shown in table 19.

Table 19: GMM Estimator with Clustered SEs and Endogenous Currency Crises

	1 Lag	*3 Lag*
Crisis Indicator	-2.908**	-2.283*
	(1.255)	(1.168)
Real Interest Rate	-.044	-.022
	(.033)	(.026)
FDI	.285***	.325***
	(.057)	(.048)
Total Debt Service	-.285**	-.280**
	(.132)	(.135)
Lagged GDP Growth	.085	.073
	(.059)	(.052)
Lagged Investment	.631***	.660***
	(.053)	(.074)
Lagged Investment (2)	-	-.195***
		(.049)
Lagged Investment (3)	-	.131***
		(.051)
Autocorrelation P-Value	.0216	.2662
Observations	256	231

Note: ***=1% significance, **=5% significance, *=10% significance

Considering the crisis indicator as an endogenous variable does not change the results very much. When currency crises are endogenous, the crisis variable becomes slightly more significant economically and marginally more significant statistically. When one lag is used, the short-run decline in investment is expected to be 2.908 percentage points (43.69% of investment standard deviation) and the long-run decline is 7.88 percentage points (118.39% of investment standard deviation). When three lags are used, investment can be expected to drop off by 2.283 percentage points (34.30% and investment standard deviation), and the fall in the long-run is 6.71 percentage points (100.81% of investment standard deviation). The marginal change is enough to make the indicator significant at the 5% level when a single lag is used, but the results are not dramatically different from table 18. Similarly, in the case of three lags, the coefficients on all three lags remain approximately the same and all are still significant at the 1% level.

The decision of whether to consider currency crises as exogenous or endogenous is not scientific, but rather based on a consideration of economic theory. On the balance theoretical likelihood, the study continues to posit that currency crises are exogenous events. However, at a minimum, it has been demonstrated that the presence of feedback does not meaningfully change the impact and significance of the variables in the analysis.

6.4. Separating Currency Crises by Severity Tier

It is interesting to next look at how currency crises vary in impact based on how severe they are. For a full breakdown of how this test is structured, see section 5.6. The model with separation by severity tier is conducted using fixed effects and Driscoll Kraay standard errors. The model is also run using an Arellano-Bond estimator with one lag of the dependent variable and an exogenous crisis variable. The results of those two estimations are shown in table 20.

Table 20: Robustness Test – Separating Currency Crises by Severity Tier

	Driscoll Kraay	***Arellano-Bond***
Crisis Indicator	-2.416	-1.441
	(1.559)	(1.752)
Medium Currency Crises	-1.257	-2.804
	(2.106)	(3.161)
Severe Currency Crises	-10.997***	-10.856***
	(1.769)	(1.988)
Real Interest Rate	-.044**	-.068
	(.019)	(.027)
FDI	.220**	.315***
	(.099)	(.060)
Total Debt Service	-.186***	-.296**
	(.063)	(.118)
Lagged GDP Growth	.131*	.078
	(.067)	(.060)
Lagged Investment	.711***	.610***
	(.069)	(.043)
Observations	283	256
Overall R-Squared	.8383	-

Note: ***=1% significance, **=5% significance, *=10% significance

While some coefficients do vary significantly in magnitude across the two estimators, the broad strokes of the results are the same. In both cases, the medium crisis variable is highly insignificant, suggesting that there is no meaningful difference between mild crises and those of medium severity. The severe crisis variable, however, is highly significant. In fact, the results imply that countries that experience a severe currency crisis can expect investment as a share of GDP to decline by 10.997 (165.22% of investment standard deviation) or 10.856 (163.10% of investment standard deviation) percentage points more than it would during a mild crisis, depending on the specification. In the long-run, the two models predict the extra impact of a severe crisis to be 38.05 (571.66% of investment standard deviation) and 27.84 (418.27% of investment standard deviation) percentage points, respectively. That makes the severe currency crisis designation massively significant economically.

