

Defending against speculative attacks – It is risky, but it can pay off

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Abstract

While currency crises are typically considered to be painful and costly events, a closer look reveals that economic developments after a speculative attack differ considerably. Monetary authorities can play a central role in determining the economic course and costs of currency crises. They have to decide whether to defend or not to defend the domestic currency giving rise to three different types of crises: (i) an immediate depreciation if the central bank does not intervene and either (ii) a successful defense or (iii) an unsuccessful defense in the case of an intervention. We find that a central bank has two options to mitigate the costs of speculative attacks, namely an immediate depreciation and a successful defense. If a central bank intervenes she might be able to stabilize the exchange rate only temporarily and risks to ultimately fail facing the worst of the three scenarios with the highest economic costs.

Keywords: Exchange Rate, Currency Crisis, Monetary Policy

JEL: E42, E58, F31

1. Introduction

Currency crises are considered to be painful events as they are often associated with poor economic developments, i. e. negative real growth, high inflation as well as severe trade and budget deficits. However, a closer look reveals that economic developments after currency crises differ considerably. Korea, for example, was subject to five currency crises between 1990 and 2006, which had quite different real effects (see figure 1).¹ While output growth remained relatively stable during the post-crisis periods of 1991 and 1995, it declined severely after the crisis of 1997/98. In the aftermath of the crisis in 2000 output growth decelerated only somewhat, while during the post-crisis period of 2005 output growth even increased.

¹For details concerning the identification of crisis events, see section [Appendix A](#).

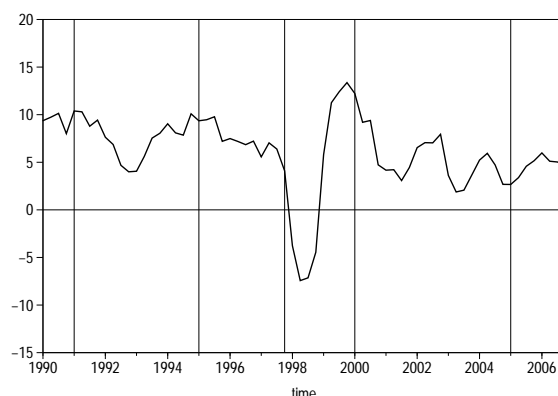


Figure 1: Korea: Real GDP and currency crises (1990 – 2006)

In analyzing why the economic costs of currency crises vary so greatly, neither theoretical nor empirical studies have paid much attention to central banks' intervention policies.² In case of a speculative attack the central bank can in principle either remain passive or intervene in the foreign exchange market in order to avoid a depreciation. This gives rise to the following four outcomes: three different types of currency crises, namely, (i) immediate depreciation, (ii) successful defense, and (iii) unsuccessful defense (see figure 2) and the no attack situation.³ In this context an unsuccessful defense might also be characterized as a delayed depreciation. Once a central bank has started to intervene in the foreign exchange market she can end the intervention and let the currency depreciate for basically two reasons: she is no longer either able to intervene, e. g. the reserves are depleted, or she is not willing to further intervene, e. g. the expected benefits of the intervention policy do no longer exceed the expected costs. As we can not differentiate between these two cases we use the terms unsuccessful defense and delayed depreciation interchangeably.

This paper analyzes how central bank intervention policies affect the economic costs of currency crises. Accordingly, we distinguish the various types of currency crises and identify the three cases. We find that intervention policies do make a difference for the economic

²Among the few exception are, e. g., [Bauer and Herz \(2007\)](#) and [Daniëls et al. \(2011\)](#), who explicitly model the simultaneous interactions between policy makers and speculative traders.

³Since currency crises – as we define them (see [AppendixA](#)) – are not limited to de jure or de facto fixed exchange rate regimes and to simplify terminology, we uniformly apply the term depreciation to depreciation as well as devaluation events.

		Defensive action	
		No	Yes
Depreciation	No	no crisis	successful defense
	Yes	immediate depreciation	unsuccessful defense/ delayed depreciation

Figure 2: Crisis definitions

development after currency crises. The empirical results provide evidence that a central bank has two options to mitigate the costs of speculative attacks, an immediate depreciation and a successful defense. Abstaining from an intervention, i. e. allowing an immediate depreciation, yields an “intermediate” scenario with only a relatively mild recession. If the central bank intervenes and permanently succeeds she can achieve the best economic performance and avoid output losses all together. However, if she is only able to stabilize the exchange rate transitorily and ultimately fails in her intervention policy, she faces the worst of the three scenarios with a particularly bad economic performance.

