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THE FINANCIAL CRISES AND THEIR ASSOCIATED OUTPUT LOSS IN EMERGING MARKETS

BY

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A Dissertation submitted to the Faculty of Claremont Graduate University in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Graduate Faculty of Economics

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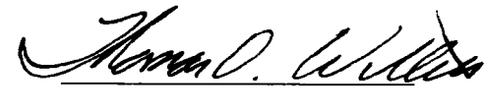

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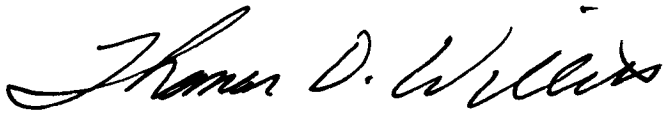

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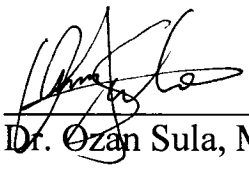

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Abstract of the dissertation

The Financial Crises and Their Associated Output Loss in Emerging Markets

by

Chiratus Ratanamaneichat

Claremont Graduate University: 2008

This dissertation consists of three essays that examine empirical questions focusing on the economic cost of financial crises. Currency crises, sudden stops, and banking crises are commonly identified in the theoretical literature as being interrelated events, yet rarely have empirical researchers considered all of these crisis varieties in their analysis of their impacts on the real economy. The first essay investigates how the economic costs differ across the crisis varieties and finds that for 37 emerging countries during 1980-2005, the impact of currency crises, sudden stops and banking crises on output loss are about 3.4%, 1.8% and 0.8% in short run (5.0%, 2.7% and 1.3% in long run), respectively. The simultaneous occurrences of currency crisis and sudden stops with banking crisis cost 3.1% and 2.9% of output loss in one year, respectively.

Despite the important interactions among these crises, most researchers in this literature have used dummy variables to indicate financial crises, which is tantamount to assuming all crises are of equal magnitude. The second essay[1] contributes to the literature by systematically analyzing the magnitudes of external crises for 37 emerging markets since 1980 and estimating their effects on real GDP growth. I show substantial variation has characterized the intensities of both currency crises and sudden stops,

[1] This essay is from a working paper of the same title co-authored with Sam Schreyer.

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although much of the variation for the latter is explained by particularly severe crises in 1997 and 2001. Real GDP growth loss estimates in the year of a currency crisis are about 2.8%, but can range from 0% to 5.5%. The typical sudden stop, on the other hand, is associated with very little output loss (about 0.5%), but can range up to 4% for the most severe episodes.

Lastly, recent empirical literature on sudden stops and banking crises has suggested the interaction of these crises is particularly harmful to the real economy. The third essay contributes to this literature by applying a panel vector autoregression to examine how these crises interact via domestic credit. This paper finds that evidence supporting the view that sudden stops occurring with banking crises are more harmful than sudden stops occurring by themselves. I also find that during the joint occurrences of these crises, domestic credit increases during the onset of a sudden stop, but this expansion in credit results in an adverse impact on real GDP growth. This finding is consistent with the hypothesis that the financial intermediaries are unable to allocate credit efficiently. Alternately, the interpretation of this relationship might be the temporal association of real output growth and domestic credit. An increase in the demand of domestic credit occurs to ease the recession.

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More than ever, I dedicate this dissertation to my family, and I would like to thank my dear parents, sister and brother with all my heart because with their love they have been my inspiration and provided me with positive attitudes and encouragement in my educational and life-long endeavor.

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CHAPTER I

VARIANTS OF EXTERNAL CRISES

1. Introduction

The last decade witnessed a series of painful financial crises in emerging markets that challenged economists' understanding of these events. In response, old models of currency crises were revamped and new theories developed; indeed, entirely new terminologies were coined, such as the *sudden stop* and *twin crisis*, reflecting economists' new emphasis of the inter-relationships between capital flows and the banking sector during and apart from currency crises. This emphasis has not carried over equally into all facets of this literature, with the empirical literature typically lagging behind the theoretical literature. For example, it was not until a working paper by Hutchison and Noy in 2002 that an empirical investigation was done distinguishing the output costs of currency crises, banking crises, and their joint occurrences.[1] Still, however, there exists scant empirical research incorporating currency crises, sudden stops, and banking crises into a single, unified analysis.

This paper attempts to fill the void between the empirical and theoretical literature by examining the impact of currency crises and sudden stops—collectively termed external crises—on the real economy while controlling for the presence of banking crises. Omitting any of these crises from the analysis risks serious bias since some of the most costly crisis episodes are associated with all of these crises (e.g., Thailand experienced all of these crises during the Asian financial crisis which its real GDP growth dropped by about 6% and a further 9% in 1997 and 1998, respectively).

[1] See Hutchison and Noy (2005) for the published version of this working paper.

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This paper is organized as follow: section 2 outlines the theoretical channels through which external crises affect the real output; section 3 reviews the empirical literature; section 4 discusses the data definitions and model used in this paper; section 5 provides descriptive statistics; section 6 discusses the empirical results in this paper; and section 7 concludes.

2. How External Crises Interact

2.1 Theoretical Links between External Crises and Output Cost

A vast amount of theoretical literature exists concerning the links between external crises and output collapses. A currency crisis is, put simply, a period of time which the monetary authority is under intense pressure to devalue.[2]

The channels through which a currency crisis can lead to output loss include the so-called original sin problem where a firm's liabilities are denominated in a foreign currency. In this case, a currency crisis increases firms' debt burdens and ultimately may lead to widespread defaults and depressed economic activity (c.f., Wijnbergen, 1986; Calvo, 1998; and Mishkin, 1999). Alternatively, liquidity squeezes can arise from firms' difficulties in rolling over short-term debt during currency crises (Rodrik and Velasco, 1999). Formal models of contactionary devaluations have also been proposed. This literature includes Agenor (1991), Gavin (1992), and Shankar (2001).

Explanations for why a sudden stop may result in collapsed output often involve a reduction in aggregate demand in the presence of certain market imperfections (Calvo, 1998 and 2000, and Calvo and Reinhart, 2002). A current account deficit equals

[2] This definition is independent of whether or not the currency actually devalues.

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aggregate demand less GNP. Thus, aggregate demand is lowered because a sharp reversal in capital flows is offset, at least partially, by an improvement in the current account. At this point, the Keynesian assumption of sticky prices/wages makes apparent that the reduction in aggregate demand will lead to a recession. Alternatively, the so-called Fisherian channel involves a fall in the price of non-tradable goods relative to their tradable counterparts following the reduction in aggregate demand (Mendoza, 2001). Assuming a fixed foreign exchange rate, the tradable goods price is exogenous and constant over time, and all loan contracts are under a fixed predetermined nominal interest rate, thus the burden of price-adjustment following a sudden stop falls on the non-tradable goods sectors. Producers in these sectors now face a higher real interest rate, which may in turn, result in a greater number of non-performing loans in the financial sector.

2.2 Theoretical Links between External Crises and Banking Crises

As is evident from the discussion of these linkages, the banking sector often plays the intermediating role between external crisis and output loss. Indeed, the empirical regularity of banking crises occurring concomitantly with currency crises has led to economists to dub this phenomenon the "twin crises." Most "third generation" currency crisis models incorporate the joint occurrence of these crises with adverse effects on the real economy (c.f., Chang and Velasco, 1998, 1999; Goldfajn and Valdes, 1997; Schneider and Tornell, 2000). Kaminsky and Reinhart (1999) show that currency depreciation may exacerbate problems in the banking industry directly if banks' foreign currency exposure is not sufficiently hedged, or indirectly through a deterioration of

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firms' balance sheets leading to an increase in banks' nonperforming loans.[3] However, if the central bank uses reserves to peg the exchange rate without sterilization, it could result in a credit crunch and ultimately a banking crisis.

Linkages between sudden stops and banking crises are also prominent in the theoretical literature. Domestic subsidiaries of multinationals or joint-venture firms may have access to foreign direct investment, thus in the aftermath of a sudden stop investment by these firms may be substantially impacted (Bosworth and Collins, 1999). Alternatively, interest rates may rise following a sudden stop, making it more difficult for domestic firms to maintain their levels of working capital, resulting in a collapse of investment, and ultimately a recession. On the other hand, a troubled banking sector can result in a substantial misallocation of resources (Mishkin, 1997), and in the presence of a sudden stop, firms may no longer be able to find credit just when they need it most.

3. Related Empirical Work

Despite a large body of theoretical research discussing how external crises interact with each other and the banking sector, relatively few empirical papers have considered multiple crises when estimating their impact on the real economy. Joyce and Nabar (2007) evaluate the impact on investment from sudden stops and banking crises using a dynamic panel model. According to these authors, focusing on investment rather than output is important because exports may pick up quickly following a crisis which may not necessarily reflect the health of the economy. Sudden stops are found only to

[3] The inability of banks and other institutions to borrow in their domestic currency, known as the problem of original sin, has been well-documented in the literature. Eichengreen, et al. (2003) emphasizes the distinction between the original sin problem and that of currency mismatch in the assets and liabilities of firms.

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have a significant impact on investment if there exists widespread bank failure, in which case the investment-to-GDP ratio declines by about 4 and 9 percentage points in the short-run and long-run, respectively. Moreover, openness to capital flows is found to be a determinant of the severity of banking crises, which they interpret as evidence that sudden stops work through the banking sector channel in the form of short term flows.

In contrast to Joyce and Nabar (2007), Hutchison and Noy (2006) find the effect of a sudden stop on the real economy to be statistically significant (albeit using real GDP growth rate instead of investment), with an impact of 1% to 2 % in the year of the crisis. They find that the joint occurrence of sudden stops and currency crises are particularly costly, reducing output growth by about 6-8%, while a currency crisis reduces real GDP growth by only 2.5% during the year of crisis.[4] The impact of the joint occurrence of sudden stops and currency crises is not only large, but also abrupt—an effect which they term the "Mexican Wave" (an experience they posit that fits many recent crises, including Indonesia, Turkey, and Korea).

Using a similar methodology and sample to their 2006 paper, Hutchinson and Noy (2005) examine the impact of currency crisis, banking crisis, and their joint occurrence. They find that currency crises and banking crises are very costly, reducing output by about 5%-8% and 8%-10%, respectively, over a 2-4 year period. As a consequence, the cumulative loss of both types of crises is very large. Interestingly, the additional feedback or the interactive effect of these crises is statistically insignificant in

[4] These authors employ a different definition for a sudden stop than the one used throughout this paper. Their definition involves the simultaneous occurrence of a currency crisis and a capital account reversal, which is at odds with our definition. For consistency in my paper, I discuss their findings, and that of other authors, using our terminology. I discuss the issue of confusing sudden stop definitions in greater detail in section 4.

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their analysis, which they interpret as evidence that there is no further damage between banking crises and currency crises.

Komarek and Melecky (2005) investigate the repercussions of currency crises and sudden stops and their joint occurrence using a large set of emerging market countries during the 1990s. This paper distinguishes the direct impact of currency crisis and sudden stops on real GDP growth from the effects these crises have on inflation, consumption, investment, and government expenditure which in turn impact output (i.e., the indirect effect).[5] They find a sudden stop leads directly to about a 1% loss in concurrent GDP annual growth, whereas the direct effect of a currency crisis is not significant. However, the direct and compounded effects of sudden stops with currency crisis are about 5 times larger than that of sudden stops alone. The authors find that the joint occurrence of sudden stops and currency crises are found not to have a statistically significant indirect effect through investment and government expenditure.

The empirical papers discussed here examine real economic effects arising from various combinations of sudden stops, currency crises, and banking crises. However, none of these papers consider all of these crises together, despite a multitude of theoretical studies suggesting their inter-relationships. Omitting one of these crisis types may potentially bias estimates, and thus explain the conflicting evidence found regarding the costs of external crises.

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[5] The direct effect analysis is examined by the traditional panel model with fixed effects. For the indirect effects, they applied the essence of the method called General Evaluation Estimator (GEE) which is created to show that the particular event significantly affects the economy comparing to how the economy would have been without the event. In this context, to observe the indirect effect through investment, government consumption, and inflation, they deem only the pre-crisis data and the first crisis episode of a country to avoid the prejudice past crises may have had on the data. They combine both effects to get the compound one using the coefficient of each controlled variables as a magnitude of the each indirect effect. However, I view this way as an inside mechanism of the direct way. For example, it would be double counted if one adds up the effect of currency crisis on GDP with the indirect effect on government expenditure.

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4. The Model

4.1 Basic Specification

There is considerable controversy about the best way to estimate the GDP cost of crises. I use one of the standard methods. Further research should check the robustness of other method of estimating costs. To examine the output loss associated with external crises, I regress real GDP growth on its lagged self, external crises, and a set of control variables using panel data.[6] Specifically, the model is

$$y_{it} = y_{it-1} + \alpha_i + \delta_t + \gamma_1 CCD_{it} + \gamma_2 SSD_{it} + \sum_{j=1}^{n} \beta_j x_{ijt} + \varepsilon_{it} \qquad (1)$$

where time invariant influences specific to country *i* are captured by the fixed effects term α, time specific shocks to all countries is captured by the dummy variable δ at year t, *CCD* and *SSD* are dummies which take a value of one if a currency crisis and sudden stop occur respectively, x_j is the j^{th} element of the vector of control variables, and ε is the disturbance term with a mean of zero and a constant variance.

4.2 Definitions of Variables

Currency crises are measured using the exchange market pressure (EMP) index which has become a standard measure to date currency crises. The index weights the percentage changes in a country's foreign exchange rate and reserve level using the inverse of each term's variance.[7] A currency crisis is deemed to occur when the EMP

[6] I choose the dynamic regression methodology since this allows me to compare results with several closely related papers, namely Hutchison and Noy (2005 and 2006), Edwards (2005), and Joyce and Nabar (2007).
[7] See Nitithaprapas and Willett (2000) and Willett et al (2005) for the criticism of this weight scheme.

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index surpasses its own mean plus 1.5 times its standard deviation.[8] Two caveats to this measure exist. First, currency crises are assumed to be of the same episode if the measure indicated a currency crisis occurred within a 1-year period of another. Second, episodes of hyperinflation can seriously skew the EMP index since, for example, a large devaluation may be significant for a country without hyperinflation and yet the same devaluation for a country experiencing hyperinflation is of little import.[9] To overcome this problem, I employ the mean and standard deviation of the full sample—that is, both the hyperinflation periods and non-hyperinflation periods—when determining the EMP index during hyperinflation episodes.[10]

Sudden stops are defined similar manner to Frankel and Cavello (2004).[11] The sudden stops take place when a decrease in the financial account surplus more than one standard deviation of a change of the financial account during the period and the event is accompanied by a current account deficit.[12] While many alternative measures of sudden stops exist, our definition has the benefit of simplicity and identifies many of the episodes typically deemed as sudden stops in the literature. As with currency crises,

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[8] Papers that use a value of 1.5 in determining the threshold for the EMP index include IMF (1998), Aziz, et al. (2000), Ahluwalia (2000), and Bordo, et al. (2001). See Angkinand (2005) for a survey of currency crisis measures.

[9] I apply the term hyperinflation more liberally than often found in the literature. Hyperinflation in this paper is defined as annual inflation rate in excess of 100%, which is low compared to the rates used by, for example, Cagan (1956) and Kaminsky (2006) who use 12,785% and 525% respectively. Semantics aside, the goal here is to keep periods of high inflation from skewing the EMP index.

[10] Kaminsky (2006) adjusts the EMP index for hyperinflation periods using the means and standard deviations occurring strictly during these periods. However, when using annual data as I do in this paper, hyperinflation periods often last for only a single period and thus during this instance the standard deviation is null and the mean becomes meaningless.

[11] I also attempt to define sudden stop dates using methodology followed Hutchison and Noy(2006) and Calvo (1998). The Frankel and Cavello (2004) definition allows me to capture most of sudden stop dates that other studies have in common.

[12] Similar sudden stop definitions were used in Eichengreen et al. (2006) who require capital outflows to exceed 1 historical standard deviation. Guidotti et al. (2004) defines a sudden stop as a contraction of capital flows such that it exceeds one historical standard deviation of those flows as well as exceed 5% of GDP.

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hyperinflation episodes may skew the dating of sudden stops. To mitigate this problem, the same distinction between hyperinflation and non-hyperinflation periods made for currency crises is made when defining sudden stops. Consecutive years of sudden stops are assumed to be of the same crisis.

Identifying banking crises is notoriously difficult. Defining these episodes based on bank runs or large-scale government intervention is a poor method since these events are typically preceded by a period of decline in the quality of banking assets. On the other hand, data on bank assets is limited. This paper uses dates for banking crises when either Caprio et al. (2005) or Demirguc-Kunt and Detragiache (2005) identify such an occurrence. Caprio et al. (2005) define banking crises mainly on expert opinions solicited from various sources. Their data distinguishes between systemic and non-systemic crises, although this paper omits this distinction.[13] Demirguc-Kunt and Detragiache (2005) define a banking crisis when at least one of the following conditions hold: ratio of nonperforming assets to total assets is greater than 2% of GDP; cost of rescue operation was at least 2% of GDP; banking-sector problems resulted in a large-scale nationalization of the banks; and extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees were enacted by the government in response to the crisis. [14]

The goal of the analysis in this paper is to observe the cost of external crises, and how this cost is altered in the presence of banking crises. Countries experiencing these crises no doubt vary considerably in how policy makers respond to these events. To this

[13] Omitting this distinction is done to simplify analysis. Boyd, Kwak, and Smith (2005) estimate output costs of non-systemic and systemic banking crises, and find the latter does not result in greater output loss.
[14] Arteta and Eichengreen (2002) compare earlier versions of Caprio et al. (2005) and Demircug-Kunt and Detragiache (2005) and find that their empirical results are unaffected by the data used.

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end, monetary and fiscal policy responses to a crisis are controlled for by using M2 money, the real interest rate (relative to the U.S.)[15], international reserves, and fiscal expenditures, where all variables except the real interest rate are measured in percentage changes.[16] It is difficult to tell a priori whether expansionary or contractionary policies are to be expected concurrent with an external crisis. Indeed, much controversy has centered over the appropriate policy a country should take during several recent crises.[17] For the purposes of this paper, however, it important only to control for policy responses to crises—the expected signs matter little since these variables enter equation (1) as explanatory variables of real GDP growth during crisis periods *and* non-crisis periods.

Trade openness is also controlled for when estimating the impact external crises have on the real economy. The size of a country's external sector matters since less open economies are likely to undergo greater domestic adjustment. The real costs of external crises are inversely proportional to trade openness (c.f., Frenkel and Razin, 1987; Calvo et al., 2003; and Edwards, 2004). Again, however, the role that trade openness plays in determining output loss during external crises is not central to our paper and this variable's specification is during crisis and non-crisis periods hence the expected sign is of little import.

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[15] In the short run analysis, the domestic real interest rate is more likely to reflect the monetary response than the real interest rate (relative to the U.S.).

[16] Rodrik and Velasco (1999) show that exposure to high levels of short-term debt is associated with more severe crises when capital flows reverse. They also show that the money supply (M2-to-GDP specifically) is associated with short-term debt.

