The Effects of Financial Crises on the Current Account Balance

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THESIS

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To my beloved family.

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LIST OF ABBREVIATIONS

BC	Banking Crisis/Crises
CA	Current-Account-Balance-to-GDP ratio
CC	Currency Crisis/Crises
EMPI	Exchange Market Pressure Index
FE	Fixed Effect
GDP	Gross Domestic Product
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
OLS	Ordinary Least Square
PPP	Purchasing Power Parity
PWT	Penn World Table
RBC	Relative Banking Crisis/Crises
RCC	Relative Currency Crisis/Crises
RE	Random Effect
RTC	Relative Twin Crisis/Crises

LIST OF ABBREVIATIONS (Continued)

TC	Twin Crisis/Crises
VAR	Vector Auto Regressive
WDI	World Development Indicators

SUMMARY

This study investigates the effects of banking crises on the current account, using a panel data set of eighty countries over the 1980-2001 period. I adopt a dynamic regression approach and derive impulse response functions that estimate the detailed dynamic responses of the Current-Account-Balance-to-GDP ratio to a banking crisis. I find that banking crises produce current account effects that are substantial and vary over time, which suggests that, by omitting the dynamics, the cross-sectional regressions of most of the literature can be misleading. In particular, my estimates suggest that a banking crisis is followed by an improvement of the current account balance that is sizable and statistically significant. This effect is shown to be temporary, however, lasting for a few years before it dies out in the long run. These results are robust to a number of different specifications. This study also discusses a few interesting extensions related to currency crises and twin crises.

CHAPTER 1

INTRODUCTION

The recent global financial crisis that swept across the United States and Europe has inspired more interest in the study of financial shocks, albeit at great social cost. Although financial crises have long been documented as an important source of macroeconomic fluctuations (1), their effects are still not fully and thoroughly understood. First, few researchers have studied the persistence of their negative consequences (an influential exception is (2)). Second, relatively little attention has been paid to the effects of those crises on macroeconomic variables other than real GDP and its growth rate. However, obtaining a more comprehensive picture of these effects (including their direction, magnitude, and persistence) on various macroeconomic variables is indispensable for a clear understanding of the propagation of financial shocks and their business-cycle effects.

The aim of my paper is to formally analyze the impact of banking crises (one type of financial crises characterized by exhaustion of bank capital) on the current account balance. This topic combines two of the most important economic challenges facing the global economy today. On the one hand, banking crises are severe and increasingly transmitted across borders. One of the transmission channels of banking crises across countries is through imports and exports of goods and services, reflected by the current account balance. At the same time, the pattern of global current account imbalances has received considerable attention in recent years, including the large deficit of the U.S. and the surpluses of Asian countries, including China, and oil-exporting

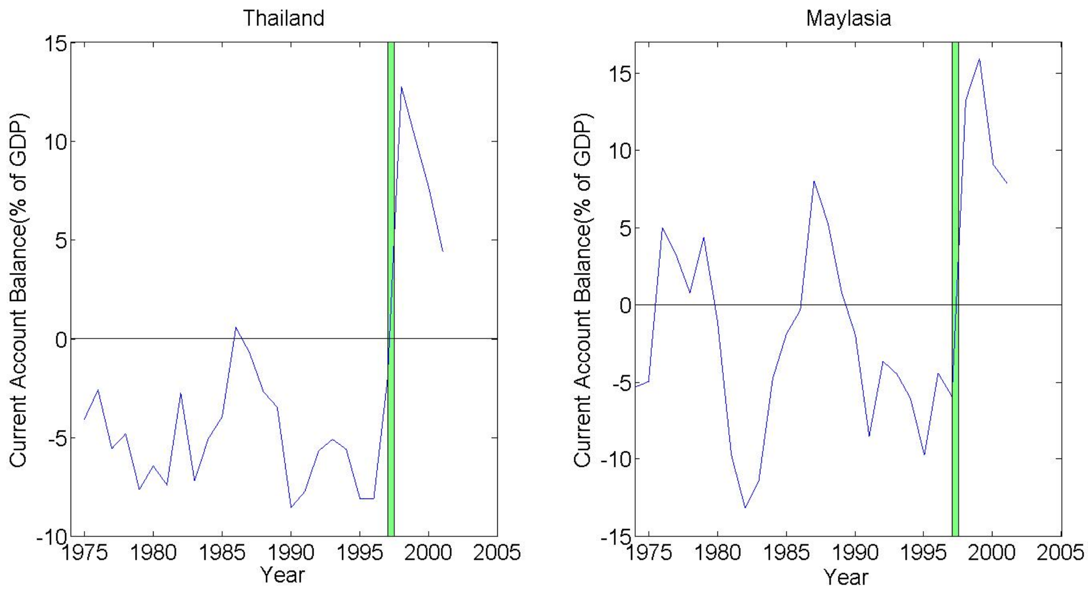

Figure 1. Illustrative examples

economies. Growing imbalances on current accounts may threaten economic stability and the prospects of sustained economic recovery (3)(4)(5). Identifying factors affecting the current account balance is thus important for determining whether the imbalances are problematic and what policy intervention can help relieve the problem if necessary.

The examples in Figure 1 illustrate the behaviors of the current account in Thailand and Malaysia following the onset of Southeast Asia financial crisis in 1997. In both countries, the current account balance as a share of GDP increased substantially at first, and then began to show signs of reversion. This trajectory was fairly common among other Southeast Asian countries impacted by that crisis (6).

While the evidence of Figure 1 is suggestive, it remains to be determined whether this kind of experience is typical across countries affected by banking crises. In order to investigate this, I put together a data set covering eighty countries over more than twenty years and estimate the impulse response functions in a dynamic model. The impulse response functions allow me to gauge not only the effects of banking crises on current account balance, but also how these effects evolve over time.

My main findings are easy to summarize. I find that financial crises produce current account effects that are both substantial and very dynamic (which suggests that, by omitting the dynamics, the cross-sectional regressions of most of the literature can be misleading). In particular, my estimates suggest that a banking crisis is followed by an improvement of the current account balance that is sizable and statistically significant. This effect is shown to be temporary, however, lasting for a few years before it dies out in the long run. This finding sheds light not only on how banking crises affect an open economy, but also on how banking crises can spread from country to country, spilling over to economies not experiencing banking crises themselves.

The thesis is organized as follows. Chapter 2 reviews existing macroeconomic theories and the empirical literature. Chapter 3 describes the methodology, data, and estimation results. Chapter 4 conducts several robustness checks. Chapter 5 discusses a few extensions regarding currency crises and twin crises. Chapter 6 concludes.

CHAPTER 2

LITERATURE REVIEW

2.1 Insights From Macroeconomic Theories

From the basic open-economy national income accounting perspective, the current account balance (CA) equals the difference between national savings (S) and domestic investment (I).

$$CA = S - I \tag{2.1}$$

A banking crisis can theoretically affect both savings and investment. Investment generally declines since the economy can no longer rely on the banking sector to perform its traditional role of channeling loanable funds from lenders to borrowers (7). However, the effects of a banking crisis on national savings are also likely to be in the same direction. First, the significant and prolonged output loss and growth slowdown that have been well documented in the literature (1)(2)(8) will restrict the ability of the household sector to save. Households will try to smooth consumption, reducing it by less than income, thus lowering private saving. Additionally, government saving may also decline as government purchases are likely to increase and tax revenue will fall, especially if policy makers try to respond with a fiscal expansion in order to smooth the downturn. The overall effect on the current account, therefore, is ambiguous as both S and I are predicted to fall.

As a second theoretical framework, we will consider the determination of the Trade Balance (TB) in the standard Keynesian model[1].The trade balance equals exports (EX) minus imports (IM). From the simple Keynesian perspective, the amount of exports is a function of the exchange rate (E) and the foreign income level (Y^*), while the amount of imports is a function of the exchange rate(E) and the domestic income level(Y):

$$TB = EX(Y^*, E) - IM(Y, E) \tag{2.2}$$

The evidence is clear that a domestic banking crisis will reduce domestic income, causing imports to decline and improving the trade balance. Assuming that financial crises are likely to depreciate the domestic currency, this will further boost the current account.

A third theoretical approach is provided by the neoclassical framework with intertemporal utility maximization and infinite time horizons, which delivers the fundamental current account equation (see (9)(10)):

$$CA_t = (Y_t - \tilde{Y}_t) - (G_t - \tilde{G}_t) - (I_t - \tilde{I}_t) \tag{2.3}$$

where CA, Y, G, and I denote the current account balance, output, government purchases and investment, respectively; a $\sim$ indicates the permanent component of a macroeconomic variable and t is indexing over time. The meaning of this equation is that the (optimal) current

[1]The trade balance equals the current account balance if we abstract from net factor income and unilateral transfers.

account should be affected only by temporary changes in Y, G, or I, but not by permanent changes in these variables. A banking crisis will have several implications for the fundamental current account equation. Most obviously, output and investment decrease, while government purchases may go up as part of a fiscal stimulus. The key issue in terms of the fundamental current account equation is whether (or the extent to which) these changes are permanent or temporary. Regarding output, the evidence seems to be that banking crises often lead to a lower long-term trend, producing losses that are permanent. For example, (2)(11)(12) find that there is persistent growth disruption by financial crises and the economy's post-crisis growth path may stay below the original trend for a long time. If indeed both output and its permanent component decrease by (roughly) the same magnitude, the current account should be (roughly) unaffected. Regarding government purchases and investment, however, the evidence is virtually non-existent. Even if the fiscal expansion leads to a "bigger government" thereafter, it is doubtful that the permanent increase in government size will be of equal magnitude as the initial amount of temporary fiscal expansion. Meanwhile, if it can be assumed that the marginal product of capital is largely determined by production efficiency and technological factors, the permanent component of investment could be unchanged. Putting it all together in the fundamental current account equation, it becomes possible that a financial crisis might improve the current account balance - however, it is far from assured.

Overall, the theoretical predictions are generally ambiguous, so the issue of the current account effects of a financial crisis needs to be resolved empirically. Despite the ambiguities, however, the theoretical considerations are valuable because they point to possible mechanisms that can explain the empirical findings and suggest variables to be used in the empirical models.

2.2 Empirical Studies

Most, if not all, of the empirical studies investigating the effects of banking crises on the current account balance are based on the estimation of cross-sectional models. By now this type of estimation is fairly standard. These regression-based models include a banking crisis indicator in the regression in addition to other standard determinants (e.g. fiscal balance, age dependency ratio, oil balance, etc.) of the current account balance. Multi-year averages of annual data are usually calculated prior to regressions in order to take out the short run fluctuations and the business cycle effect. This methodology is informative, but does not fully exploit the information in the data, since it ignores the time dimension and omits dynamics, focusing instead on medium-run or long-run relationships. The literature also includes me event-based, before-after analyses, relying either on graphs or on the comparison of simple statistics to show the evolution of series of interest around crises. These are often the by-products of papers that aim at studying the effect of crises on growth or investment. The dynamics of current account balances are generally followed only a couple of years before and after financial shocks.

A number of papers using the methods mentioned above are summarized in Table I. These empirical papers do provide evidence that banking crises strengthen the current account, and that the average impact of banking crises on the current account balance remains positive and significant until the medium run.

TABLE I

SUMMARY OF EMPIRICAL STUDIES IN LITERATURE REVIEW

Source	Sample	Methodology	Findings
(13)	61 countries between 1982 and 2003	Panel regression (multi-year averages of annual observations considered)	When incorporating banking crises in a regression model in addition to the standard determinants of the current account, the overall effect of banking crises on the current account is positive and significant. The augmented current account model explains Asian surpluses well but not the recent large U.S. deficits.
(14)	U.S. sub-prime crisis and 18 bank-centered financial crises from the post-war period	Graphical-based comparison around different banking crises events (t-4 through t, t is the crisis year)	Typically current account balance/GDP decreases (capital inflows accelerates[a]) up to the eve of the crisis and then increases during the crisis year
(15)	65 advanced and emerging markets between 1969 and 2008	Pooled OLS regression of a empirical model of current account determination (4-year averages of annual observations)	Financial crisis dummy variable (capture the disruption in access to capital markets for countries) have positive coefficients (significant in the overall sample and emerging market subsample) in the current account equation

[a] The current account balance is equal to the negative capital account balance in balance of payment accounting.

CHAPTER 3

DYNAMIC ESTIMATION

3.1 Methodology

I am examining the effects of banking crises on the current account balance, allowing for a full set of dynamic responses. The methodology in this section draws on the influential recent contribution of (2) where they estimate the impact of financial and political shocks on the economy's real growth rate. For each of the countries in my sample, and for each year, I first construct an indicator of banking crises relative to rest of the world. Then I use a full panel data set to estimate a dynamic model that allows the current account as a fraction of GDP to be affected by current and lagged values of my relative banking crisis indicator. Finally, I use the estimated model to derive the implied impulse response functions that capture the responses of the Current-Account-Balance-to-GDP ratio to a relative banking crisis shock.

More specifically, the benchmark estimated model is given by:

$$CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it} \tag{3.1}$$

where CA denotes the Current-Account-Balance-to-GDP ratio, RBC denotes the relative banking crisis variable (the construction of which is explained below), μ_i and λ_t are country- and year-specific effects (to be modeled as fixed[1] or random effects), and the subscripts i and t index over countries and years, respectively. The β's and γ's are parameters to be estimated. The β's are the autoregressive terms allowing the CA to exhibit persistence, while the γ's capture the effects of a relative banking crisis. The lag length of three has been based on the likelihood ratio lag length test.

Impact, short-run, long-run and cumulative responses can be then calculated as functions of the estimated coefficients. These impulse response functions to a relative banking crisis shock are then plotted, providing a practical way to visually view the behavior of the current account in response to the shock. The main advantage of this technique over a cross-sectional methodology is that it provides a full picture of the dynamic response of the current account over time – rather than a single coefficient[2].

A banking crisis should affect a country's current account only when it occurs in relative terms. If all countries are in a crisis (of equal severity) simultaneously, there should be no impact on current account balances. This is the reason I transform my banking crisis variable into a relative measure by subtracting from the value of each country's original zero/one crisis binary variable a GDP-weighted world average of these dummies in the corresponding year. This is

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[1]One concern associated with the fixed effect estimation is that the inclusion of lagged dependent variable makes the With estimator biased of $O(1/T)$ (T is the number of total time periods); the consistency will depend upon T being large (16). My sample spans 22 years and thus can probably be considered as having a large T.

[2]Technically, this dynamic approach allows us to estimate $\frac{\partial CA_{t+j}}{\partial BC_t}$ rather than simply $\frac{\partial CA_t}{\partial BC_t}$ as in most of the existing literature.

actually a common practice in the literature that studies various determinants of the current account (17)(18)(13)(15). Ideally, it might be more intuitive to use trade volume weighed or distance weighed world averages to more closely capture the international trade and crises contagions between any two countries. Due to lack of data and massive amount of computation, however, it is very difficult in practice.

Mathematically, let BC_{it} denotes the banking crisis dummy variable, which equals one if country i is experiencing a banking crisis in year t, and equals zero otherwise. For each year t, the GDP-weighed world average of these binary banking crisis variables is calculated as[1]

$$\overline{BC_t} = \sum_i GDP_{it}BC_{it} / \sum_i GDP_{it} \tag{3.2}$$

The Relative Banking Crisis (RBC) indicator for the ith country during year t is then expressed as the deviation of the original binary banking crisis dummy from the GDP-weighed world mean, as described in Equation 3.3 .

$$RBC_{it} = BC_{it} - \overline{BC_t} \tag{3.3}$$

[1]The calculation the GDP-weighed world means is based on more than 100 countries that have available data. Since a country's current account balance can be influenced both by countries included and not included in my balanced panel, using the broadest set of countries possible allows more accurate measure of rest of the world.

3.2 Data

For the dependent variable, I use the current account (as % of GDP) from the World Bank's World Development Indicators (19). For the construction of the weights used for the relative banking crises in Equation 3.2, I use PPP-adjusted GDP (chain series) at 2005 constant prices, so that values are comparable both across countries and over time (20). The PPP-adjusted aggregate GDP series are simply computed as the product of the GDP per capita (PPP, chain series, 2005 prices) and population, both obtained from the Penn World Table (21).

I obtain banking crisis data on a large set of countries from (2). Their timing of banking crisis follows that of (22)(23) and is confined to systemic banking crisis (as opposed to smaller and borderline banking crisis). (22)(23) argue that if much, or all, banking capital is exhausted and a banking system is insolvent, then the problem is systemic. For example, if bank capital is 5% of assets, non-performing loans net of provisions are 10% of assets and if banks generally collect 50% on these loans, the losses would be sufficient to wipe out the banking system's capital. In these papers systemic banking crises occur when the ratio of non-performing loans to total loans is above 5 percent, including cases with low net worth (when the ratio is between 5 to 10 percent) and cases with negative net worth (when the ratio is above 10 percent). This measure is likely to be conservative. Estimates of non-performing loans are often biased downward. The collection rate (50%) and capital ratio (5%) assumed are higher than the developing country average for the 1990s. The loan loss provisioning was also limited since banks often try to cover up the problem. As mentioned in the earlier papers by (22)(23), their work is a part of a larger project by the World Bank to study the causes and consequences of bank insolvency and is the first of such efforts that gathers information on episodes of bank insolvency that have occurred since the late I970s. Their episodes of bank insolvency rely heavily upon the assessment of a variety of insiders (financial professionals and experts) familiar with individual episodes. A more systematic and quantitative source may become available in the future, but until then the data in (24) remains the best available resource and is widely used by researchers interested in this area (see (2)(13)(18)(25)). Some kind of financial condition/stress index to reflect the exact severity of the financial shock is highly desirable, but in practice it is very difficult. According to (26): First the range of potential financial measures to be included in such a financial condition index is quite vast, and the relative importance of these financial variables may be quite different across countries and over time; Second such financial condition indexes cannot be underpinned by a structural model derived from stable underlying microeconomic foundations so far. As such, they are certainly vulnerable to the Lucas critique: the response of financial conditions and the link between financial conditions and economic activity may change as policy changes. These are possibly the reasons why the existing indexes cover only limited countries and periods, and their stability and validity is sometimes a bit questionable.

My data consist of balanced panels of annual observations spanning 80 countries from 1980 to 2001. Out of the total number of 1760 observations, 363 correspond to banking crises events (21% of the sample). The average Current-Account-Balance-to-GDP ratio over the full sample is minus 3 percent. In Table IV, Appendix A, I provide sample means of banking crises incidence and current account balances by country. The banking crises incidence for a few selected countries can also be viewed directly in the bar chart below (Figure 2).

The second column in Table IV, Appendix A reports the fraction of the 1980-2001 time period that a country is in a banking crisis. This incidence of banking crises varies widely across countries, with a standard deviation of 20 percent. At the one extreme, Central African Republic spent 91% of the time period in banking crises, while at the other extreme, countries such as Singapore and the United States did not experience banking crisis at all. The data suggest that banking crises occur both in emerging market and developing economies, as well as in developed countries. Japan, for example, is well known for the problems in its banking sector in the 1990s. This is reflected in the data set, where Japan spent half of the time in banking crises during my sample period. At the same time, a quick glance at Table IV, Appendix A and Figure 2 confirms that less advanced economies do seem to experience more banking crises on average. For each country, the third column in Table IV lists the average Current-Account-Balance-to-GDP ratio of all years. The standard deviation of these average Current-Account-Balance-to-GDP ratios is around 3 percent across countries, and the range is -25 percent (Lebanon) to 13 percent (Kuwait).

Figure 3 focuses on the time dimension of the data, showing the fraction of countries in a banking crisis in each year. This is a straightforward way to examine the pattern of the series over time. The incidence of banking crises ranges from 0.10 in 1980, a relative tranquil year, to 0.28 in 1988, a relatively volatile year. There are two properties of the data made apparent by Figure 3. First, while the values at the end of the period are higher than at the beginning, there seems to be no apparent trend, as the series exhibits mean reversion around the time average of

0.21. Second, while banking crisis incidence has sizeable variation over time (standard deviation 0.05), this is considerably smaller than the variable's volatility across different countries[1].