The paper closest to our empirical analysis of the costs of different types of currency crises is [Eichengreen and Rose \(2003\)](#), who analyze and compare the economic consequences of successful attacks and successful defenses. The authors find that a successful attack is on average followed by a loss of 3% of GDP in the subsequent year. However, their results are not informative concerning the important decision whether a central bank should intervene or not intervene as they combine an immediate depreciation and an unsuccessful defense to the successful attack scenario. In another interesting study [Gupta et al. \(2007\)](#) analyze the output effects of currency crises in a more general approach. The authors adopt the crisis definitions of other studies, i. e. they only identify those periods as crisis years that were already tagged by a majority of other studies, thereby intermingling different types of crisis definitions. Their empirical results indicate that crises can have very different economic outcomes and are typically more severe in the case of large capital inflows during pre-crisis

periods, fewer capital market restrictions, lower trade openness and higher external long-term debt. Again, due to the encompassing crisis definition it remains unclear what role central bank policies could have in explaining the diversity of crisis outcomes. [Cerra and Saxena \(2008\)](#) and [Bussière et al. \(2010\)](#) propose a new way to examine the persistence of output effects in the aftermath of currency crises. Their findings indicate that currency crises are associated with a permanent output loss of 2–6% of GDP relative to the no-crisis trend. However, as both studies are based on aggregated crisis definitions, namely the so-called Exchange Market Pressure Index (EMPI) in the case of [Cerra and Saxena \(2008\)](#) and a significant depreciation measure in the study of [Bussière et al. \(2010\)](#) they can not differentiate between the three types of crises and the respective role of central banks.

The paper is organized as follows. Section 2 presents some stylized facts. The empirical analysis to evaluate the economic consequences of the different types of currency crises which is based on a panel VAR framework is outlined in section 3. The main findings are summarized in section 4.

2. Some stylized facts

To examine the economic consequences of the three types of crises, namely immediate depreciations, successful interventions, and unsuccessful interventions, we characterize these crisis events along two dimensions. On the one hand we use an intervention index (INTX) to capture the central bank’s (no)intervention decision. The INTX is defined as the standard deviations weighted sum of interest rate changes and percentage changes in reserves ($\text{INTX} = \Delta i_t / \sigma_{\Delta i_t} - \Delta r_t / \sigma_{\Delta r_t}$). On the other hand we use changes of the exchange rate (Δs_t) to measure the outcome of the central bank’s policy.⁴

Our empirical analysis is in principle based on annual data due to data limitations. However, as the data relevant for the timing of currency crises, especially interest rates,

⁴To be more precise, we first check the input data for significant interventions and depreciations. In a second step, we examine whether the interventions are followed by depreciations within a 12-month time window or if both are single situations. This allows us to differentiate between the three crisis types. For further details see appendix and [Bauer et al. \(2012\)](#).

exchange rates and reserves, are typically available at higher frequencies, we determine the crisis events on the basis of monthly data and assign them to the respective years (see, e. g., [Bussière et al., 2010](#)). An important issue in identifying crisis events is to appropriately differentiate whether subsequent crises are individual events or part of an ongoing crisis. After determining currency crisis events we apply a one-year window and drop all crises with overlapping time windows, i. e. crises have to be at least two years apart to be considered as distinct currency crises.⁵ By doing so we ensure that the effects of a specific crisis type in year T are not biased by other nearby currency crises. If, for instance, a successful defense occurs in year T and an unsuccessful defense in year $T + 1$, the post-crisis effects of the successful defense could be influenced by the effects of the unsuccessful defense. Therefore, to avoid possible interferences in such a situation, these two crisis events are dropped from our analysis.