[17] For example, Paul Krugman (1999) is highly critical of the IMF's policy advice given during the Asian financial crisis: "but when the financial disaster struck Asia, the policies those countries followed in response were almost exactly the reverse of what the United States does in the face of a slump. Fiscal austerity was the order of the day; interest rates were increased, often to punitive levels... Why did these extremely clever men advocate policies for emerging market economies that would have been regarded as completely perverse if applied at home?" pp. 103-105.

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As a final control, dummy variables for sovereign debt defaults are included in equation (1), where the dummy takes the value of 1 if a default occurs and zero otherwise. Sovereign defaults may skew the effect of external crises on GDP growth since it restricts credit channels at the very least, and at most can be intimately linked with external crises. Dreher et al. (2005) give several reasons why an external crisis may be associated with a sovereign debt default. First, their joint occurrence can happen from the common factors. For instance, relatively low interest rates can lead to capital outflows, which in turn may lead to a sudden stop. However, if interest rates are raised, the domestic debtors' interest payments are greater, as well as a decline in domestic investment and consumption. A recession can shrink tax revenues and increase government spending, making servicing the debt more difficult. Alternatively, speculators may interpret a sovereign debt default as a bad omen and begin to pull out much of their portfolio investment from the country. I employ data from the Paris Club—an informal group of official creditors who renegotiate external debts with debtor nations in arrears—following the methodology of Rose (2003).[18]

4.3 Method of Estimation

The dependent variable GDP growth appears with a lag on the right-hand side of equation (1) due to well-documented evidence of this variable's persistence. However, neither OLS nor fixed effects estimation yield unbiased and consistent estimators with

[18] Unlike Rose, however, I include all types of renegotiations rather than strictly occurring under the "Classic" terms. The key difference is that renegotiation under classic terms does not involve a grant element reducing the net present value of the debt, whereas the other types of renegotiation do. I include these additional renegotiation terms since, regardless of the presence of a grant element, a default has occurred and immediate access to additional credit is likely to be negatively impacted.

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dynamic models—a problem termed *dynamic panel bias*.[19] Moreover, there is likely endogeneity amongst the regressors. To address these concerns, I employ a Generalized Method of Moments estimator developed by Arellano and Bond (1991). Related papers that also employ the Arellano and Bond estimation method include Dreher et al. (2005), Hutchison and Noy (2005, 2006), and Joyce and Nabar (2007). This procedure involves first-differencing equation (1) and using second and higher lagged values of the in levels as instruments for the endogenous variables.[20] An appealing feature of this procedure relative to other estimation methods that account for dynamic panel bias is that more moment conditions are utilized to obtain more efficient estimates (c.f., Ahn and Schmidt, 1995; Arellano and Bond, 1991; Blundell and Bond, 1998). This appeal, however, is not without a cost. Unless restrictions are imposed, the number of instruments grows quadratically in the time dimension (T), thus a tremendous amount of instruments can easily be generated. Having excessive instruments can overfit endogenous variables, leading to biased estimates as well as increase the type 1 error in testing for the validity of the instruments (Roodman, 2006, 2007). Since what constitutes an excessive number of instruments is subjective, I follow the advice of Roodman (2007) and keep the number of instruments less than the number of observations.

5. Descriptive Statistics

To observe the effect of external crises on GDP growth I use an unbalanced panel of data spanning 1980-2005 for 37 emerging economies. I identify 53 years of currency crises and 63 years of sudden stops using the methodology described above, which are

[19] See Nickell (1981) for a rigorous formulation of the bias arising from dynamic models with fixed effects.
[20] Arellano and Bover (1995) and Blundell and Bond (1998) extend this methodology to include instruments in 1st differences in addition to levels.

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reported in Table 1.[21] Table 2 provides dates of external crises used in Hutchison and Noy (2005) and Joyce and Nabar (2007)—two papers similar in methodology and purpose to this one. Juxtaposing this table with Table 1 reveals the similarities of our crises, despite using slightly different methodologies to date crisis episodes and different samples.

On average, each country has experienced 1.24 and 1.57 currency crises and sudden stops during our nearly 25-year sample. Alternatively, each year has experienced 2.12 and 2.52 currency crises and sudden stops, respectively. Yet, as Figure 1 and Figure 2 illustrate, external crises are far from being uniformly distributed. The year with the highest frequency of currency crises is 1997—during which the Asian financial crisis occurred—and is double that of any other year in the sample. Sudden stops, on the other hand, become much more common during the 1990s (almost twice as common with respect to the previous decade). This fact is not entirely surprising given capital mobility to many emerging markets increased substantially during the 1990s.

Table 3 presents the frequency of currency crises, sudden stops and banking crises occurring simultaneously and 1-year from each other. The joint occurrence of both types of external crises is found to be about 22 (19) % of the total number of currency crisis (sudden stop) events. There is no evidence suggesting that either type of external crisis tends to precede the other by 1-year. Roughly, half of the external crises occur simultaneously with banking crises. Unsurprisingly, tranquil periods are the most common, accounting for about 65.6 % of all sample observations, with currency crises and sudden stops occurring in 5.7% and 6.4 % of the sample, respectively.

[21] Assuming that consecutive crisis years are of the same episode results in 46 currency crises and 58 sudden stops.

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Changes in the macroeconomy before and after external crises are reported in Table 4, parts of which are depicted in figure 3, Figure 4, and Figure 5. The median change in real GDP growth during the period of 1980 - 2005 for currency crises and sudden stops is about 4 % and 2 %, respectively, in the year of the crisis. The impact of the currency crisis is not only larger compared to sudden stops, but is longer as well (illustrating no improvement in GDP a year after the crisis)—however, the improvement after a currency crisis tends to be faster than with a sudden stops. Figure 4 and Figure 5 also show the median current account and financial account (in terms of nominal GDP) before and after the external crises. Current account deficits and financial account surpluses appear to exist before both crises, but the size of the deficit and surplus for sudden stops is larger than that for currency crises. Both accounts rapidly approach zero in the year of the crisis (regardless of the type of external crisis), remaining there for at least another 2 years, illustrating that the effect of external crises on emerging markets can persist long after real GDP growth has recovered.

6. Empirical Analysis

To examine the impact of external crises on the real economy as well as the interactions between these crises, I first estimate equation (1) using basic OLS (or naïve) and fixed effects regressions: the results of these regressions are shown in Table 5. As discussed earlier, both of these regression methods result in biased and inconsistent estimates—nonetheless, they can provide a reasonable bound for which the parameter of the lagged dependent variable should fall since the former is upwards biased and the latter is downwards biased. Regressions NV(1) and FE(1) show the estimates when only

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the lagged dependent variable and the pair of external crises are specified, while the remaining regressions add control variables (including a dummy variable for banking crises). The effect of currency crises on the real economy remains highly significant throughout the series of regressions, resulting in 3.6% to 4.8 % loss in real GDP growth. Similarly, sudden stops result in about a 1.9 % loss in output growth, and are highly sensitive to the inclusion of the real interest rate (measured relative to the U.S.). Apart from taking a first pass at the estimates, the regressions in Table 5 provide a quick way to evaluate future regressions by examining the range of the lagged dependent variable's coefficient, which suggests the parameter should lie between 0.22 and 0.45.

The next step in the analysis is to apply the Arellano and Bond/GMM method of estimation to equation (1). Regressions AB(1) in Table 6 specifies all explanatory variables as exogenous, followed by AB(2) which makes only the external crises endogenous, and finally, AB(3) where all explanatory variables are made endogenous. The estimates are by in large unaffected by the endogeneity / exogeneity specification, although the former assumption is maintained throughout the remainder of the analysis. The other regressions in this table show various combinations of control variables and external crises. Regression AB(4) reports results without taking into account banking crises and other control variables. The coefficient for currency crises is noticeably larger than in other specifications, implying that omitting banking crises and policy response variables results in overestimating of the impact of currency crisis on the real economy.

The concurrent impacts on output loss from currency crises and sudden stops are highly significant—at about 3.39% and 1.83 %, respectively—while the same effect from a banking crisis is considerably lower (about a 0.76 % loss). Also, the coefficients for the

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lagged dependent variable are about 0.33 in the regressions, well within the suggested upper and lower bounds for the parameter in Table 5. As Figure 3 suggests, the effect of external crises may persist for more than one year. To investigate this possibility, 1-year lags of these crises are included in some of the regressions. However, only in the case of a lagged currency crisis when the concurrent year case is omitted is there statistical significance (with about a 1.8 % loss in real GDP growth significant only at the 10% level). Yet this finding does not preclude the effect of external crises on output from lasting more than 1 year.

In this approach, the cumulative long-run effect of financial crises on the economy can easily be found given the autoregressive specification of real GDP growth in model (1). The intuition here is that a crisis adversely impacts real GDP growth at time *t*, which partially manifests itself on future realizations of real GDP growth since GDP growth is affected by its own past. It is important to stress, however, that the long-run estimates obtained in this manner are a natural by-product of the dynamic model used and assume that the direct effects of the crises only occur during the first year.[22] The long-run impact on real GDP growth from a currency crisis, sudden stop, and banking crisis—obtained by summing the lagged and concurrent coefficients multiplied by the median intensity and divided by one minus the coefficient of lag GDP growth—is 5.02%, 2.71% and 1.26%, respectively.

Table 7 extends the analysis to include the interaction of currency crises with banking crises. The result shows that none of the interaction terms are significant. However, currency crises and banking crises independent of each other do retain their

[22] Estimates of the long-run impact of crises on the real economy vary based on the framework and methodology used. For alternative approaches in estimating these long-run effects, see Yilmazkuday (2007) and Boyd, Kwak, and Smith (2005).

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significance. This finding is consistent with Hutchison and Noy (2005)—there is no evidence of feedback effects between the so-called twin crises.

The examination of interaction terms is continued in Table 8, although now for sudden stops and banking crises.[23] The interaction term of banking crisis and sudden stops appears to be highly significant at -2.89 % on average. However, the independent effects of both of these crises are not always significant. Moreover, the size of the coefficients for these independent effects (including those from the other tables) is smaller than that of their interaction. This indicates the most damaging aspect of a sudden stop does not originate from the crisis itself, but rather by interacting with the banking crisis, and vice versa. This finding corresponds with Joyce and Nabar (2007) who find that sudden stops occurring independent of banking crises are statistically insignificant, yet their interaction does adversely affect investment. Joyce and Nabar do, however, find stronger evidence than presented here that independent banking crises negatively impact investment. The long run effect of this joint occurrence on output loss is very harmful (about 6.27 % loss in real GDP growth)—larger than any of the costs associated with the crises occurring independently.

7. Conclusions

This paper applies an unbalanced panel of 37 emerging economies between 1980 and 2005 and finds that the concurrent impacts on output loss of currency crisis, sudden stops and banking crisis are roughly 3.39%, 1.83% and 0.76%, respectively. The long-run impact on GDP loss of currency crisis, sudden stops and banking crisis are 5.02%,

[23] I also examine the interaction between currency crises and sudden stops. However, the joint occurrence of these crises occurs in only 12 observations.

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2.71% and 1.26 %, in that order. Considering the joint occurrence between banking crises and currency crises, the interaction between twin crises is insignificant. On the other hand, banking crises and sudden stops do appear to interact with each other, leading to particularly deleterious effects on real GDP growth (about a 2.89% and 6.27 % output loss in the short run and long run, respectively). These results are consistent with previous research.

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Table 1 - Currency Crisis & Sudden Stop Dates

Sample of 37 emerging markets from 1980-2005

Country	Currency Crisis			Sudden Stops			
	1st Year	2nd Year	3rd Year	1st Year	2nd Year	3rd Year	4th Year
Albania	1997			1990	1995†		
Argentina	1990†	2002†		1994	2001†		
Belarus	1998†	2000†		2005			
Belize				1994	2001	2003	
Bolivia	1985	1989		1982	2003†		
Brazil	1981	1994†		1999†	2002		
Chile	1982±†	1985†‡		1982†	1983†	1998	2004
Colombia	1985†			1998	1999†		
Costa Rica	1981±			1981	1996†	2000	
Czech Republic	1997			2003			
Egypt	1989	1990±	1991†‡	1990			
Estonia				1998†			
Georgia	1998						
Hong Kong	2000						
Hungary				1996			
India	1991†			1995†			
Indonesia	1997±†	1998†‡		1997†			
Jordan	1988	1989†‡		1992‡	1993		
Korea	1980	1997±†		1986	1997†		
Latvia	2005			2000			
Lithuania	2005			1999	2000	2004	
Malaysia	1997±†			1994	1997†		
Malta	1992			1995	2000	2004	
Mexico	1982±†	1986†‡	1987†	1982†	1995†		
Morocco	1981†	1983†‡		1995			
Panama				1980	2000	2002	
Philippines	1983±†	1984†‡	1997±	1983†	1997	1998†	2001†
Poland	1986	1988	1989	1994†			
Russia	1994‡	1998†					
Singapore	1997						
Slovak Republic				2003			
Thailand	1997±†			1997†			
Trinidad and Tobago	1985†	1993†		1984†	1999		
Tunisia	1981			2000			
Turkey	1994±†	2001±†		1991†	1994†	1998	2001†
Uruguay	1982†			1983†	2002†		
Venezuela, Rep. Bol.	1986	1989		1994†			
No of Crises	53			63			
No. of Countries	37						

Note: ± indicate a currency crisis occurred simultaneously with a sudden stop. (12)

† indicate an above crisis occurred simultaneously with a banking crisis. (currency crisis = 29 and sudden stops = 27)

‡ indicate an above crisis occurred simultaneously with a sovereign debt default. (currency crisis = 8 and sudden stop = 1)

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Figure 1 - Frequency of Currency Crises over Time

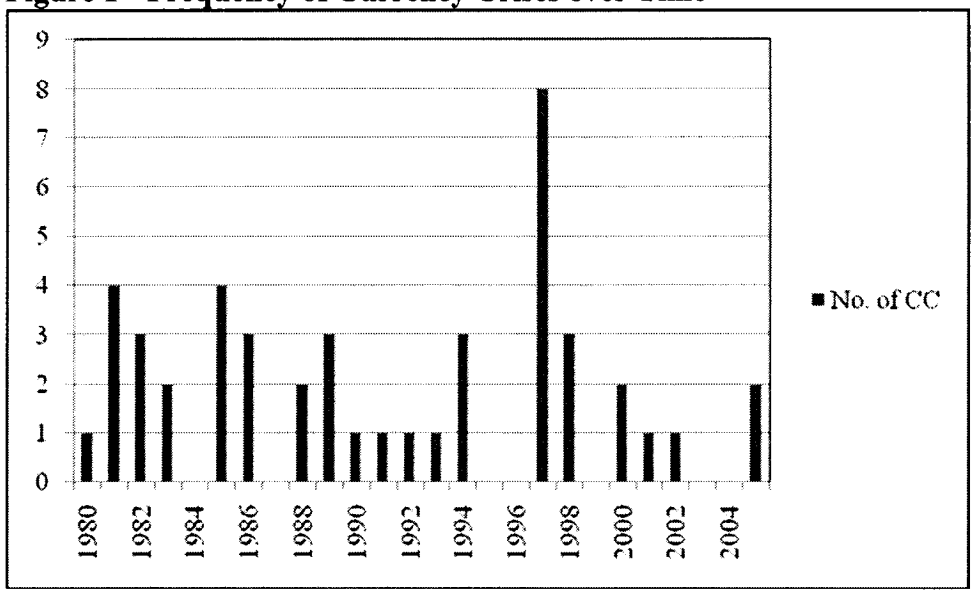

Figure 2 - Frequency of Sudden Stops over Time

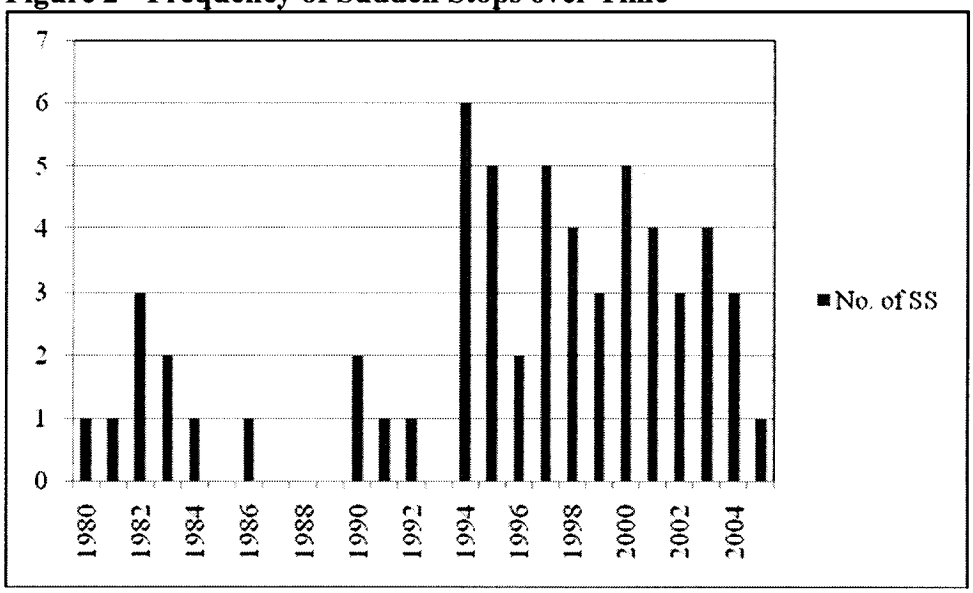

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Table 2 - External Crisis Dates Used in Related Papers

Hutchison and Noy (2005)		Joyce and Nabar (2007)	
Country	Currency Crisis	Country	Sudden Stop
Argentina	1975-1976, 1982-1983, 1989-1991	Argentina	2001
Brazil	1982-1983, 1987, 1990-1991, 1995	Brazil	2002
Chile	1985	Chile	1982-1983, 1988
Hong Kong	--	China	--
Columbia	1985	Colombia	1998-1999
Costa Rica	1981	Czech Rep.	
Cyprus	--	Egypt	1990
Indonesia	1978, 1983, 1986, 1997	Hungary	1996
Jordan	1983, 1987-1989, 1992	India	--
Korea	1980, 1997	Indonesia	1997
Malaysia	1986, 1997	Jordan	1992-1993, 2001
Malta	1992, 1997	Malaysia	1997
Mauritius	1979, 1981	Mexico	1982, 1994-1995
Mexico	1976, 1982, 1985, 1994-1995	Morocco	1995
Panama	--	Pakistan	1998
Philippines	1983-1984, 1986, 1997	Peru	1998
Singapore	1975	Philippines	1997-1998
South Africa	1975, 1978, 1984-1986, 1996	Poland	1994, 2001
Thailand	1981, 1984, 1997	Russia	--
Trinidad & Tob.	1985, 1988, 1993	Slovak Rep.	--
Tunisia	1993	South Africa	2000
Turkey	1978-1980, 1994	Sri Lanka	2001
Uruguay	1982-1983	Thailand	1997
Venezuela	1984, 1986, 1994-1996	Turkey	1991, 1994, 1998, 2001
		Venezuela	1994
		Zimbabwe	1983

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Table 3 - Conditional Frequencies

Count		Banking Crisis (t)						
		0			1			
		Currency Crisis (t)			Currency Crisis (t)			
		0	1	Cond. Total	0	1	Cond. Total	Total
Sudden Stop (t)	0	561	17	578	204	20	224	802
	1	25	3	28	18	9	27	55
Total		586	20	606	222	29	251	857