[1]Similarly in each year one can calculate the average Current-Account-Balance-to-GDP ratio of all countries. The average Current-Account-to-GDP ratio here has a standard deviation of 0.016.

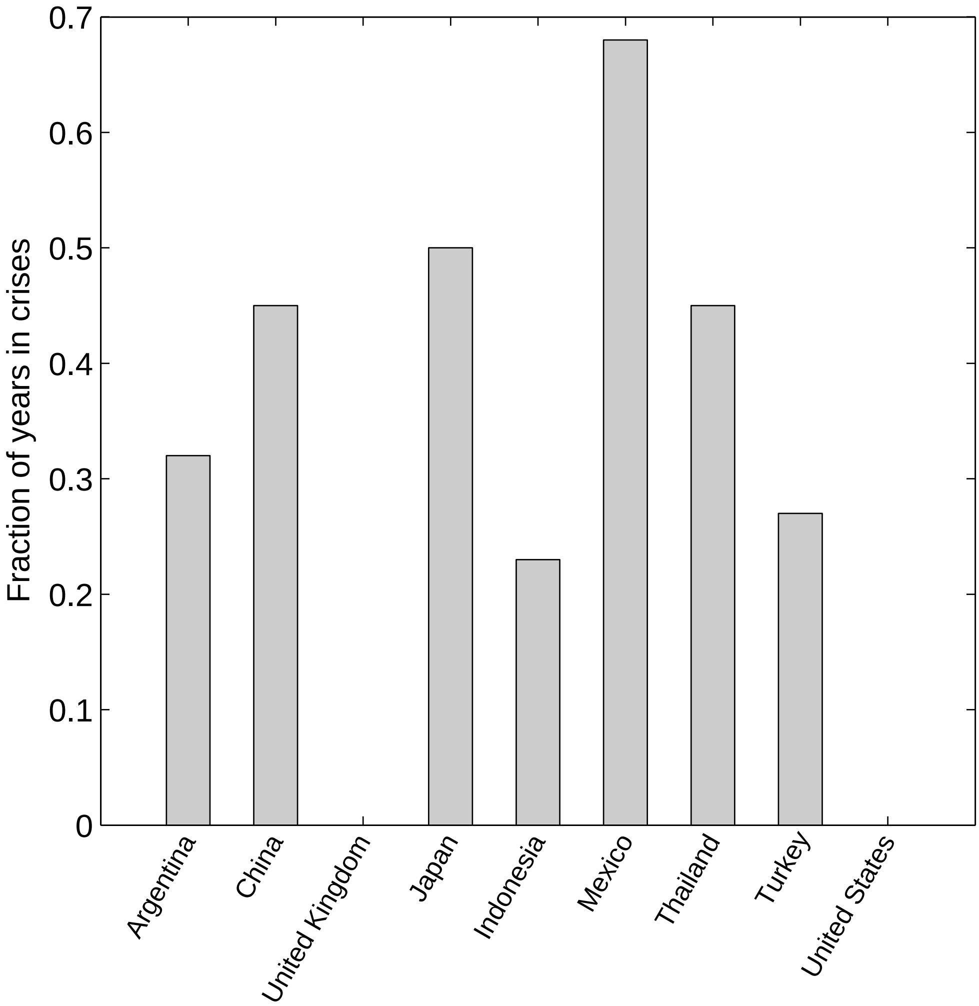


Figure 2. Fraction of years (of the 1980-2001 period) in banking crises, selected countries

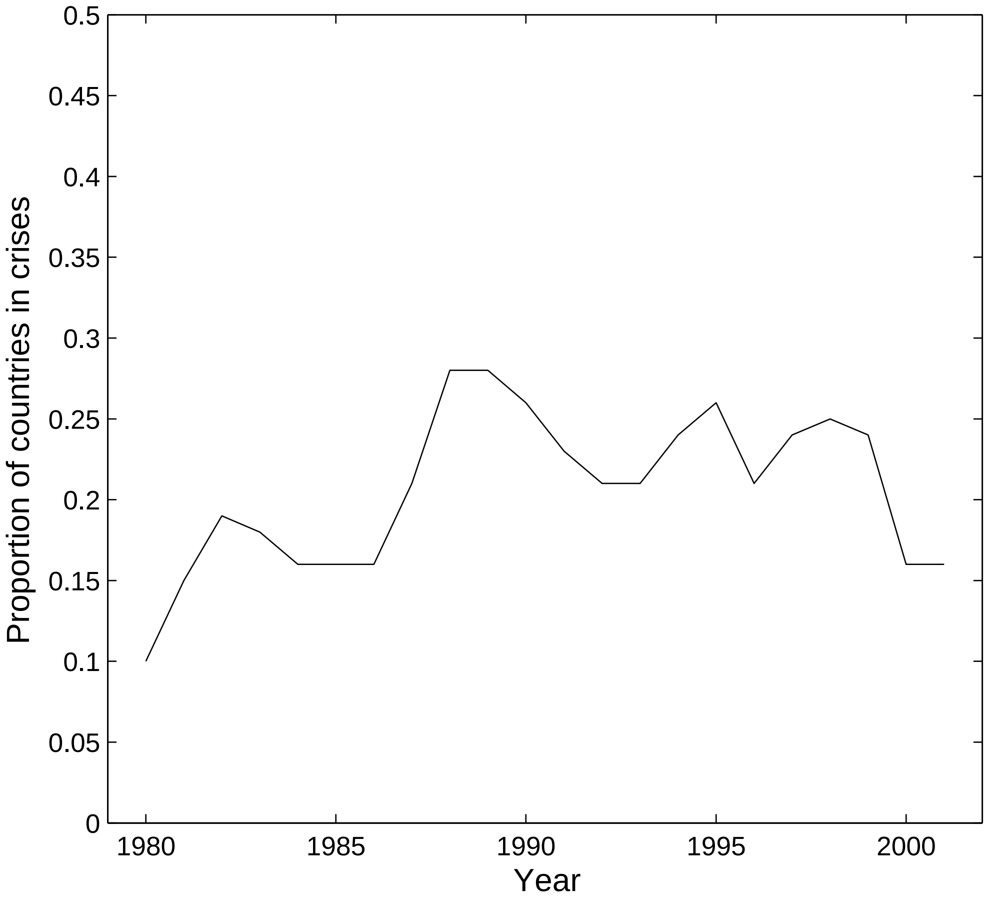


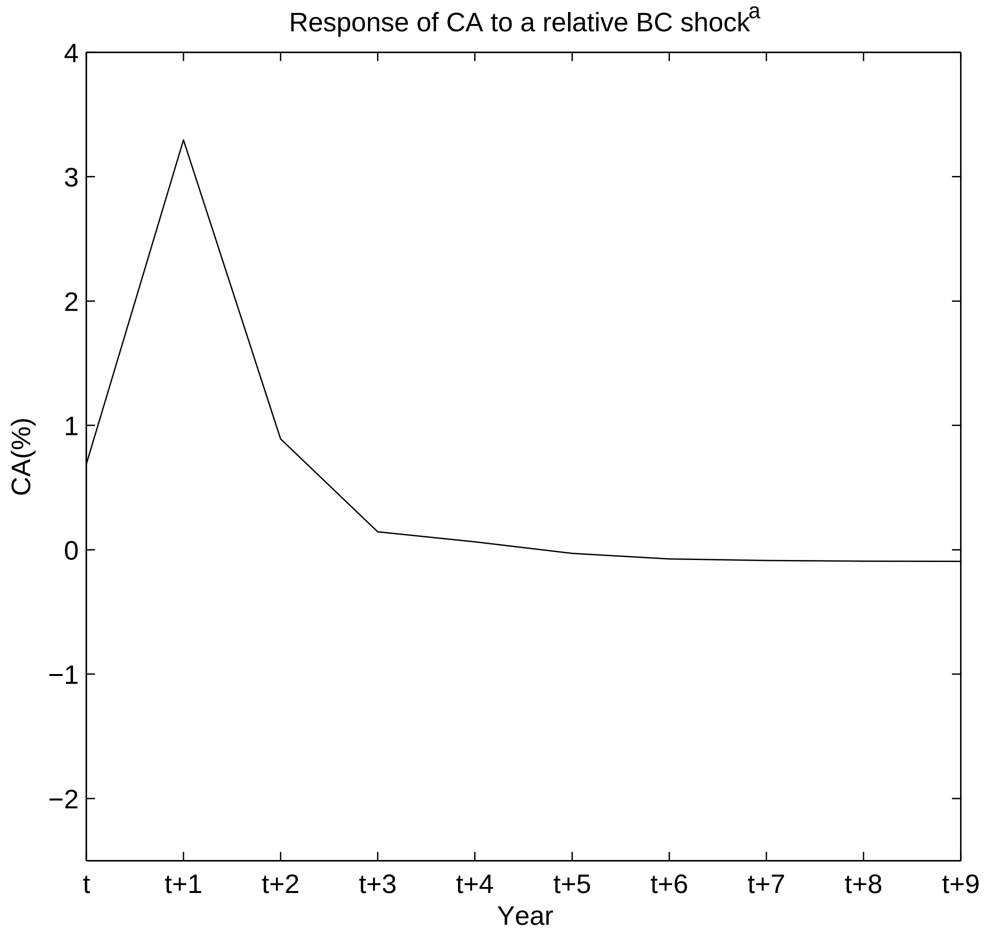
Figure 3. Proportion of countries in banking crises, 1980-2001

3.3 Results

We first report results from the benchmark model Equation 3.1 where μ_i and λ_t are modeled as fixed effects, and the lag length equals three. While pretesting determined this as the most appropriate specification, additional ones will be reported later in the paper to demonstrate robustness.

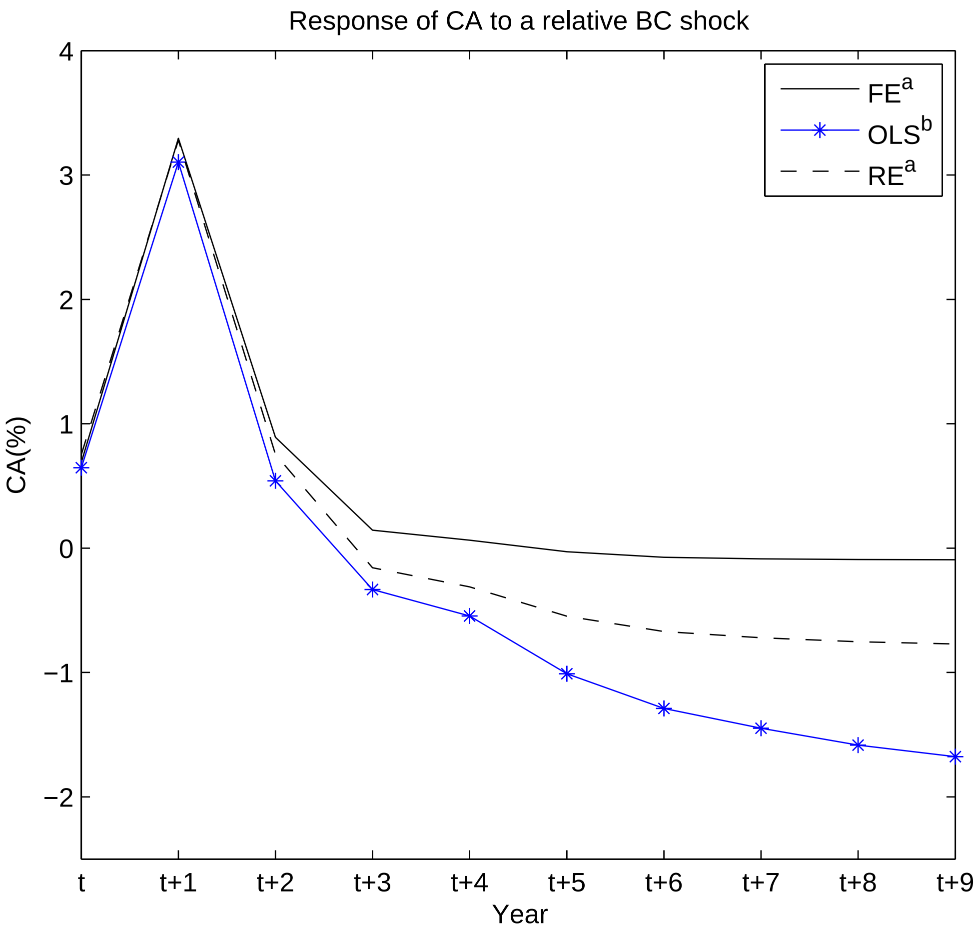
Figure 4 plots the estimated response of the Current-Account-Balance-to-GDP ratio to a banking crisis shock, i.e., $(\frac{\partial CA_{t+j}}{\partial BC_t})$, for $s = 0, 1, \ldots, 9$. There is an immediate increase of less than 1% in the Current-Account-Balance-to-GDP ratio during the crisis year. In the following year $(t + 1)$ of a relative banking crisis shock, the improvement in the CA exceeds 3%, which turns out to be the maximum response. Beginning with the next period, the responses gradually diminish, effectively returning to zero four to five years after the shock . Overall, the impulse response function shows a hump-shaped response, suggesting that a banking crisis is followed by an improvement in the current account that reaches a peak the next year after the shock, and disappears in the long run. Note that the sign of this effect is consistent with what has been found in cross-sectional regression models in the literature. The contribution of the present model is that it goes beyond the sign of the effect, providing information on its dynamics.

The impulse response functions obtained from simple OLS regressions (imposing $\lambda_i = 0$ and $\mu_t = 0$) and random effect (RE) regressions are added in Figure 5 for comparison. It can readily be seen that the basic shape of the three curves is similar. The curves closely track each other in the short run, though there appears to be some discrepancy after the medium run.



[a] Fixed effect estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it}$

Figure 4. Impulse responses: CA to one unit of RBC Shock



[a] FE and RE estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it}$

[b] OLS estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \varepsilon_{it}$

Figure 5. Comparison of impulse responses in FE, OLS and RE estimation, RBC shock

Formal tests of the size and statistical significance (to check whether significantly different from zero) of the maximum and long run responses are presented in Table II. In all three specifications, the peak response occurs at time $t+1$ (one year after the banking crisis shock), and ranges from 3.10% (OLS) to 3.30% (RE). The point estimates of the long-run effect are negative, but statistically insignificant, in all three specifications.

Based on the results, therefore, the current account impact of a relative banking crisis shock is positive, sizable, and significant in the short run. One year after the shock the current account balance as a percent of GDP improves by approximately 3%. After that this positive effect dies out and completely dissipates in the long run. The null hypothesis that the long run multiplier is zero cannot be rejected in any of the specifications.

TABLE II

COMPARISON OF RESPONSES IN FE, OLS AND RE REGRESSION, RBC SHOCK

Estimation method	Year when peak response occurs[a]	Peak response (standard error)[b]	Long-run multiplier (standard error)[c]
FE	$t+1$	3.28 (0.93)**	-0.09 (1.03)
OLS	$t+1$	3.10 (0.97)**	-1.89 (1.36)
RE	$t+1$	3.30 (0.95)**	-0.79 (1.09)

[a] t is the crisis year.

[b] Based on the estimation of Equation 3.1,the point estimates of the peak response can be expressed as $\hat{\rho} = \hat{\gamma}_1 + \hat{\beta}_1\hat{\gamma}_0 + \hat{\gamma}_0$. Let $\rho = [\beta_1, \beta_2, \beta_3, \gamma_0, \gamma_1, \gamma_2, \gamma_3]'$, any set of nonlinear restriction $H_0 : c(\rho) = q$ can be tested by the delta method (27). If $\hat{G} = \frac{\partial c(\hat{\rho})}{\partial \hat{\rho}'}$, the estimate of the asymptotic covariance matrix is $Est.Asy.Var[\hat{c}] = \hat{G}(Est.Asy.Var[\hat{\rho}])\hat{G}'$. And the test statistic $W = (\hat{c} - q)'(Est.Asy.Var[\hat{c}])^{-1}(\hat{c} - q)$ has a chi-square distribution with degrees of freedom equal to the number of restrictions. In my case, $q = 0$ and the number of restrictions equals to one.** significant at 5%; * significant at 10%.

[c] Based on the estimation of Equation 3.1, the point estimates of the long-run multiplier can be expressed as $(\hat{\gamma}_0 + \hat{\gamma}_1 + \hat{\gamma}_2 + \hat{\gamma}_3)/(1 - \hat{\beta}_1 - \hat{\beta}_2 - \hat{\beta}_3)$. The standard errors can similarly be constructed as above.

CHAPTER 4

ROBUSTNESS CHECKS

This section checks the robustness of my results using alternative lag structures, controlling for currency crises, and dividing my sample to OECD and non-OECD countries as well as to oil-exporters and others.

4.1 Exogeneity

My estimation of Equation 3.1 assumes that one can treat the occurrence of a banking crisis as a contemporaneously exogenous event with respect to the current account balance. This assumption may not hold, and if indeed banking crisis is endogenous, my estimation method could lead to biased coefficients[1]. To address this, I exclude the contemporaneous banking crisis term and allow only lagged terms of the relative banking crisis variable to enter the right-hand side. In particular, I estimate the following:

$$CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it} \tag{4.1}$$

The impulse responses and the tests of the peak and long run effects obtained from Equation 4.1 are summarized in Figure 6 and Table III, along with the results from other specifica-

[1]Based on Granger causality tests, it is shown that relative banking crises Granger cause the current-account-balance-to-GDP, but not vice versa. Although a Granger causality test is not a test for exogeneity in the structural sense, it offers suggestive evidence that the causation likely runs from banking crises to the current account balance.

tions. In Figure 6 and Table III, Equation 4.1 is referred to as Model 2, indicating the estimation includes relative banking crisis shock terms starting from the one lag. The benchmark in the figure and table is Equation 3.1, which is referred to as Model 1.

In Figure 6 the basic shape of the curve marked Model 2 mimics that of curve Model 1, both in terms of when the maximum response of CA emerges and how the initial positive responses decrease to zero in the medium run and stabilize near zero afterwards. As one can expect, the impact multiplier (response at year t) from Model 2 is zero, compared to about 0.7% from Model 1. The impulse responses from Model 2 are also constantly lower than those from Model 1. Table III (second row) presents the value and significance of the maximum effect and the long run effect of a relative banking crisis shock from Equation 4.1. The maximum effect is again positive, sizable and significant, while the long run effect is not significantly different from zero. The basic conclusion of short run positive impact and long run neutrality of banking crises on the current account balance still hold.

4.2 Controlling For Currency Crises

My estimation is based on identified banking crises. It could be problematic if the banking crises variables are proxying[1] for currency crises. Currency crises, compared to banking crises, represent a more proximate cause of the current account balance,and could indeed be interpret-

[1]Figure 7 and Figure 8, Appendix C describe side by side banking crises and currency crises incidence in selected countries and over time. Based on the graphs, banking crises and currency crises incidence are noticeably different. Also there does not seem to be serious correlation based on the calculation of correlation coefficients. Although the correlation coefficients between the binary banking crises indicator and currency crises indicator and between the relative banking crises variable and relative currency crises variable are both significant at 5%, both coefficients are 0.06 and the magnitude is fairly small.

ed as endogenous. In principle it would be desirable to correct this problem with instrumental variables, but in practice the literature on this topic suggests it would be difficult to find instruments that are correlated with banking crises but uncorrelated with currency crises (1)(13). Instead I assess the effects of banking crises once I control for currency crises.

Most often, currency crises are expressed as a devaluation of the domestic currency or the floatation of the exchange rate; however if central banks resort to contractionary monetary policy and foreign-exchange market intervention, currency market turmoil will be reflected in steep increases in domestic interest rates and massive losses of foreign-exchange reserves (1). Hence, they think an index of currency crises should capture these different manifestations of shocks.