The last question is whether or not medium crises and severe crises differ. The way the model was specified, no single coefficient gives an answer to that question. An F-test was therefore conducted on both estimators to see if the medium crisis coefficient is statistically different from the severe crisis coefficient. Both coefficients were measured relative to the same baseline (the mild crisis), so comparing these coefficients is equivalent to comparing the impact of the two severity tiers. The null hypothesis in both F-tests was that the two coefficients were the same. The probability of the fixed effects estimator with Driscoll Kraay standard errors returning results as or more extreme than what is observed if the medium and severe crisis coefficients are actually equal is negligible (<.0001), so the null hypothesis is strongly rejected. The same probability when the test is run with the Arellano-Bond estimator is .0342, which also leads to a rejection of the null hypothesis. Thus, it is clear that severe crises have a larger negative impact on investment as a share of GDP than crises of medium severity.

The natural question to now ask is, is the effect that has been observed up until this point being driven by these few, exceptionally rare crises? Among the simplest, but most effective, ways of answering this question is to simply remove these observations from the study; because there are only four severe crises, the analysis can proceed without much concern that too many data points are being lost. The results of a fixed effects regression with Driscoll Kraay standard errors and an Arellano-Bond estimator after making this adjustment are shown in table 21.

Table 21: Robustness Test using only Currency Crises of Mild or Medium Severity

	Driscoll Kraay	***Arellano-Bond***
Mild/Medium Currency	-2.694*	-2.267
Crisis Indicator	(1.389)	(1.517)
Real Interest Rate	-.046**	-.071**
	(.019)	(.031)
FDI	.220**	.289***
	(.100)	(.067)
Total Debt Service	-.188***	-.245**
	(.063)	(.100)
Lagged GDP Growth	.129*	.024
	(.068)	(.053)
Lagged Investment	.715***	.621***
	(.071)	(.036)
Observations	282	253
Overall R-Squared	.8390	-

Note: ***=1% significance, **=5% significance, *=10% significance

A few things here merit observation. First, in both specifications the indicator remains quite negative. Additionally, the real interest rate variable remains negative and significant at the 5% level. However, the significance of the crisis indicator differs across the specifications. In the fixed effects case, the crisis indicator is significant at the 7% level, but in the Arellano-Bond case, the significance level drops to 14%. In the fixed effects case, investment is expected to decline by 2.694 (40.47% of investment standard deviation) percentage points, and the long-run decline in investment is predicted to be 9.45 (141.98% of investment standard deviation). This is an inconclusive result; the study is unable to assert definitively that non-severe currency crises meaningfully contribute to investment collapse.

At this point in the analysis, the preponderance of evidence leads to three conclusions. First, all currency crises seem to have a negative impact on investment. The range of significant short-run impact varies between -2.136 and -3.167 percentage points, depending on the model. The significant long-run impact varies between -5.38 and -25.14 percentage points. Second, it appears as though severe crises are significantly worse than both mild and medium crises, but mild and medium crises do not differ. This result holds regardless of the specification. Finally, the independent impact of mild and medium crises is unclear, so it is possible that the initial results were being driven mostly by the exceptionally severe crises.

6.5. Inclusion of other Financial Crises

The next test includes the possibility that banking and/or sovereign debt crises may be driving changes in investment activity. Once more, the fixed effects estimator with Driscoll Kraay standard errors and the Arellano-Bond model with clustered SEs and 1 lagged dependent variable are estimated. The results of those specifications are shown in table 22.

Table 22: Robustness Test – Inclusion of Banking and Sovereign Debt Crises

	Driscoll Kraay (1)	*Arellano-Bond (1)*	*Driscoll Kraay (2)*	*Arellano-Bond (2)*
Currency Crisis	-2.298	-2.141	-2.289	-2.131
Indicator	(1.369)	(1.505)	(1.379)	(1.523)
Banking Crisis	-3.948***	-3.247*	-3.969***	-3.258*
Indicator	(.749)	(1.697)	(.758)	(1.712)
Sovereign Debt	.669	.944	-	-
Crisis Indicator	(1.398)	(1.198)		
Real Interest Rate	-.034*	-.062*	-.034*	-.060*
	(.020)	(.033)	(.019)	(.032)
FDI	.229**	.314***	.227**	.317***
	(.091)	(.059)	(.093)	(.060)
Total Debt Service	-.233***	-.325***	-.230***	-.321***
	(.071)	(.121)	(.069)	(.121)
Lagged GDP	.132*	.081	.129*	.074
Growth	(.070)	(.063)	(.065)	(.060)
Lagged Investment	.721***	.629***	.718***	.627***
	(.066)	(.043)	(.066)	(.043)
Observations	283	256	283	256
Overall R-Squared	.842	-	.858	-