Count		Banking Crisis (t)						
		0			1			
		Currency Crisis (t-1)			Currency Crisis (t-1)			
		0	1	Cond. Total	0	1	Cond. Total	Total
Sudden Stop (t)	0	559	19	578	197	27	224	802
	1	27	1	28	24	3	27	55
Total		586	20	606	221	30	251	857

Count		Banking Crisis (t)						
		0			1			
		Currency Crisis (t)			Currency Crisis (t)			
		0	1	Cond. Total	0	1	Cond. Total	Total
Sudden Stop (t-1)	0	560	20	580	200	24	224	804
	1	26	0	26	22	5	27	53
Total		586	20	606	222	29	251	857

Count		Banking Crisis (t-1)						
		0			1			
		Currency Crisis (t)			Currency Crisis (t)			
		0	1	Cond. Total	0	1	Cond. Total	Total
Sudden Stop (t)	0	569	19	588	211	17	228	816
	1	31	8	39	13	4	17	56
Total		600	27	627	224	21	245	872

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Figure 3 - Median Real GDP Growth during External Crises

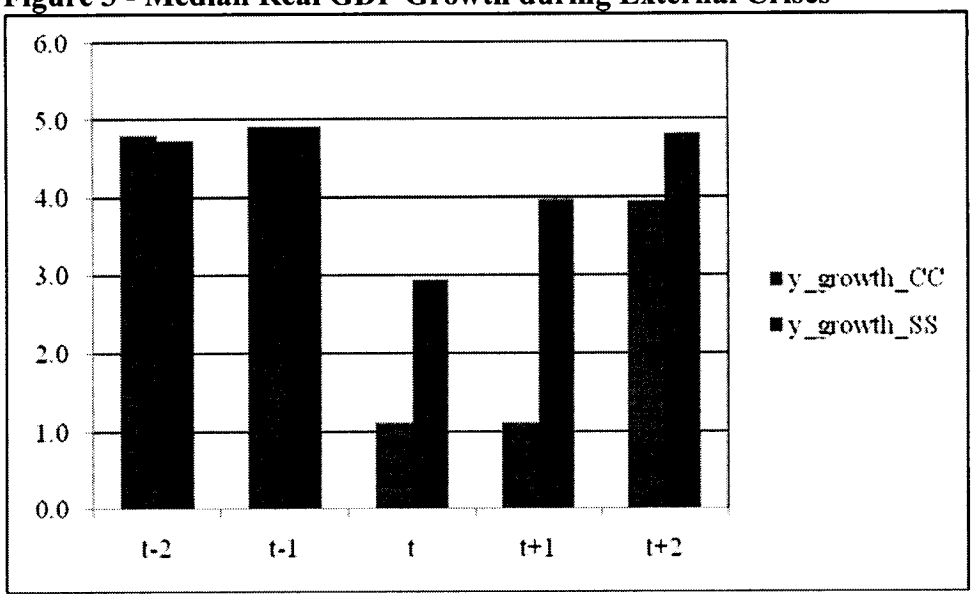

Figure 4 - Median Current Account during External Crises (% of GDP)

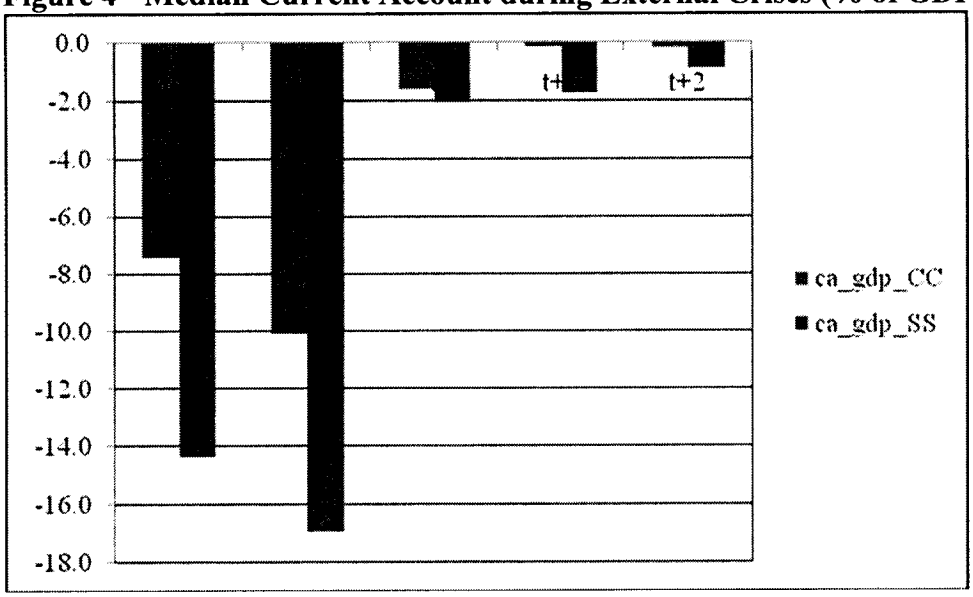

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Figure 5 Median Financial Account during External Crises (% of GDP)

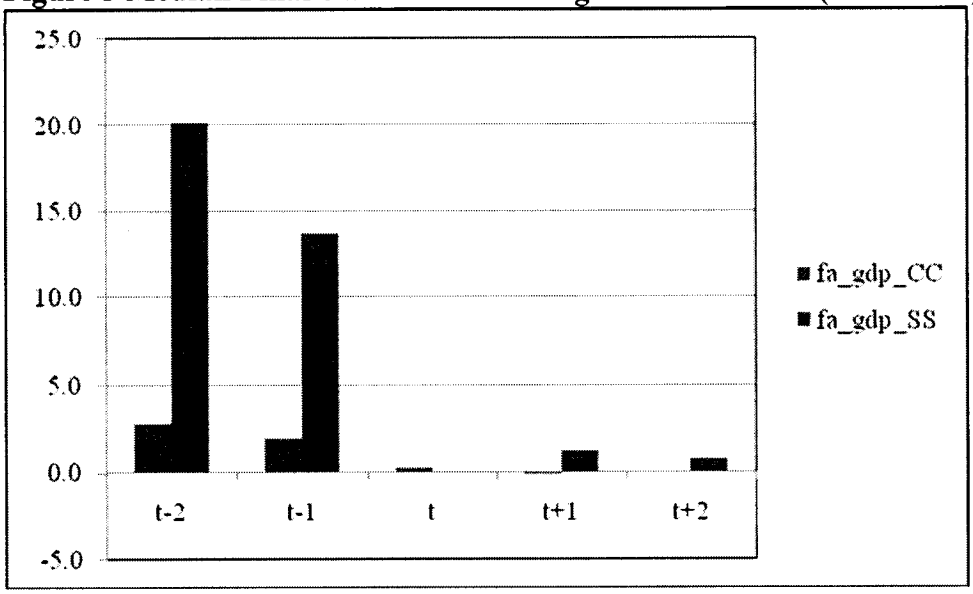

Table 4 - Median Macroeconomic Indicators during External Crises

Currency crisis	t-2	t-1	t	t+1	t+2
GDP growth (%)	4.8	4.9	1.1	1.1	3.9
Current account (% GDP)	-7.4	-10.1	-1.6	-0.1	-0.2
Financial account (% GDP)	2.8	2.0	0.3	0.0	0.0
Inflation (%)	13.82	11.76	17.65	20.63	14.58
Fiscal expenditure (% Δ)	15.7	17.3	13.9	20.7	17.4

Sudden stops	t-2	t-1	t	t+1	t+2
GDP growth	4.7	4.9	2.9	4.0	4.8
Current account	-14.4	-17.0	-2.1	-1.7	-0.9
Financial account	20.2	13.7	0.0	1.3	0.8
Inflation	7.19	5.83	6.17	7.41	6.40
Fiscal expenditure (% Δ)	16.5	12.7	10.2	10.3	12.6

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Table 5 - Naive & Fixed Effects Regressions

Dependent variable: real GDP growth

Independent variable	NV (1)	NV (2)	NV(3)	FE (1)	FE (2)	FE (3)
Real GDP growth (t-1)	0.45***	0.34***	0.35***	0.39***	0.24***	0.22***
	(14.69)	(9.36)	(7.94)	(11.86)	(6.14)	(4.76)
Currency crisis dummy (t)	-3.96***	-3.84***	-4.78***	-3.81***	-3.63***	-4.82***
	(-5.93)	(-5.68)	(-6.05)	(-5.58)	(-5.34)	(-6.02)
Sudden stops dummy (t)	-1.95***	-1.96***	-0.64	-1.88***	-1.91***	-0.57
	(-3.20)	(-3.21)	(-0.93)	(-3.00)	(-3.14)	(-0.83)
Banking crisis dummy (t)		-0.83**	-1.09**		-1.30***	-1.64***
		(-2.27)	(-2.57)		(-3.24)	(-3.43)
Sovereign debt dummy (t)		-1.24**	0.02		-1.20*	-0.25
		(-2.06)	(0.03)		(-1.9)	(-0.32)
m2 money (% Δ)		0.00	0.01		0.00	0.01
		(1.26)	(0.96)		(1.27)	(0.96)
Fiscal expenditure (% Δ)		-0.00	-0.01***		-0.00	-0.01***
		(-1.30)	(-3.74)		(-1.36)	(3.72)
Trade openness (% of GDP)		0.01	0.00		0.02*	0.03**
		(1.51)	(0.04)		(1.92)	(2.13)
International reserves (% Δ)			-0.00			-0.00
			(-0.03)			(-0.73)
Relative interest rate (% Δ)			0.03***			0.03***
			(3.22)			(3.19)
Observations	807	618	428	807	618	428
R-squared	0.31	0.30	0.36	0.26	0.26	0.34

Absolute value of t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

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Table 6 - Arellano & Bond Regressions

Dependent variable: real GDP growth

Independent variable	AB (1)	AB (2)	AB (3)	AB (4)	AB (5)	AB (6)	AB (7)	AB (8)	AB (9)
Real GDP growth (t-1)	0.31***	0.33***	0.33***	0.34***	0.33***	0.32***	0.33***	0.31***	0.33***
	(3.94)	(4.37)	(4.58)	(4.92)	(4.54)	(4.32)	(4.63)	(4.06)	(4.55)
Currency crisis dummy (t)	-3.82***	-3.33***	-3.45***	-6.05***	-3.25***		-3.24***	-3.84***	-3.23***
	(-4.46)	(-3.47)	(-3.40)	(-3.44)	(-3.20)		(-3.41)	(-3.80)	(-3.18)
Currency crisis dummy (t-1)					-1.47	-1.79*			-1.43
					(-1.34)	(-1.65)			(-1.31)
Sudden stops dummy (t)	-1.47**	-1.66**	-1.87***	-2.15**	-1.99***	-2.38***	-1.96***		-2.01***
	(-2.18)	(-2.45)	(-2.73)	(-2.07)	(-2.93)	(-3.41)	(-2.91)		(-2.98)
Sudden stops dummy (t-1)							-0.27	-0.16	-0.15
							(-0.37)	(-0.22)	(-0.20)
Banking crisis dummy (t)	-0.79*	-0.76*	-0.77*		-0.69*	-0.93**	-0.78*	-0.81*	-0.70*
	(-1.94)	(-1.91)	(-1.93)		(-1.67)	(-2.15)	(-1.95)	(-1.95)	(-1.70)
Sovereign Debt Dummy (t)	-1.26*	-1.06	-0.88		-1.13	-1.13	-0.95	-0.9	-1.14
	(-1.75)	(-1.60)	(-1.36)		(-1.61)	(-1.57)	(-1.46)	(-1.39)	(-1.61)
m2 money (%Δ)	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
	-0.72	-0.77	-0.75		-0.71	-0.93	-0.74	-0.66	-0.72
Fiscal expenditure (%Δ)	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
	(-0.59)	(-0.65)	(-0.64)		(-0.60)	(-0.92)	(-0.65)	(-0.55)	(-0.60)
Trade openness (% of GDP)	0.01	0	0		0.01	0.01	0	0	0.01
	-1.28	-1.14	-1.14		-1.37	-1.26	-1.07	-1.25	-1.36
Observations/instruments	618/483	618/517	618/547	807/298	618/565	618/563	618/553	618/554	618/557
Number of id	34	34	34	37	34	34	34	34	34
Sargan p-value	0.2	0.35	0.47	0.03	0.29	0.38	0.38	0.31	0.21
AR(1) p-value	0	0	0	0	0	0	0	0	0
AR(2) p-value	0.41	0.4	0.38	0.44	0.37	0.42	0.39	0.51	0.36

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7 - Arellano & Bond Regressions

Dependent variable: real GDP growth

Independent variable	AB (10)	AB (11)	AB (12)
Real GDP growth (t-1)	0.35***	0.33***	0.32***
	(4.72)	(4.90)	(4.26)
Currency crisis dummy (t)	-2.63**	-2.13**	
	(-1.97)	(-2.03)	
Currency crisis dummy (t-1)			0.24
			(0.16)
Sudden stops dummy (t)	-1.95***	-2.16***	-2.43***
	(-2.83)	(-3.21)	(-3.47)
Sudden stops dummy (t-1)			
Banking crisis dummy (t)	-0.71*		-0.69*
	(-1.78)		(-1.68)
Banking crisis dummy (t-1)		0.59	
		(1.26)	
Sovereign Debt Dummy (t)	-1.08	-0.98*	-1.07
	(-1.54)	(-1.70)	(-1.62)
Interaction between banking crisis (t) and currency crisis (t)	-1.17		
	(-0.63)		
Interaction between banking crisis (t-1) and currency crisis (t)		-3.14	
		(-1.49)	
Interaction between banking crisis (t) and currency crisis (t-1)			-3.15
			(-1.64)
m2 money (% Δ)	0.00	0.00	0.00
	(0.71)	(1.01)	(0.98)
Fiscal expenditure (% Δ)	-0.00	-0.00	-0.00
	(-0.58)	(-0.87)	(-0.95)
Trade openness (% of GDP)	0.01	0.00	0.01
	(1.35)	(1.30)	(1.25)
International reserves (% Δ)			
Relative interest rate (% Δ)			
Observations/Instruments	618/559	631/565	618/558
Number of id	34	34	34
Sargan p-value	0.32	0.26	0.35
AR(1) p-value	0.00	0.00	0.00
AR(2) p-value	0.35	0.47	0.42

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

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Table 8 – Arellano & Bond Regressions

Dependent variable: real GDP growth

Independent variable	AB (13)	AB (14)	AB (15)	AB (16)	AB (17)	AB (18)
Real GDP growth (t-1)	0.35***	0.34***	0.34***	0.34***	0.31***	0.31***
	(4.68)	(4.71)	(4.97)	(5.05)	(4.08)	(4.40)
Currency crisis dummy (t)	-3.20***	-3.20***	-3.35***	-3.41***	-3.60***	-3.76***
	(-3.40)	(-3.40)	(-3.50)	(-3.54)	(-3.66)	(-3.75)
Currency crisis dummy (t-1)						
Sudden stops dummy (t)	-0.82	-0.87	-1.49**	-1.45**		
	(-1.06)	(-1.12)	(-1.97)	(-2.05)		
Sudden stops dummy (t-1)					0.46	-0.37
					(0.59)	(-0.47)
Banking crisis dummy (t)	-0.55	-0.57			-0.71	
	(-1.28)	(-1.32)			(-1.58)	
Banking crisis dummy (t-1)			0.58	0.56		0.58
			(1.34)	(1.33)		(1.18)
Sovereign Debt Dummy (t)	-1.18*	-1.08	-0.92	-1.00	-1.00	-1.11*
	(-1.70)	(-1.50)	(-1.55)	(-1.48)	(-1.57)	(-1.80)
Interaction between banking crisis (t) and sudden stops (t)	-2.61**	-2.62**				
	(-2.01)	(-1.99)				
Interaction between banking crisis (t-1) and sudden stops (t)			-2.71**	-2.77**		
			(-2.21)	(-2.23)		
Interaction between banking crisis (t) and sudden stops (t-1)					-1.61	
					(-0.89)	
Interaction between banking crisis (t-1) and sudden stops (t-1)						-0.88
						(-0.45)
m2 money (% Δ)	0.00	0.00	0.00	0.00	0.00	0.00
	(0.81)	(0.85)	(0.91)	(0.89)	(0.68)	(0.81)
Fiscal expenditure (% Δ)	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(-0.68)	(-0.68)	(-0.74)	(-0.74)	(-0.56)	(-0.63)
Trade openness (% of GDP)	0.01	0.00	0.00	0.00	0.00	0.00
	(1.29)	(1.24)	(1.34)	(1.25)	(1.24)	(1.52)
International reserves (% Δ)		-0.00		0.00		
		(-0.65)		(0.34)		
Relative interest rate (% Δ)						
Observations/Instruments	618/564	617/568	631/575	630/580	618/559	631/570
Number of id	34	34	34	34	34	34
Sargan p-value	0.41	0.38	0.43	0.47	0.33	0.29
AR(1) p-value	0.00	0.00	0.00	0.00	0.00	0.00
AR(2) p-value	0.34	0.40	0.49	0.46	0.53	0.51

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

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Table 9 - Data Definitions

Variable	Data used	IFS Line
GDP growth rate	GDP volume	99B.PZF and 99B.RZF
Currency Crises	Exchange rate, international reserves and CPI (see text for details).	
Sudden Stops	Financial account, current account and CPI (See text for details).	78BJ.ZF, 78AL.ZF and 64..ZF
Banking Crises	Crises indicated in Caprio, et al. (2006) or Demirguc-Kunt and Detragiache (2005) (see text for details).	--
Sovereign Debt Crises	Defaults indicated in Paris Club website (see text for details).	--
M2 money (% Δ)	M1and quasi-money	34...ZF, 35...ZF
Fiscal expenditure (% Δ)	Government consumption expenditure	91F..ZF
Trade openness (% of GDP)	Exports of goods and services, imports of goods and services, and nominal GDP	90C.ZF, 98C.ZF and 99B..ZF
International reserve (% Δ)	Total reserves minus gold	1L.DZF
Relative real interest rate (% Δ)	Nominal interest rate, CPI	60..ZF and 64..ZF

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CHAPTER II

THE SEVERITY OF EXTERNAL CRISES[1]

1. Introduction

The large body of empirical literature concerned with the economic costs of external crises has emerged over the past decade. Understanding these costs and under what circumstances they may arise is critical for policy makers, particularly those in emerging markets whose economies are often subject to such crises. However, very few researchers have allowed for variation in the severity of external crises when examining the economic costs associated with these crises. Our paper considers this issue.

The general approach taken to date in the literature on currency crises and sudden stops is to find instances when a variable representing the phenomena of interest exceeds a particular threshold, in which case the crisis variable takes a value of 1 and zero otherwise. This approach, termed the *dummy method*, has been widely used over the past decade, its popularity due in part to the fact that it facilitates analysis and follows the binary nature in which we often speak of external crises. The dummy method does, however, impose the assumption that all crises are identical in their magnitude. While it may be the case that variation within these crisis magnitudes is sufficiently small to justify their classification as a homogenous group, there exists no systematic study on crisis intensities to substantiate this possibility.

The paper proceeds as follows: section 2 reviews related literature that have incorporated the magnitudes of crises into the analysis; section 3 discusses the data used

[1] This essay is from a working paper of the same title co-authored with Sam Schreyer.