My raw currency crises indicators are obtained from (2). They form a panel dataset for currency crises by constructing an exchange market pressure index (EMPI) for each country. The EMPI is defined as the percentage depreciation in the (nominal) exchange rate plus the percentage loss in foreign exchange reserves. Their currency crisis dummy variable takes the value one if for a specific year and country the EMPI is in the upper quartile of all observations across their panel dataset. In the total number of 1760 usable observations, there are 565 currency crises events (32% of the sample).

To control for rest-of-the-world effects, the currency crises indicators are converted into relative measures by calculating the deviations from their GDP-weighted world mean. I also experiment with different lag specifications with relative currency crises by including and not including the contemporaneous relative currency crises term.

Naturally, in Figure 6 the curves show different responses in year t (positive or zero) depending on whether a contemporaneous term of relative banking crisis is included in the estimated model. But otherwise the curves closely match each other. According to Table III, the maximum response is positive and significant in each model, and the long run response is not significant. Apparently, my results are not sensitive to whether currency crises are controlled and to different lag specifications of crises shocks.

TABLE III

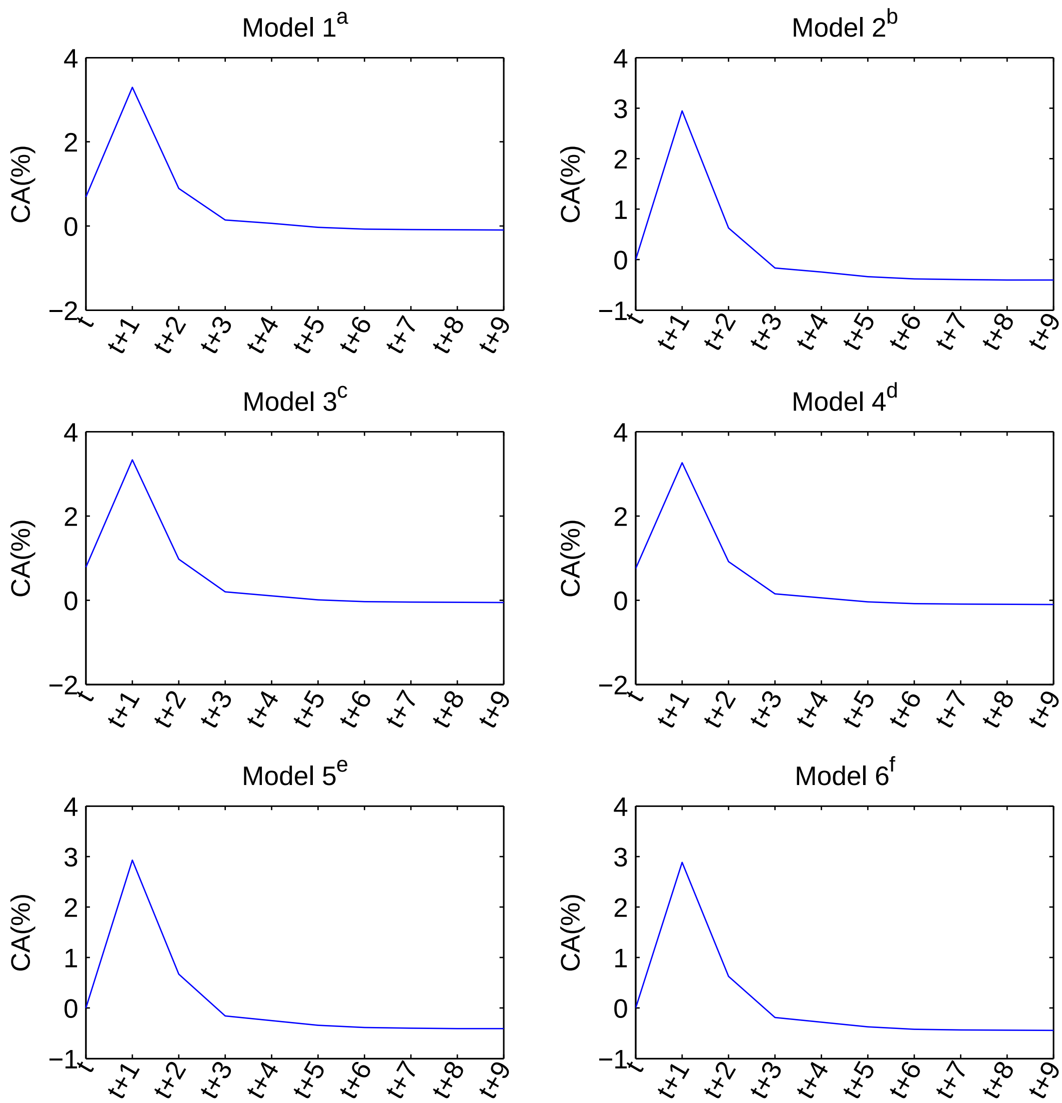
COMPARISON OF RESPONSES IN FE REGRESSIONS WITH DIFFERENT MODEL SPECIFICATIONS, RBC SHOCK

Model[a]	Year when peak response occurs[b]	Peak response (standard error)[c]	Long-run multiplier (standard error)[c]
1	$t+1$	3.28 (0.93)**	-0.09 (1.03)
2	$t+1$	2.95 (0.85)**	-0.41 (0.96)
3	$t+1$	3.33 (0.96)**	-0.06 (1.04)
4	$t+1$	3.26 (0.95)**	-0.10 (1.04)
5	$t+1$	2.93 (0.85)**	-0.41 (0.96)
6	$t+1$	2.88 (0.85)**	-0.44 (0.96)

[a] Notations of model form follow that of Figure 6. All results based on FE regressions.

[b] t is the crisis year.

[c] ** significant at 5%; * significant at 10%. Test if significantly different from zero. Refer to Table II for how to calculate point estimates, standard errors and test statistics..



[a] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it}$

[b] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it}$

[c] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[d] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[e] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[f] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

Figure 6. Comparison of CA responses to one unit RBC shock in FE regressions

4.3 OECD vs. Non-OECD Countries

My analysis, so far, assumes that the effects of banking crises on the current account balance are the same for the entire sample. It is possible, however, that these effects are different in countries in different stages of economic development. More developed economies may be less prone to macroeconomic fluctuations caused by banking crises due to better designed financial systems, institutions and regulations, while less developed economies may be less able to absorb such shocks well through built-in automatic stabilizers. It is also possible, however, that more advanced economies rely more heavily on financial intermediaries and financial markets and are more leveraged due to all kinds of financial instruments so that they are more fragile. If the effects of banking crises on the current account balance are indeed significantly different in developed and less developed economies, ignoring these differences in the estimation could yield incorrect and biased results.

To explore this possibility, I perform a Chow test of structural stability. To that effect, I divide my sample between OECD and non-OECD countries [1], estimate Equation 3.1 first separately over the two subsamples (the unrestricted version) and then over the whole sample (the restricted version), and then compare the residual sums of squares to test the null hypothesis of structural stability.

From the regression results in Table VI, Appendix A, there is some evidence that the banking crises cause larger fluctuations in the current account balance in non-OECD countries, since

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[1] http://www.oecd.org/general/listofoecdmembercountries-ratificationoftheconventionontheoecd.htm

the absolute value of the estimated coefficients on the relative banking crisis terms tend to be larger for the these countries. However the difference is not statistically significant between OECD and non-OECD countries according to the Chow test. The results should be interpreted with caution, since my sample only includes a limited number of OECD/high income countries and may not have enough power to identify a structural change.

4.4 Oil-exporting Countries vs. Others

In some sense, oil balance is not as "fundamental" as other factors that affect the current account balance. Nonetheless, the contemporary high and rising oil prices do play an important role in the current account surplus/deficit in many countries. It is also natural to think that the dynamics of the current account balance are closely associated with oil importing and exporting activities. In my benchmark model (Equation 3.1), the variation in world oil prices partly gets controlled by the time fixed effects, and whether a country is an oil-importer or oil-exporter gets controlled by the country fixed effects. But concerns may arise if one believes that somehow banking crises may have different effects on the macro-economy in oil importers and oil exporters. This is plausible, for example, if in these two types of countries industry structures and banking systems are designed differently, and the real sectors have different degrees of reliance on the financial sectors. A potential solution is to divide my sample into two categories - oil-exporters vs. others, and to examine the effects of banking crises in the two subgroups. Similar to subsection above, formal analysis can be done through a Chow test with the two subgroups.

I count a country as an oil exporter either if it is a member of Organization of the Petroleum Exporting Countries [1] or it is listed as one of the top world net oil-exporters by U.S. Energy Information Administration (28). The subsample regression results are presented in Table VII, Appendix A. The estimated coefficients are not statistically different at 5% significance level. Again one should keep in mind the fact that less than ten oil-exporters exist in my sample and the Chow test is of limited power. The estimated coefficients suggest banking crises do not cause significant fluctuations in the oil-exporting group. Those countries may have relatively simple industry structures, and their business sectors do not need as much external borrowing from banks to finance the purchases of important production resources.

[1] http://www.opec.orgopec_web/en/about_us/25.htm

CHAPTER 5

EXTENSIONS

Two main types of financial crises are banking crises (characterized by exhaustion of bank capital) and currency crises (characterized by large nominal devaluation). The exact definitions of banking crises and currency crises are given in previous text in this paper. While both crises are often associated with disruption in the orderly working of financial markets and macroeconomic activities, these two types of events have very different characteristics and therefore have different dissipation channels. This section discusses a few extensions, adding analyses related to the current account effect of currency crises.

5.1 Granger Causality Test in a Three-variable System

In previous sections, two issues were brought up briefly: first the possible feedback between financial crises and the current account balance, second the possible links between banking crises and currency crises. Here I adopt a system perspective and elaborate and examine the relationship among banking crises, currency crises and current account balances in more details.

The significant output loss, growth slowdown and investment reduction associated with a banking crisis imply a sizable modification in consumption and saving behaviors that can affect the current account. The conventional wisdom regarding a currency crisis is that devaluation improves the current account. Of course the improvement would depend on whether the

Marshall-Lerner condition holds (the condition is more likely to hold in reality), and the current account may initially deteriorate from a J-curve effect (29).

Both domestic factors such as low reserves and macroeconomic policies, and external factors such as unfavorable terms of trade and higher interest rates in foreign countries, may trigger current account adjustments and financial crises at the same time (30). Changes in the current account can also be causally prior to financial crises. For example, (31) investigated the relationship between optimal current account deficits and currency crises in an intertemporal framework and discovered in five cases (in a sample of seventeen countries and ten of which did experience a currency crisis) current account levels deviated substantially from the optimal level before the occurrence of the currency crisis. This is consistent with the evidence found by some other scholars that current account deficits are somewhat larger before crises than in tranquil periods (30). And another example in reality may be found in the dynamics of an exchange-rate-based inflation stabilization plan, such as that of Mexico in 1987, which is described by (1) as follows:

> Because inflation converges to international levels only gradually, there is a marked cumulative real exchange-rate appreciation. Also, at the early stages of the plan there is a boom in imports and economic activity, financed by borrowing abroad. As the current account deficit continues to widen, financial markets become convicted that the stabilization program is unsustainable, fueling an attack against the domestic currency. Since the boom is usually financed by a surge in bank credit,

> as banks borrow abroad, when the capital inflows become outflows and asset markets crash, the banking system caves in. (p. 475)

(30) examined 105 low- and middle-income countries over the period 1970-1996 and found that the majority or reversals were not accompanied by a currency crisis. (32) classified ninety-six crises in twenty countries and indicated that currency vulnerabilities can arise from current account (14%), financial excesses (29%), fiscal deficits (5%), debt problems (42%), and sudden stops (5%), or be self-fulfilling (4%). Although the endogeneity/simultaneity problem of the current account balance may not seem to be present in many financial crises, it is still a legitimate concern and worth noting.

There are possible links between banking crises and currency crises, although theory does not provide an unambiguous answer as to what the causal direction is. The two types of financial crises may have common causes, as indicated in the Mexico 1987 example above. The chain of causation can run from currency depreciation to bank insolvency. If a large share of the banking system's liability is denominated in foreign currencies, the occurrence of depreciation/devaluation can definitely undermine the solvency of the banking system (33). Other models stress the opposite causal direction. (34) pointed out that banking sector problems may lead to weakening of domestic currency, if central banks bail out troubled financial institutions by excessive money creation.

To summarize, in principle, 1) banking/currency crises disturb normal saving and investment activities and can affect the current account balance; 2) when analyzing the impact of banking/currency crises on the current account balance, the possible endogeneity and simultaneity problem should be kept in mind; 3) there may be potential linkages between banking crises and currency crises, although the causation relationship is unclear. To explore more about the relationship among banking crises, currency crises and current account balances, I conduct Granger causality tests in a system consisted of three variables – Current-Account-Balance-to-GDP-ratio, relative banking crisis indicator and relative currency crisis indicator. Granger causality test checks whether the lags of one variable enter into the equation of another variable. Note that it is something quite different from a test of exogeneity (for a variable to be exogenous, it should not be affected by the contemporaneous values of other variable). However, Granger causality provides some clue about the effects of past values of another variable on the current value of the variable of interest and whether one series helps improve the forecasting performance of another (35).

In my case, the Granger tests can be done in a standard Vector Auto-Regressive (VAR) system as shown below:

$$CA_{it} = \sum_{j=1}^{3} \beta_{1,j} CA_{i,t-j} + \sum_{s=1}^{3} \gamma_{1,s} RBC_{i,t-s} + \sum_{k=1}^{3} \delta_{1,k} RCC_{i,t-k} + \alpha_1 + \varepsilon_{1,it} \tag{5.1}$$

$$RBC_{it} = \sum_{j=1}^{3} \beta_{2,j} CA_{i,t-j} + \sum_{s=1}^{3} \gamma_{2,s} RBC_{i,t-s} + \sum_{k=1}^{3} \delta_{2,k} RCC_{i,t-k} + \alpha_2 + \varepsilon_{2,it} \tag{5.2}$$

$$RCC_{it} = \sum_{j=1}^{3} \beta_{3,j} CA_{i,t-j} + \sum_{s=1}^{3} \gamma_{3,s} RBC_{i,t-s} + \sum_{k=1}^{3} \delta_{3,k} RCC_{i,t-k} + \alpha_3 + \varepsilon_{3,it} \tag{5.3}$$

The error terms can be decomposed into $\varepsilon_{m,it} = \mu_i + \lambda_t + u_{m,it}(m = 1, 2, 3)$ and $u_{m,it}$ is assumed to be i.i.d.) depending on different estimation techniques, and μ_i and λ_t denote country and time effects, respectively. The likelihood ratio statistic suggests that 3 lags for the variables in the VAR system are appropriate at 5% significance level. If in a specific equation the coefficients on the lags of a right-hand-side variable (other than the dependent variable) can all be set equal to zero, then this variable does not Granger cause the dependent variable. It is straightforward to test the desired restrictions use standard F-tests. The results from the F-tests can be summarized in Table IX, Appendix A.

Based on the F-statistics and p-values, the patterns of Granger causations are consistent in different estimation techniques. It is evident that relative banking crises significantly granger causes Current-Account-Balance-to-GDP ratio all the time. Only with OLS, relative currency crises granger causes Current-Account-Balance-to GDP ratio at 10%. All the other directions of Granger causations are insignificant. Therefore in my dataset at least, there is no obvious trace of the Current Account feeding backing to financial crises, and one type of financial crises leading to the other. But Granger tests definitely cannot be deemed as conclusive evidence against the feedback and linkages of the three variables in the system [1].

5.2 The Impulse Responses After Currency Crises

Another interesting extension is to examine the impact of currency crises on the Current Account balance. As said before, currency crises are expected to boost the Current Account.

[1]In Appendix B, I construct an alternative dataset of 48 countries over 24 years. In this alternative dataset I rerun the Granger causality tests with different estimation techniques and lag specifications. The basic patterns of Granger causations appear to persist in OLS, fixed-effects and random effects. With 4 lags, only RBC and RCC are found to significantly Granger causes CA at 5%. With 3 lags, RBC and RCC are also found to significantly Granger causes CA at 5%. In addition, CA is found to Granger causes RCC at 5% and 10% significance respectively in OLS and RE (in FE the p-value is slightly larger than 0.10) with 3 lags.

A preliminary look at the empirical work, however, provides some but not solid proof for such a pattern. Usually the analyses are informal, based on before-after comparisons of Current Account balances a couple of years around currency crises. (36) discovered that the Current Account Balance as a percentage of GDP improves within two years following currency crises in 24 emerging market economies during 1975-1997. (30) examined a sample of 105 low and middle income countries over period 1970-1996 and found an improvement in the Current Account position after the devaluation only for middle-income countries; and overall current account imbalances are not sharply reduced up to three years following a currency crisis. Moreover, current literature about macroeconomic performance (mostly on output and some on investment) around currency crises events does not seem to reach consensuses in many other aspects, including output cost (36)(37), necessary time for adjustment or recovery (2)(30)(38)(39), access to international capital markets (31)(32) and so on. The diversity of results may arise from different data and methodologies adopted, but it may also suggest possible endogeneity and simultaneity issues and differences in the nature of currency crises. Although it is widely realized that there are many causes of currency crises, up to now only a few studies have tried to categorize the crises events into various types based on their salient feature (32). Clearly more effort is needed on this classification front.

The dynamic panel regression and impulse response functions can easily be migrated to study the dynamic effects of a relative currency crisis shock (RCC) on the Current-Account-

Balance-to-GDP ratio (CA). First I examine the total effect of RCC on CA, that is $\frac{\partial CA_{t+k}}{\partial RCC_t}$ (t denotes the crises year and $k = 0, 1, 2, 3 \ldots$) in the following:

$$CA_{it} = \alpha + \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{k=k_0}^{3} \delta_k RCC_{i,t-k} + \varepsilon_{it} \tag{5.4}$$

where $\varepsilon_{it} = \mu_i + \lambda_t + u_{it}$ (u_{it} is assumed to be i.i.d.), and the μ_i and λ_t can either be modeled as country and time effects respectively in fixed effect or random effect regressions or both set to zero in OLS regressions. k_0 can take the value 0 or 1.)

The impulse responses calculated from estimating a number of variants of Equation 5.4 are summarized in Figure 12, Appendix C. The basic shape of the impulse response functions is fairly robust to different estimation techniques, including OLS, fixed effect and random effect regressions. There are some small fluctuations in the first three years following a relative currency crisis shock. The current account balance as a percent of GDP first decreases and then increases and then falls again, but the magnitude of all fluctuations is small (within 1%). After three years the responses of CA become more or less steady, except in two OLS regressions OLS_0 and OLS_1, where the decline in CA further reaches 2% and 3% respectively at year $t + 9$. Depending on different assumptions about when a relative currency crisis shock begins to influence the current account, the impact effect can be zero or negative. In the latter case, the initial reduction in CA is between 0 and 1%. Based on the average responses shown in the plot, in the medium run the effect of a relative currency crisis shock on CA is typically not significantly different from zero or slightly negative. Tests of significance of the long run multipliers in different specifications indicate that only the long run multiplier in OLS_0 is significantly different from zero at 7%.

I also examined the effect of a relative currency crisis on CA when controlling for the effect of a relative banking crisis. Figure 13, Appendix C summarizes $\frac{\partial CA_{t+k}}{\partial RCC_t}$, for $k = 0, 1, \ldots, 9$ in variants of the following equation:

$$CA_{it} = \alpha + \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=s_0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=k_0}^{3} \delta_k RCC_{i,t-k} + \varepsilon_{it} \tag{5.5}$$

Notations in Equation 5.5 are the same as in Equation 5.4. s_0 is set to be equal to k_0 and can either be 0 or 1. The partial effect of a currency crisis shock shown in Figure 13, Appendix C is also similar to its total effect shown in Figure 12, Appendix C. There are also small variations in the impulse responses in the first couple of years following the shock, and subsequently the curves more or less stabilize. Again the long run multipliers in all specifications are not significantly different from zero in the Figure, except OLS_0 ($p = 0.08$).