Note: ***=1% significance, **=5% significance, *=10% significance

The obvious result here is that when banking and sovereign debt crises are included in the regression, the currency crisis indicator loses its statistical significance. The coefficient is still very negative in both specifications, but in the fixed effects estimator it is significant only at the 11% level, and in the Arellano-Bond estimator it is significant only at the 16% level. Banking crises seem to be the variable that is now dominating. In fact, the banking crisis indicator is even more negative than the currency crisis indicator, and it is significant at the 10% level in the Arellano-Bond estimator and at the 1% level in the fixed effects estimator. The sovereign debt crisis variable makes little sense. In both estimators, the coefficient is positive – suggesting that countries experiencing a sovereign debt crisis can, all else equal, expect investment as a share of GDP to increase. However, because the coefficient is so insignificant statistically, that confusing result can be disregarded. The same specifications are estimated after discarding sovereign debt crises. The results do not change much; no coefficient changes drastically after this adjustment and each variable is significant at the same level. Moving forward, the sovereign debt crises will continue to be excluded.

It is now important to analyze if, up until this point, the results have really just been suffering from omitted variables bias. To arrive at the answer, the regressions are re-run with the inclusion of an interacted crisis term. The term (labelled "twin crisis" in tables 23-26) is simply the currency crisis indicator multiplied by the banking crisis indicator so that the interacted indicator takes on a value of 1 if *both* a currency and banking crisis occurred in country i and year t, and 0 otherwise. The goal of including this term is to separate out the effects of the currency and banking crises. If the interaction term is negative and significant, the short-run impact of currency (banking) crises on investment is equal to the coefficient on the currency (banking) crisis indicator plus the coefficient on the interaction term *if* there is a simultaneous banking (currency) crisis. An insignificant interaction term suggests that there was nothing wrong with the non-interacted crisis approach taken up until this point. The result of this new specification, tested again in a fixed effects regression with Driscoll Kraay standard errors and an Arellano-Bond estimator is shown in table 23.

Table 23: Robustness Test – Inclusion of Banking and Twin Currency/Banking Crises

	Driscoll Kraay	***Arellano-Bond***
Currency Crisis Indicator	-1.732	-1.291
	(1.243)	(1.661)
Banking Crisis Indicator	-1.927***	-.440
	(.578)	(.916)
Twin Crisis Indicator	-4.668	-8.219***
	(2.900)	(3.046)
Real Interest Rate	-.036*	-.067**
	(.020)	(.032)
FDI	.214**	.300***
	(.096)	(.062)
Total Debt Service	-.215***	-.300***
	(.056)	(.108)
Lagged GDP Growth	.129*	.083
	(.066)	(.060)
Lagged Investment	.722***	.645***
	(.059)	(.048)
Observations	283	256
Overall R-Squared	.8459	-

Note: ***=1% significance, **=5% significance, *=10% significance

The result here is model dependent. In the fixed effects case, the interaction term is significant only at the 13% level, the banking crisis indicator is significant at the 1% level, and the currency crisis indicator is significant only at the 18% level. The results diverge significantly in the Arellano-Bond case. In that model, it is the interaction term that is highly significant, and *both* the currency and banking crisis indicators are insignificant. Although the models return different results, the conclusions are surprisingly similar. Both models say banking crises do contribute to investment decline – the Arellano-Bond model just implies that the contribution of banking crises is only significant if it happens alongside currency crises. Moreover, in both results, currency crises are not an independent determinant of investment. The biggest difference between the outputs is that the fixed effects model says that currency crises never matter, while the Arellano-Bond model says that they matter if a banking crisis happens concurrently.

6.6. Combining the Robustness Tests

To resolve the slight tension in the last result, the robustness tests are combined. Both the fixed effects estimator with Driscoll Kraay standard errors and Arellano-Bond dynamic panel data estimator with one lag and robust standard errors are tested. Indicators for banking crises, medium currency crises, and severe currency crises are included. Once more, the coefficients on the medium and severe currency crisis indicator tests their significance *over* mild crises, not an independent significance. The results of that regression are shown in table 24.