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in this paper and provides descriptive statistics; section 4 reports a series of regressions for testing how crises' severities translate into output loss; and section 5 concludes.

2. The Empirical Literature

Research concerning the costs of external crises is a large and growing literature (see chapter I for a review of this literature). While consideration of a crisis's magnitude is not new to this literature, it is surprisingly scant and rarely emphasized. This section reviews several recent papers that have incorporated magnitude of external crises into their analysis of the costs of these crises.

2.1 Crisis Magnitude as a Determinant of Output Loss

Guidotti, Sturzenegger, and Villar (2004) focus on identifying factors that mitigate the adverse effects in the aftermath of a sudden stop. Sudden stops are defined as a capital account contraction below two standard deviations its mean conditional that the contraction exceed 5% of the country's GDP. These episodes are then classified into those that require a domestic adjustment via improvement in the current account, and those that do not. Using a sample of all possible countries beginning in 1974, 313 sudden stops are identified, 265 of which required domestic adjustment. The authors rank the sudden stop episodes based on the size of the sudden stop (defined as the change in the capital account as a fraction of GDP) and find a wide array of countries in terms of income, development, and country size are among the most severe. When they included the sudden stop's magnitude in pooled growth regressions, the variable was statistically insignificant towards explaining output loss during sudden stops (regardless of domestic

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adjustment taking place). In comments to their paper, Jose de Gregorio says a "puzzling result is that the magnitude of the sudden stop does not affect the growth effect. This means that whether the adjustment is 5% or 20% of GDP does not affect the output costs of the sudden stop after controlling for other variables."[2]

Hutchison and Noy (2005) address empirically whether the interaction of banking crises and currency crises adversely affects output beyond that of each crisis acting independently. Most of their analysis is done treating all currency crises and all banking crises as dummy variables. The authors do, however, ask whether more severe crises result in more output loss. To test this, they differentiate between standard and severe currency crises, defining the former when the exchange market pressure (EMP) index exceeds its mean plus 2 standard deviations and the latter in a similar manner but with 3 standard deviations instead. Using a sample of 24 emerging markets over 1975-1997, the distinction in currency crisis magnitude results in 51 standard crises, 42 of which are severe.[3] Although the regressions are not reported, Hutchison and Noy indicate that "somewhat surprisingly" output loss from severe currency crises is not greater than that from standard crises.[4]

In a similar paper, Hutchison and Noy (2006) examine output loss for current account reversals, currency crises, and the joint occurrence of these events which is interpreted as a sudden stop by the authors. Major and standard currency crises are distinguished as in their 2005 paper, with virtually the same results (using virtually the

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[2] Guidotti, Sturzenegger, and Villar (2004), pp. 207-208.
[3] Banking crises are also categorized into being either standard or severe, using banking crises identified by Caprio and Klingebiel (1999) as being systemic for the latter. Details regarding how they defined currency crises and banking crises can be found on pp. 735-37 in their paper.
[4] The authors mention that in one specification severe currency crises resulted in a 2.3% and 2.8% loss in real GDP growth at time t and t-1, respectively, whereas standard currency crises resulted in 2.5% and 2.6% loss during the same time periods.

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same sample). Again, they find that output loss from their subset of major currency crises is not more costly that the sample of standard currency crises. However, they interpret this finding as being "not particularly surprising as most of the crises in our sample are defined as major." They conclude "major currency and balance of payments crises therefore do not appear to have a substantially different impact on output growth than a broader sample that includes more moderate crisis periods."[5] Current account reversals are also distinguished as being either standard or major episodes when the reversal exceeds a 3% and 5% threshold, respectively. However, the more stringent threshold does not result in greater output loss relative to the 3% threshold in 4 of the 5 regressions reported, with the difference in output loss being less than 1% between the two.[6] The authors examine the robustness of their results by accounting for the magnitude of the currency crisis (measured as the deviation of the EMP index from the country specific mean during the crisis and zero otherwise). The magnitude variable is insignificant and the crisis dummy coefficients remain largely unchanged.[7] However, the magnitude of the capital account reversal (defined as the reversal as a fraction of GDP) is statistically significant, indicating that a flow reversal of 1% of GDP reduces real GDP growth by 0.2%. The authors state that "central to our argument is the finding that the coefficient on the sudden stop dummy does not change much—indicating that non-linearities are important in understanding the effects of crises. A sudden stop is a unique event that is important above and beyond the actual size of the reversal."

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[5] Quotes are from p. 237 of HN (2006).
[6] See Table 4, p. 238 of HN (2006).
[7] The authors also examine whether the binary specification of currency crises is important by specifying both the binary (dummy) variable and the EMP index for all observations. Although not reported in their paper, the authors indicate the EMP index was statistically insignificant and the coefficient for the binary variable did not change much leading them to the conclusion currency crises are plausibly binary.

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Edwards (2004) examines various facets of current account reversal, including the output costs associated with current account reversals over the last three decades. Using a Barro-growth equation with a dummy variable to capture current account reversals, Edwards finds the reversal to be associated with about a 2.5% loss in real GDP growth with the estimate about 1% lower (higher) for countries more (less) open to trade. In a section of the paper immediately before the conclusion, Edwards notes that "a potential limitation of this analysis is that it does not consider the actual magnitude of the reversal ...." He re-runs regressions, using the magnitude of the crisis instead of the dummy variable (which takes a value of zero during non-crisis periods). The result, however, was not statistically significant leading Edwards to conclude "that once reversals reach a certain level, their effects on growth are similar."[8]

2.2 Summarizing the Literature's Findings

It is worthwhile to summarize and elaborate on what the literature cited above has found about output loss being affected by the magnitude of a crisis. First, in none of these papers was this issue central to the analysis. Second, the statistical significance of this variable is not a forgone conclusion, and, in fact, seems to be the exception rather than the rule. This point has been interpreted by some authors as justification for specifying crises in a binary fashion. Yet conceptualizing the occurrence of a crisis as an entirely separate phenomenon from its magnitude is precarious since, by definition, the occurrence of a crisis is an event of at least a certain magnitude. This leads us directly to our last point. Edwards suggests that the size of a current account reversal size may matter in explaining output loss, but only up to a point—and that this point was already

[8] Quotes are from p. 33 of Edwards (2004).

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obtained for the crisis dates he examined—hence the statistical insignificance for the size of the current account reversal. In other words, the relationship between output loss and the intensity of a crisis may be non-linear. To generalize this point, his interpretation has potentially serious ramifications regarding the methodology researchers employ to date crises. If in fact the size of a reversal affects output up to a given threshold, then sample selection bias in favor of the most severe crises may be occurring since researchers are only selecting crises where this threshold has been reached. This possibility is reinforced when one considers that, indeed, the most costly crisis episodes tend to dominate researcher's attention. Taking these points together clearly demonstrate the need for a systematic study of crises' magnitudes and their bearing on output loss.

3. The Data

We begin our study of external crises' magnitudes and their role in explaining output loss by employing the same data set and crisis definitions used in chapter I. The sample is composed of 37 emerging markets from 1980 to 2005, with 53 and 63 years of currency crises and sudden stops identified, respectively.

The intensity of an external crisis can manifest itself through a number of ways making its quantification particularly cumbersome. Indeed, the same issues confront researchers when attempting to date crises (e.g., pressure for a currency depreciation / devaluation may arise through sharp changes in the interest rate, foreign exchange rate, and/or the central bank's reserves). The shared nature of the beast make using the criterion for dating crises a logical starting point to capture the crises intensities. For this reason, we obtain the same crisis-dating methodology from chapter I, and this time,

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measure a crisis's severity based on the deviation between the variable and threshold used to date the crisis. These values are then standardized using severity data across all countries and times to facilitate comparison among crises of the same type. Specifically, the intensity of a currency crisis (*CC*) for country *i* at time *t* is defined as:

$$CC_{it} = \begin{cases} \frac{k_{it}}{\sigma_k}, & \text{if } k_{it} = EMP_{it} - \alpha^* > 0 \\ 0, & \text{otherwise} \end{cases} \qquad (1)$$

where α^* is the threshold that the exchange market pressure (EMP) index must exceed in order for a currency crisis to occur, and σ is the standard deviation of the difference between the EMP index and the threshold during crises taken across all episodes independent of time. Similarly, a sudden stop (*SS*) is defined as:

$$SS_{it} = \begin{cases} \frac{j_{it}}{\sigma_j}, & \text{if } j_{it} = -\Delta FA_{it} + \omega^* > 0 \\ 0, & \text{otherwise} \end{cases} \qquad (2)$$

which is the difference between the change in the financial account (ΔFA) and the threshold ω^* used to define the sudden stop, divided by the standard deviation of this difference taken across all episodes independent of time.[9]

The crisis dates and intensities obtained using the methodology described above are shown in Table 2 and Table 3. Taking the median intensity as representative of the typical currency crisis, we see that, for example, Thailand's 1997 currency crisis was about 2.5 times more severe than the typical currency crisis, and about 1.5 times more intense than Korea's currency crisis in the same year. Similarly, Mexico's sudden stop

[9] The currency crisis and sudden stop thresholds, α^* and ω^*, are 1.5 and 1 standard deviation(s) beyond their country-mean, respectively. The occurrence of a sudden stop is also required to have a current account deficit and financial account surplus in the previous year. See chapter I for additional details.

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during the 1982 Latin American debt crisis was nearly 6 times the intensity of the typical sudden stop, yet only about 2/3 as severe on its sudden stop in 1995.[10]

The time-independent distribution of intensities for CC and SS, shown in Figure 1 and Figure 2 respectively, confirm the heterogeneous nature of external crises. Not surprisingly, most observations lie to the left of the distribution indicating that many crisis episodes just exceed the definition of a crisis. As the intensity level increases, the number of crises decreases with a noticeable gap in episodes occurring at about 1.65 for CC and 1.5 for SS. It is interesting to note that while a traditional examination of distributions such as these might suggest that the values lying to the extreme right are outliers, these values represent some of the crises most commonly included in samples of studies using dummy variables to estimate the impact of external crises (see Table 1 for the ten most intense crises).

The median intensity of CC over time is shown in Figure 3. There is no clear trend in the intensity of currency crises, and the early 1980s Latin American debt crisis and 1997-98 Asian financial crisis do not appear to be extraordinarily severe periods. The story changes when considering the time plot of SS (Figure 4). Here, the years 1997 and 2001 have a median intensity of about 1.4—more than twice that of any other year in our sample.

The basic question this paper seeks to address is how variations in crises' magnitudes translate to output loss. Insight into this question can be garnered by examining real GDP growth for the crises on both extremes of the magnitude's

[10] Care should be taken when interpreting these intensities relative to a sample statistic such as the median. Since the median is easily influenced by the definition used to define a crisis, comparisons to the median are also sensitive. The intensities, however, do not lose their ordinal and proportional standing to each other. Thus, according to our measure of crisis intensity, Thailand's 1997 currency crisis will always be about 1.5 as intense as in Korea 1997 regardless of the sample used.

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distribution. Figure 5 and Figure 6 6 graph median real GDP growth for the ten most severe and ten least CC and SS occurring at time *t*. A stark difference in growth experiences is revealed: the median real GDP growth rate for the most severe CCs drops about 3% in the year of the crisis, followed by a 7% drop in following year. In contrast, the median output growth rate for the least intense CCs drops 0.6% at time *t*, only to exceed the pre-crisis growth rate the next year. The most intense SSs also exhibit a pronounced drop in real GDP growth, dropping by about 6% and another 2% at time *t* and *t*+1. In contrast, the growth rate drops just over 1% at time *t* for the least intense SSs, followed by an improvement of about 0.5% in the next year.

The descriptive evidence presented in this section suggests external crises occur with great variation in their intensities, and that this intensity is a relevant factor in the associated output loss of these crises. It remains to be seen, however, whether this relationship is changed when the joint occurrence of crises and policy responses to these crises are controlled for. To answer this, we turn to a formal regression analysis.

4. Regression Analysis

4.1 Dual-dummy Specification

One way to estimate the relationship between a crisis's magnitude and the associated output loss is a refinement of the standard dummy approach presented in chapter I. We define a dummy variable for particularly severe crises of both types and another dummy for less severe crises, again for both types—crises with magnitudes less than (greater than) the sample median are classified in the latter (former). The model is specified as:

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$$y_{it} = y_{it-1} + \alpha_i + \delta_t + \gamma_1 CCSD_{it} + \gamma_2 CCNSD_{it} + \gamma_3 SSSD_{it} + \gamma_4 SSNSD_{it} \sum_{j=1}^{n} \beta_j x_{ijt} + \varepsilon_{it} \quad (3)$$

where time invariant influences specific to country i are captured by the fixed effects term α, time specific shocks to all countries is captured by the dummy variable δ at year t, x_j is the j^{th} element of the vector of control variables, and ε is the disturbance term with a mean of zero and a constant variance.

Table 4 shows a series of regressions based on equation (3) estimated using the Arellano and Bond (1991) procedure.[11] Severe currency crises reduce real GDP growth by about 3.6% in the year of the crisis while their non-severe counterpart fluctuates between statistical insignificance and a reduction in growth by 2.9% at the 10% level. Similarly, severe sudden stops reduce growth by about 2.5% with the non-severe version failing to show any statistical significance. Chapter I found that mild evidence the lagged currency crisis dummy was significant—here, regressions AB(2) and AB(3) include the lagged versions of the severe and non-severe dummies, showing neither to be statistically significant. Similar to the findings in Hutchison and Noy (2005), we fail to find significance when interacting the severe and non-severe currency crisis dummies with banking crises and yet each of these events occurring independently remain significant.[12] Non-severe sudden stops interacted with banking crises, on the other hand, are highly significant (resulting in a nearly 4% drop in real GDP growth) but the non-severe sudden stop dummy acting independently is insignificant suggesting that non-severe sudden stops are only harmful to growth if concurrent with banking crises.

[11] See chapter I for details regarding this method of estimation.
[12] Results available upon request.

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4.2 Linear Pseudo-dummy Specification

The binary classification of crises into severe and non-severe episodes is insightful, yet suffers not only from the subjective nature of the classification but also the fact that much variation in crises' intensities exists within each classification (e.g., Morocco 1983 and Korea 1997 are both classified as severe currency crises even though the intensity of the latter is about 2.6 times that of Morocco's crisis). To overcome these drawbacks, we modify the specification AB (6) such that the dummy variables are replaced with the standardized deviation from the threshold used to define the crisis (see equations 1 and 2). We call these new variables *pseudo-dummies* for the fact that they are zero during non-crisis years but retain continuous data during crisis episodes.

Table 5 shows regressions based on a modified equation (3) where pseudo dummies are used in place of the dual dummies. The coefficients on the currency crisis pseudo dummy at time *t* is statistically significant at roughly -1.2, meaning that the typical currency crisis (defined by the median intensity) results in 0.75% concurrent reduction in real GDP growth , and yet the range with which these crises are predicted to reduce growth is between 0% and 5.1%. The 1-year lagged currency crisis pseudo dummy is also significant (see regressions AB (9) and AB (14)) and its estimated coefficient is larger than the concurrent effect, suggesting the largest impact from crises' magnitudes takes a year to manifest itself on the economy—a point also in line with Figure 5. The long-run effect[13] of a typical currency crisis on real GDP growth is estimated to be roughly -2.4%, with the most severe currency crises reaching nearly -19.0%.

[13] See essay 1 for details on how to calculate the long-run effect.

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The estimates are less dramatic for the sudden stop pseudo dummies. Despite being mostly statistically significant in the regressions in Table 5, the estimated impact of typical sudden stops is tiny at best. The typical sudden stop results in only a 0.25% decline in growth when using the largest estimated impact (regression AB (14)). And while the most intense sudden stop episode is estimated to result in an 8.4% drop in real GDP growth in the short run and 12.0% in the long run , it is worthwhile to recall that in only three sudden stop events did the yearly-median sudden stop intensity exceed 0.4 (see Figure 4).

4.3 Quadratic Pseudo-dummy Specification

The magnitude of a crisis may not impact real GDP growth in a linear fashion as modeled in Table 5. Table 6 specifies pseudo dummies quadratically to capture the possibility of diminishing returns. The currency crisis pseudo dummy remains highly significant, with the typical currency crisis resulting in about a 2.8% decline in real GDP growth in short run and 4.2% in long run. This estimate is markedly higher than obtained with the linear pseudo dummy, and is essentially the same estimate as the non-severe dummy reported in Table 4. The quadratic relationship between currency crises and real GDP growth reaches its minimum at a magnitude of about 1.8—about the same level of magnitude where the frequency of crises tapers off leaving only 7 extreme / outlier episodes (see

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Figure 5)—corresponding to a maximum loss in real GDP growth of about 5.5%. The sudden stop pseudo dummy is also mostly significant when specified quadratically, and like its linear specification the impact on growth is tiny (about -0.5% and -0.7% impacts on real GDP growth in short run and long run, respectively). The quadratic minimum is attained a magnitude of roughly 2.3 standardized unit which captures all but five sudden stop episodes in our sample, and corresponds to an output loss slightly over 4%.

5. Conclusion

The immediate aim of this paper is to examine the extent to which variation in emerging market's real GDP growth performances during external crises is explained by these crises' intensities. To this end, we find that currency crises have exhibited substantial heterogeneity in their intensities over the last 25 years. Given the wide variety in which these crises manifest themselves, researchers should take care when treating these crises as homogenous events. Indeed, real GDP growth loss estimates in the year of a currency crisis are shown to range anywhere from 0% to 5.5% once the crisis's magnitude has been taken into account. Sudden stop intensities have also exhibited a similar heterogeneity, but unlike currency crises, much of the variation seems to arise from a few particularly severe episodes concentrated in select years. This point may help to explain why there continues to be disagreement the economic cost of sudden stops. The evidence in this paper suggests that the overwhelming majority of sudden stops, by themselves, are not very costly events in terms of real GDP growth.

At a broader level, examining crises' intensities in the context of output loss motivates several important questions about what researchers consider to be crises.

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Theory and practice clearly suggest external crises can have adverse impacts on the real economy. Since the occurrence of a crisis (as manifested by a dummy variable) is by definition an event of a certain magnitude, empirical findings that the occurrence of a crisis matters for output loss—but not its magnitude—is cause for concern. The relationship between output loss and the intensity of a crisis may be highly nonlinear as suggested in Edwards (2004), in which case the magnitude for a sufficiently intense crisis could fail to exhibit a significant impact on the real economy. Yet finding such insignificance for the whole sample suggests that the sample is biased towards containing only the most intense crises.

An aspect not examined in this paper is the similarity, or lack of, between different measures of intensity of the crises. Indeed, this may help to explain why some papers (e.g., Guidotti, Sturzenegger, and Villar, 2004) find very little evidence that the magnitude of a crisis helps determine the cost of the crisis. We believe further research on this topic is important in reconciling the varied findings on severity and its effect on the real economy. Additionally, it would be interesting to examine how well models predicting the occurrence of crises perform when instead predicting their magnitudes. Lastly, further research is needed on the distribution of crisis intensities, across time and across countries and regions.