Figure 14, Appendix C examines more closely to see whether the impulse responses are sensitive to different specifications of when a relative currency crisis shock starts to have an impact. All the regressions in the figure are estimated with two-way fixed effects. The reason of choosing fixed effect regression is that it allows for arbitrary correlation between the country-/year- specific effect and the relative currency crisis and thus may still yield consistent estimates of coefficients when OLS and random effect regressions cannot. Besides the fixed effect estimations that have been explored in Figure 12, Appendix C and Figure 13, Appendix C, two other variants of Equation 5.5 in which s_0 and k_0 are not equal are also experimented. Naturally, the six curves show different responses at year t, but otherwise the curves resemble each other in shape and closely track each other in values. The responses of CA to a relative currency crisis shock are apparently robust to different lag specifications. Moreover, in Figure 14, Appendix C none of the impulse responses in the short run, medium run and long run are significantly different from zero according to formal statistical tests using delta method.

One by-product in Appendix B is an alternative balanced panel dataset formed in analysis, which is smaller compared to the dataset used so far. The alternative dataset consists of 48 countries from 1977 to 2001. The dependent variable (the share of the current account balance in GDP) and the independent variables (relative banking crisis indicator and relative currency crisis indicator) are constructed in the same way as before. Figure 15, Appendix C documents the responses of CA to a relative currency crisis in the smaller dataset. The differences between Figure 14, Appendix C and Figure 15, Appendix C are obvious. In the latter, the impact effect is negative or zero, depending on whether a contemporaneous term of currency crisis shock (RCC_t) is included in model, which is consistent with the former. But after that instead of fluctuating up and down and returning to a response level that is very close to the initial response, the impulse response in the latter slowly goes up and stabilizes after three or four years. The long term response at year $t+9$ can be either near 0 or +3% in the latter, comparing to around 0 or -0.8% in the former. In Figure 15, Appendix C, the long-run multipliers in specifications cc1, bc1cc1 and bc0cc1 are significantly different from zero at 5%.

Note that when using alternative datasets, the impulse responses of CA to relative banking crises are more consistent comparing with the CA responses to relative currency crises. Figure 11, Appendix C records the responses of CA to a relative banking crisis in the smaller dataset. The corresponding graph for the larger dataset used previously is Figure 6. By comparison, one will notice that the impulse responses in Figure 11, Appendix C resemble those in Figure 6 in shape. The basic conclusions from Figure 6 still hold in Figure 11, Appendix C. CA first increases after the shock, then the positive effect of the shock reaches the peak and begins to fall. After about 4 or 5 years, the impulse responses drop to below zero and persist into the long run. The responses are always positive in the short run, around zero or slightly negative in the medium run and long run. Yet there are a few differences. First in Figure 11, Appendix C, a relative banking crisis shock virtually has no contemporaneous effect on the Current-Account-Balance-to-GDP ratio, even when a contemporaneous relative banking crisis term (RBC_t) is included in the estimated model. Second, the peak of the impulse responses shows up in the second year following the shock in Figure 11, Appendix C, instead of in the following year of the shock in Figure 6. Third, the long run effect in Figure 11, Appendix C seems more negative than in Figure 6. The magnitude of the impulse responses is generally smaller in the short run and medium run in Figure 11, Appendix C. For instance, the peak positive response is between 1 and 1.5 percent in Figure 11, Appendix C, as opposed to between 3 and 3.5% in Figure 6. Formal statistical tests suggest that the peak responses in Figure 11, Appendix C are all significantly different zero at 10% (the p-values range from 0.06 to 0.10), and none of the long run multipliers is significant. All these differences are not crucial ones and may arise from different datasets. Previously in Figure 6, the larger dataset is utilized and it covers a wider variety of countries (80 countries) and a short time period (1980-2001). Furthermore, one can also see higher incidence of banking and currency crisis events in the large dataset.

In brief, when using alternative datasets, the impulse responses of CA to relative banking crises are more robust comparing with the CA responses to relative currency crises. As for currency crises, the discrepancies may be caused by the aforementioned reason of distinct datasets, as well as the more serious endogeneity/simultaneity problem of currency crises with regard to the current account. Banking crises may indeed be deemed as a more exogenous factor concerning the current account.

5.3 Twin Crises

The influential study of (1) on twin crises paid much attention to the interaction between banking and currency problems. Banking crises and currency crises may deepen each other and activate a vicious spiral in the economy. The co-occurrence of banking crises and currency crises (twin crises) may also make the boom-bust cycles even more pronounced. Therefore, another interesting extension is to examine whether twin crises can produce exaggerated business cycle swings that go beyond the summation of the related banking crises effects and the currency crises effects.

I have qualitative indicators of banking crises and currency crises in my dataset, based on which I derive my raw twin crises indicators. Let BC_{it} and CC_{it} denote the binary banking crises and currency crises indicators in country i and year t, respectively, the qualitative twin crises indicator TC_{it} is set to one if both BC_{it} and CC_{it} are equal to one, and TC_{it} is set to zero otherwise. Then the binary TC_{it} indicators are converted to relative twin crises measures RTC_{it} by calculating the deviations from their GDP-weighed world mean in each year. One can refer to previous sections for the detailed reasoning and calculation of the relative twin crises measures, since the process is an analogy to the construction of relative banking crises measures. In total, there are 135 twin crises events out of the 1760 observations (the twin crises incidence is around 7.7%) in my data. Note that there are 363 banking crises events and 565 currency crises, so that around 37% of banking crises are accompanied by currency crises and 24% of currency crises are accompanied by banking crises.

Before analyzing the additional effects of twin crises, it is meaningful to first take a look at the total effects of twin crises without controlling banking and currency crises. I run a two-way fixed effect model:

$$CA_{it} = \sum_{j} \beta_j CA_{i,t-j} + \sum_{l} \theta_l RTC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it} \tag{5.6}$$

Different lag specifications are attempted, including three, four and five lags. Different assumptions regarding when relative twin crises start to influence are also checked. The regressions are summarized in Table X, Appendix A. The coefficients on the third and fourth lags of relative twin crises terms are significant, while the coefficient on the fifth lag is not. Therefore, estimation with four lags is probably most appropriate, without discarding important information in data. While the coefficients on the third and fourth lags of relative twin crises terms are always large, significant and negative, the coefficients on other lags of relative twin crises are insignificant and small. This pattern persists in all columns in Table X, Appendix A. Corresponding regression coefficients are similar in significance and magnitude across columns in the table. As a result, one can expect the basic shapes of the impulse responses curves (that describe CA evolution following one unit of RTC shock) to be similar in all specifications.

Figure 16, Appendix C plots the impulse responses of CA to a relative TC shock in regressions with 3 or 4 lags in combination with different starting years (let l_0 denote the initial value of l, l_0 can be either 0 or 1 in Equation 5.6) of relative twin crises terms. One can easily tell that total Current Account effects of twin crises are different from that of banking crises and currency crises. The impact responses start from a slight negative value (between 0 and -1%) if $l_0 = 0$ is designated. In all curves, the impulse responses increase gradually and reach the maximums two years after the shock. The maximums range from 0.75% to 1.52%, but none is significantly different from zero even at 10%. After that, the impulse responses quickly turn negative, further decline and eventually stabilize in the medium run and long run. There are shaper declines after $t + 2$ in impulse response curves with 4 lags, and the distances between the curves widen after t+4 and last till $t + 9$. The long run multipliers calculated with 4 lags are more negative than those calculated with 3 lags, no matter what the starting value of l is in Equation 5.6. The two long run multipliers calculated with 4 lags are both lower than -4% and significantly different from zero at 5%. The long run multiplier calculated with 3 lags and $l_0 = 0$ is around -3% and significantly differ from zero at 10% ($p = 0.09$), while the one calculated with 3 lags and $l_0 = 1$ is the least negative (-2.5%) and the significance test yields a p-value of 0.14. The total effects of twin crises on the Current Account balance turn out positive in the short run and become negative in the long run. However, the short run positive impact is a lot smaller and less significant compared to the negative impact in the long run.

There are two types of settings in which to examine the extra effects of twin crises-the additive way and the multiplicative way. The additive way can be set up as the following:

$$CA_{it} = \sum_j \beta_j CA_{i,t-j} + \sum_s \gamma_s RBC_{i,t-s} + \sum_k \delta_k RCC_{i,t-k} + \sum_l \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it} \quad (5.7)$$

A twin crisis is a combination of a banking crisis and a currency crisis by definition, so it should have the effects of both an individual banking crisis and an individual currency crisis. If twin crises have no extra influence, then after partialing out relative banking crises and relative currency crises in Equation 5.7, the coefficients on all the relative twin crises terms should be jointly insignificant.

Similar to the analyses of total effects of twin crises on the Current Account balance, the analyses of partial effects of twin crises involve experimenting with different starting years and lag lengths of the crises terms. Following the custom and for simplicity, I always maintain symmetry in Equation 5.7. That is, at all times, the initial values of s, k and l are equal, and the ending values of j, s, k and l are equal. The initial value of s, k and l can be either zero or one, while I tried 3, 4 and 5 for the ending value of j, s, k and l. The estimated coefficients are shown in Table XI, Appendix A. The regressions are all performed with country and year fixed effects. The corresponding coefficients in Table XI, Appendix A are quite similar to those in Table X, Appendix A. The coefficients on the autoregressive terms (lagged CA) and their standard errors are nearly identical. When the fourth lag or RTC is included it is always highly significant, suggesting estimating with 4 lags is probably necessary. The third and fourth lags of RTC are significant in all columns while the other lags of RTC are insignificant, which is the same as before. The coefficients on the fourth lag of RTC are however more negative in Table XI, Appendix A than in Table X, Appendix A. In all columns, the hypothesis that the coefficients on all the relative twin crises terms are jointly equal to zero can be rejected at 5%. This implies that twin crises do have Current Account effects that go further than the effects connected with banking crises and currency crises. Moreover, the signs, sizes and significance of the coefficients on CA, RBC and RCC terms do not change much when RTC terms are added or not added in regressions, except that when RTC terms are added, all RCC terms are insignificant and sometimes the fifth lag of CA and fourth lag of RBC becomes significant at 10%. Whereas in regressions without RTC terms, the second lag of RCC is usually significant, and the fifth lag of CA and the fourth lag of RBC are never found to be significant.

Table XI, Appendix A summarizes the CA responses following a relative TC shock after controlling for the effects implied by banking and currency crises. The shapes of the impulse response curves resemble those in the preceding figure in appendix. The impact responses are a little more negative (close to -2%) now under $s = k = l = 1$. Instead of a slow but monotonic increase of responses from t to $t + 2$, now from t to $t + 1$ the curves are either flat or have a very minor decline. At $t + 2$ again all curves show a spike. The spikes are lower than before, ranging from -1.4% to 1%. None of them is significantly different from zero. The curves begin to diverge since $t+3$. The two curves with 4 lags fall more sharply. The long run multipliers in all specifications are apparently more negative, ranging from -9% to -3%. Significance test on the long run multipliers suggest that all are significant at 10% (the two with 4 lags are significant at 5%) except the one with 3 lags and $l_0 = 1$.

Figure 17, Appendix C summarizes the CA responses following a relative TC shock after controlling for the effects implied by banking and currency crises. The shapes of the impulse response curves resemble those in the preceding figure in appendix. The impact responses are a little more negative (close to -2%) now under $s = k = l = 1$. Instead of a slow but monotonic increase of responses from t to $t+2$, now from t to $t+1$ the curves are either flat or have a very minor decline. At $t+2$ again all curves show a spike. The spikes are lower than before, ranging from -1.4% to 1%. None of them is significantly different from zero. The curves begin to diverge since $t+3$. The two curves with 4 lags fall more sharply. The long run multipliers in all specifications are apparently more negative, ranging from -9% to -3%. Significance test on the long run multipliers suggest that all are significant at 10% (the two with 4 lags are significant at 5%) except the one with 3 lags and $l_0 = 1$.

Equation 5.7 can also generate two sets of impulse responses besides the impulses responses associated with a relative TC shock: the CA responses following a relative BC shock and the CA responses following a relative CC shock. The subsequent two figures in appendix put together the CA responses after a shock of RBC, RCC and RTC. The impulse responses in both graphs are derived in regressions with 4 lags, since 4 lags seem most appropriate from inspecting the coefficients. The impulse responses with 3 lags are also derived for comparison purposes, but the results are not presented. The basic tendency and turning points of impulse response curves are similar with 3 lags and with 4 lags, although the magnitudes may differ. From Figure 18, Appendix C and Figure 19, Appendix C, a few things can be learned. First is that the partial effects of RBC, RCC and RTC are different. So eventually when one studies the mechanisms through which shocks affect the economy, the mechanisms for different types of financial shocks should not be the same and they should be able to explain different CA responses after different types of shocks. Second in the short run (t to $t+3$) the impulse responses to RBC and RCC are not sensitive to whether 4 lags or 3 lags are included and to whether RTC is controlled for. However after $t+3$ whether RTC is controlled matters more. As before, the impulse responses to RBC show a positive spike around 3% at $t+2$, which are significantly different from zero at 5%. The impulse responses to RCC show some small fluctuations (first decrease and then increase) in the first couple of years, but the changes are not significant. After $t+3$ there are noticeable discrepancies, regarding whether RTC is partialed out. When RTC is not included and 4 lags are used, the impulse responses to RBC and RCC (not shown) look very similar to corresponding curves in Figure 10, Appendix C and Figure 13, Appendix C where 3 lags are used. Yet in Figure 18, Appendix C and Figure 19, Appendix C, the RBC curves lift back up in the medium run and keep a positive value (but not as high as the maximum values) till the long run, rather than steadily diminishing and eventually dying out (as in Figure 10, Appendix C). The RCC curves also further increase in the medium run and then flatten at a small positive number, instead of becoming virtually flat since $t+3$ (as in Figure 13, Appendix C). The long run RBC multiplier in Figure 18,

Appendix C is even significantly different from zero (marginally at 5%), but the long run RBC multiplier in Figure 19, Appendix C is insignificant. The long run RBC multipliers would also be insignificant if they are calculated with 3 lags and RTC controlled. The long run RCC multipliers, on the other hand, are found to be insignificant in all specifications. These medium run and long run discrepancies probably result from two facts. One is that the construction of RTC implies that there might be high correlation between RTC with RBC and between RTC and RCC. Actually the Pearson correlation coefficients between BC and TC and between RBC and RTC are approximately 0.6. The correlation coefficients between CC and TC and between RCC and RTC are 0.4. All correlation coefficients are significant at 5%. The other one is that RTC has significant effects on CA (and note that the coefficients on the third and fourth lags of RTC terms are large and significant according to Table XI, Appendix A).

The effects of twin crises can also be discussed in the multiplicative setting, where the interaction terms of relative twin crises terms and the relative banking/currency crises terms are included in estimation. From the results one can tell whether the effects of banking/currency crises on the Current Account balance differ under twin crises compared to not under twin crises. The equation can be expressed as:

$$\begin{aligned} CA_{it} = \sum_j \beta_j CA_{i,t-j} + \sum_s \gamma_s RBC_{i,t-s} + \sum_k \delta_k RCC_{i,t-k} \\ + \sum_l \theta_l RTC_{i,t-l} RBC_{i,t-l} + \sum_m \phi_m RTC_{i,t-m} RCC_{i,t-m} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \tag{5.8}$$

The lags in the equation are symmetrically established, meaning j, s, k, l and m always have the same ending values (3 or 4) and the last four parameters have the same initial values (0 or 1). The θ's (ϕ's) can be tested to see whether they are jointly different from zero and further to conclude whether the effects of banking crises (currency crises) are significantly different in twin crises. The estimation results are listed in Table XII, Appendix A. The basic conclusions about the Current Account effects of banking/currency crises and the significance of the interaction terms are consistent in different columns. The hypothesis that the parameters on the interaction terms of relative banking crises (relative currency crises) and relative twin crises are jointly equal to zero cannot be rejected at all times. The effects of banking crises and currency crises therefore are not shown to be different under twin crises case and not under twin crises. The estimated parameters on the relative currency crises terms are mostly insignificant, and the parameters on the relative banking crises terms demonstrate that the banking crises first lead to an improvement and then deterioration in the Current Account balance.

CHAPTER 6

CONCLUSION

This study has investigated the effects of banking crises on the current account. Even though the topic has generated considerable interest, it remains theoretically indeterminate, and so has to be resolved empirically. The existing empirical literature has determined that the effect is positive (i.e., banking crises improve the current account) but in the context of cross-sectional regressions that cannot shed light on the dynamics of this effect.

Using a dynamic model on panel data for a broad set of countries, this paper confirms that banking crises result in current account improvements, but it goes further by showing that these effect is both substantial and time-varying. In particular, banking crises are shown to be followed by an improvement in the current account that quickly reaches its maximum effect one year later, and dies out in the long run.

The results therefore contribute to the literature by unfolding the detailed dynamics of the current account following a banking crisis. The dynamics allow one to tell not only the overall effect of a banking crisis on the current account balance at certain point, but also how the effects evolve over time.

The findings also shed light on how the crises effects can spread from country to country, spilling over to economies that did not experience banking crises themselves, since by definition a current account improvement for one country must imply a current account deterioration for someone else.

My research is also pointing out some promising directions for the future. The observed behaviors of the current account following banking crises raise a question about the mechanisms through which a banking crisis influences the current account balance. There is still ambiguity in theory about the effects of banking crises on the different components of the current account. It would be useful, therefore, to further investigate the post-shock responses of macroeconomic variables such as savings and investment, or exports and imports, in order to eventually develop a complete framework about how the financial sector influences the real sector.

Although the Granger tests do not reveal a clear sequence of different types of financial crises and the Current Account balance, my methodology can be modified a bit by specifying a near VAR system and arbitrarily imposing an order of events. This may help sharpen the estimated effects of a currency crisis which, unlike those of banking crises, are currently ambiguous.

My analyses also imply that twin crises may have Current Account effects that go beyond the effects connected with banking crises and currency crises. Besides, the Current Account effects of banking crises, currency crises and twin crises turn out very different. So eventually when one studies the mechanisms through which shocks affect the economy, the mechanisms for different types of financial shocks should not be the same and it is desirable that they are able to explain different Current Account responses after different types of shocks.

Alternative and potentially more precise measures of financial crises can also be explored. As in most of the literature, my raw financial crises variables are 0-1 binary variables, indicating whether there is a crisis or not. One of my plans for future research is to construct more accurate measures that will capture the intensity of a financial crisis. (40) developed a money market pressure index based on the ratio of borrowed reserves to deposits in the banking sector and the short-term interest rate. They identify banking crises as periods in which there is excessive demand for liquidity in the money market and the index of money market pressure is high. This approach is more objective than using market events and is one interesting attempt to construct more quantitative, accurate and comparable measures to define banking crises. Making progress in these directions will shed additional light into how financial shocks affect economic outcomes and spread from country to country.