Our sample covers the years from 1960–2011 and incorporates 32 emerging market economies. We identify 163 crisis events with 42 immediate depreciations, 87 successful interventions and 34 unsuccessful interventions.⁶ To better understand the role of macroeconomic fundamentals and central bank policies on the course of currency crises we examine several macroeconomic indicators in the pre- and post-crisis periods. We follow the literature and focus in principle on output, consumer prices, current account balances and private capital inflows (see, e. g., [Calvo and Reinhart, 2000](#); [Hong and Tornell, 2005](#); [Rancière et al., 2006](#); [Gupta et al., 2007](#); [Lahiri and Végh, 2007](#); [Bussière et al., 2010](#)). In addition, we consider components of aggregate demand to better understand how the different sectors of an economy behave in the wake of the different types of crises. Furthermore, we take into account the development of the unemployment rate, the real effective exchange rate, the nominal exchange rate, money, and reserves.⁷

Output growth plays a crucial role in our analysis, as the costs of currency crises are often defined in terms of output loss. By taking inflation into account we consider on the

⁵See [Bussière et al. \(2010\)](#) for a similar approach.

⁶See appendix for an overview concerning the identified currency crises across the different countries.

⁷See appendix for a detailed description of the data.

one hand the economic consequences of high inflationary periods and on the other hand it serves as a policy response indicator (see, e. g. [Hong and Tornell, 2005](#); [Bussière et al., 2010](#)).

Changes in the current account balance and foreign private capital inflows might affect real growth, if – for instance – less foreign capital is available. Real growth is likely to slow down (see, for example [Calvo and Reinhart, 2000](#); [Gupta et al., 2007](#)), if firms are not able to finance investments due to a lack of financial resources (see, e. g. [Hong and Tornell, 2005](#)).

We decompose aggregate demand – private consumption, investment, exports and imports – to consider potential different transmission channels of the three types of crises. For instance, in the wake of an unsuccessful defense the exchange rate volatility rises and thus uncertainty increases. As a result private investments could decrease.

The impact of currency crises on exports and imports can be ambiguous. Exchange rate changes can mitigate the negative effects of a currency crisis, if the depreciation of the nominal exchange rate translates into a real devaluation. This enhances the economy’s competitiveness and thus exports might increase (see [Gupta et al., 2007](#)).⁸ However, currency crises could also be accompanied by negative effects on exports and imports (see, e. g., [Ma and Cheng, 2005](#)). In particular, depreciation events which lead to higher exchange rate volatility can increase the exchange rate exposure of trade businesses. Thus, importers and exporters may decide to lower their trade engagement in order to reduce the exchange rate risk.

Despite the previously described effects, monetary policy could likewise support or restrain economic growth. A tighter monetary policy can increase the chance of a successful defense, yet it can also have a negative impact on growth at least in the short to medium term (see, among others, [Chiodo and Owyang, 2002](#); [Lahiri and Végh, 2007](#)).

Moreover we take the country’s exchange rate regime into account. For example, in case of a hard peg policy, a depreciation of the exchange rate might imply greater uncertainty in the course of a speculative attack than in the case of a more flexible exchange rate regime and could therefore have a more negative impact on real growth (see, e. g. [Eichengreen and](#)

⁸At the same time the nominal depreciation increases the real value of the country’s foreign debt that is not denominated in domestic currency.

Rose, 2003). Finally, foreign exchange reserves are of interest as they are an important indicator of a country's ability to defend the exchange rate. Accordingly, reserve losses are an important dimension of the economic costs of currency crises.

Table 1 displays summary statistics with respect to the macroeconomic environment during the pre-crisis period (upper panel) and post-crisis period (lower panel).⁹ In addition, it provides results of a non-parametric Wilcoxon test that examines whether macroeconomic fundamentals differ from one type of crisis to the other.¹⁰ If macroeconomic fundamentals do not differ significantly in the pre-crisis period between the different types of crises while differences appear to be significant during the post-crisis period this could be an indication that central bank policy might have an important effect on the economic costs of currency crises. Column 1 of table 1 reports the sample mean for the no-crisis periods. Columns 2 – 5 of table 1 display the means for the pre-crisis and post-crisis periods, distinguishing between the three types of currency crises. Due to the test design we are only able to analyze if one crisis type is statistically significant from the other two types, or if all three types are statistically significant from each other at the same time. A single shaded area therefore denotes a crisis type which is statistically significant different from the other two types at the 5% level. Three simultaneously shaded areas point to statistically significant differences between the three types at the same time. For example, to examine pre-crisis inflation rates we perform three Wilcoxon tests, namely, (i) immediate depreciation vs. successful defense, (ii) immediate depreciation vs. unsuccessful defense and (iii) successful defense vs. unsuccessful defense. As a result, we obtain 2 out of 3 significant test statistics. The first statistic indicates that successful interventions have significantly lower pre-crisis inflation rates than immediate depreciations. The second statistic shows that successful interventions are associated with significantly lower pre-crisis inflation rates compared to unsuccessful interventions. Given this, the value of pre-crisis inflation rate is shaded gray in