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Figure 1 - Distribution of Standardized Intensities for Currency Crises

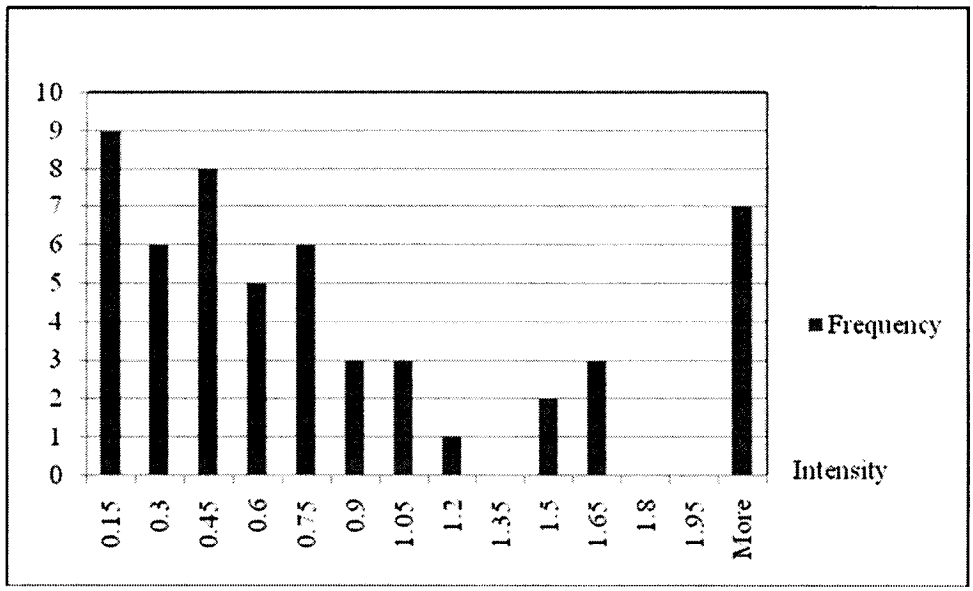

Figure 2- Distribution of Standardized Intensities for Sudden Stops

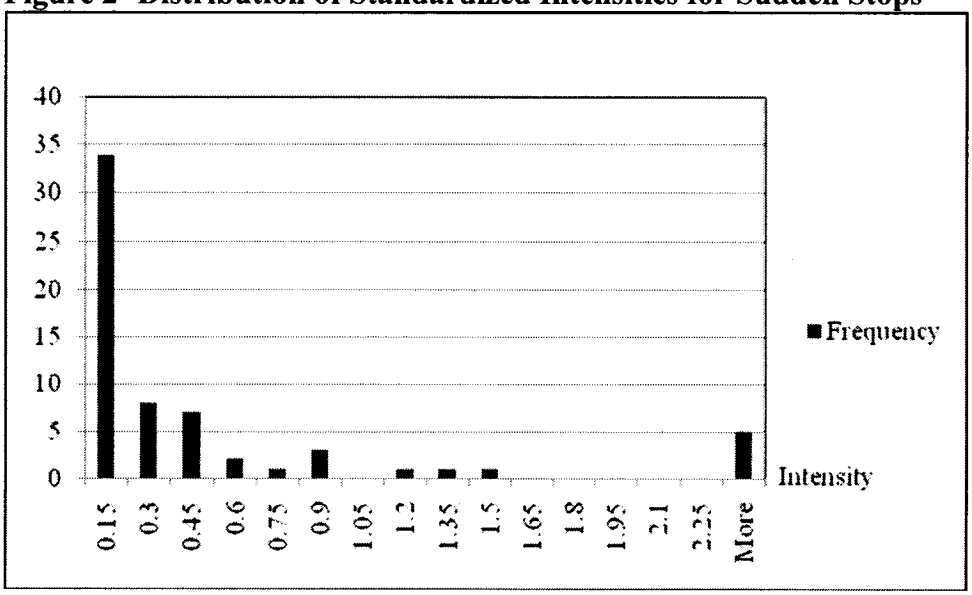

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Table 1 - Ten Most Intense External Crises

Currency Crises			Sudden Stops		
Country	Year	Severity	Country	Year	Severity
Malaysia	1997	4.27	Korea	1997	4.85
Singapore	1997	4.15	Thailand	1997	4.80
Bolivia	1989	3.36	Turkey	2001	3.09
India	1991	2.54	Argentina	2001	2.58
Trinidad & Tob.	1985	2.53	Brazil	2002	2.39
Jordan	1988	2.36	Indonesia	1997	1.41
Thailand	1997	2.30	Mexico	1995	1.29
Korea	1997	1.56	Egypt	1990	1.11
Chile	1985	1.54	Mexico	1982	0.84
Costa Rica	1981	1.51	Malaysia	1994	0.82

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Figure 3 - Median Currency Crisis Intensity by Year

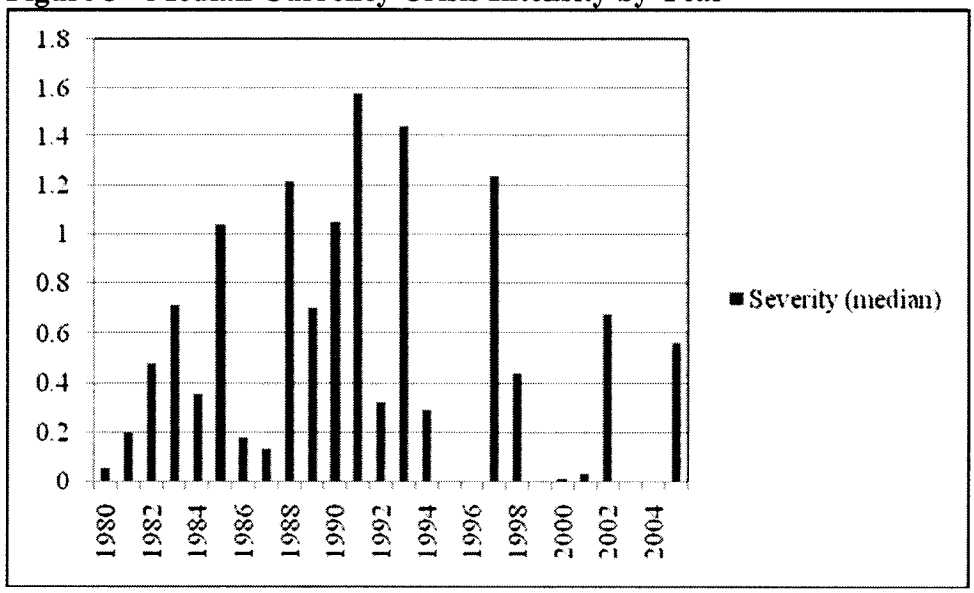

Figure 4 - Median Sudden Stop Intensity by Year

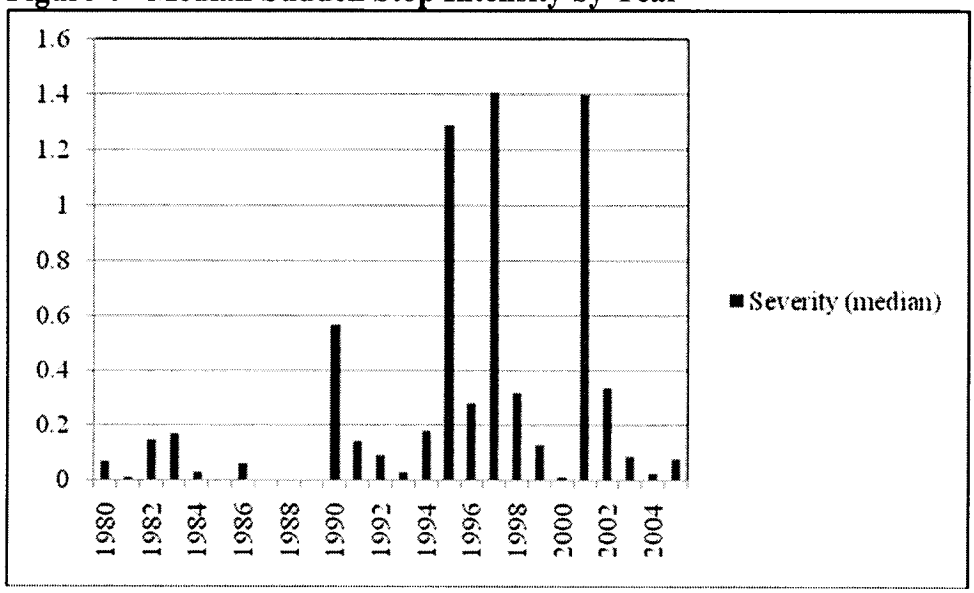

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Figure 5 – Median Real GDP Growth for the 10 Most / Least Intense CCs

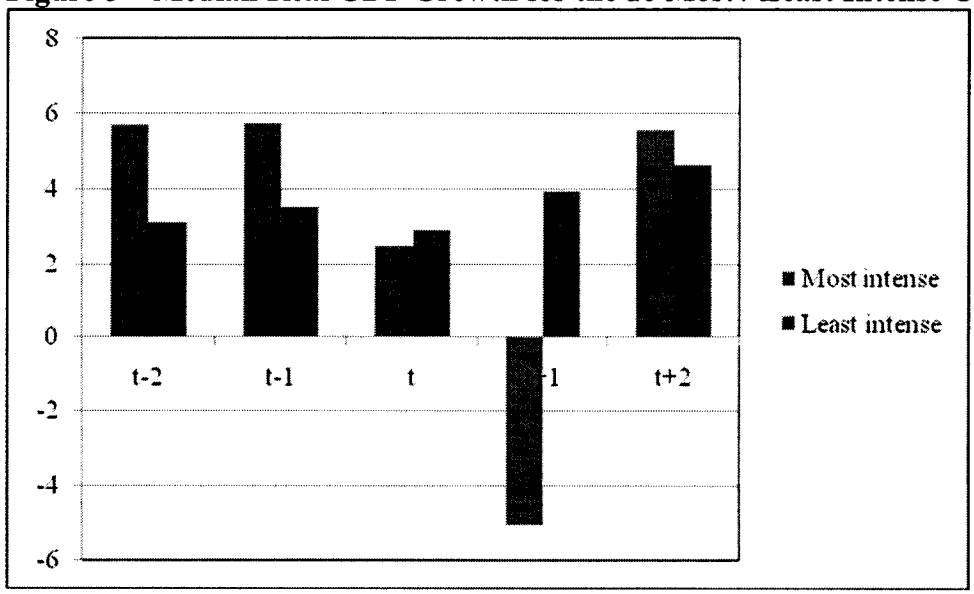

Figure 6 – Median Real GDP Growth for the 10 Most / Least Intense SSs

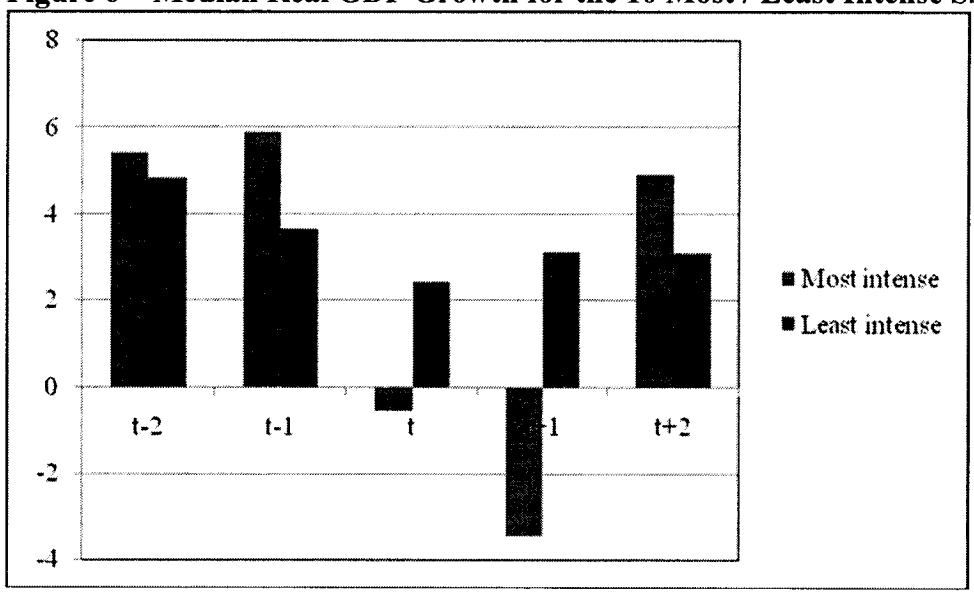

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Table 2 – Currency Crises by Country & Year

Country	1st Year	Severity	2nd Year	Severity	3rd Year	Severity
Albania	1997	0.845				
Argentina	1990†	1.152	2002†	0.682		
Belarus	1998†	0.000	2000†	0.006		
Belize						
Bolivia	1985	0.319	1989	3.360		
Brazil	1981	0.213	1994†	0.380		
Chile	1982±†	0.194	1985†‡	1.544		
Colombia	1985†	0.537				
Costa Rica	1981±	1.511				
Czech Republic	1997	0.311				
Egypt	1989	0.393	1990±	0.956	1991†‡	0.621
Estonia						
Georgia	1998	0.953				
Hong Kong	2000	0.020				
Hungary						
India	1991†	2.536				
Indonesia	1997±†	0.927	1998†‡	0.529		
Jordan	1988	2.365	1989†‡	1.493		
Korea	1980	0.059	1997±†	1.557		
Latvia	2005	0.693				
Lithuania	2005	0.433				
Malaysia	1997±†	4.271				
Malta	1992	0.323				
Mexico	1982±†	0.480	1986†‡	0.181	1987†	0.136
Morocco	1981†	0.128	1983†‡	0.588		
Panama						
Philippines	1983±†	0.842	1984†‡	0.357	1997±	0.818
Poland	1986	0.517	1988	0.075	1989	0.644
Russia	1994‡	0.294	1998†	0.351		
Singapore	1997	4.153				
Slovak Republic						
Thailand	1997±†	2.299				
Trinidad and Tobago	1985†	2.532	1993†	1.443		
Tunisia	1981	0.186				
Turkey	1994±†	0.290	2001±†	0.038		
Uruguay	1982†	0.619				
Venezuela, Rep. Bol.	1986	0.007	1989	0.707		

No. of Crises	53	Mean	0.884	Max.	4.271	Nobs	26
St. Dev.	1	Median	0.537	Min.	0.000	Nocs	73

Note: ± indicate an above crisis occurred simultaneously with a sudden stop. (12)
† indicate an above crisis occurred simultaneously with a banking crisis. (29)
‡ indicate an above crisis occurred simultaneously with a soverienge debt defult crisis. (8)

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Table 3 - Sudden Stops by Country & Year

Country	1st Year	Severity	2nd Year	Severity	3rd Year	Severity	4th Year	Severity
Albania	1990	0.037	1995†	0.030				
Argentina	1994	0.083	2001†	2.584				
Belarus	2005	0.078						
Belize	1994	0.002	2001	0.004	2003	0.003		
Bolivia	1982	0.011	2003†	0.033				
Brazil	1999†	0.239	2002	2.393				
Chile	1982†	0.149	1983†	0.171	1998	0.298	2004	0.068
Colombia	1998	0.322	1999†	0.424				
Costa Rica	1981	0.014	1996†	0.026	2000	0.069		
Czech Republic	2003	0.143						
Egypt	1990	1.106						
Estonia	1998†	0.020						
Georgia								
Hong Kong								
Hungary	1996	0.545						
India	1995†	0.605						
Indonesia	1997†	1.408						
Jordan	1992‡	0.094	1993	0.034				
Korea	1986	0.061	1997†	4.851				
Latvia	2000	0.009						
Lithuania	1999	0.007	2000	0.003	2004	0.028		
Malaysia	1994	0.815	1997†	0.421				
Malta	1995	0.042	2000	0.000	2004	0.009		
Mexico	1982†	0.837	1995†	1.294				
Morocco	1995	0.205						
Panama	1980	0.067	2000	0.158	2002	0.088		
Philippines	1983†	0.287	1997	0.559	1998†	0.776	2001†	0.222
Poland	1994†	0.281						
Russia								
Singapore								
Slovak Republic	2003	0.394						
Thailand	1997†	4.805						
Trinidad and Tobago	1984†	0.034	1999	0.021				
Tunisia	2000	0.019						
Turkey	1991†	0.145	1994†	0.047	1998	0.388	2001†	3.087
Uruguay	1983†	0.065	2002†	0.339				
Venezuela, Rep. Bol.	1994†	0.362						

No. of Crises	63	Mean	0.503	Max.	4.851	Nobs	26
St. Dev.	1	Median	0.143	Min.	0.000	Nocs	73

Note: † indicate an above crisis occurred simultaneously with a banking crisis. (27)
‡ indicate an above crisis occurred simultaneously with a soverienge debt defult crisis. (1)

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Table 4 – Dual Dummy Regressions

Independent variable	AB (1)	AB (2)	AB (3)	AB (4)	AB (5)	AB (6)	AB (7)
Real GDP growth (t-1)	0.33***	0.31***	0.33***	0.35***	0.32***	0.34***	0.34***
	(4.62)	(4.23)	(4.60)	(4.70)	(4.42)	(4.69)	(4.70)
Non-severe currency crisis dummy (t)	-2.82		-2.54			-2.89*	-2.90*
	(-1.64)		(-1.53)			(-1.67)	(-1.66)
Severe currency crisis dummy (t)	-3.58***	-3.70***				-3.59***	-3.59***
	(-2.93)	(-2.71)				(-2.94)	(-2.98)
Non-severe currency crisis dummy (t-1)		-2.51					
		(-1.64)					
Severe currency crisis dummy (t-1)			-0.08				
			(-0.06)				
Currency crisis dummy (t)				-3.23***	-3.57***		
				(-3.27)	(-3.79)		
Non-severe Sudden stops dummy (t)				-1.27	0.03	-1.31	-1.28
				(-1.40)	(0.03)	(-1.43)	(-1.37)
Severe Sudden stops dummy (t)				-2.49***		-2.42***	-2.48***
				(-2.94)		(-2.85)	(-3.02)
Sudden stops dummy (t)	-1.99***	-1.89**	-2.50***				
	(-2.83)	(-2.46)	(-3.55)				
Banking crisis dummy (t)	-0.81**	-0.72*	-0.86**	-0.77*	-0.72*	-0.78*	-0.79**
	(-2.02)	(-1.78)	(-2.1)	(-1.93)	(-1.86)	(-1.96)	(-1.98)
Sovereign Debt Dummy (t)	-0.84	-0.70	-0.97	-1.16*	-0.89	-1.18*	-1.08
	(-1.36)	(-1.15)	(-1.49)	(-1.68)	(-1.39)	(-1.70)	(-1.49)
Interaction between banking crisis (t)& non-severe sudden stop (t)					-4.13**		
					(-2.22)		
m2 money (%Δ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.76)	(0.99)	(0.76)	(0.76)	(0.71)	(0.77)	(0.80)
Fiscal expenditure (%Δ)	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00
	(0.66)	(-1.01)	(0.66)	(-0.64)	(0.59)	(-0.66)	(0.65)
Trade openness (% of GDP)	0.00	0.00	0.00	0.01	0.00	0.01	0.00
	(1.17)	(1.03)	(1.04)	(1.30)	(1.26)	(1.30)	(1.24)
International reserves (%Δ)							-0.00
							(0.60)
Observations/ Instruments	618/557	618/545	618/566	618/556	618/564	618/566	617/570
Number of id	34	34	34	34	34	34	34
Sargan p-value	0.45	0.43	0.32	0.37	0.34	0.39	0.33
AR(1) p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AR(2) p-value	0.37	0.40	0.48	0.35	0.45	0.34	0.41