APPENDICES

Appendix A

TABLES

TABLE IV

BANKING CRISES INCIDENCE AND THE

CURRENCY-ACCOUNT-BALANCE-TO-GDP RATIO

BY COUNTRY: SAMPLE MEANS OVER 1980-2001

Country	Banking crises (% of years)	Current account balance (% of GDP)
Algeria	14	1
Argentina	32	-3
Australia	0	-4
Bangladesh	45	-1
Benin	14	-6
Bolivia	18	-6
Botswana	0	4
Brazil	32	-2
Burkina Faso	32	-4
Burundi	5	-6
Cameroon	50	-4

Appendix A (Continued)

Table IV – continued

Country	Banking crises (% of years)	Current account balance (% of GDP)
Canada	0	-2
Cape Verde	5	-9
Central African Rep.	91	-4
Chad	50	-6
Chile	27	-5
China, P.R.: Mainland	45	1
Colombia	27	-2
Congo, Republic of	45	-14
Costa Rica	0	-5
Cote d'Ivoire	18	-7
Denmark	0	-1
Ecuador	41	-4
Egypt	14	-1
El Salvador	5	-1
Ethiopia	0	-2
Gabon	0	2
Gambia, The	0	-2
Ghana	36	-5
Guatemala	0	-4

Appendix A (Continued)

Table IV – continued

Country	Banking crises (% of years)	Current account balance (% of GDP)
Iceland	0	-3
India	0	-1
Indonesia	23	-1
Israel	18	-3
Jamaica	32	-5
Japan	50	2
Jordan	0	-3
Kenya	41	-7
Korea	23	0
Kuwait	45	13
Lebanon	14	-25
Madagascarfig:bctimeplot	5	-7
Malaysia	23	-1
Mali	14	-10
Mauritania	45	-10
Mauritius	0	-2
Mexico	68	-2
Morocco	14	-3
Myanmar	0	-10

Appendix A (Continued)

Table IV – continued

Country	Banking crises (% of years)	Current account balance (% of GDP)
Nepal	5	-5
New Zealand	0	-5
Niger	5	-7
Nigeria	41	1
Norway	32	3
Panama	9	-2
Papua New Guinea	0	-2
Paraguay	23	-4
Peru	36	-5
Philippines	50	-3
Poland	45	-4
Rwanda	0	-3
Senegal	18	-8
Sierra Leone	55	-6
Singapore	0	7
South Africa	0	0
Sri Lanka	23	-6
Swaziland	5	-4
Sweden	5	0

Appendix A (Continued)

Table IV – continued

Country	Banking crises (% of years)	Current account balance (% of GDP)
Tanzania	59	-8
Thailand	45	-2
Togo	14	-7
Trinidad and Tobago	0	-1
Tunisia	0	-4
Turkey	27	-1
Uganda	36	-4
United Kingdom	0	-1
United States	0	-2
Uruguay	18	-2
Venezuela, Rep. Bol.	9	3
Zimbabwe	32	-3

Appendix A (Continued)

TABLE V

RELATIVE BANKING CRISES, CURRENCY CRISES

AND RELATIVE CURRENCY CRISES INDICATORS BY

COUNTRY, AVERAGED OVER 1980-2001

Country	Relative BC	Currency Crises	Relative CC
Argentina	0.18	0.45	0.28
Australia	-0.14	0.23	0.05
Burundi	-0.1	0.5	0.32
Benin	-0.01	0.32	0.14
Burkina Faso	0.18	0.27	0.1
Bangladesh	0.31	0.45	0.28
Bolivia	0.04	0.41	0.23
Brazil	0.18	0.64	0.46
Botswana	-0.14	0.09	-0.09
Central African Rep.	0.77	0.23	0.05
Canada	-0.14	0.14	-0.04
Chile	0.13	0.32	0.14
China,P.R.: Mainland	0.31	0.14	-0.04
Cote d'Ivoire	0.04	0.41	0.23

Appendix A (Continued)

Table V – continued

Country	Relative BC	Currency Crises	Relative CC
Cameroon	0.36	0.5	0.32
Congo, Republic of	0.31	0.41	0.23
Colombia	0.13	0.23	0.05
Cape Verde	-0.1	0.45	0.28
Costa Rica	-0.14	0.32	0.14
Denmark	-0.14	0.32	0.14
Algeria	-0.01	0.5	0.32
Ecuador	0.27	0.55	0.37
Egypt	-0.01	0.09	-0.09
Ethiopia	-0.14	0.5	0.32
Gabon	-0.14	0.32	0.14
United Kingdom	-0.14	0.27	0.1
Ghana	0.22	0.45	0.28
Gambia, The	-0.14	0.27	0.1
Guatemala	-0.14	0.41	0.23
Indonesia	0.09	0.23	0.05
India	-0.14	0.23	0.05
Iceland	-0.14	0.45	0.28
Israel	0.04	0.36	0.19

Appendix A (Continued)

Table V – continued

Country	Relative BC	Currency Crises	Relative CC
Jamaica	0.18	0.36	0.19
Jordan	-0.14	0.23	0.05
Japan	0.36	0.09	-0.09
Kenya	0.27	0.36	0.19
Korea	0.09	0.18	0.01
Kuwait	0.31	0.23	0.05
Lebanon	-0.01	0.45	0.28
Sri Lanka	0.09	0.36	0.19
Morocco	-0.01	0.27	0.1
Madagascar	-0.1	0.27	0.1
Mexico	0.54	0.23	0.05
Mali	-0.01	0.32	0.14
Myanmar	-0.14	0.36	0.19
Mauritania	0.31	0.41	0.23
Mauritius	-0.14	0.27	0.1
Malaysia	0.09	0.09	-0.09
Niger	-0.1	0.36	0.19
Nigeria	0.27	0.36	0.19
Norway	0.18	0.18	0.01

Appendix A (Continued)

Table V – continued

Country	Relative BC	Currency Crises	Relative CC
Nepal	-0.1	0.23	0.05
New Zealand	-0.14	0.36	0.19
Panama	-0.05	0.18	0.01
Peru	0.22	0.64	0.46
Philippines	0.36	0.32	0.14
Papua New Guinea	-0.14	0.27	0.1
Poland	0.31	0.32	0.14
Paraguay	0.09	0.45	0.28
Rwanda	-0.14	0.32	0.14
Senegal	0.04	0.23	0.05
Singapore	-0.14	0	-0.18
Sierra Leone	0.4	0.5	0.32
El Salvador	-0.1	0.14	-0.04
Sweden	-0.1	0.18	0.01
Swaziland	-0.1	0.41	0.23
Chad	0.36	0.32	0.14
Togo	-0.01	0.27	0.1
Thailand	0.31	0.14	-0.04
Trinidad and Tobago	-0.14	0.36	0.19

Appendix A (Continued)

Table V – continued

Country	Relative BC	Currency Crises	Relative CC
Tunisia	-0.14	0.23	0.05
Turkey	0.13	0.59	0.41
Tanzania	0.45	0.32	0.14
Uganda	0.22	0.27	0.1
Uruguay	0.04	0.32	0.14
United States	-0.14	0	-0.18
Venezuela, Rep. Bol.	-0.05	0.55	0.37
South Africa	-0.14	0.36	0.19
Zimbabwe	0.18	0.55	0.37

Appendix A (Continued)

TABLE VI

CHOW TEST: OECD VS. NON OECD COUNTRIES

Dependent variable: CA

	(1)[a]	(2)[a]
CA_1	0.21(0.03)**	0.21(0.03)**
CA_2	0.00(0.03)	0.00(0.03)
CA_3	0.03(0.02)	0.03(0.03)
RBC	0.69(0.86)	0.86(0.92)
RBC_1	2.46(1.04)**	2.90(1.12)**
RBC_2	-2.96(1.05)**	-3.44(1.13)**
RBC_3	-0.26(0.87)	-0.23(0.95)**
$OECD^b * CA\_1$		0.43(0.21)**
$OECD * CA\_2$		-0.19(0.25)
$OECD * CA\_3$		0.03(0.21)
$OECD * RBC$		-0.59(2.51)
$OECD * RBC\_1$		-3.56(3.13)
$OECD * RBC\_2$		4.11(3.11)
$OECD * RBC\_3$		-0.49(2.47)
Chow F-Stat (p-value)[c]		1.04(0.40)

[a] $N = 1,760$. $**p < .05; *p < .1$ Column (1) and (2) are based on two-way fixed effect estimation. RBC is the relative banking crisis indicator, CA is the Current-Account-to-GDP ratio, and OECD is a binary variable which equals 1 for OECD countries and 0 otherwise. CA_1 to CA_3 and RBC_1 to RBC_3 stand for corresponding lags of CA and RBC, respectively.

[b] OECD countries in my sample include: United Kingdom, New Zealand, Japan, Denmark, Australia, Sweden, Canada, United States, Norway, Iceland, Chile, Korea, Republic of Turkey, Poland, Mexico, and Israel. Ideally OECD countries at the beginning of my data (1980) should be used to classify countries. However, due to sample size concerns (my sample only covers a limited number of OECD/high income countries), OECD countries as of today are used.

[c] The Chow test is equivalent to an F-test of excluding all the interaction terms in column (2).The test statistic has an F(7,1408) distribution.

Appendix A (Continued)

TABLE VII

CHOW TEST: OIL-EXPORTERS VS. OTHERS

Dependent variable: CA

	(1)[a]	(2)[a]
CA_1	0.21(0.03)**	0.20(0.03)**
CA_2	0.00(0.03)	0.01(0.03)
CA_3	0.03(0.02)	0.04(0.03)
RBC	0.69(0.86)	0.97(0.92)
RBC_1	2.46(1.04)**	2.32(1.11)**
RBC_2	-2.96(1.05)**	-3.33(1.12)**
RBC_3	-0.26(0.87)	0.02(0.93)**
$OIL^b * CA\_1$		0.34(0.12)**
$OIL * CA\_2$		-0.30(0.14) **
$OIL * CA\_3$		0.00(0.13)
$OIL * RBC$		-1.42(2.57)
$OIL * RBC\_1$		0.30(3.19)
$OIL * RBC\_2$		2.27(3.21)
$OIL * RBC\_3$		-1.59(2.62)
Chow F-Stat (p-value)[c]		1.72(0.10)

[a] $N = 1,760$. $**p < .05; *p < .1$ Column (1) and (2) are based on two-way fixed effect estimation. RBC is the relative banking crisis indicator, CA is the Current-Account-to-GDP ratio, and OIL is a binary variable which equals 1 for oil-exporting countries and 0 otherwise. CA_1 to CA_3 and RBC_1 to RBC_3 stand for corresponding lags of CA and RBC, respectively.

[b] Oil-exporting countries in my sample include: Algeria, Ecuador, Kuwait, Nigeria, Venezuela, Norway, Canada and Mexico. A country as an oil exporter either if it is a current member of Organization of the Petroleum Exporting Countries (OPEC) or it is listed as one of the top world net oil-exporters by U.S. Energy Information Administration in 2011 (28). Current information is used since it is easily accessible and being a major oil-exporter today should be a good indicator of being a major oil-exporter in the past.

[c] The Chow test is equivalent to an F-test of excluding all the interaction terms in column (2).The test statistic has an F(7,1408) distribution.

Appendix A (Continued)

TABLE VIII

GRANGER CAUSALITY TESTS: CA AND RBC

Test Direction[a]	F-Stat[b]	P-value[b]
$CA \rightarrow RBC$	0.30	0.82
$RBC \rightarrow CA$	5.18	$< .01$

[a] The Granger Causality tests are based on two-way fixed effect estimation of the following two equations (same notations as elsewhere in the paper):
$RBC_{it} = \sum_{j=1}^{3} \beta_{1,j} CA_{i,t-j} + \sum_{s=0}^{3} \gamma_{1,s} RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{1,it}$
$CA_{it} = \sum_{j=1}^{3} \beta_{2,j} CA_{i,t-j} + \sum_{s=0}^{3} \gamma_{2,s} RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{2,it}$
In first equation, lags of CA are excluded to test whether CA granger causes RBC. In second equation, lags of RBC are excluded to test whether RBC granger causes CA.

[b] The F-Stats and p values suggest RBC granger causes CA but CA does not granger causes RBC.

Appendix A (Continued)

TABLE IX

GRANGER CAUSALITY TESTS: CA, RBC AND RCC

Test Direction[a]	OLS[b]	FE[b]	RE[b]
$RBC \rightarrow CA$	$F = 6.08^{**}$	$F = 5.01^{**}$	$F = 5.99^{**}$
	$(p < .01)$	$(p < .01)$	$(p < .01)$
$RCC \rightarrow CA$	$F = 2.43^{*}$	$F = 1.54$	$F = 1.98$
	$(p = 0.06)$	$(p = 0.20)$	$(p = .11)$
$CA \rightarrow RBC$	$F = 0.13$	$F = 0.33$	$F = 0.13$
	$(p = 0.94)$	$(p = 0.80)$	$(p = 0.94)$
$RCC \rightarrow RBC$	$F = 1.44$	$F = 0.98$	$F = 1.23$
	$(p = 0.23)$	$(p = 0.40)$	$(p = 0.30)$
$CA \rightarrow RCC$	$F = 1.82$	$F = 0.24$	$F = 1.15$
	$(p = 0.14)$	$(p = 0.87)$	$(p = 0.33)$
$RBC \rightarrow RCC$	$F = 1.16$	$F = 1.11$	$F = 1.21$
	$(p = 0.32)$	$(p < .35)$	$(p = 0.30)$

[a] The Granger Causality tests are based on OLS, two-way fixed effect and two-way random effect estimation of the system consists of Equation 5.1,Equation 5.2 and Equation 5.3.

[b] ** significant at 5%, * significant at 10%. The Granger Causality tests are performed also with four lags (instead of three lags). The basic conclusions based on the F-stats and p-values there are the same as here.

Appendix A (Continued)

TABLE X

TOTAL EFFECTS OF TWIN CRISES ON THE CURRENT ACCOUNT BALANCE

Dependent variable: CA^a

	(1)	(2)	(3)	(4)	(5)	(6)
CA_1	0.22(0.03)**	0.21(0.03)**	0.20(0.03)**	0.22(0.03)**	0.21(0.03)**	0.20(0.03)**
CA_2	0.00(0.03)	-0.01(0.03)	-0.02(0.03)	0.00(0.03)	-0.01(0.03)	-0.02(0.03)
CA_3	0.03(0.03)	0.03(0.03)	0.01(0.03)	0.03(0.02)	0.03(0.03)	0.01(0.03)
CA_4		-0.02(0.03)	-0.02(0.03)		-0.02(0.03)	-0.02(0.03)
CA_5			−0.04(0.03)*			−0.04(0.03)*
RTC	-0.70(0.89)	-0.59(0.93)	-0.23(0.97)			
RTC_1	0.49(0.89)	0.48(0.94)	0.60(0.98)	0.34(0.87)	0.37(0.92)	0.55(0.96)
RTC_2	1.04(0.88)	1.07(0.92)	1.30(0.97)	1.05(0.88)	1.08(0.92)	1.31(0.97)
RTC_3	−3.21(0.87)**	−2.98(0.92)**	−2.97(0.96)**	−3.24(0.87)**	−3.01(0.92)**	−2.98(0.96)**
RTC_4		−1.64(0.92)*	−1.94(0.97)**		−1.64(0.92)*	−1.95(0.97)**
RTC_5			1.15(0.99)			1.17(0.99)

[a] $N = 1,760.^{**}p < .05,^{*}p < .1$. All regressions are based on two-way fixed effect estimation. In all columns, the hypothesis that the coefficients on the relative twin crises terms are jointly zero can be rejected at 5% in F-test.

TABLE XI

PARTIAL EFFECTS OF TWIN CRISES ON THE CURRENT ACCOUNT BALANCE

Dependent variable: CA^a

	(1)	(2)	(3)	(4)	(5)	(6)
CA_1	0.22(0.03)**	0.21(0.03)**	0.20(0.03)**	0.22(0.03)**	0.21(0.03)**	0.20(0.03)**
CA_2	0.00(0.03)	-0.01(0.03)	-0.02(0.03)	0.00(0.03)	-0.01(0.03)	-0.02(0.03)
CA_3	0.03(0.02)	0.03(0.03)	0.01(0.03)	0.03(0.02)	0.02(0.03)	0.01(0.03)
CA_4		-0.02(0.03)	-0.02(0.03)		-0.02(0.03)	-0.02(0.03)
CA_5			−0.04(0.03)*			−0.04(0.03)*
RBC	1.41(0.95)	1.36(0.99)	1.51(1.03)			
RBC_1	2.26(1.13)**	2.25(1.16)*	2.19(1.21)*	2.82(0.94)**	2.80(0.98)**	2.91(1.03)**
RBC_2	−3.24(1.13)**	−3.38(1.17)**	−3.54(1.21)**	−3.25(1.13)**	−3.41(1.17)**	−3.56(1.21)**
RBC_3	0.96(0.98)	0.63(1.18)	0.80(1.22)	0.94(0.98)	0.66(1.18)	0.82(1.22)
RBC_4		1.79(1.02)*	1.56(1.22)		1.70(1.01)*	1.51(1.22)
RBC_5			-0.04(1.06)			-0.15(1.06)
RCC	-0.13(0.56)	0.06(0.60)	-0.03(0.63)			
RCC_1	-0.35(0.56)	-0.37(0.59)	-0.46(0.63)	-0.31(0.56)	-0.32(0.59)	-0.42(0.63)
RCC_2	0.60(0.56)	0.80(0.59)	0.78(0.63)	0.60(0.56)	0.79(0.59)	0.77(0.63)
RCC_3	0.19(0.55)	-0.00(0.58)	0.12(0.62)	0.23(0.55)	0.04(0.58)	0.16(0.62)
RCC_4		0.76(0.58)	0.74(0.62)		0.80(0.58)	0.77(0.62)
RCC_5			0.49(0.62)			0.48(0.61)
RTC	-1.74(1.15)	-1.70(1.20)	-1.33(1.27)			
RTC_1	-0.08(1.13)	-0.08(1.19)	0.15(1.26)	-0.19(1.13)	-0.17(1.20)	0.09(1.26)
RTC_2	1.11(1.13)	0.83(1.18)	1.10(1.26)	1.21(1.12)	0.96(1.17)	1.21(1.25)
RTC_3	−3.21(1.15)**	−3.12(1.19)**	−3.25(1.25)**	−3.28(1.14)**	−3.15(1.18)**	−3.26(1.24)**
RTC_4		−3.07(1.22)**	−3.10(1.26)**		−3.12(1.22)**	−3.16(1.26)**
RTC_5			0.50(1.30)			0.62(1.30)

[a] $N = 1,760.^{**}p < .05,^{*}p < .1$. All regressions are based on two-way fixed effect estimation. In all columns, the hypothesis that the coefficients on the relative twin crises terms are jointly zero can be rejected at 5% in F-test.

Appendix A (Continued)

TABLE XII

THE CA EFFECTS OF BANKING/CURRENCY CRISES UNDER TWIN CRISES

Dependent variable: CA

	(1)	(2)	(3)	(4)
CA_1	0.21(0.03)**	0.21(0.03)**	0.21(0.03)**	0.21(0.03)**
CA_2	0.00(0.03)	-0.01(0.03)	0.00(0.03)	-0.01(0.03)
CA_3	0.03(0.02)	0.02(0.03)	0.03(0.02)	0.02(0.03)
CA_4		-0.02(0.03)		-0.02(0.03)
RBC	1.46(0.96)	1.46(1.01)		
RBC_1	2.21(1.13)**	2.01(1.18)*	2.82(0.94)**	2.62(0.99)**
RBC_2	−3.31(1.14)**	−3.29(1.17)**	−3.33(1.13)**	−3.30(1.17)**
RBC_3	0.87(0.99)	0.49(1.18)	0.81(0.98)	0.45(1.17)
RBC_4		2.14(1.03)**		2.05(1.03)**
RCC	-0.18(0.59)	-0.07(0.62)		
RCC_1	-0.25(0.58)	-0.23(0.62)	-0.23(0.58)	-0.23(0.62)
RCC_2	0.76(0.58)	0.88(0.61)	0.79(0.58)	0.88(0.61)
RCC_3	0.45(0.58)	0.30(0.60)	0.47(0.58)	0.33(0.60)
RCC_4		0.47(0.60)		0.49(0.60)
$RBC * RTC$	1.01(6.65)	3.09(6.84)		
$RBC\_1 * RTC\_1$	-1.57(5.07)	-2.58(6.84)	-1.25(5.04)	-1.81(6.79)
$RBC\_2 * RTC\_2$	-2.82(4.76)	-2.20(5.23)	-3.44(4.74)	-2.32(5.21)
$RBC\_3 * RTC\_3$	−8.61(4.81)*	−9.95(4.97)**	−8.40(4.80)*	−9.79(4.97)**
$RBC\_4 * RTC\_4$		6.85(4.97)		6.91(4.97)
$RCC * RTC$	-3.02(6.67)	-4.99(6.83)		
$RCC\_1 * RTC\_1$	1.51(5.21)	2.55(6.88)	1.06(5.17)	1.67(6.83)
$RCC\_2 * RTC\_2$	4.39(4.98)	3.12(5.41)	5.17(4.95)	3.44(5.38)
$RCC\_3 * RTC\_3$	4.69(5.08)	6.04(5.25)	4.40(5.08)	5.87(5.24)
$RCC\_4 * RTC\_4$		−11.80(5.30)**		−11.92(5.29)**
F-test for RBC-RTC interactions	1.06 (p=0.37)	1.26 (p=0.28)	1.44 (p=0.23)	1.51 (p=0.20)
F-test for RCC-RTC interactions	0.57 (p=0.68)	1.42 (p=0.21)	0.78 (p=0.51)	1.68 (p=0.15)

$N = 1,760$.