Table 24: Robustness Test – Separated by Severity Tier, including Banking and Twin Crises

	Driscoll Kraay	*Arellano-Bond*
Currency Crisis Indicator	-1.177 (1.182)	-.399 (1.626)
Medium Currency Crisis Indicator	-3.033 (3.013)	-4.478 (3.344)
Severe Currency Crisis Indicator	-4.162** (1.721)	1.121 (2.795)
Banking Crisis Indicator	-1.860*** (.568)	-.381 (.918)
Twin Crisis Indicator	-6.121*** (1.598)	-12.073*** (2.787)
Medium Twin Crisis Indicator	9.562*** (3.029)	16.112*** (4.375)
Severe Twin Crisis Indicator	-	-
Real Interest Rate	-.040** (.019)	-.071*** (.027)
FDI	.187 (.111)	.291*** (.065)
Total Debt Service	-.184*** (.051)	-.267** (.119)
Lagged GDP Growth	.127* (.067)	.081 (.062)
Lagged Investment	.727*** (.058)	.632*** (.052)
Observations	283	256
Overall R-Squared	.8511	-

Note: ***=1% significance, **=5% significance, *=10% significance

The different severity tiers of currency crises are all interacted with the banking crisis indicator. These interaction terms should be interpreted in a manner analogous to the two currency crisis severity tier variables. That is, “Med. Currency and Banking” is the impact of the simultaneous occurrence of a medium currency crisis and a banking crisis *over* the simultaneous impact of a mild currency crisis and a banking crisis. The general takeaways of the conclusion here are similar to those in table 23. In the fixed effects case, the severe currency crisis indicator, the banking crisis indicator, the twin crisis indicator, and the twin banking and medium currency indicator are all significant at the 1% level. In this case, severe currency crises are associated with a decline of investment in short run of 4.162 percentage points (62.53% of investment standard deviation) more than mild crises, and in the long run of 15.25 percentage points (229.12% of investment standard deviation) more than mild crises.

Interestingly, an F-test of the equality of medium currency crises and severe currency crises fails to produce evidence that the latter is more impactful than the former. In the Arellano-Bond case, no crisis indicator is significant save both interaction terms. The result suggests, puzzlingly, that the simultaneous occurrence of banking and medium currency crises is better for investment than the simultaneous occurrence of banking and mild currency crises. The result is statistically significant, but there are only three instance of medium currency crises happening alongside banking crises, so it is possible that a few outliers are driving this nonsensical outcome. Even though this is an anomalous conclusion, the balance of evidence up to this point suggests that the impact of twin crises on investment is catalytically depressing.

The majority of evidence thus far implies that banking crises were inflating the observed effect of currency crises when only the latter was modeled in the specification. However, there is still some evidence (see table 24) that when banking crises are modeled in, severe crises are more impactful than mild crises. This warrants a test of whether or not severe currency crises are independently impactful when tested alongside banking crises. The two main models are run once more where the banking crisis indicator is included, but where the currency crisis indicator takes on a value of 1 only if the currency crisis is severe, as previously defined, and 0 otherwise. The interaction term is now the severe crisis indicator multiplied by the banking crisis indicator. This interaction term is included for consistency, but returns a coefficient value of 0 because none of the four severe crises happened alongside banking crises, so every observation of "twin crises" in this case takes on the value of 0. The results of those tests are shown in table 25.

Table 25: Robustness Test – Severe Currency Crises, Banking Crises, and Severe Twin Crises

	Driscoll Kraay	***Arellano-Bond***
Severe Currency Crisis Indicator	-8.805*** (1.222)	-9.059*** (2.919)
Banking Crisis Indicator	-3.950*** (.598)	-2.789* (1.670)
Twin Crisis Indicator	-	-
Real Interest Rate	-.040** (.019)	-.069** (.034)
FDI	.239** (.092)	.322*** (.062)
Total Debt Service	-.215*** (.065)	-.310*** (.099)
Lagged GDP Growth	.129* (.070)	.074 (.063)
Lagged Investment	.730*** (.070)	.641*** (.044)
Observations	283	256
Overall R-Squared	.8424	-

Note: ***=1% significance, **=5% significance, *=10% significance

After a severe currency crisis, the fixed effects case predicts a short run investment decline of 8.805 percentage points (132.29% of investment standard deviation) and a long-run drop of 32.61 percentage points. At 489.93% of investment standard deviation, this is the largest long-run decline of any crisis variable across all of the specifications. The Arellano-Bond model suggests a larger short-run decline of 9.059 percentage points and a smaller long-run fall of