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

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Table 5 - Linear Pseudo Dummy Regressions

Independent variable	AB (8)	AB (9)	AB (10)	AB (11)	AB (12)	AB (13)	AB (14)
Real GDP growth (t-1)	0.32***	0.30***	0.31***	0.30***	0.33***	0.31***	0.30***
	(4.42)	(4.18)	(4.10)	(3.99)	(4.39)	(4.13)	(3.85)
Pseudo currency crisis dummy (t)	-1.24*	-1.21**				-1.25**	-0.94**
	(1.95)	(2.01)				(2.16)	(2.03)
Pseudo currency crisis dummy (t-1)		-1.91***					-1.52**
		(2.91)					(2.23)
Currency crisis dummy (t)			-3.53***	-3.18***	-3.27***		
			(3.28)	(3.24)	(3.28)		
Pseudo sudden stops dummy (t)			-0.77	-0.93*	-0.11	-1.07*	-1.73**
			(1.50)	(1.85)	(0.17)	(1.91)	(2.29)
Pseudo sudden stops dummy (t-1)				-1.52**			-1.34
				(2.33)			(1.45)
Sudden stops dummy (t)	-2.12***	-2.12***					
	(2.89)	(2.94)					
Banking crisis dummy (t)	-0.93**	-0.73*	-0.82**	-0.66	-0.79*	-0.95**	-0.61
	(2.29)	(1.76)	(1.96)	(1.54)	(1.88)	(2.31)	(1.40)
Sovereign Debt Dummy (t)	-0.85	-0.64	-1.03	-1.05*	-1.08	-0.92	-0.65
	(1.40)	(1.02)	(1.60)	(1.65)	(1.55)	(1.47)	(1.08)
m2 money (%Δ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.95)	(0.95)	(0.69)	(0.72)	(0.71)	(0.89)	(0.96)
Fiscal expenditure (%Δ)	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.92)	(0.94)	(0.57)	(0.62)	(0.59)	(0.86)	(0.93)
Trade openness (% of GDP)	0.00	0.01	0.01	0.00	0.01	0.00	0.01
	(1.13)	(1.19)	(1.37)	(1.16)	(1.40)	(1.18)	(1.20)
International reserves (%Δ)							
Observations / instruments	618/547	618/552	618/550	618/555	618/565	618/550	618/497
Number of id	34	34	34	34	34	34	34
Sargan p-value	0.45	0.25	0.39	0.22	0.35	0.47	0.42
AR(1) p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AR(2) p-value	0.38	0.47	0.41	0.48	0.37	0.37	0.43

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

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Table 6 - Quadratic Pseudo Dummy Regressions

Independent variable	AB (15)	AB (16)	AB (17)	AB (18)	AB (19)
Real GDP growth (t-1)	0.34***	0.34***	0.33***	0.33***	0.32***
	(4.56)	(4.47)	(4.39)	(4.41)	(4.93)
CC(t)	-5.76***		-6.13***	-6.08***	-10.09***
	(-3:65)		(-3.76)	(-3.74)	(-3.31)
$CC^2(t)$	1.61***		1.67***	1.66***	3.60***
	(3.34)		(3.37)	(3.34)	(2.87)
Currency crisis dummy (t)		-3.29***			
		(-3.33)			
SS(t)		-3.10**	-3.73**	3.75**	-1.11
		(-2.16)	(-2.31)	(-2.34)	(-0.54)
$SS^2(t)$		0.59*	0.80**	0.80**	0.25
		(1.76)	(2.15)	(2.14)	(0.55)
Sudden stops dummy (t)	-2.08***				
	(-2.90)				
Banking crisis dummy (t)	-0.95**	-0.80*	-0.91**	-0.92**	-1.27***
	(-2.31)	(-1.95)	(-2.20)	(-2.22)	(-2.59)
Sovereign debt dummy (t)	-1.10	-1.16	-1.12	-1.04	-0.22
	(-1.51)	(-1.66)	(-1.56)	(-1.39)	(-0.30)
M2 money (% Δ)	0.00	0.00	0.00	0.00	
	(0.82)	(0.72)	(0.77)	(0.79)	
Fiscal expenditure (% Δ)	-0.00	-0.00	-0.00	-0.00	-0.01***
	(-0.76)	(-0.60)	(-0.72)	(-0.72)	(-5.22)
Trade openness (% of GDP)	0.00	0.01	0.00	0.00	-0.00
	(1.10)	(1.31)	(1.04)	(1.01)	(-0.57)
International reserves (% Δ)				-0.00	0.00
				(-0.42)	(-0.42)
Relative interest rate (% Δ)					0.03***
					-4.73
Critical pseudo currency crisis	1.79		1.83	1.83	1.40
Maximum GDP loss	-5.14		-5.62	-5.55	-7.07
Median pseudo currency crisis	0.54		0.54	0.54	0.54
GDP loss at median pseudo currency crisis	-2.64		-2.82	-2.80	-4.40
Critical pseudo sudden stops		2.64	2.33	2.35	2.21
Maximum GDP loss		-4.09	-4.35	-4.41	-1.22
Median pseudo sudden stops		0.14	0.14	0.14	0.14
GDP loss at Median pseudo sudden stops		-0.42	-0.51	-0.51	-0.15
Observations / instruments	618/567	631/563	618/571	618/572	617/419
Number of id	34	34	34	34	26
Sargan p-value	0.43	0.33	0.42	0.38	0.39
AR(1) p-value	0.00	0.00	0.00	0.00	0.00
AR(2) p-value	0.41	0.41	0.52	0.57	0.88

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

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CHAPTER III

HOW SUDDEN STOPS AND BANKING CRISES INTERACT: A PANEL VECTOR AUTOREGRESSION ANALYSIS

1. Introduction

A rich body of empirical literature analyzing the economic costs of sudden stops has emerged since the late 1990s. In particular, attention has focused on how this event works with and independently of the banking sector when the latter is in distress. Mounting evidence in this literature suggests the adverse effects of sudden stops manifest themselves through a distressed banking sector, presumably via a misallocation of credit. The implications of this finding are important for emerging markets: it is not the opening of financial markets (and hence the susceptibility to sudden stops) per se that risk painful recessions, but rather opening financial markets concomitantly with an unsound domestic banking sector.

Despite the important connection between the banking crises and sudden stops, little is known *how* these crises interact. This shortcoming stems from the typical methodology used by researchers to estimate the impact of these crises on the real economy. This methodology involves measuring crises with dummy variables and then regressing these dummies on real GDP growth. Regression methods employed often involve controlling for the endogeneity of crises using instrumental variables, as well as eliminating the bias which results when the dependent variable is specified autoregressively.[1] While this approach is useful in obtaining estimates of the impacts

[1] See chapter I for a discussion of dynamic panel bias.

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these crises have on the economy, information regarding the nature of the interaction is limited to a point estimate describing the net effect of the interaction on the economy.

To shed greater light on how sudden stops interact with banking crises I apply an unbalanced panel vector autoregression (VAR). My paper contributes to the cost-of-crises literature in two important ways. First, by using a VAR on panel data I am able to consider the complex inter-relationships among the crises themselves, as well as with the real economy, while allowing for unobserved heterogeneity across countries (i.e., fixed effects). Second, the effect of a shock precipitated by either a banking crisis or a sudden stop can be isolated to each variable in the VAR system by analyzing orthogonalized impulse response functions, thus providing insight into the dynamics between crises and the real economy.

This paper outlines into 4 sections. The second section provides the literature review of the panel VAR. Section 3 represents the methodology and data used in this paper. Section 4 demonstrates the basic causality tests on the banking crisis alone, sudden stop alone and the concurrence of both types. The empirical result and conclusions can be found in the section 5 and section 6, respectively.

2. Literature Review

A VAR is a multivariate simultaneous equation system, in which each variable in the system is regressed on a finite number of lags of all variables jointly considered. An advantageous feature of this method is that it treats all variables in its system as endogenous variables. Thus, it is suitable to adopt this model for observing relationships

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where one is not sure whether variables are exogenous.[2] Feedback effects between variables are observable since coefficients are obtained for each lagged variable in the system regressed on each variable. Additionally, a VAR allows one to trace of the effect of a shock to variable on another by examination of the impulse response functions.

This model has been often used with time series data over the past couple decades. Recently, however, the VAR model has gained prominence in a panel data setting. By merging traditional fixed effect regressions with the time series VAR, this method allows the benefits of the VAR described above to be applied to multiple cross-sections. Additionally, a panel VAR eliminates the country-specific effects (i.e., fixed effects) which can generate the endogeneity problem of lagged values of the dependent variable and result in omitted variable bias.[3]

An early paper to apply a panel VAR to the external crisis literature is Lee and Chinn (1998). They study the impact of money and productivity shocks on current accounts and real exchange rates for seven major industrialized countries spanning from 1979Q2 to 1996Q1[4]. For the identification problem, they employ Blanchard-Quah (1989)[5] not only to avoid the ordering problem, but also to avoid assuming a particular macroeconomic paradigm of assuming the degree of exogenous and endogenous for the system variables. Thus, the short-run movements of the endogenous variables can depend both on the dynamics of the exogenous variables and the unspecified intrinsic dynamics of the model. They perform a lag-length test using Akaike information criterion (AIC)

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[2] Enders (1995) explained these benefits in more detail. One can let the time path of system variables to be affected by current and past realizations of these variables.

[3] I discuss the process of eliminating time specific shocks and country specific fixed effects in the methodology section.

[4] Contains the United States, Cananda, the United Kingdom,Japan, Germany, France and Italy.

[5] This strategy relies on long-run economic restrictions and avoids the contemporaneous ordering restrictions of standard VAR analysis.

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and Schwartz Bayesian criterion (SBC). These measures are calculated to find a reasonable approximation to the infinite-order VAR. The results suggest including 2 lagged instruments. Lee and Chin find the empirical results are consistent with the sticky price intertemporal model by Obstfeld and Rogoff (1995). Permanent productivity shocks have large long term effects on the real exchange rate, relatively small effects on the current account, while money shocks have large effects on the current account and exchange rate in the short run, but neither variable in the long run.

Terada-Hagiwara (2005) investigates the causes behind real exchange rate devaluation events with particular attention paid to the Sudden Stop of capital flows. The quarterly data contains eight emerging countries spanning from 1980Q1 to 2000Q4.[6] He uses measures for the world interest rate, terms of trade, monetary policy, productivity, demand, and the current account (used to represent a sudden stop shock) as the system regressors. The methodology is similar to Lee and Chinn (1998). He argues that there is an asymmetric response across sudden stop and tranquil times. Terada-Hagiwara also compares the sudden stops between those that happened during the 1980s debt crises and those that happened in the 1990s, arguing that sudden stops have become more prominent in explaining the real exchange rate disturbances.

Powell et al. (2002) examines the determinants, consequences, and inter-relationships among capital inflows and outflows while controlling for the interaction between them. The variables include capital inflows, private capital outflows, real exchange rate, GDP growth and fiscal balance. With these 5 variables, the authors perform a panel VAR regression for all developing countries from 1980-1999. In addition, they also split poor countries out and examine if there is any difference in the

[6] Argentina, Brazil, Chile, Mexico, Indonesia, Korea, Philippines, and Thailand.

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results. To eliminate the country-specific effect, the Helmert procedure is applied.[7] They employ the one lagged repressors as instruments and estimate the coefficients by system GMM. Fixed effects are removed by subtracting the mean values of variables calculated annually across countries. To depict the impulse response functions, Monte Carlo simulation is used to generate the standard error bands. They find that there is evidence of vicious and virtuous cycles: lower inflows/higher outflows lead to lower growth and, among other effects, result in a higher fiscal deficit, which feeds back to lower inflows/higher outflows. Powell et al. conclude it is particularly important for developing countries to maintain prudent policies, and especially adequate fiscal discipline, to avoid vicious and reinforce virtuous cycles.

Love and Zicchino (2002) use firm-level panel data from 36 countries to study the dynamic relationship between firms' financial conditions and investment. They split the sample into two groups: high financial development countries and low financial development countries using median value as the criterion. Their methodology is the same as Powell et al. (2002). They find that the impact of the financial factors on investment is significantly larger in countries with less developed financial systems. Thus, the accumulation of capital will be less efficient in countries that are less financially developed, ultimately, leading to slower economic growth.

Leblebbicioglu (2005) employs a panel VAR model to observe how the dynamical behavior of consumption and output differ between financially developed and underdeveloped countries in response greater financial openness. She uses annual data for 76 countries from 1980-2001, and classifies these countries into two groups based on

[7] This method was created by Arellano and Bover (1995) and involves forward mean differencing, i.e. the mean of all future observations available for each series year. It avoids biased coefficients, which will take place if one applies the mean differencing process to eradicate the country specific effect instead. .

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their level of financial development. The VAR system has five variables: consumption, GDP, real exchange rate, terms of trade and gross private capital flows. She first investigates the time series properties of the data by running unit root tests and transforming the non-stationary series into log levels. The time specific effects and country-specific fixed effects are eliminated by the mean values of variables similar manner as in Powell et al. (2002) and first differencing, respectively. A Cholesky decomposition is applied, allowing the VAR system to recover its structural form.[8] The VAR coefficients and the impulse response functions are estimated followed Powell et al. (2002) and Love and Zicchino (2002). The main result of this paper is that in the financially developed countries, consumption decreases in reaction to an increase in financial integration, while the consumption in the developing countries increases in reaction to a similar one. This is a gauge of the different consumption-saving behavior in these two group countries. This also highlights the importance of the level of financial development in the financial integration debate.

3. Methodology

The literature reviewed in the previous section illustrates that the panel VAR has been applied to a wide variety of topics, including topics similar to the one explored in this paper. To begin the analysis, I employ the same country sample of 37 emerging markets as in chapter I from 1980Q1 to 2005Q4.[9] The onset of banking crises and

[8] The identifying assumption implies that the variables appeared earlier in the system are more exogenous and the one that appear later are more endogenous.

[9] Quarterly data was used in this paper since many interactions and dynamics are lost when annual data is used. Separately, quarterly data is more likely to make the results representative of a more concentrated

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sudden stops are obtained using the crisis dates from chapter I. Since this method requires the translation of annual dates (chapter I) to a quarterly frequency, I assume the onset of all crises begins in the first quarter.[10] While this assumption obviates the use of potentially more precise start dates for sudden stops, dating these episodes is notoriously imperfect. Furthermore, this assumption allows me to compare the results obtained here with chapter I which also considered the interaction between sudden stops and banking crises, albeit in a different fashion.[11] Lastly, in order to capture the interactions between sudden stops and, banking crises, and the real economy, I assume a crisis window taking the data only 1-year before and 2-year after the onset of a crisis.

Three sub-samples are distinguished: the first and second samples are composed of crisis periods when a banking crisis occurs independently of a sudden stop, and vice versa; the third sample is when both crises occur concurrently which is defined when the two crises occur in the same period or within 1-year lag/lead of each other. Separating the data in this manner enables me to compare the interactions of each crisis and the real economy with the interactions occurring when both crises occur jointly.

The reduced form of the panel VAR model used in this paper is:

$$A_0 Y_{it} = A(L)Y_{it} + \eta_i + \delta_t + u_{it} \qquad (1)$$

where $Y'_{it} = [credit_{it}, fa_{it}, y\_growth_{it}]$ is the vector of endogenous variables, η_i is a vector of country-specific effects independent of time, δ_t is a time-specific shock

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group of countries since less emerging markets report quarterly data, and those that do, account for a greater proportion of the sample.

[10] Dates for banking crises were taken from external sources which reported them at an annual frequency.

[11] Sudden stops dates are constructed using annual data from 1980 to 2005, defined as in Frankel and Cavello (2004). A sudden stop occurs when a current account deficit is accompanied with a fall in the financial account surplus more than one standard deviation. The banking crises take place when either Caprio et al. (2005) and Demirguc-Kunt and Detragiache (2005) identify such an episode. See chapter I for more details.

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common to all countries, u_{it} is the vector of structural shocks, and $A(L)$ is the matrix polynomial in the lag operator of order 3. This lag order is based on lag-length tests based on the Akaike information criterion (AIC) and Schwartz Bayesian criterion (SBC). These criteria change little between lags 1 and 3, after which there is substantial deterioration of these criteria. Although criteria for the 2nd order lag is better than with 3 lags, I opt for the latter since studies using annual data (including chapter I) have found statistical significance for the interaction of sudden stops and banking crises at a 1-year period.

The variables in vector Y_{it}' are domestic credit ($credit_{it}$), financial account (fa_{it}) and real GDP growth (y_growth_{it}). Looking at the movements of these variables is superior to using crisis dummies in the typical crisis impact model. The benefit is that it takes into account the magnitude of a crisis, which is important to make a firm distinction. As discussed in my second essay, there is no a priori reason these magnitudes should be viewed as one and the same.

Three variables are of primary interest in the VAR system: financial account, real GDP growth, and domestic credit. The financial account is also included in the VAR system and represents the sudden stop. A sudden stop is defined using the financial account (see chapter I), thus its inclusion here accounts for the magnitude of the event. The impact of banking crises and sudden stops on the economy is observed by including real GDP growth in the VAR system. In addition to data availability, domestic credit is used in the VAR system since it has been found to be a robust indicator of banking crises (c.f., Eichengreen and Arteta, 2002). During a banking crisis, the banking system fails to act as a financial intermediary and transmit funds from savings to investments due to the

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problems of moral hazard and adverse selections. This can result in worsened real output since the resources in the economy cannot be allocated efficiently (e.g., Hutchinson and Noy, 2005; Joyce and Nabar, 2007; Bernanke and Gertler, 1989; Bernanke, Gertler, and Gilchrist, 1996; Kiyotaki and Moore, 1997). In addition to the main variables of interest, I include the real interest rate as a control variable since this represents monetary policy that can affect credit and the intensity of sudden stops.[12]

The next step is to transform the structural model in equation (1) by subtracting the mean values of each variable calculated across all countries for each year. This transformation removes time-specific effects, taking the form:

$$A_0 \tilde{Y}_{it} = A(L)\tilde{Y}_{it} + \tilde{\eta}_i + \tilde{u}_{it} \qquad (2)$$

where the tildes represent variables in deviation form. Next, country-specific effects are eliminated because they are correlated with lagged dependent variables which results in dynamic panel bias.[13] This is done by taking the first difference of equation (2):

$$A_0 \Delta\tilde{Y}_{it} = A(L)\Delta\tilde{Y}_{it} + \Delta\tilde{u}_{it} \qquad (3)$$

Equation (3) can be estimated using ordinary least square (OLS). The OLS uses lagged regressors as instruments to estimate the coefficients.[14] The matrices of the impulse response functions are constructed from the estimated VAR coefficients. The

[12] I also attempted to control for fiscal policy response to these crises using data for budget deficit/surplus. However, a lack of data precluded this variable from being included in the analysis.
[13] See Nickel (1981) for a rigorous derivation of dynamic panel bias.
[14] I test the robustness of this method of estimation by performing the system GMM to estimate the coefficients followed Powell et al. (2002), Love and Ziccino (2002) and Leblebbicioglu (2005). The results for banking crisis and sudden stops alone show consistency. Unfortunately, there is not enough degrees of freedom to employ the system GMM with the joint occurrence between banking crisis and sudden stops crisis sample.