$^{**}p < .05$, $^{*}p < .1$. All regressions are based on two-way fixed effect estimation.

Appendix A (Continued)

TABLE XIII

TOTAL EFFECTS OF BANKING CRISES ON THE CURRENT ACCOUNT BALANCE

Dependent variable: CA

	(1)	(2)	(3)	(4)
CA_1	0.21(0.03)**	0.21(0.03)**	0.21(0.03)**	0.21(0.03)**
CA_2	0.00(0.03)	-0.01(0.03)	0.00(0.03)	-0.01(0.03)
CA_3	0.03(0.02)	0.03(0.03)	0.03(0.02)	0.03(0.03)
CA_4		-0.02(0.03)		-0.02(0.03)
RBC	0.69(0.86)	0.74(0.90)		
RBC_1	2.46(1.04)**	2.48(1.08)**	2.95(0.85)**	2.99(0.88)**
RBC_2	−2.96(1.05)**	−3.13(1.08)**	−2.95(1.05)**	−3.11(1.08)**
RBC_3	-0.26(0.87)	-0.50(1.09)	-0.31(0.87)	-0.50(1.09)
RBC_4		0.38(0.90)		0.32(0.90)

$N = 1,760$.

$^{**}p < .05$, $^{*}p < .1$.

All regressions are based on two-way fixed effect estimation.

Appendix A (Continued)

TABLE XIV

TOTAL EFFECTS OF CURRENCY CRISES ON THE CURRENT ACCOUNT BALANCE

Dependent variable: CA

	(1)	(2)	(3)	(4)
CA_1	0.22(0.03)**	0.21(0.03)**	0.22(0.03)**	0.21(0.03)**
CA_2	0.00(0.03)	-0.01(0.03)	0.00(0.03)	-0.01(0.03)
CA_3	0.03(0.03)	0.03(0.03)	0.03(0.03)	0.03(0.03)
CA_4		-0.02(0.03)		-0.02(0.03)
RCC	-0.57(0.50)	-0.39(0.53)		
RCC_1	-0.33(0.50)	-0.44(0.52)	-0.35(0.50)	-0.45(0.52)
RCC_2	0.89(0.50)*	1.05(0.52)**	0.91(0.50)*	1.07(0.52)**
RCC_3	-0.59(0.49)	-0.77(0.52)	-0.60(0.49)	-0.78(0.52)
RCC_4		0.09(0.52)		0.10(0.52)

$N = 1,760$.

$^{**}p < .05$, $^{*}p < .1$.

All regressions are based on two-way fixed effect estimation.

Appendix A (Continued)

TABLE XV

THE CA EFFECTS OF BANKING/CURRENCY CRISES,SYMMETRIC AND ASYMMETRIC LAG SPECIFICATIONS

Dependent variable: CA

	(1)	(2)	(3)	(4)
CA_1	0.21(0.03)**	0.21(0.03)**	0.21(0.03)**	0.21(0.03)**
CA_2	0.00(0.03)	0.00(0.03)	0.00(0.03)	0.00(0.03)
CA_3	0.03(0.03)	0.03(0.03)	0.03(0.03)	0.03(0.03)
RBC	0.78(0.86)		0.75(0.86)	
RBC_1	2.38(1.04)**	2.88(0.85)**	2.35(1.04)**	2.93(0.85)**
RBC_2	−2.90(1.05)**	−2.88(1.05)**	−2.89(1.05)**	−2.89(1.05)**
RBC_3	-0.30(0.87)	-0.34(0.87)	-0.29(0.87)	-0.35(0.87)
RCC	-0.65(0.50)			-0.64(0.50)
RCC_1	-0.36(0.50)	-0.36(0.50)	-0.37(0.50)	-0.34(0.50)
RCC_2	0.87(0.50)*	0.88(0.50)*	0.89(0.50)*	0.86(0.50)*
RCC_3	-0.51(0.49)	-0.52(0.49)	-0.52(0.49)	-0.50(0.49)

$N = 1,760$.

$^{**}p < .05$, $^{*}p < .1$.

All regressions are based on two-way fixed effect estimation.

Appendix B

NON-DYNAMIC REGRESSIONS

I estimate cross-sectional and panel regression models to determine whether banking crises are a significant determinant of the current account balance. This gives a snapshot of the influence of crises in the medium/long run and also allows comparison with existing regression results in the literature.

The basic empirical specification I consider is of the following form:

$$CA_{it} = \alpha + \sum_{j} \beta_j X_{it}^{j} + \gamma RBC_{it} + \varepsilon_{it} \tag{B.1}$$

where CA_{it} is the current account balance (expressed as a ratio to GDP), X_{it}^{j} are a set of control variables such as the relative age dependency ratio and openness which are discussed below, and RBC_{it} and is the relative banking crisis indicator. ε_{it} is the error term. The i subscripts index over countries, and t over time. A couple of variants of the model will be estimated. For example, country effect μ_i and/or time-specific effect (λ_t) will be included (to be modeled as fixed or random effects) in regression.

My sample consists of a balanced panel of annual observations on 48 countries over the period between 1977 and 2000. As in most of the previous research in this area ((13)(15)(17)(18)), I consider multi-year averages of annual observations. The sample is chosen based on the data availability of some of the key variables adopted in those papers. Averages are constructed over

Appendix B (Continued)

1977-1981, 1982-1986, 1987-1991, 1992-1996, and 1997-2000. Sometimes yearly observations prior to 1977 are used to create lagged observations. The list of countries is presented later with the summary of statistics.

The selection of regressors largely follows the specifications reported in the previous literature. Where appropriate, the independent variables are measured in relative terms or converted into the deviations from their GDP-weight world mean prior to the calculation of multi-year averages. This practice helps control for rest-of-the-world effects.

The data used here were drawn from a number of different places. I provide in Table XVI, Appendix B a listing of series used in the analysis, descriptions of these series and the sources from which the primary data were taken.

Before proceeding to the econometric estimates, I also provide a brief overview of the data. Note that the summary of statistics is based on the unweighed annual observations. In total there are 1152 observations (48 countries over 24 years).

Appendix B (Continued)

TABLE XVI

KEY SERIES AND DATA SOURCE, NON-DYNAMIC REGRESSIONS

Series	Sources[a]
Current account balance (% of GDP)	WDI
Age dependency ratio, old (% of working-age population)	WDI
Age dependency ratio, young (% of working-age population)	WDI
General government budget balance (% of GDP)	(18)
PPP converted GDP per capita (chain series), at 2005 constant prices. Unit: 2005 international dollar per person	PWT
Population (in thousands)	PWT
Exports of goods and services (% of GDP)	WDI
Imports of goods and services (% of GDP)	WDI
Net foreign assets (current local currency unit)	WDI
GDP (current local currency unit)	WDI
Oil exporting dummy variable	(18)
Domestic credit to private sector (% of GDP)	WDI
Banking crisis dummy variable	(2)
Currency crisis dummy variable	(2)

[a] Mnemonics for the sources: WDI stands for World Development Indicators (2011) and PWT stands for Penn World table 7.0.

Appendix B (Continued)

TABLE XVII

SUMMARY STATISTICS, NON-DYNAMIC REGRESSIONS

Variables	Mean	Std. Dev.	Max	Min
Current account (% of GDP)	-2.83	5.52	31.98	-28.95
Per capita income(2005 international dollar)	9054.96	9902.88	44827.97	391.8
Change in growth rate (%)	-0.1	7.63	111.4	-66.33
Fiscal balance (% of GDP)	-3.14	4.78	22.63	-41.22
Lagged net foreign asset (% of GDP)	3.99	17.85	126.5	-128.22
Age dependency ratio, old (%)	10.03	6.12	27.84	3.65
Age dependency ratio, young (%)	62.48	22	106.47	21.42
Openness (% of GDP)	61.04	32.23	220.41	6.32
Oil-exporting dummy	0.06	0.24	1	0
Private credit (% of GDP)	41.64	37.14	231.08	0
Banking crisis	0.16	0.36	1	0
Currency crisis	0.29	0.45	1	0

Sample: Argentina, Australia, Burkina Faso, Bangladesh, Bolivia, Botswana, Canada, Chile, Cameron, Columbia, Costa Rica, Denmark, Ecuador, Egypt, United Kingdom, Ghana, Greece, India, Iceland, Israel, Jordan, Japan, Kenya, Korea, Sri Lanka, Morocco, Mali, Mauritius, Malaysia, Nigeria, Norway, Nepal, New Zealand, Peru, Philippines, Papua New Guinea, Paraguay, Rwanda, Sierra Leone, El Salvador, Sweden, Swaziland, Thailand, Trinidad and Tobago, Tunisia, United States, Venezuela, Rep. Bol., South Africa.

Appendix B (Continued)

TABLE XVIII

NON-DYNAMIC REGRESSION RESULTS

Dependent variable: CA

	OLS	Country FE	Time FE	Two-way FE	Country RE
Banking crisis	1.607*(0.829)	1.612*(0.920)	1.495*(0.819)	1.375 (0.930)	1.649**(0.837)
Currency crisis	-1.313 (1.128)	0.890 (1.218)	-1.304 (1.126)	0.632 (1.237)	-0.475 (1.118)
Net foreign asset (lagged)	0.079**(0.017)	0.046*(0.028)	0.079**(0.017)	0.048*(0.028)	0.080**(0.018)
Fiscal balance	0.140**(0.065)	0.245**(0.084)	0.109**(0.065)	0.181**(0.086)	0.167**(0.034)
Elderly ratio	-0.029 (0.100)	0.328 (0.313)	-0.042 (0.097)	0.077 (0.322)	-0.083 (0.121)
Youth ratio	−0.038*(0.022)	-0.079 (0.059)	-0.032 (0.021)	-0.058 (0.060)	-0.043 (0.026)
Real GDP per capita	0.404(0.587)	4.718**(2.210)	0.487 (0.571)	4.991**(2.219)	0.763 (0.716)
Change in growth	0.147 (0.158)	0.167 (0.162)	0.146 (0.154)	0.173 (0.160)	0.170 (0.155)
Openness	-0.013 (0.008)	0.008 (0.021)	-0.013 (0.008)	0.003 (0.021)	-0.012 (0.010)
Oil exporting country	2.807**(1.024)		2.831**(0.996)		
Financial development	0.004 (0.008)	−0.065**(0.019)	0.008 (0.009)	−0.043**(0.020)	-0.004 (0.010)
F test for no Country FE		$F = 1.67 (p < .01)$		$F = 1.55 (p = .02)$	
F test for no Time FE			$F = 4.44 (p < .01)$	$F = 2.72 (p = .03)$	
F test for no Two-way FE				$F = 1.81 (p < .01)$	
Hausman test (FE vs. RE)					$m = 17.4 (p = .07)$
Num. of observations	240	240	240	240	240

$^{**}p < .05$, $^{*}p < .1$. Standard errors reported in parentheses unless otherwise specified.

Appendix B (Continued)

Table XVIII, Appendix B presents the regression results for several variants of Equation B.1. As described above, I estimate over data that is organized into period-averages for five different periods. Column OLS shows the results of estimating Equation B.1, i.e. the pooled OLS. The following four columns are fixed effects regressions, adding country fixed effects, time fixed effects (for each period) or both, respectively. The last column demonstrates the results of one-way country random effect estimation. One-way time random effect and two-way random effect models are also estimated, but the magnitude, signs and significance of the coefficients of those models are not very different from the last column. Therefore they are not included in the table.

Due to different sample countries/time spans covered and different set (or definition) of variables included in regressions, my results may not be directly comparable to other research in this area. Yet the estimated results still appear reasonable when looking at other studies, such as (13), (18) and (15). The R^2 of my regressions (not shown in the table) ranges from approximately 0.20 to 0.50, similar to those found in other research. The effects of net foreign assets and fiscal balance in my regressions are also similar to others'. Other variables, including change in growth, dependency ratios (the youth dependency ratio is defined as the ratio of the population ages 0-14 to the working age population that ages 15-64 and the old-age dependency ratio is defined as the ratio of the population aged 65 and above to the working age population), openness (defined as the sum of imports and exports as a percent of GDP), relative income per capita and financial development (defined as private credit as a percent of GDP), are not found to be significant in all specifications nor with large coefficients. The coefficients

Appendix B (Continued)

on currency crisis are never statistically significant and sometimes the signs flip, although the absolute values of the coefficients are usually large. Across all specifications, the coefficients on banking crisis are significant (except in two-way FE column only significant at 15%). The coefficients are more or less consistent in their size, and the signs are as always positive. Banking crises are found to boost the current account balance, as in previous literature. The estimated coefficients on banking crisis in my regressions are considerably larger than some other research in this area (for example, nearly three-folds of that in (13)). The non-dynamic methodology is enlightening, however, it is static, providing a single coefficient instead of the full picture of the dynamic response of the current account over time.

Appendix C

FIGURES

Appendix C (Continued)

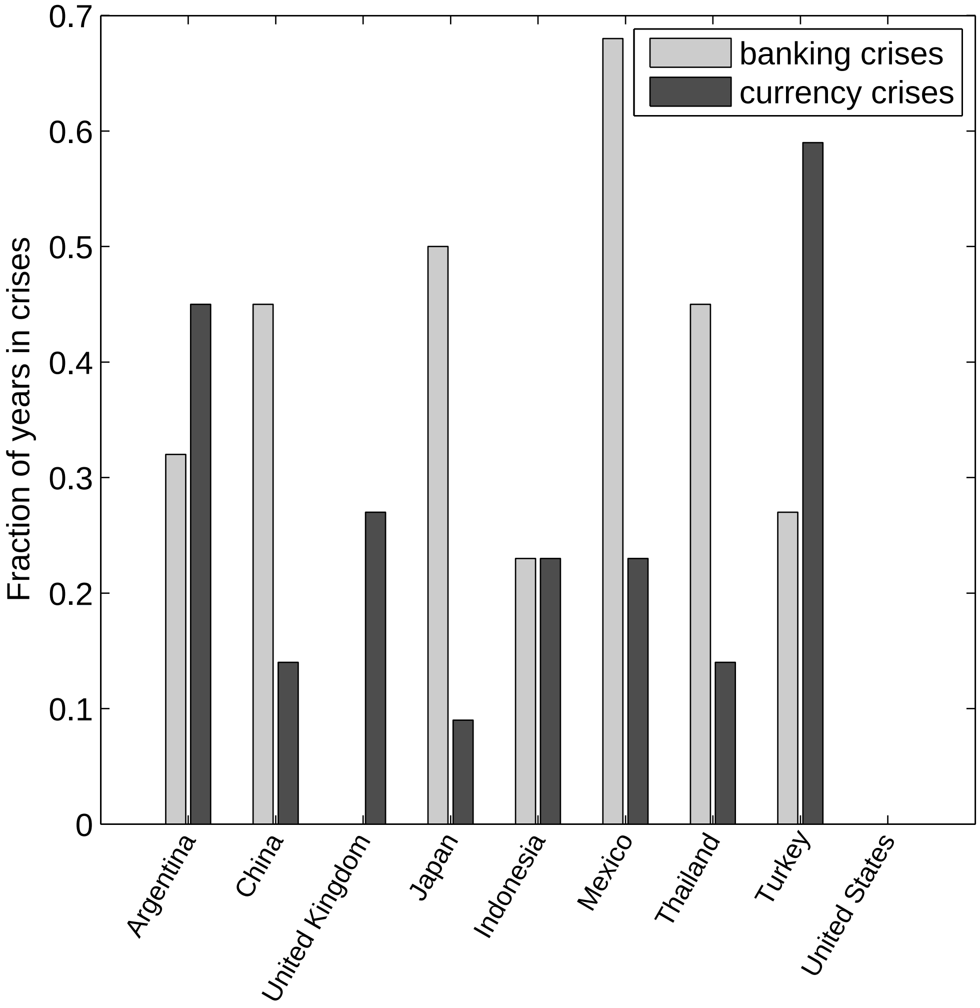


Figure 7. Fraction of years (of the 1980-2001 period) in banking and currency crises, selected countries

Appendix C (Continued)

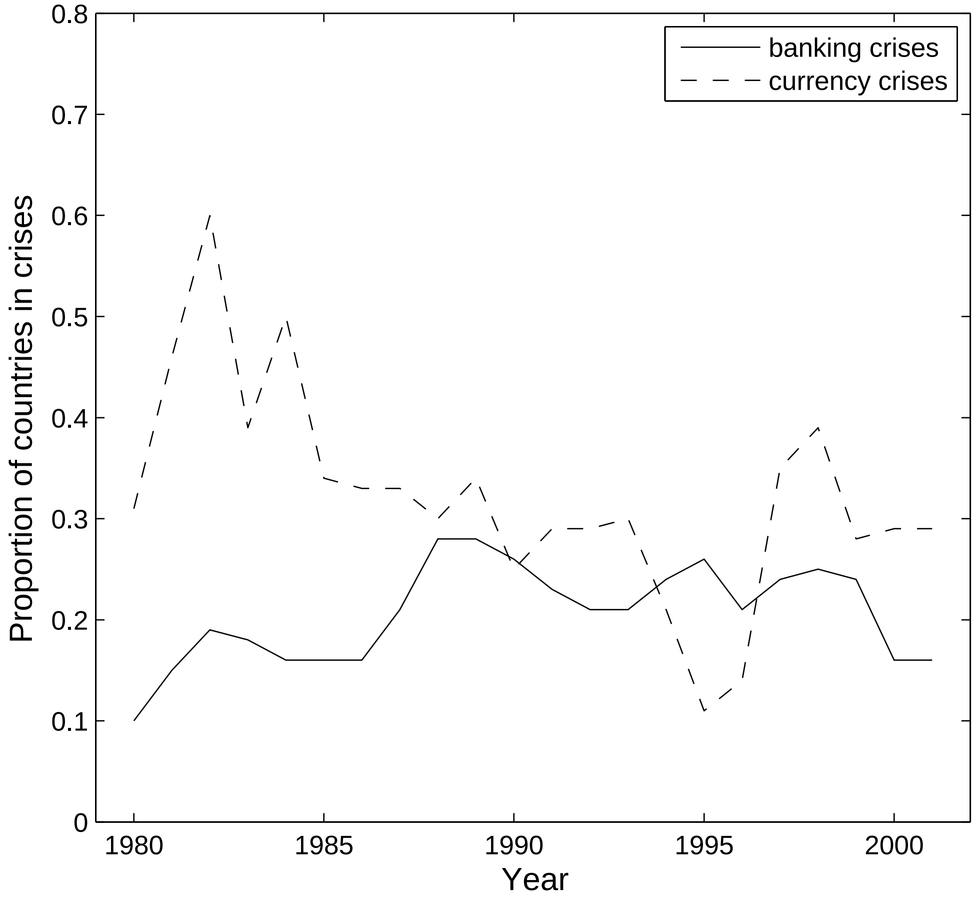
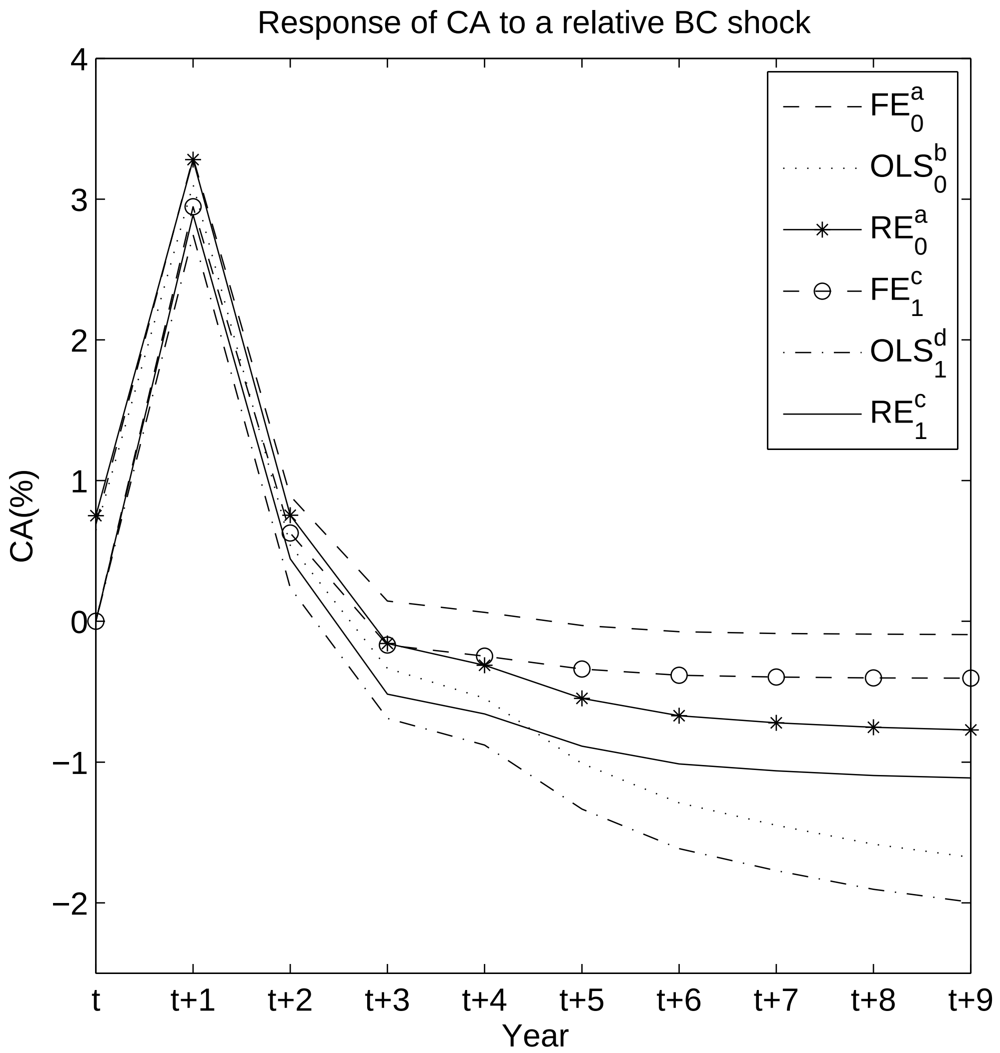