25.23 percentage points (379.06% of investment standard deviation). The short-run impact in the Arellano-Bond models is 136.10% of investment standard deviation, the largest of any short-run crisis variable in any model. In both models, the severe currency crisis variable and the banking crisis indicator are significant at the 10% level, and in the fixed effects model with Driscoll Kraay standard errors, they are both significant at the 1% level. This suggests that when currency crises are re-defined in a way that only includes the extremely severe crises, the omitted variables bias vanishes. In this case, both severe currency crises and banking crises contribute significantly to investment collapse. It is noteworthy that the banking crisis indicator is significantly smaller in magnitude than the severe currency crisis indicator, so severe currency crises seem to have more influence on investment activity than banking crises. In fact, the currency crisis indicator is more than twice as powerful in the fixed effects case, and more than three times as impactful in the Arellano-Bond case. The banking crisis indicator, however, is still extremely significant economically.

This result begs the question, at what level do these currency crises become significant? The same tests are re-run including all currency crises in which the real exchange rate depreciated by 15% or more in the worst month of the crisis. A monthly depreciation of 15% is 4.536 standard deviations below the average monthly change in the real exchange rate across all countries.[5] When crises were originally disaggregated by severity tier, there were 21 mild crises, but only six of those crises brought a 15% or larger depreciation at its peak.[6] This suggests that the severity distribution of currency crises is skewed right. The depreciations in the worst month

[5] The average monthly change in the real exchange rate across all countries is 0.08% and the standard deviation of monthly real exchange rate movements is 3.29% - see section 4.1 on the definition of currency crises.

[6] The six mild crises that experienced at least one month in which the real exchange rate depreciated by 15% or more were Bulgaria (1994), Russia (2015), South Africa (2002), Thailand (1998), Turkey (2001), and Venezuela (2002).

of crises in the study range from 10.33% to 49.96%, but the worst month of 15 of 35 (42.86%) crises sees a depreciation of less than 15%.[7] Now, the interaction term takes on a value of 1 if a banking crisis *and* a currency crisis with a minimum depreciation of 15% (in the worst month of the crisis) occurred in country i and year t, and 0 otherwise. These instances are coded as adjusted currency crises. The results of both tests are shown in table 26.

Table 26: Robustness Test – Adjusted Currency Crises, Banking, and Severe Twin Crises

	Driscoll Kraay	***Arellano-Bond***
Adjusted Currency Crisis Indicator	-4.837**	-5.374**
	(2.008)	(2.404)
Banking Crisis Indicator	-3.822***	-3.119*
	(.518)	(1.832)
Adjusted Twin Crisis Indicator	1.421	.857
	(3.167)	(3.841)
Real Interest Rate	-.030*	-.059**
	(.017)	(.030)
FDI	.237**	.326***
	(.086)	(.053)
Total Debt Service	-.221***	-.303***
	(.061)	(.104)
Lagged GDP Growth	.122*	.070
	(.062)	(.057)
Lagged Investment	.708***	.615***
	(.066)	(.042)
Observations	283	256
Overall R-Squared	.8442	-

Note: ***=1% significance, **=5% significance, *=10% significance

In the fixed effects specification, the short-run, negative impact of these adjusted currency crises on investment is 4.837 percentage points (72.67% of investment standard deviation) and the long-run decline is 16.57 percentage points (248.95% of investment standard deviation). In the Arellano-Bond model, the analogous drops in investment are 5.374 percentage points (80.74% of investment standard deviation) and 13.96 percentage points (209.74% of investment standard deviation). In both the fixed effects and Arellano-Bond case, the adjusted

[7] The crisis in which the real exchange rate depreciated by only 10.33% in the worst month happened in Malaysia in 1998. The crisis in which the real exchange rate depreciated by 49.96% in the worst month occurred in Argentina in 2002.

currency crisis indicator is significant at 5%. In the fixed effects case the banking crisis indicator is significant at the 1% level and in the Arellano-Bond case it is significant at the 10% level. Again, both variables are meaningful economically. The interaction term in both cases is very insignificant, suggesting only an additive twin crisis effect when currency crises are defined in this way. This produces a novel final conclusion: only relatively severe currency crises have a significant, negative impact on investment. Statistically, the implication of this outcome is that it was not bias from the omission of banking crises that was driving the statistically and economically significant results in tables 14-20, but the presence of relatively mild, less impactful crises that were making the all currency crises appear insignificant in tables 21-24.[8]

7. Conclusion and Discussion of Results

Condensing the results from section 6 into more digestible conclusions is done in three steps. First, a few broad conclusions will be teased out from the empirical analysis of the previous section with a focus on the economic implications of that analysis. Second, the primary limitations of the study must be pointed out. These limitations have been mentioned in passing at various points in the paper, but listing them more methodically should give the reader a clearer picture of how to interpret the results. Finally, the gaps in the research that were elucidated both by the limits of the research and by the empirical results will be suggested as potential avenues for future research.