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standard errors and confidence intervals of the impulse response functions are obtained from Monte Carlo simulations with 500 iterations.

4. Descriptive Statistics

I obtain a total of 58 sudden stops[15] and 54 banking crises using the sample of 37 emerging markets and crisis dates from chapter I during 1980Q1-2005Q4. The joint occurrence of these crises is defined as when they occur in the same period or within 1-year lag/lead of each other, which yields 24 such episodes. I begin examining the data by performing Granger causality tests with 3 lags for each of the three sub-samples. The results of these tests are shown in Table 1, Table 2, and Table 3.

Table 1 shows that there are no statistically significant relationships in terms of Granger causality during the periods of banking crises when sudden stops do not occur. In Table 2, the tests suggest that real GDP growth at time *t* Granger causes the financial account the following period during the sudden stops. This finding is expected since foreign investors consider output growth as a leading indicator of economic health, hence a downturn in the economy in the right circumstances can precipitate a sudden stop.

Interestingly, Table 3 shows that changes in both domestic credit and the financial account tend to precede (i.e., Granger cause) real GDP growth during the joint occurrence of banking crises and sudden stops. The direction of Granger causality between real GDP growth and these variables is not, however, symmetric—suggesting that most jointly occurring banking crises and sudden stops are not preceded by adverse changes in the real economy. The Granger causality test is only a test of precedence and neglects, among other things, the inter-relationships between the variables. To incorporate these

[15] If there is a sudden stop following another one in the previous year, I count it as the same event.

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inter-relationships into the analysis, I estimate the panel VAR model for each of the sub-samples in the next section.

5. VAR Estimates

The empirical analysis is shown in Table 4, Table 5, and Table 6. I report the estimates of the coefficients of the system given in equation (3) where the fixed effects and the country-specific effects have been removed. Table 4 shows the results of the model during banking crisis episodes in the absence of sudden stops, while Table 5 presents the same model for sudden stops when banking crises have not occurred. Table 6 represents the same model during the joint occurrence of sudden stop and banking crisis. Figure 1, Figure 2, and Figure 3 depict the impulse response functions and the 5% error bands generated by Monte Carlo simulations with 500 iterations of the model during the banking crisis episodes alone; sudden stops episodes alone and the model during the join occurrence of sudden stops and banking crisis, respectively.

As shown in Table 4 and Figure 1, the persistence of domestic credit, financial account, and real output growth are the dominating factors when banking crises occur in the absence of sudden stops. The interaction between domestic credit and the financial account is statistically insignificant, which is expected since no sudden stop is occurring. What is less expected, however, is that credit plays no role here.

In contrast to the previous result, Table 5 and Figure 2 show the impact of the financial on real GDP growth to be statistically significant during sudden stops. The effect of the financial account takes about 2 quarters to occur, and remains significant for at least 1 year. This is expected since, during sudden stop episodes without banking

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crises, the decrease in financial account as a supply of foreign funds for domestic investment leads to the fall in real output. Real GDP growth explains the financial account positively as expected since foreign investors perceive an economic growth as an indicator of invest their funds in a country. This last finding corresponds with results from the Granger causality tests.

The panel VAR results when both crises occur jointly are shown in Table 6 and Figure 3. Real output growth deteriorates through both the financial account channel and the domestic credit channel. The magnitude of the impact from financial account channel on output loss is about twice of that during the sudden stops alone, confirming that sudden stops occurring with banking crises are particularly harmful to the real economy. Furthermore, the effect of the financial account on real GDP growth occurs 1-period sooner than when the sudden stop occurs independent of banking crises, and this effect is sustained for at least 1-year. A reduction in credit adversely affects output growth with a 3-quarter lag.

Table 6 also shows domestic credit being explained by the financial account negatively in the previous quarter. In the presence of banking crises, the domestic credit can play an adverse role in the economy, since the problems of moral hazard and adverse selection plague the ability of financial intermediaries from efficiently allocating resources. The increase in credit, albeit brief, can be interpreted as a natural response by financial intermediaries to an increased demand for liquidity following a sudden stop. The credit, however, is not allocated efficiently, and as the VAR regression shows, this increase in credit adversely affects the real economy. Alternatively, the explanation of this relationship could be the temporal association between domestic credit and real GDP

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growth. The recession in real output leads to increase in liquidity, and ultimately, domestic credit expansion. The evidence obtained here suggests that the effect of a banking crisis on real GDP growth is worsened by the presence of a sudden stop, yet there is no evidence that a sudden stops' effect on output is worsened by a banking crisis.

To check the robustness of the model, panel VARs were run using various combinations of credit, real GDP growth, and the financial account with several lag orders. Additionally, M2 money growth, inflation, the foreign exchange rate, and the real interest rate were included as control variables. The basic results remained unchanged—including the statistically significant negative relationship between the financial account and credit—although I include only the VAR results showing the inclusion of the real interest rate in Table 7, Table 8, Table 9 for brevity. Indeed, Table 10, Table 11, and Table 12 report the result of the benchmark model using the time spanning of 1980 – 1996 to show the robustness across time period. Yet, one should be aware that the degree of freedoms for this time span is low.

6. Conclusion

This paper uses a panel vector autoregression to investigate how sudden stops and banking crises interact with each other and how this interaction impacts real GDP growth. Jointly occurring crises are more harmful to the real economy than when only one of these crises occurs. Additionally, a decline in the financial account during the joint occurrence lead to about twice size larger of output loss comparing to that during the sudden stops in the absence of banking crises. Sudden stops occurring jointly also impact real output quicker than when occurring alone. These findings are evidence that sudden

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stops and banking crises interact in a fashion that is above and beyond their individual effects, a point which is consistent with the literature.

Whereas past empirical studies on the interaction of sudden stops and banking crises have observed the net effect of the interaction of these crises, I am able to observe this interaction at a greater level of detail. The interaction this paper studies is through the channel of domestic credit. In the presence of banking crises, the domestic credit can play an adverse role in the economy, since the problems of moral hazard and adverse selection plague the ability of financial intermediaries from efficiently allocating resources. The results obtained in this paper show a negative relationship between the financial account and domestic credit, although this relationship holds only for the immediate period after the onset of a sudden stop. This can be interpreted as a natural response by financial intermediaries since the abrupt cessation of foreign capital inflow has led to an increased demand for liquidity. Since the banking sector is itself in crisis, much of the increased credit is not allocated efficiently. Furthermore, the inefficient allocation of credit results in an adverse impact on the economy. Alternately, the interpretation of this relationship might be the temporal association of real output growth and domestic credit. An increase in the demand of domestic credit occurs to ease the recession.

There are, of course, several caveats to the findings in this paper. The primary goal of this paper is to observe the interrelationships among banking crises, sudden stops, and real output. In this regard, the panel VAR is very informative. However, this benefit is at the expense of obtaining forecastable parameter estimates. This point has been widely discussed by such as Sim (1980), Doan (1992), and Enders (1995). Lastly, this

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paper examines crises beginning 1-year prior to their onset until 2-years later. While this is done in part because calculating the start and end dates of crises is tremendously difficult, it also helped increase the degrees of freedom. Obtaining better quality data would be useful for future research. Moreover, one might apply the methodology to examine the interrelationships of other types of external crises.

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Table 1 - Granger Causality Tests: Banking Crises without Sudden Stops

Variable	Credit (t)	Financial Account (t)	Real GDP growth (t)
Credit (t-1)	n.a. n.a.	0.14 (0.93)	0.05 (0.98)
Credit (t)	n.a. n.a.	0.43 (0.73)	0.12 (0.95)
Credit (t+1)	n.a. n.a.	0.44 (0.73)	0.96 (0.41)
Financial Account (t-1)	0.68 (0.57)	n.a. n.a.	0.42 (0.74)
Financial Account (t)	0.52 (0.67)	n.a. n.a.	0.16 (0.93)
Financial Account (t+1)	0.48 (0.69)	n.a. n.a.	0.09 (0.96)
Real GDP growth (t-1)	0.96 (0.41)	0.30 (0.83)	n.a. n.a.
Real GDP growth (t)	1.01 (0.39)	0.79 (0.50)	n.a. n.a.
Real GDP growth (t+1)	0.70 (0.55)	0.75 (0.52)	n.a. n.a.

P-values are in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

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Table 2 - Granger Causality Tests: Sudden Stops without Banking Crises

Variable	Credit (t)	Financial Account (t)	Real GDP growth (t)
Credit (t-1)	n.a. n.a.	0.27 (0.85)	0.67 (0.57)
Credit (t)	n.a. n.a.	0.84 (0.48)	0.54 (0.65)
Credit (t+1)	n.a. n.a.	1.17 (0.32)	0.59 (0.62)
Financial Account (t-1)	1.07 (0.36)	n.a. n.a.	1.18 (0.32)
Financial Account (t)	0.50 (0.68)	n.a. n.a.	1.96 (0.12)
Financial Account (t+1)	0.39 (0.76)	n.a. n.a.	1.25 (0.29)
Real GDP growth (t-1)	0.47 (0.70)	2.25* (0.09)	n.a. n.a.
Real GDP growth (t)	0.60 (0.62)	1.88 (0.14)	n.a. n.a.
Real GDP growth (t+1)	0.66 (0.58)	1.88 (0.14)	n.a. n.a.

P-values are in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

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Table 3 - Granger Causality Tests: Sudden Stops & Banking Crises

Variable	Credit (t)	Financial Account (t)	Real GDP growth (t)
Credit (t-1)	n.a. n.a.	0.29 (0.83)	3.00** (0.03)
Credit (t)	n.a. n.a.	0.75 (0.52)	4.17*** (0.01)
Credit (t+1)	n.a. n.a.	1.33 (0.27)	2.49* (0.06)
Financial Account (t-1)	0.57 (0.64)	n.a. n.a.	18.86*** (0.00)
Financial Account (t)	2.07 (0.11)	n.a. n.a.	7.50*** (0.00)
Financial Account (t+1)	3.81*** (0.01)	n.a. n.a.	3.50** (0.02)
Real GDP growth (t-1)	0.81 (0.49)	0.81 (0.49)	n.a. n.a.
Real GDP growth (t)	0.04 (0.99)	0.36 (0.78)	n.a. n.a.
Real GDP growth (t+1)	0.22 (0.88)	0.22 (0.88)	n.a. n.a.

P-values are in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

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Table 4 - Panel VAR Estimates: Banking Crises without Sudden Stops

System variable	Credit (t)	Financial account (t)	Real GDP growth (t)
Credit (t-1)	0.12***	-7.57[a]	5.76[b]
	(5.68)	(-0.88)	(0.29)
Credit (t-2)	0.32***	4.60[a]	0.68[b]
	(14.85)	(0.53)	(0.03)
Credit (t-3)	0.28***	4.42[a]	9.12[b]
	(13.63)	(0.54)	(0.49)
Financial account (t-1)	-91.46	-0.63***	0.67[a]
	(-0.61)	(-10.35)	(0.48)
Financial account (t-2)	22.27	-0.49***	1.11[a]
	(0.14)	(-7.52)	(0.74)
Financial account (t-3)	62.14	-0.23***	3.83[a]
	(0.42)	(-3.84)	(0.28)
Real GDP growth (t-1)	1.45[c]	-2169.12	-0.80***
	(0.36)	(-1.34)	(-21.66)
Real GDP growth (t-2)	-3.87[c]	-63.87	-0.84***
	(-0.98)	(-0.04)	(-23.20)
Real GDP growth (t-3)	3.74[c]	-548.7	-0.76***
	(0.89)	(-0.32)	(-19.80)
R-squared	0.71	0.31	0.74
Adj. R-squared	0.70	0.29	0.74
F-statistic	80.60	14.84	94.98
Log likelihood	-4517.95	-2399.11	497.07
AIC	47.57		
SBC	47.93		
No. of obs.	271		

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] E-06, [b] E-11, [c] E+06

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Figure 1 - Impulse Responses: Banking Crises without Sudden Stops

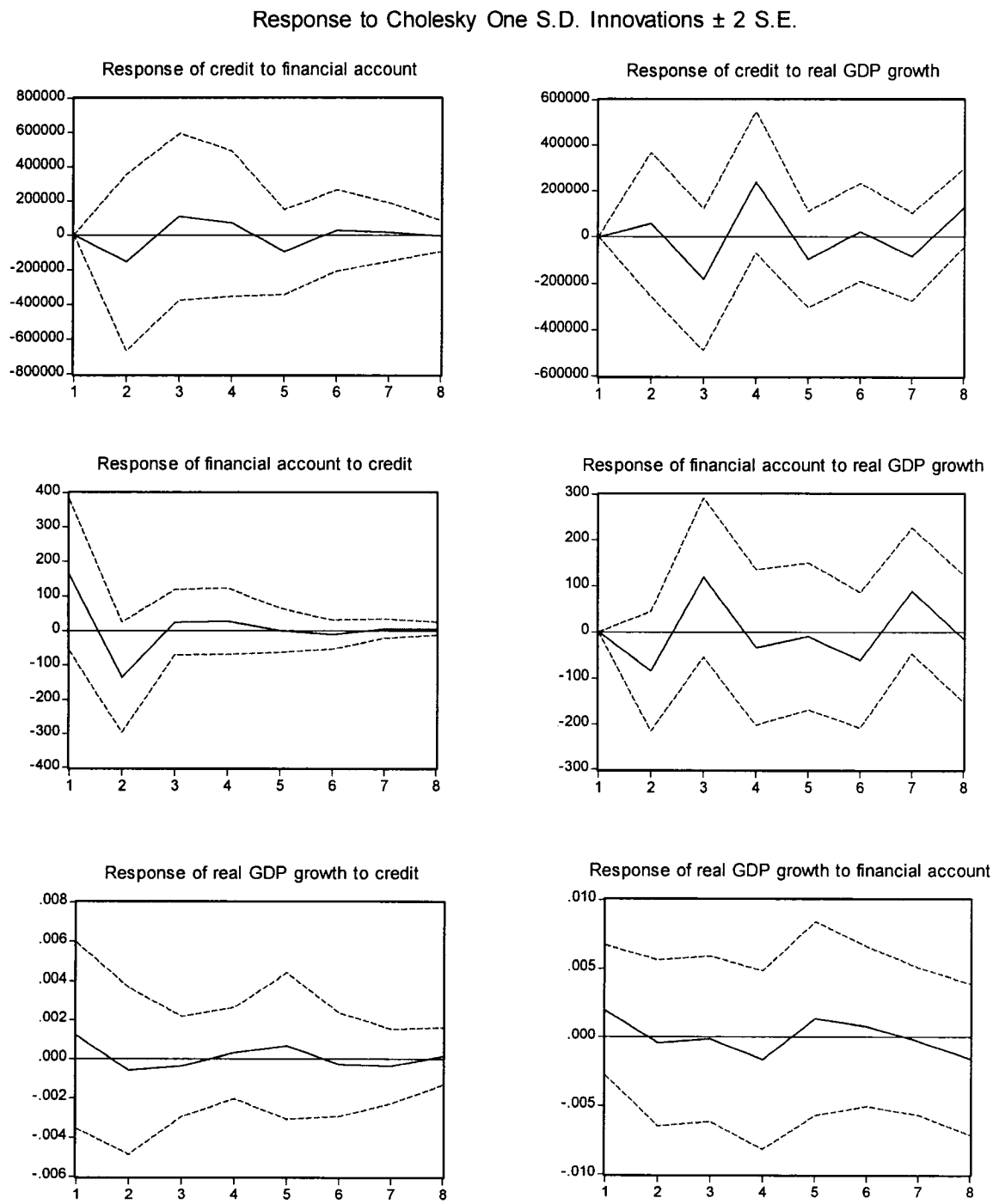

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Table 5 - Panel VAR Estimates: Sudden Stops without Banking Crises

System variable	Credit (t)	Financial account (t)	Real GDP growth (t)
Credit (t-1)	0.30***	66.10 [a]	76.90 [b]
	(4.14)	(1.11)	(0.53)
Credit (t-2)	0.00	61.90 [a]	-127.00 [b]
	(0.01)	(0.93)	(-0.78)
Credit (t-3)	0.08	-2.15 [a]	-49.80 [b]
	(0.97)	(-0.33)	(-0.31)
Financial account (t-1)	-11.43	-0.77***	3.00 [a]
	(-0.12)	(-10.24)	(1.62)
Financial account (t-2)	-67.61	-0.63***	5.00 [a] **
	(-0.70)	(-8.02)	(2.62)
Financial account (t-3)	-120.48	-0.29***	3.29 [a] *
	(-1.40)	(-4.22)	(1.93)
Real GDP growth (t-1)	0.72 [c]	2877.57*	-0.87***
	(0.36)	(1.77)	(-21.79)
Real GDP growth (t-2)	2.09 [c]	2026.46	-0.91***
	(1.32)	(1.58)	(-28.78)
Real GDP growth (t-3)	0.29 [c]	3778.10	-0.83***
	(0.14)	(2.24)	(-20.12)
R-squared	-0.02	0.44	0.87
Adj. R-squared	-0.07	0.41	0.86
F-statistic	-0.39	16.10	137.62
Log likelihood	-2769.20	-1523.51	334.69
AIC		45.52	
SBC		46.01	
No. of obs.		175	

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] E-06, [b] E-11,[c] E+06

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Figure 2 - Impulse Responses: Sudden Stop without Banking Crises

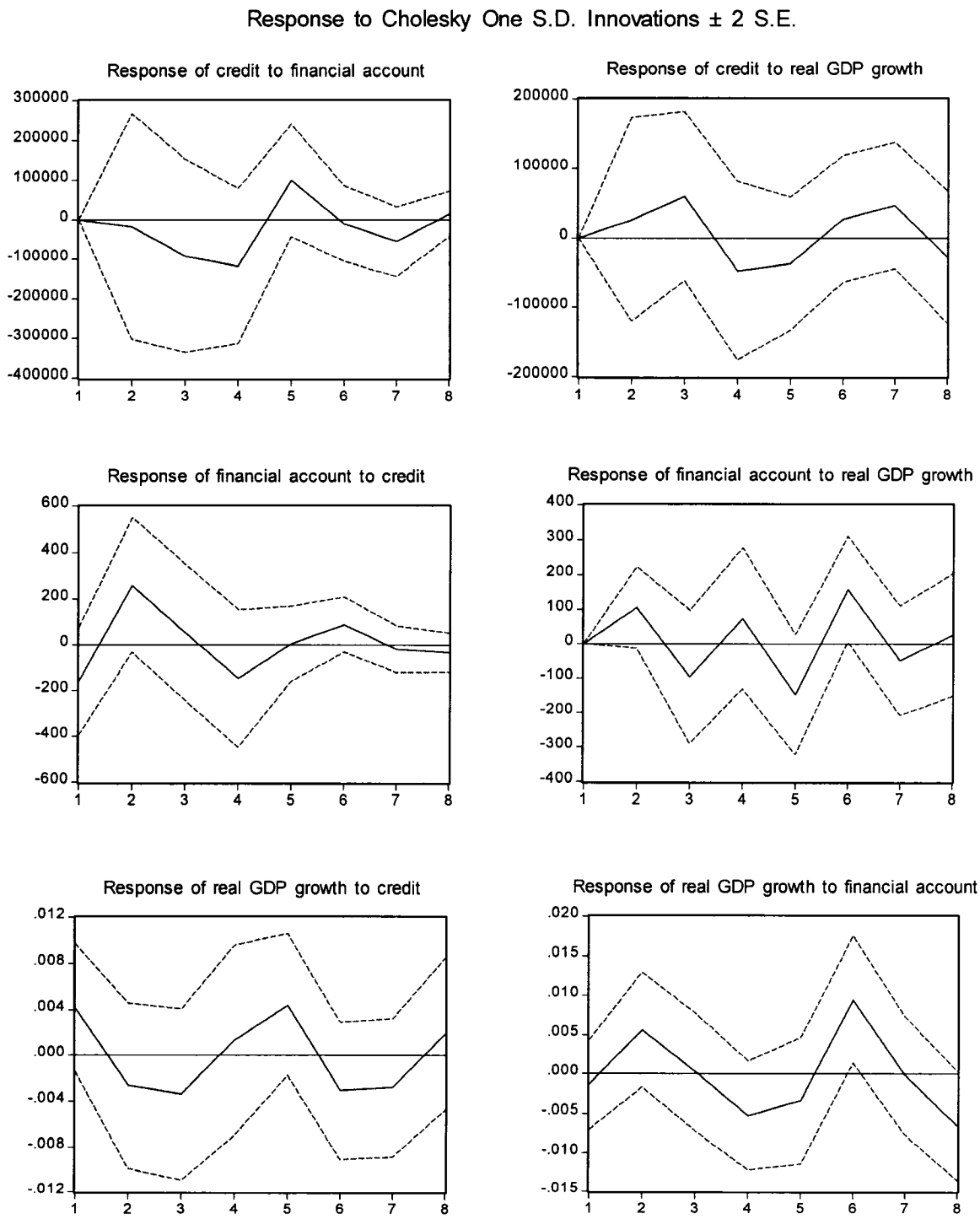

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Table 6 - Panel VAR Estimates: Sudden Stops & Banking Crises