Figure 8. Proportion of countries in banking and currency crises, 1980-2001

Appendix C (Continued)



[a] FE and RE estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it}$

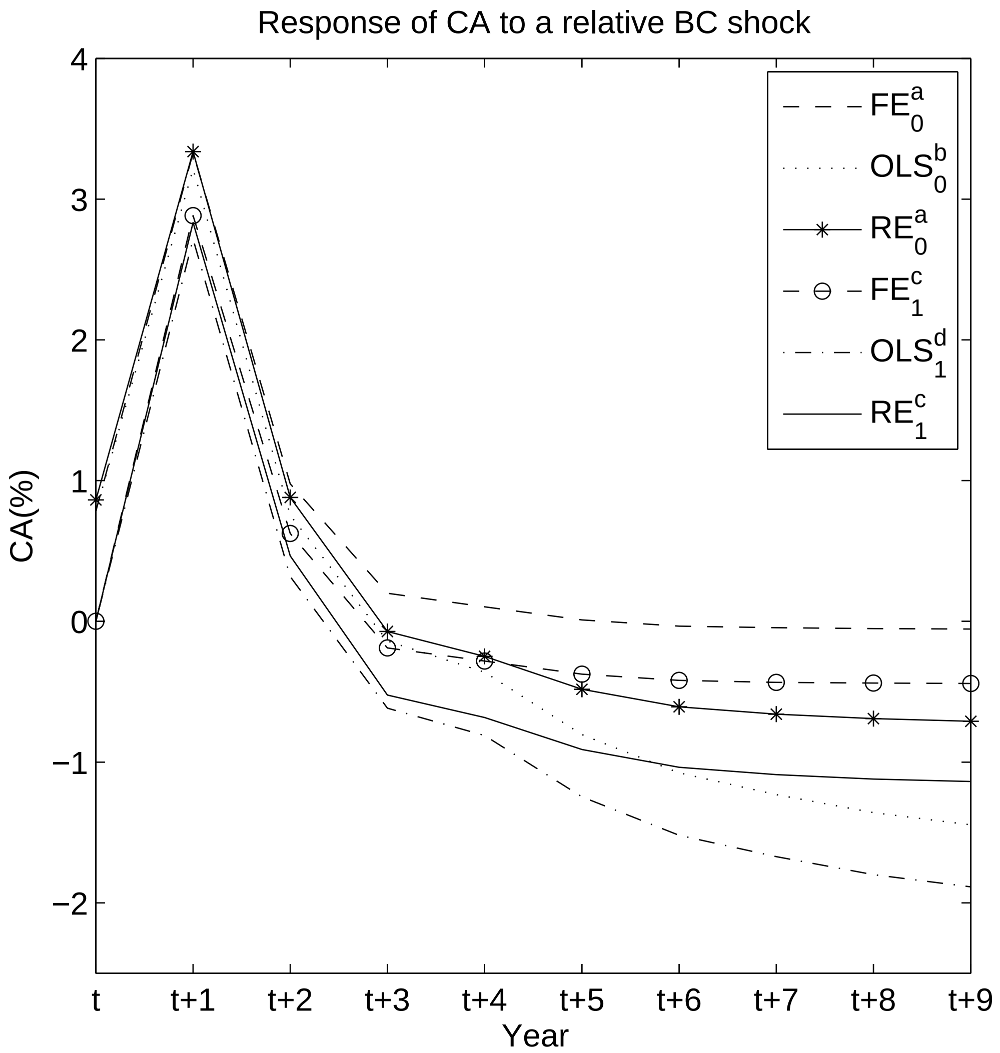
[b] OLS estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \varepsilon_{it}$

[c] FE and RE estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it}$

[d] OLS estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \varepsilon_{it}$

Figure 9. Total effects of RBC on CA

Appendix C (Continued)



[a] FE and RE estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

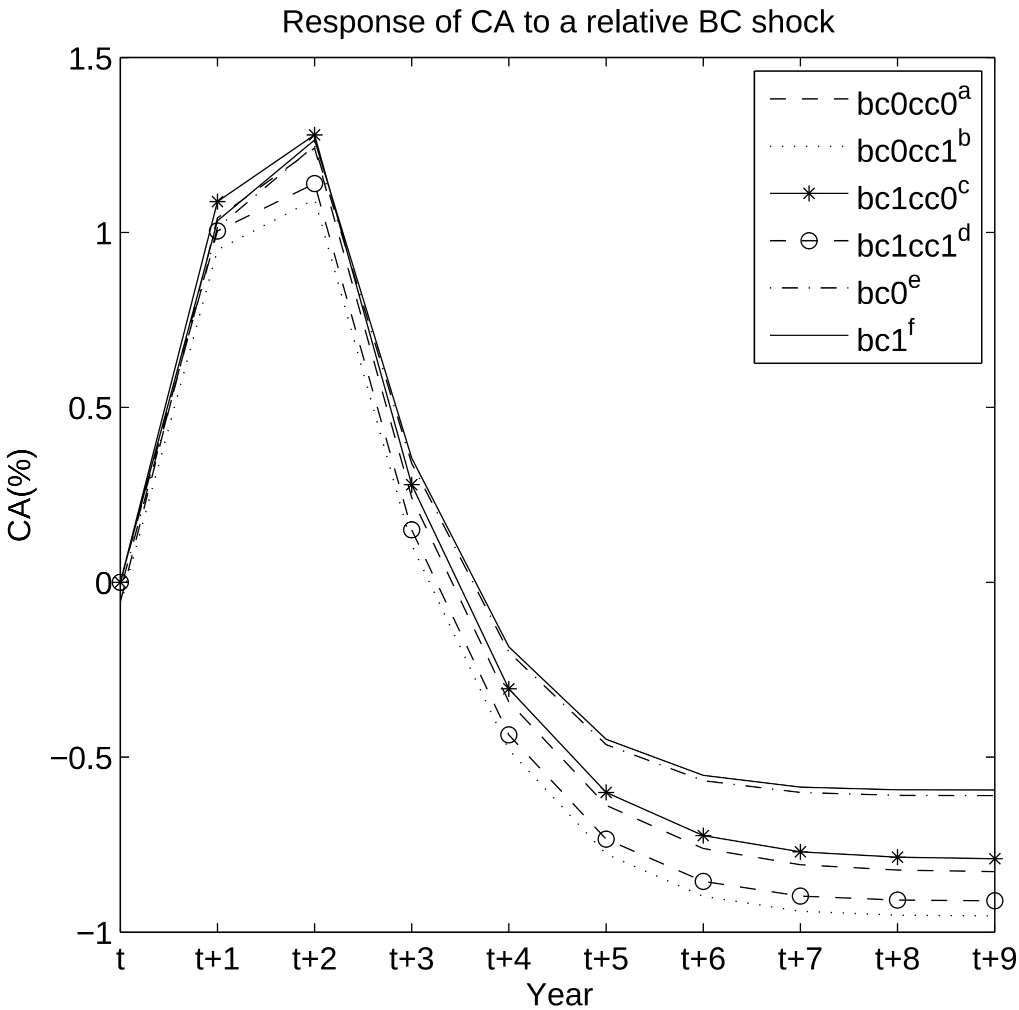
[b] OLS estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \varepsilon_{it}$

[c] FE and RE estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[d] OLS estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \varepsilon_{it}$

Figure 10. Partial effects of RBC on CA

Appendix C (Continued)



[a] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[b] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[c] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

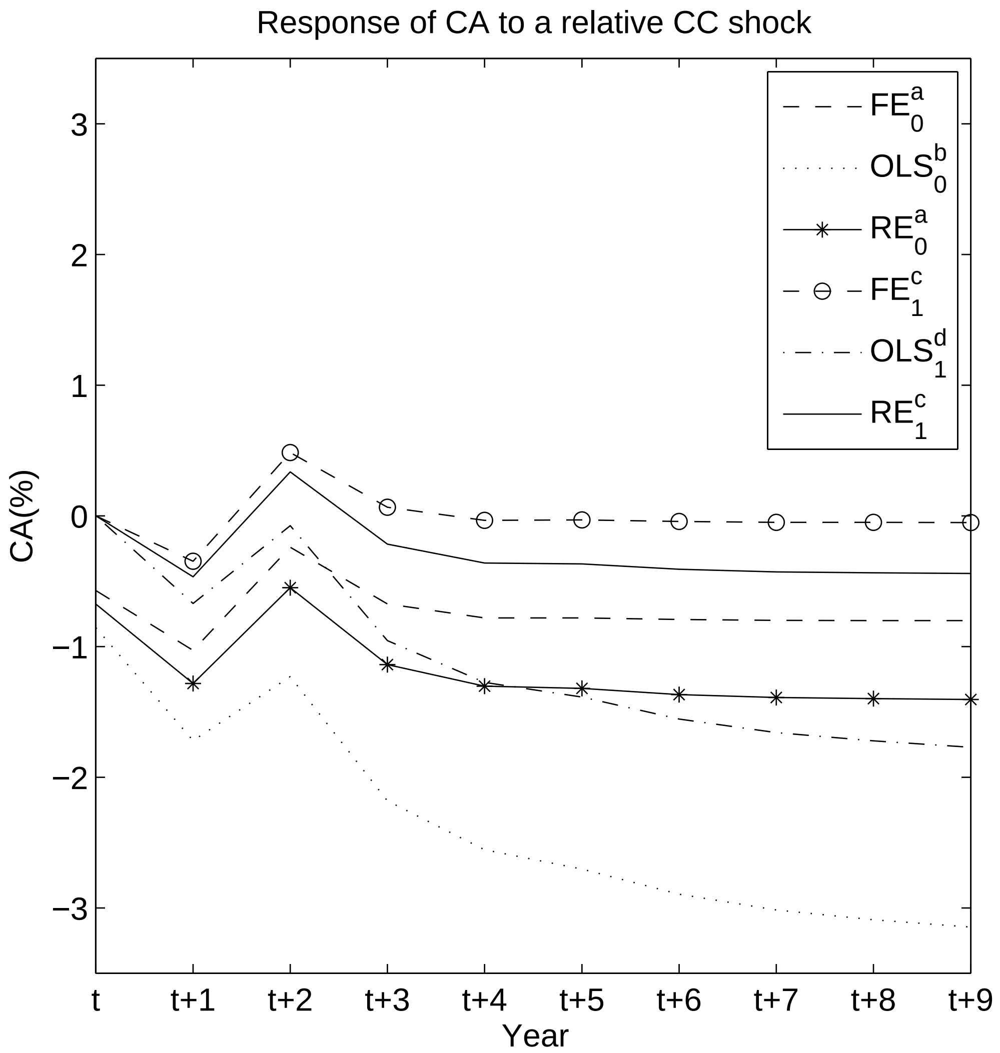
[d] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[e] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it}$

[f] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \mu_i + \lambda_t + \varepsilon_{it}$

Figure 11. Comparison of CA responses to one unit RBC shock in FE regressions in an alternative dataset

Appendix C (Continued)



[a] FE and RE estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

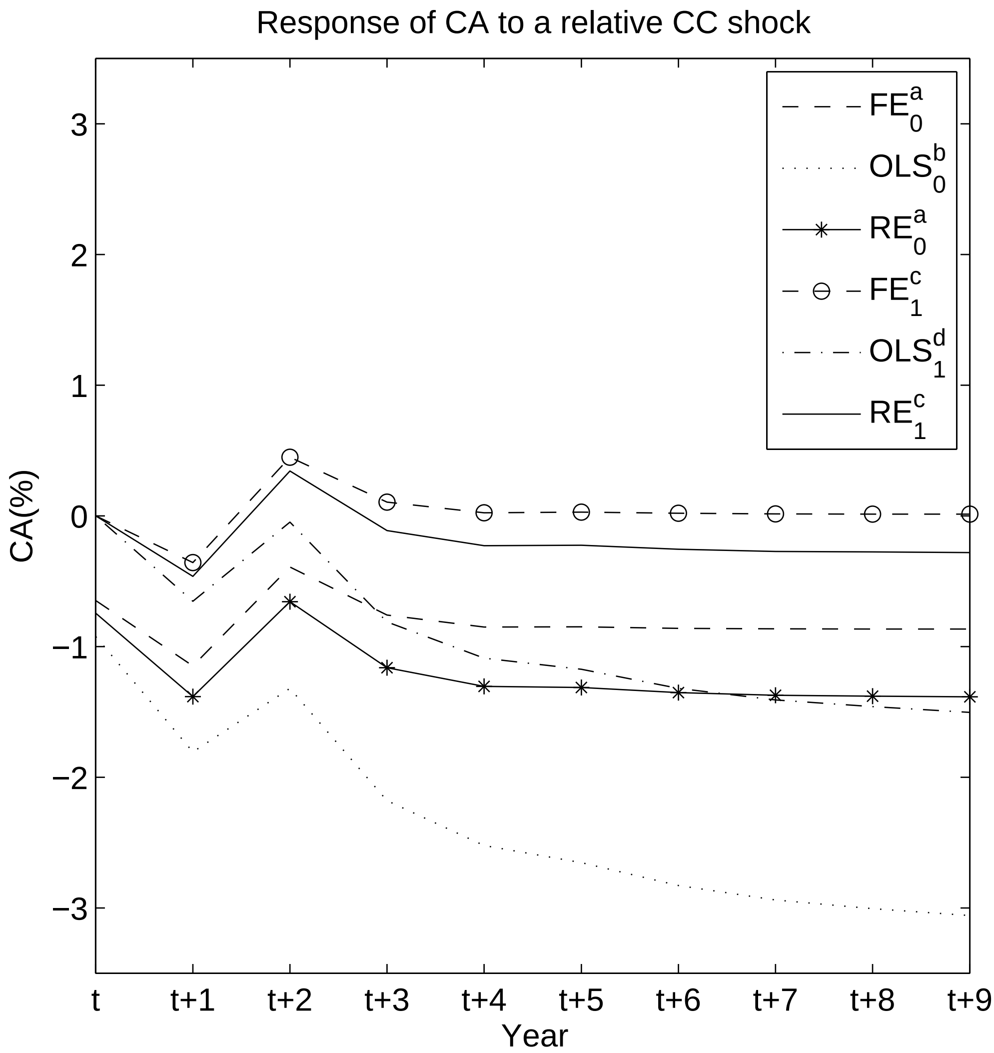
[b] OLS estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \varepsilon_{it}$

[c] FE and RE estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[d] OLS estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \varepsilon_{it}$

Figure 12. Total effects of RCC on CA

Appendix C (Continued)



[a] FE and RE estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

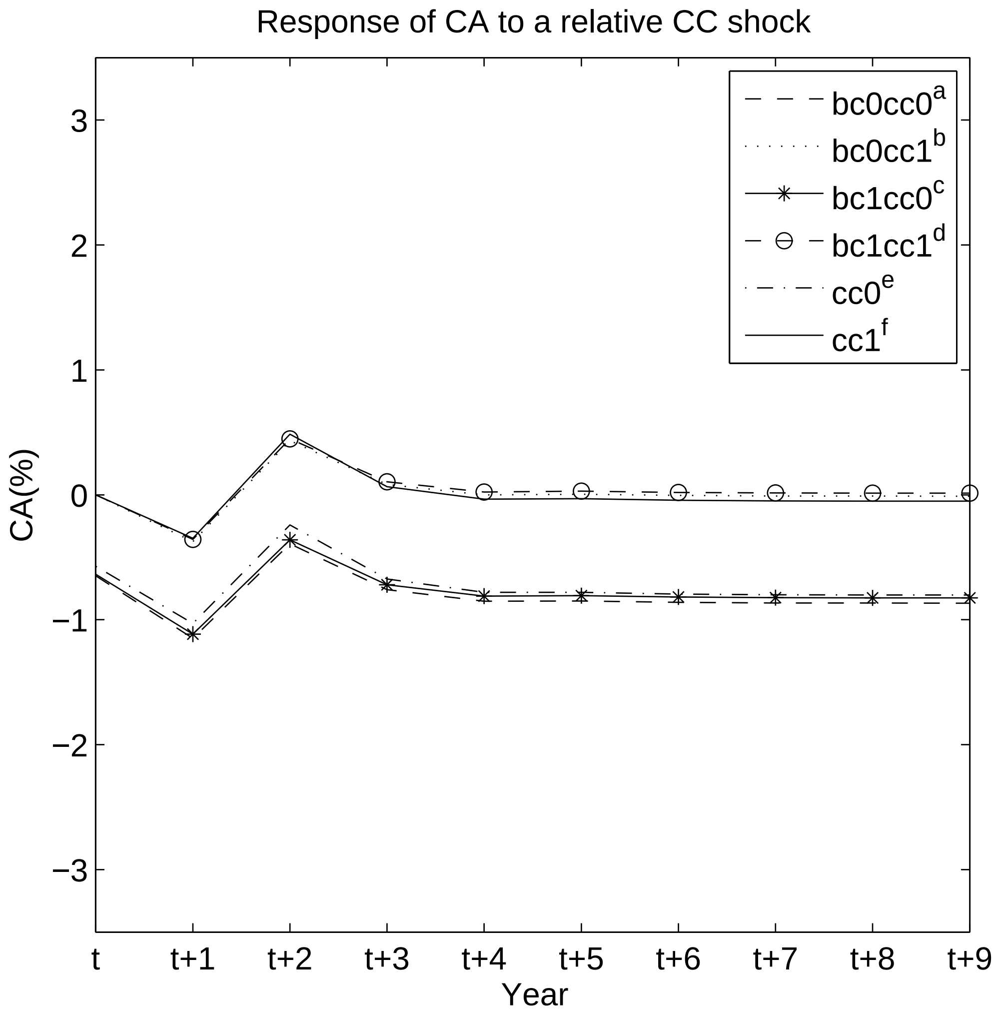
[b] OLS estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \varepsilon_{it}$