[8] "Relatively mild" currency crises are those in which the largest monthly depreciation in the real exchange rate was between 10% and 15%.

7.1. Conclusions from the Results

The presentation of results in section 6 provided a number of useful insights, but synthesizing those insights into more succinct conclusions is helpful. Let's begin with the most general question, "do currency crises cause investment to decline?", and then build towards more nuance. At first glance, just about every regression result suggests that the answer to that question is yes. Besides the robustness checks, there is only one regression in which the currency crisis indicator is not significant at the 10% level. That regression, fixed effects with standard errors clustered by capital account openness tier, was the specification with the most obvious deficiencies, so it is among the results that the reader should put the least stock in. Those flaws are detailed in section 5.4. Five fixed effects specifications have the crisis indicator significant at the 10% level, of which 4 are significant at the 5% level and 2% are significant at the 1% level. Perhaps most importantly, the crisis indicator is significant at the 5% level in the fixed effects estimator with Driscoll Kraay standard errors, the method is robust against autocorrelation, heteroscedasticity, and cross-sectional dependence.

Four total general method of moments specifications were tested, and all four reported the crisis indicator significant at the 10% level, regardless of the number of lags or whether or not crises were considered endogenous. One had the indicator significant at the 5% level. In every regression (fixed effects or GMM), the crisis indicator is quite negative, meaning it has important economic significance. Indeed, all of these fixed effects estimators predicted a short run investment decline of 3.144 percentage points, and a long-run decline of 10.41 percentage points. The Arellano-Bond model estimated a range of short-run drop-offs from 2.136 to 2.908 percentage points and a long-run fall of 5.58 to 7.88 percentage points. This result sheds light on the true destructive capacity of currency crises as a phenomenon whose impact is not just restricted to financial markets, but transmits swiftly and powerfully to the real economy.

The second conclusion from the results comes from the first robustness check with severity tiers. The takeaway here is that while there is no significant difference between medium and mild crises, there is a significant difference between severe crisis and the other two types. These results hold regardless of whether a fixed effects estimator with Driscoll Kraay standard errors or an Arellano-Bond model is used. These severe crises are exceedingly rare. Indeed, only four of the 35 crises (11.43%) qualify as severe – and that is within a group of currency crises that was already defined to be rare. The study was unable to conclude, however, that mild and medium crises are independently impactful. When a fixed effects estimator with Driscoll Kraay standard errors was used, the indicator remained significant, but when the dynamic panel estimator was used, it was not. Economically, this is a statement of gradation. All currency crises *may* be bad, but interested actors should not treat this class of financial panics as a monolith. Indeed, when currency crises become extremely severe, their impact is undisputed and they ought not be ignored.[9]

The next important result comes from the robustness check with other financial crises. In both the fixed effects with Driscoll Kraay standard error case and the Arellano-Bond case, the currency crisis indicator is insignificant at the 10% level after the inclusion of both sovereign debt and banking crisis indicators. The sovereign debt crisis indicator is even less significant than the currency crisis indicator, but the banking crisis indicator is significant at the 1% level in the fixed effects specification and 6% in the Arellano-Bond specification. The natural hypothesis

[9] "Extremely severe" currency crises are those in which the largest monthly depreciation in the real exchange rate was more than 30%.

is now that banking crises are the dominant predictor, and that currency crises are only a frequent side act. Statistically, the claim is that earlier results were suffering from omitted variables bias.