System variable	Credit (t)	Financial account (t)	Real GDP growth (t)
Credit (t-1)	0.64***	22.10 [a]	-36.00 [b]
	(7.23)	(1.51)	(-1.56)
Credit (t-2)	-1.15***	-14.5 [a]	-5.54 [b]
	(-8.51)	(-0.65)	(-0.16)
Credit (t-3)	1.29***	-27.9 [a]	-115 [b] **
	(-7.31)	(-0.95)	(-2.48)
Financial account (t-1)	-1524.43**	-0.26**	3.16 [a] **
	(-2.57)	(-2.64)	(-2.03)
Financial account (t-2)	-655.58	-0.12	6.99 [a] ***
	(-1.07)	(-1.19)	(-4.36)
Financial account (t-3)	-537.49	0.04	6.20 [a] ***
	(-0.87)	(0.42)	(-3.82)
Real GDP growth (t-1)	-1.71 [c]	-1839.63	-0.80***
	(-0.08)	(-0.51)	(-14.02)
Real GDP growth (t-2)	0.01 [c]	1697.68	-0.79***
	(-0.00)	(-0.49)	(-14.51)
Real GDP growth (t-3)	-3.56 [c]	-1665.37	-0.77***
	(-0.15)	(-0.43)	(-12.61)
R-squared	0.50	0.11	0.77
Adj. R-squared	0.46	0.04	0.76
F-statistic	12.58	1.58	43.21
Log likelihood	-2009.22	-1051.83	164.35
AIC		53.14	
SBC		53.80	
No. of obs.		110	

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] E-06, [b] E-11, [c] E+06

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Figure 3 - Impulse Responses: Sudden Stops & Banking Crises

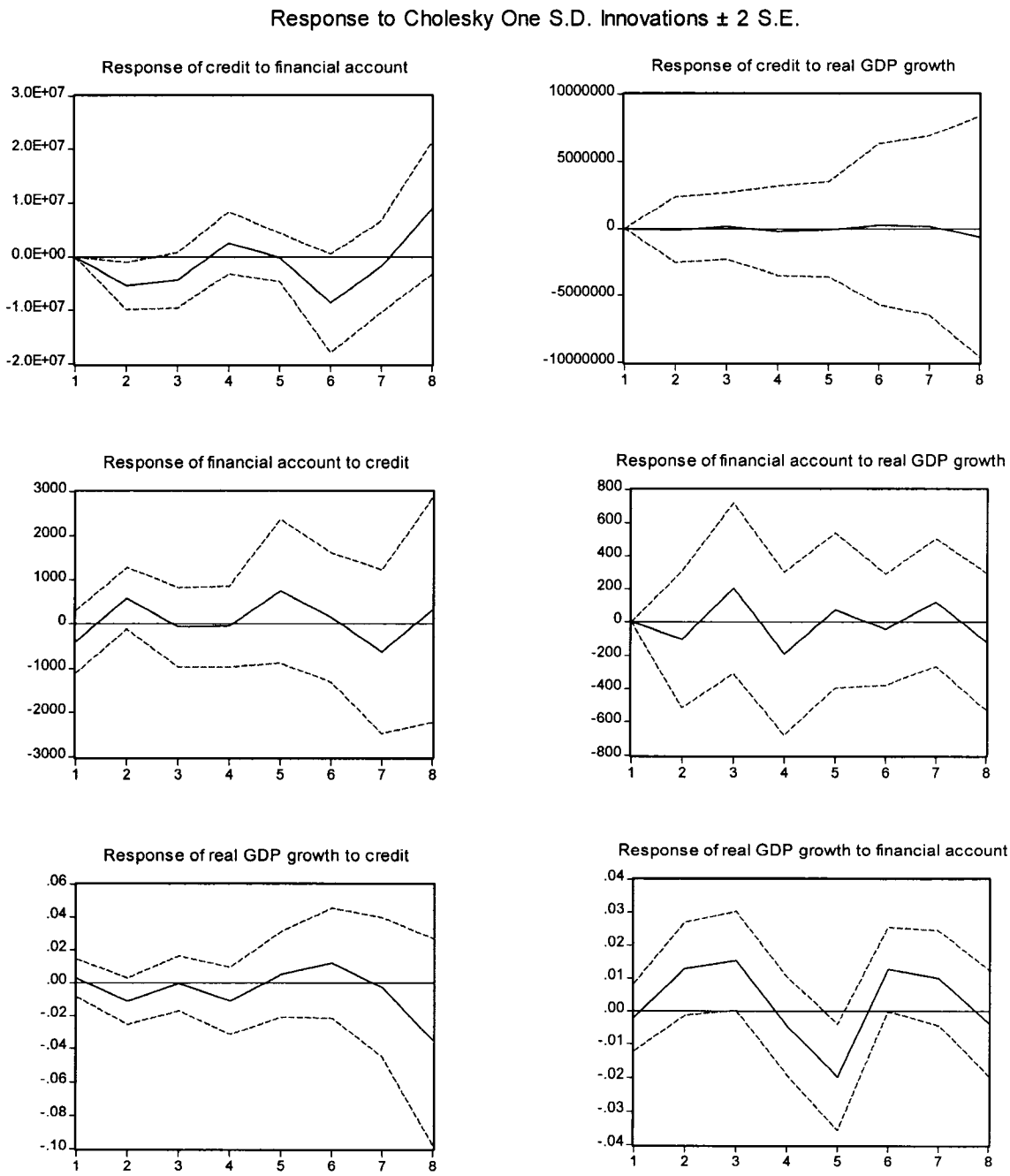

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Table 7 - Panel VAR Estimates: Banking Crises without Sudden Stops, with Real Interest Rate

System variable	Credit (t)	Financial account (t)	Real GDP growth (t)	Real interest rate (t)
Credit (t-1)	0.12***	-7.23 [a]	7.64 [b]	5.26 [b]
	(4.87)	(-0.77)	(0.40)	(0.23)
Credit (t-2)	0.33***	5.37 [a]	4.59 [b]	-5.08 [b]
	(13.20)	(0.56) [a]	(0.24)	(-0.22)
Credit (t-3)	0.28***	4.63	10.10 [b]	-0.01 [b]
	(12.13)	(0.52)	(0.55)	(-0.00)
Financial account (t-1)	-140.71	-0.59***	8.97 [a]	-0.07
	(-0.77)	(-8.27)	(0.62)	(-0.39)
Financial account (t-2)	18.81	-0.45***	1.84 [a]	-0.09
	(0.10)	(-6.00)	(1.20)	(-0.47)
Financial account (t-3)	45.1	-0.23***	6.64 [a]	-0.15
	(0.26)	(-3.39)	(0.48)	(-0.91)
Real GDP growth (t-1)	0.93 [c]	-3045.38	-0.78***	-4078.76
	(0.16)	(-1.35)	(-16.94)	(-0.75)
Real GDP growth (t-2)	-6.79 [c]	1463.96	-0.78***	3701.05
	(-1.09)	(0.61)	(-15.90)	(0.64)
Real GDP growth (t-3)	7.20 [c]	2035.67	-0.69***	-6775.28
	(1.14)	(0.83)	(-13.79)	(-1.15)
Real interest rate (t-1)	0.34	0.00	-0.23 [a] **	0.10
	(0.03)	(0.31)	(-2.28)	-8.66
Real interest rate (t-2)	-1.40	0.00	-0.15 [a] **	0.00
	(-0.17)	(1.17)	(-2.36)	(-0.53)
Real interest rate (t-3)	0.10	0.00	-0.03 [a]	0.00
	(0.02)	(0.39)	(0.74)	(0.56)
R-squared	0.72	0.31	0.69	0.34
Adj. R-squared	0.70	0.27	0.67	0.30
F-statistic	44.48	7.65	38.65	8.89
Log likelihood	-3406.47	-1811.34	380.60	-1990.21
AIC	64.72			
SIC	68.51			
No. of obs.	203			

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] E-06, [b] E-11, [c] E+06

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Table 8 - Panel VAR Estimates: Sudden Stops without Banking Crises, with Real Interest Rate

System variable	Credit (t)	Financial account (t)	Real GDP growth (t)	Real interest rate (t)
Credit (t-1)	0.29***	79.80 [a]	123.00 [b]	330.00 [b]
	(3.82)	(1.31)	(0.82)	(0.21)
Credit (t-2)	0.00	58.80 [a]	-109.00 [b]	-743.00 [b]
	(0.00)	(0.87)	(0.65)	(0.43)
Credit (t-3)	0.07	-26.60 [a]	-22.61 [b]	156.00 [b]
	(0.82)	(-0.40)	(-0.14)	(0.09)
Financial account (t-1)	-28.90	-0.77	2.61 [a]	1.16
	(-0.28)	(-9.45)	(1.29)	(0.56)
Financial account (t-2)	-101.52	-0.59	5.27 [a]**	1.98
	(-0.97)	(-7.18)	(2.57)	(0.94)
Financial account (t-3)	-143.23	-0.26	3.73 [a]**	2.89
	(-1.57)	(-3.69)	(2.10)	(1.59)
Real GDP growth (t-1)	0.63 [c]	2936.01	-0.88***	13017.77
	(0.29)	(1.71)	(-20.62)	(0.30)
Real GDP growth (t-2)	1.50 [c]	2360.02	-0.90***	23743.42
	(0.87)	(1.74)	(-26.82)	(0.69)
Real GDP growth (t-3)	0.42 [c]	4386.98	-0.83***	24226.23
	(0.19)	(2.51)	(-19.22)	(0.55)
Real interest rate (t-1)	1.68	0.00	0.62 [a]	-0.51***
	(0.42)	(1.06)	(-0.80)	(-6.37)
Real interest rate (t-2)	0.41	-0.01***	1.32 [a]	-0.49***
	(0.09)	(-3.20)	(-1.43)	(-5.21)
Real interest rate (t-3)	1.12	0.00	-1.14 [a]	-0.28**
	(0.21)	(-0.34)	(-1.07)	(-2.59)
R-squared	-0.01	0.48	0.87	0.25
Adj. R-squared	-0.09	0.44	0.86	0.20
F-statistic	-0.19	12.58	90.07	4.60
Log likelihood	-2551.01	-1400.68	306.89	-1920.92
AIC	69.68			
SIC	70.60			
No. of obs.	161			

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] E-06, [b] E-11,[c] E+06

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Table 9 - Panel VAR Estimates: Sudden Stops & Banking Crises, with Real Interest Rate

System variable	Credit (t)	Financial account (t)	Real GDP growth (t)	Real interest rate (t)
Credit (t-1)	0.64***	21.70 [a]	-36.70 [b]	-33.10 [b]
	(7.02)	(1.45)	(-1.56)	(-0.24)
Credit (t-2)	-1.15***	-14.30 [a]	-5.00 [b]	-33.00 [b]
	(-8.26)	(-0.62)	(-0.14)	(-0.16)
Credit (t-3)	1.29***	28.40 [a]	-115.00 [b]**	14.40 [b]
	(7.11)	(0.95)	(-2.43)	-0.05
Financial account (t-1)	-1546.03**	-0.26**	3.19 [a] **	-0.29
	(-2.52)	(-2.55)	(2.00)	(-0.30)
Financial account (t-2)	-643.80	-0.13	6.77 [a] ***	-0.74
	(-1.01)	(-1.27)	(4.07)	(-0.75)
Financial account (t-3)	-585.29	0.04	6.14 [a] ***	-0.48
	(-0.90)	(0.33)	(3.62)	(-0.48)
Real GDP growth (t-1)	-2.17 [c]	-1083.79	-0.79***	-13787.37
	(-0.09)	(-0.28)	(-13.19)	(-0.39)
Real GDP growth (t-2)	2.07 [c]	2418.30	-0.79***	-27542.63
	(0.09)	(0.65)	(-13.39)	(-0.79)
Real GDP growth (t-3)	-3.31 [c]	-1839.84	-0.77***	-136503.00
	(-0.13)	(-0.45)	(-11.96)	(-3.59)
Real interest rate (t-1)	-1.94	0.00	-0.05 [a]	-0.25***
	(-0.03)	(-0.46)	(-0.31)	(-2.85)
Real interest rate (t-2)	-11.53	0.00	0.06 [a]	-0.19**
	(-0.22)	(0.45)	(0.46)	(-2.32)
Real interest rate (t-3)	8.55	0.01	0.06 [a]	-0.09
	(0.18)	(0.86)	(0.48)	(-1.30)
R-squared	0.50	0.13	0.78	0.26
Adj. R-squared	0.44	0.02	0.75	0.17
F-statistic	8.63	1.24	30.17	3.00
Log likelihood	-1955.82	-1023.65	159.49	-1262.25
AIC	77.15			
SIC	78.35			
No. of obs.	107			

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] E-06, [b] E-11, [c] E+06

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Table 10 - VAR Estimates: Banking Crises without Sudden Stops, Period of 1980 - 1996

System variable	Credit (t)	Financial account (t)	Real GDP growth (t)
Credit (t-1)	0.22**	172.00 [a]	72.00 [b]
	(2.19)	(0.48)	(0.64)
Credit (t-2)	0.65***	-177.00 [a]	1151.00 [b]
	(6.43)	(-0.50)	(1.35)
Credit (t-3)	0.05	-469.00 [a]	-271.00 [b]
	(0.43)	(-1.14)	(-0.21)
Financial account (t-1)	12.23	-0.53	-2.81 [a]
	(0.44)	(-5.43)	(-0.91)
Financial account (t-2)	-9.09	-0.54***	-0.49 [a]
	(-0.33)	(-5.73)	(-0.16)
Financial account (t-3)	0.88	-0.20**	-1.53 [a]
	(0.03)	(-2.08)	(-0.50)
Real GDP growth (t-1)	-1.69 [c] **	-1086.94	-0.55***
	(-2.22)	(-0.41)	(-6.46123)
Real GDP growth (t-2)	-1.26 [c]	2760.72	-0.59***
	(-1.48)	(0.93)	(-6.31)
Real GDP growth (t-3)	-0.26 [c]	498.89	-0.53***
	(-0.32)	(0.18)	(-5.88)
R-squared	0.00	0.33	0.44
Adj. R-squared	-0.08	0.27	0.39
F-statistic	-0.05	6.04	9.80
Log likelihood	-1556.18	-939.60	189.31
AIC		42.78	
SIC		43.44	
No. of obs.		109	

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] E-06, [b] E-11, [c] E+06

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Table 11 - VAR Estimates: Sudden Stops without Banking Crises, Period of 1980 - 1996

System variable	Credit (t)	Financial account (t)	Real GDP growth (t)
Credit (t-1)	0.10 (0.65)	-402.00 [a] (-0.93)	142.00 [b] (-0.17)
Credit (t-2)	0.62*** (4.37)	283.00 [a] (0.74)	1800.00[b]** (2.45)
Credit (t-3)	0.27 (1.51)	115.00 [a] (0.24)	1191.00 [b] (1.27)
Financial account (t-1)	28.62 (0.41)	-0.49*** (-2.64)	7.30 [a] ** (2.03)
Financial account (t-2)	41.49 (0.65)	-0.39** (-2.29)	8.46 [a] ** (2.58)
Financial account (t-3)	-14.74 (-0.27)	-0.23 (-1.57)	6.46 [a] ** (2.28)
Real GDP growth (t-1)	-0.15 [c] (-0.13)	477.72 (0.16)	-0.97*** (-16.60)
Real GDP growth (t-2)	1.19 [c] (1.22)	-985.40 (-0.38)	-0.96*** (-19.09)
Real GDP growth (t-3)	-0.94 [c] (-0.80)	843.75 (0.27)	-0.92*** (-15.06)
R-squared	0.66	0.25	0.95
Adj. R-squared	0.57	0.06	0.93
F-statistic	7.40	1.29	68.34
Log likelihood	-589.89	-353.23	81.14
AIC		44.38	
SIC		45.52	
No. of obs.		40	

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] E-06, [b] E-11, [c] E+06

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Table 12 - Panel VAR Estimates: Sudden Stops & Banking Crises, Period of 1980 - 1996

System variable	Credit (t)	Financial account (t)	Real GDP growth (t)
Credit (t-1)	0.22**	-301.00 [a]	581.00 [b]
	(2.10)	(-0.25)	(-0.27)
Credit (t-2)	0.87***	482.00 [a]	735.00 [b]
	(5.45)	(0.27)	(0.23)
Credit (t-3)	-0.18	1766.00 [a]	4940.00 [b]
	(-1.24)	(1.10)	(1.72)
Financial account (t-1)	11.75	-0.30	0.00 [a]
	(0.65)	(-1.50)	(0.01)
Financial account (t-2)	-6.37	0.15	8.48 [a] **
	(-0.37)	(0.79)	(2.46)
Financial account (t-3)	-3.98	0.17	8.08 [a] **
	(-0.23)	(0.87)	(2.30)
Real GDP growth (t-1)	0.85 [c]	-5718.87	-0.82***
	(1.68)	(-1.01)	(-8.11)
Real GDP growth (t-2)	0.19 [c]	4859.07	-0.81***
	(0.45)	(1.03)	(-9.63)
Real GDP growth (t-3)	-0.19 [c]	-4393.47	-0.75***
	(-0.34)	(-0.71)	(-6.76)
R-squared	0.98	0.23	0.84
Adj. R-squared	0.98	0.02	0.80
F-statistic	220.21	1.10	19.11
Log likelihood	-528.28	-357.44	57.84
AIC		44.72	
SIC		45.89	
No. of obs.		38	

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] E-06, [b] E-11, [c] E+06

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