[c] FE and RE estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[d] OLS estimation of model $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \varepsilon_{it}$

Figure 13. Partial effects of RCC on CA

Appendix C (Continued)



[a] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[b] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[c] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

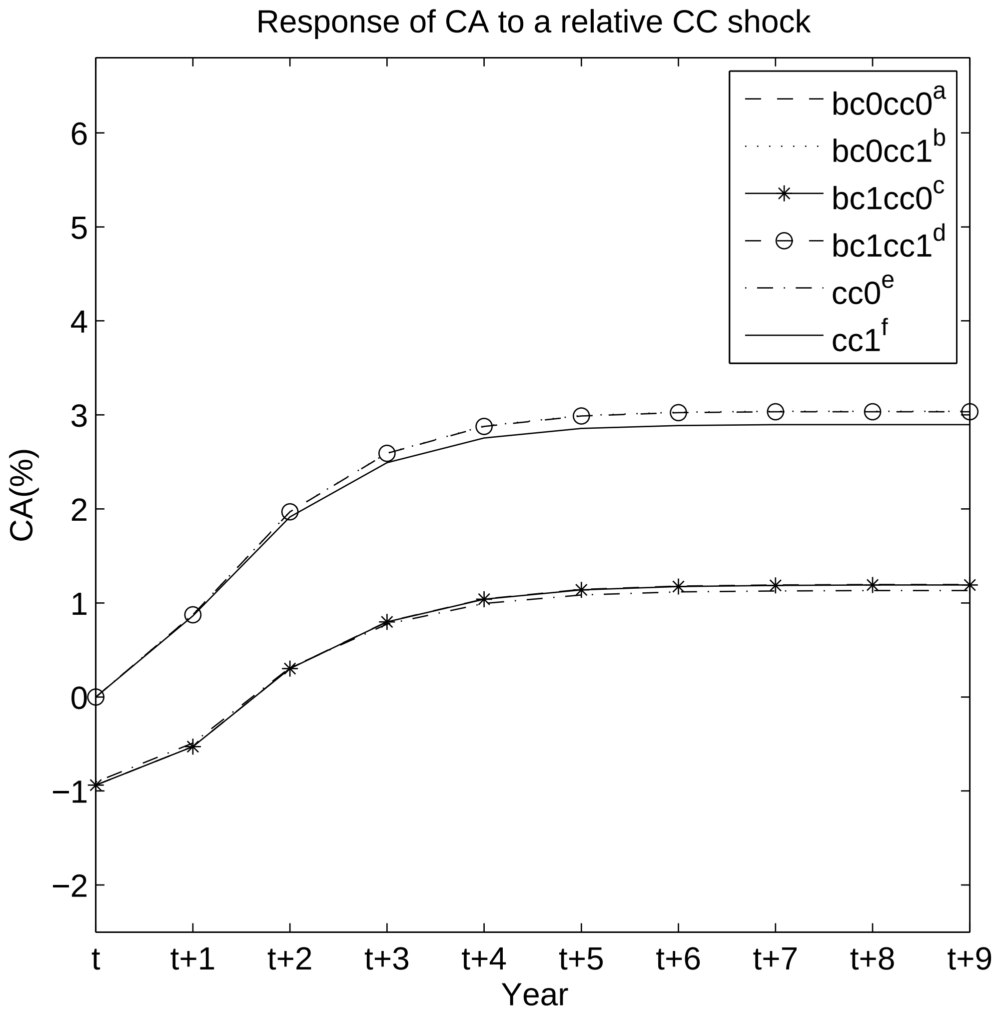
[d] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[e] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[f] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

Figure 14. Comparison of CA responses to one unit RCC shock in FE regressions

Appendix C (Continued)



[a] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[b] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[c] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

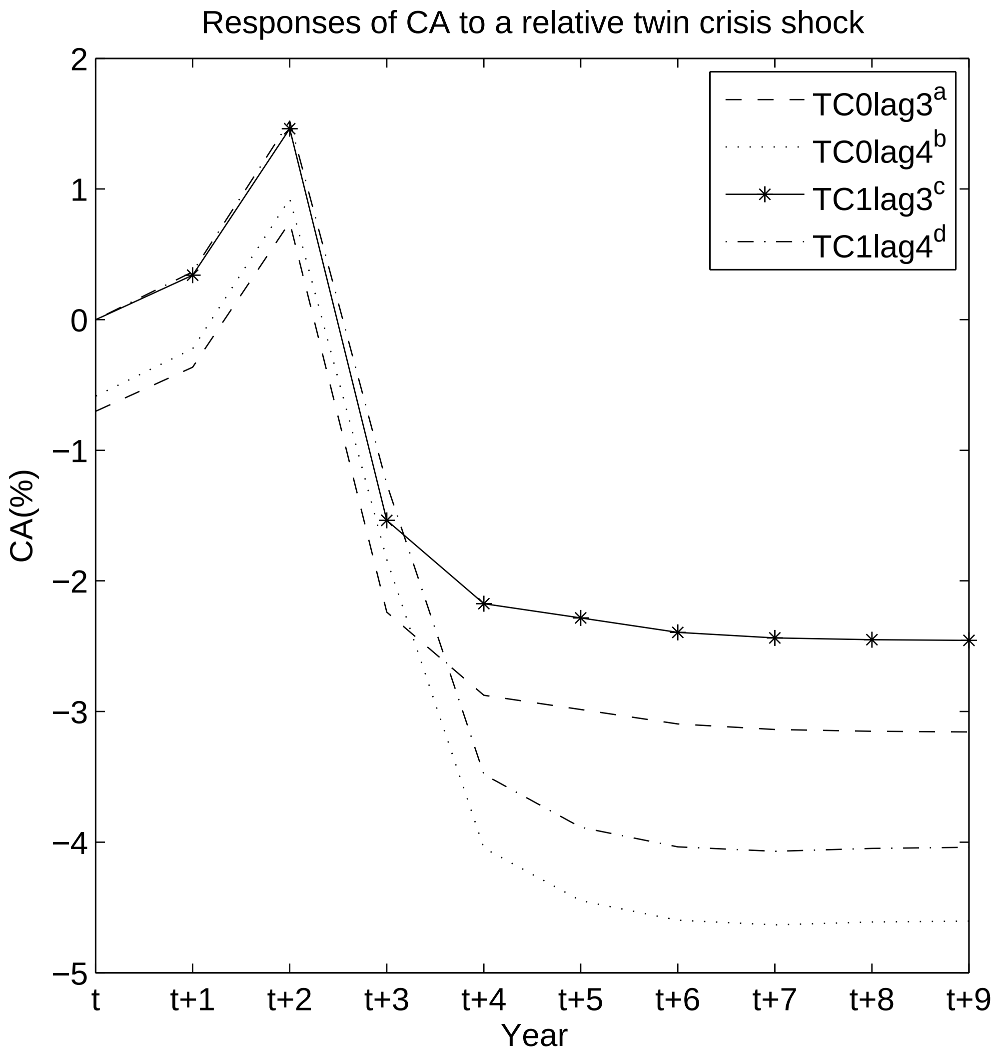
[d] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[e] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

[f] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \mu_i + \lambda_t + \varepsilon_{it}$

Figure 15. Comparison of CA responses to one unit RCC shock in FE regressions in an alternative dataset

Appendix C (Continued)



[a] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{l=0}^{3} \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it}$

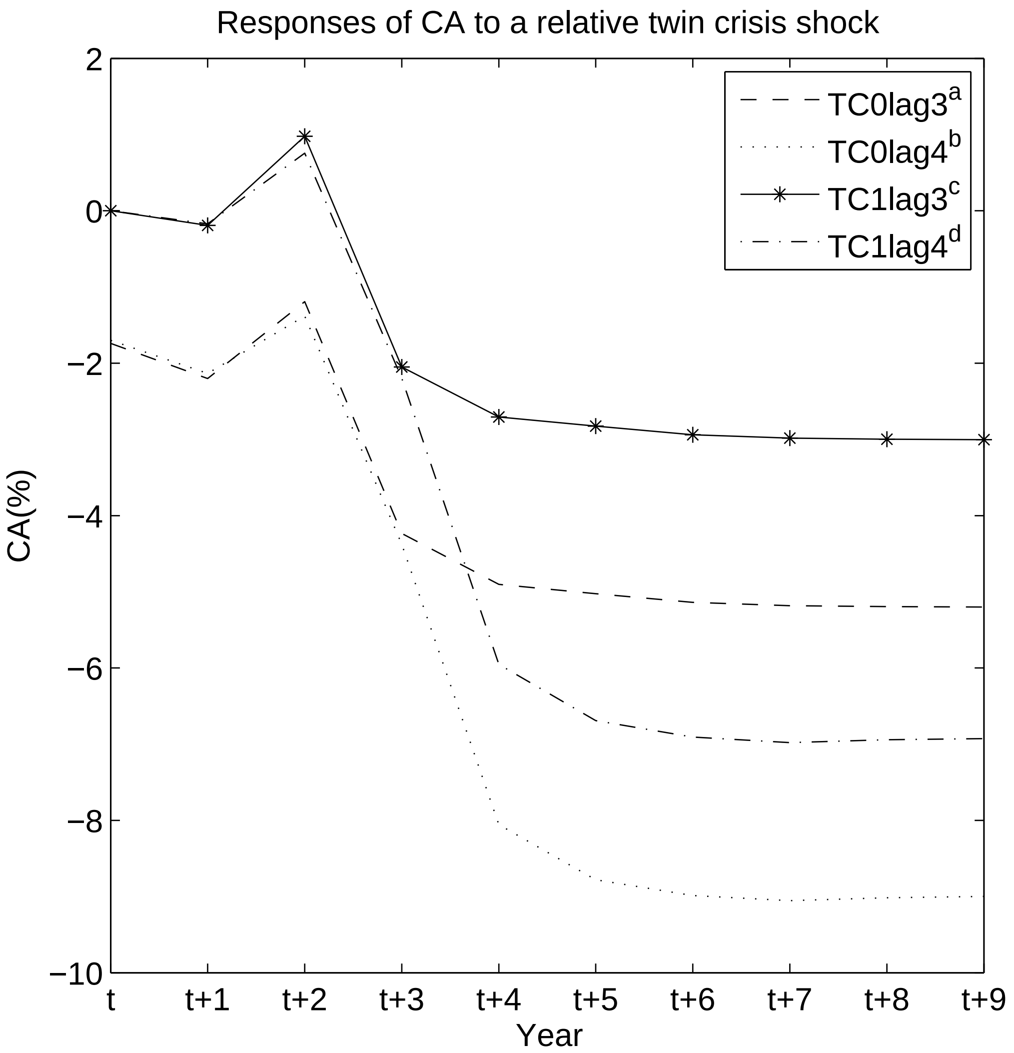
[b] $CA_{it} = \sum_{j=1}^{4} \beta_j CA_{i,t-j} + \sum_{l=0}^{4} \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it}$

[c] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{l=1}^{3} \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it}$

[d] $CA_{it} = \sum_{j=1}^{4} \beta_j CA_{i,t-j} + \sum_{l=1}^{4} \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it}$

Figure 16. Total effects of RTC on CA

Appendix C (Continued)



[a] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=0}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{3} \delta_k RCC_{i,t-k} + \sum_{l=0}^{3} \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it}$

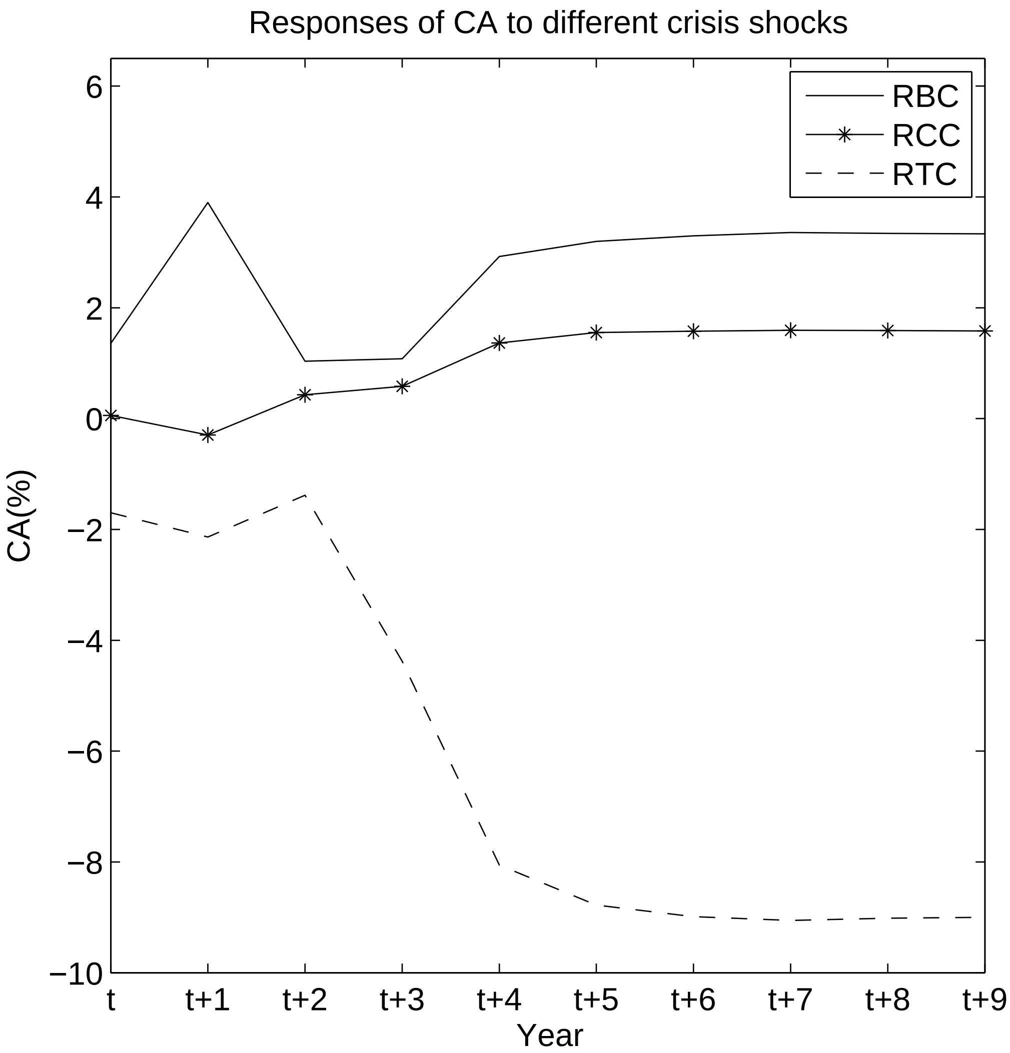
[b] $CA_{it} = \sum_{j=1}^{4} \beta_j CA_{i,t-j} + \sum_{s=0}^{4} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{4} \delta_k RCC_{i,t-k} + \sum_{l=0}^{4} \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it}$

[c] $CA_{it} = \sum_{j=1}^{3} \beta_j CA_{i,t-j} + \sum_{s=1}^{3} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{3} \delta_k RCC_{i,t-k} + \sum_{l=1}^{3} \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it}$

[d] $CA_{it} = \sum_{j=1}^{4} \beta_j CA_{i,t-j} + \sum_{s=1}^{4} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{4} \delta_k RCC_{i,t-k} + \sum_{l=1}^{4} \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it}$

Figure 17. Paritial effects of RTC on CA

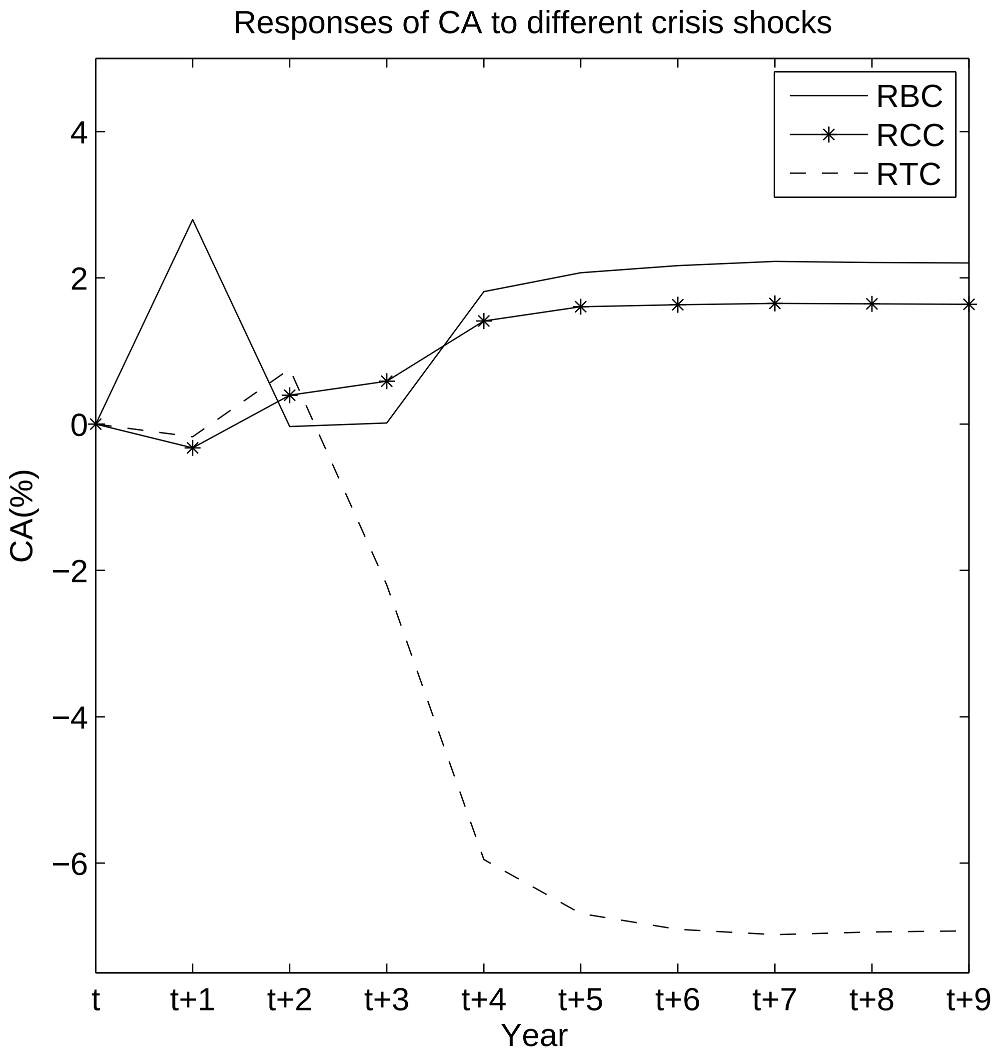
Appendix C (Continued)



[a] All curves are based on fixed effect regression of $CA_{it} = \sum_{j=1}^{4} \beta_j CA_{i,t-j} + \sum_{s=0}^{4} \gamma_s RBC_{i,t-s} + \sum_{k=0}^{4} \delta_k RCC_{i,t-k} + \sum_{l=0}^{4} \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it}$

Figure 18. Comparison of CA responses after one unit RBC, RCC and RTC shock, with contemporaneous crises terms[a]

Appendix C (Continued)



[a] All curves are based on fixed effect regression of $CA_{it} = \sum_{j=1}^{4} \beta_j CA_{i,t-j} + \sum_{s=1}^{4} \gamma_s RBC_{i,t-s} + \sum_{k=1}^{4} \delta_k RCC_{i,t-k} + \sum_{l=1}^{4} \theta_l RTC_{i,t-l} + \mu_i + \lambda_t + \varepsilon_{it}$

Figure 19. Comparison of CA responses after one unit RBC, RCC and RTC shock, without contemporaneous crises terms[a]

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