This concern is exacerbated when the regressions are re-run without the sovereign debt crises and including an interaction term between banking and currency crises. Now, the currency crisis indicator is even less significant. The banking crisis indicator is highly significant in the fixed effects case and highly insignificant in the Arellano-Bond case. In the fixed effects case the interaction term is insignificant, but in the Arellano-Bond case it is the *only* significant crisis variable. There is clearly some amount of conflict here, but the results produce some agreement as well. Both models agree that currency crises are independently insignificant, although the Arellano-Bond results imply that currency crises are significant when they happen alongside banking crises. Both models also agree that banking crises are meaningful, but the Arellano-Bond specification suggests that banking crises are only significant if they are one half of a twin crisis.

Combining the two robustness tests helps to resolve the issue induced by the previous test. Specifically, even in the face of banking crises, currency crises are significant if some of the less severe crises are not included in the specification (only crises in which the worst month of the crisis saw a decline in the real exchange rate of 15% or larger were included). This leads to the conclusion that *some* currency crises do contribute significantly to investment collapse, even if that cannot be said of all currency crises. Additionally, these relatively harsh crises are economically powerful. Those crises are expected to precipitate a decline in investment between 4.837 and 5.374 percentage points, depending on the specification, in the short-run. The analogous long-run reductions in investment were 16.57 and 13.96 percentage points, respectively. Relative to the other outputs in the study, these figures are quite large. In fact, save the robustness test that includes banking crises and only severe currency crises, the former long-run effect is the largest of any specification. This final conclusion on the significance of relatively severe currency crises, even in the face of banking and twin crisis robustness testing, is the most important in the study.

7.2. Limitations of the Analysis

The limitations of the study can be broadly classified as problems with the empirical methodology or problems with the data. The discussion will begin with the former. As discussed at the end of section 5, the most important empirical problem is the difficulty of simultaneously dealing with autocorrelation, cross-sectional dependence, and heteroscedasticity in a model without inherently biased standard errors. In the fixed effects specification, all three problems can be simultaneously corrected with Driscoll Kraay standard errors, but the presence of a lagged dependent variable creates, by construction, correlation between a regressor (that lagged dependent variable) and the idiosyncratic error term. The remedy for this was to use the dynamic panel data specification developed by Arellano and Bond. While that estimator is robust against heteroscedasticity, it is not robust against cross-sectional dependence and is only robust against autocorrelation if three lags are introduced. Essentially, no solution solves all. It is, therefore, advisable not to treat a single regression output as perfectly optimal, but rather to consider the balance of imperfect evidence when drawing conclusions.

There are two limitations related to data that are worthy of discussion. The first is simply the incompleteness of certain variables. In particular, the total debt service and the real interest rate variable lack a significant number of observations. Moreover, the lack of observations is not uniformly distributed across the countries in the study (more often than not, missing observations are concentrated in a few countries), leading to unbalanced panels. There is a concern in some research facing this issue that the lack of observations is not random, and actually related to the onset of a currency crisis. The only reasonable link one could draw is that countries that are less economically stable are more likely to both experience currency crises and have lackluster economic data collection services. That argument still seems to be a bit of stretch. Indeed, an equally plausible counterargument would posit that countries with relatively open capital accounts are more likely to experience currency crises, but are also the types of countries in which data collection would be easier. Therefore, the common fixes for selection bias such as Heckman's Selection Model are not necessary. Unbalanced panels still create less than ideal estimating conditions, leading to coefficients and standard errors that, while unbiased, are not as accurate as possible.

The second issue in the data is the timing of crises. The concern is that investment might not react instantaneously to currency crises. The solution used in the study is to code crises that occurred in the second half of a year as part of the following year to allow more than a few months for investment activity to adjust. This is an imperfect solution for a number of reasons. First, it assumes that if a crisis happened in July, firms would be unable to react until the next year, but if it happens in June then they would be able to react in the same year. Of course, the cutoff point would be equally arbitrary no matter where it is, so this is simply an issue without a resolution. Second, this solution is imperfect because it sets an implicit upper bound of one year on the amount of time it takes for investment to react to a crisis. The study would certainly be interested in knowing if a currency crisis in year t leads to investment collapse in year t+2 or t+3, but the specifications in the model don't allow for that possibility. The choice not to include that possibility was informed – in measuring the impact of currency crises on credit availability, Arteta and Hale (2009) showed that firm behavior really only changed in the first year and especially in the first five months. By the second year the effects were much smaller and by the third year they had just about disappeared (Arteta and Hale, 2009). Still, there is a chance that the model is missing some investment decline that was not as time sensitive as the initial decline.

7.3. Suggestions for Further Research

The list of potential research avenues on currency crises in emerging markets is too long to enumerate. That said, there are three in particular that would be logical extensions of this study. First, more work should be done on the impact of twin banking and currency crises on investment. It is fairly clear at this point that each are individually impactful, but there is interesting room to see if there is an interacted effect as opposed to an additive effect. While this study includes an interaction term in many of the models, much more analysis is needed to determine under which conditions crises are additive and under which conditions they are catalytic. There are reasons one might expect the two crises to accelerate one another. For example, a currency crisis might exacerbate a banking panic if the rapid depreciation caused by a currency crisis leads to a decrease in banks' assets value and an increase in the cost of their liabilities. That would happen if banks in the crisis country had liabilities denominated in foreign currencies and assets denominated in the local currency. A banking crisis might accelerate a currency crisis if banking sector stress was triggering asset dumping by foreign investors who no longer trusted the solvency of their counterparties. That asset selling would require currency conversion, and that selling pressure could cause substantial exchange rate depreciation.

The second direction of potential research is on the time sensitivity of investment decline. While the study remarks on the long-run decline, more can certainly be done to understand how currency crises and different policy responses impact the adjustment capacity of an economy in each year after the crisis. Research of this sort might seek to answer the question, when do the effects of currency crises disappear? This type of research might be especially fruitful in sectors of an economy in which investment decisions take a long time to come on and offline. Industries that have very high variable costs (i.e. it is expensive to change production quickly) or industries in which high fixed cost investment would be required to expand productions (such as building a new electrical grid) would be good candidates for this focus. Of course, if those firms expected currency depreciations to be short lived (i.e. they think that exchange rates are mean reverting), they may decide not to change investment levels in the face of a crisis. Certainly this is a question worthy of more discussion.

The last area of recommended research is a disaggregation between supply and demand effects. This study analyzes aggregate investment activity, but pays no attention to which dimension was the prevailing factor in the investment change. This, however, has important policy implications. Low investment because of large sovereign risk premium adjustments to interest rates after a crash (i.e. supply effects), might encourage a government to lower domestic rates or take steps to lessen sovereign default risk to boost foreign lending. On the other hand, if investment is soft because firms simply think that investment would lead to larger inventories instead of more profit (i.e. demand effects), the proper solution could be to do fiscal stimulus in order to reinvigorate aggregate demand.

In all, this study aimed to measure the impact of currency crises on investment in emerging markets. The result is a set of conclusions that confirm the influence that currency crises have on investment, but with a high degree of sensitivity to the definition of crises and the other macroeconomic events that are modeled into the test. This specific question, and the sub-questions that emerge from an analysis of this sort, will hopefully peak the interest of researchers to come because the answers to these questions have massive implications for how developing markets make policy and organize themselves. Specifically, this field of research helps policymakers assign a cost to financial openness and other factors that cause currency crises. As countries in this study progress along the development track towards high income status, they will almost certainly become less prone to all sorts of financial panic. That, however, may just usher in a new group of countries whose economies could fall victim to the onslaught of financial crises. If that is the case, the need for research of this sort will only continue to grow.

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9. Data Appendix

Appendix A: Data Definition and Sources

Variable Name	***Series***	***Source***
Investment	Gross Capital Formation (% of GDP)	World Development Indicators (WDI)
Currency Crises	Real Broad Effective Exchange Rate (by country)	Federal Reserve Bank of St. Louis Economic Data (FRED)
Banking Crises	Appendix A.3. Dates of Banking Crises	This Time is Different: Eight Centuries of Financial Folly - Reinhart and Rogoff (2009)
Sovereign Debt Crises	Table 6.3 and 6.4 Default and Rescheduling: Africa and Asia/Europe and Latin America, twentieth century to 2008	This Time is Different: Eight Centuries of Financial Folly - Reinhart and Rogoff (2009)
Real Interest Rate	Real Interest Rate	Bloomberg
Total Debt Service	Total Debt Service (% of GNI)	World Development Indicators (WDI)
Foreign Direct Investment	Foreign direct investment, net inflows (% of GDP)	World Development Indicators (WDI)
Lagged GDP Growth	GDP growth (annual %)	World Development Indicators (WDI)
Capital Account Openness	KAOPEN	Chinn, Menzie D. and Hiro Ito (2006)