⁹As our crisis definition is based on monthly data and a crisis can last for twelve months, the post-crisis period is defined as the crisis year and the first post-crisis year. The pre-crisis period covers the average development of three pre-crisis years. We also applied different lengths (from 1 to 4 years) of the pre-crisis and crisis period and have found our results to be robust.

¹⁰We additionally performed a Kolmogorov-Smirnov test which yields identical results.

Table 1: Mean values of macroeconomic indicators by different crisis events

Variable	no crisis (1)	all crises (2)	immediate depreciation (3)	successful defense (4)	unsuccessful defense (5)
<i>pre-crisis</i>					
Output growth	0.059	0.046	0.037	0.049	0.050
Inflation	0.059	0.091	0.106	0.072	0.123
Current account	-0.008	0.004	-0.007	0.017	-0.015
Private capital inflows	0.016	0.012	0.013	0.012	0.012
Private consumption growth	0.053	0.047	0.042	0.047	0.056
Investment growth	0.083	0.055	0.046	0.055	0.067
Export growth	0.092	0.075	0.063	0.081	0.077
Import growth	0.095	0.077	0.059	0.077	0.100
Debt-to-GDP ratio	0.442	0.403	0.391	0.391	0.453
Unemployment rate	0.072	0.076	0.094	0.065	0.082
Δ Real effective exchange rate	0.005	0.013	0.021	0.002	0.030
Δ Nominal exchange rate	0.014	0.086	0.124	0.047	0.137
Δ M1	0.159	0.217	0.212	0.199	0.266
Δ Total reserves	0.182	0.162	0.135	0.175	0.164
Δ Exchange rate regime	6.8	8.2	9.5	7.2	9.2
<i>post-crisis</i>					
Output growth	0.059	0.036	0.029	0.054	0.002
Inflation	0.059	0.101	0.111	0.062	0.186
Current account	-0.008	0.002	-0.016	0.010	0.005
Private capital inflows	0.016	0.009	0.009	0.009	0.007
Private consumption growth	0.053	0.038	0.033	0.057	-0.002
Investment growth	0.083	0.029	0.028	0.072	-0.073
Export growth	0.092	0.067	0.049	0.083	0.047
Import growth	0.095	0.051	0.043	0.094	-0.042
Debt-to-GDP ratio	0.442	0.414	0.452	0.381	0.457
Unemployment rate	0.072	0.080	0.100	0.064	0.091
Δ Real effective exchange rate	0.005	-0.008	-0.002	0.011	-0.056
Δ Nominal exchange rate	0.014	0.143	0.167	0.024	0.403
Δ M1	0.159	0.197	0.183	0.149	0.327
Δ Total reserves	0.182	0.099	0.160	0.100	0.032
Δ Exchange rate regime	6.8	8.8	9.6	7.3	11.3

Notes: A nominal depreciation is defined as an increase in the nominal exchange rate. A real depreciation is given by a decrease in the real effective exchange rate. The exchange rate regime classification is based on [Ilzetzi et al. \(2008\)](#) and ranges from 1 to 15 – from de facto pegged to de facto floating. Shaded areas denote statistically significant differences at the 5% level of one type of crisis compared to the two other types of crises within the respective group.

case of a successful defense.

Table 1 indicates that there is only weak evidence for systematic pre-crisis differences between the three types of crises. With the exception of inflation, import growth and the exchange rate regime, the macroeconomic indicators do not differ significantly between the three types of crises during the pre-crisis period. In the case of inflation we find a significant pre-crisis difference between a successful defense and the other two types of crises, i.e. between on the one hand the case of a stable exchange rate and on the other hand a drop of the exchange rate either due to an immediate depreciation or an unsuccessful

defense. The pre-crisis inflation rate of successful interventions is about 7.2% (column 4) and significantly lower than the pre-crisis inflation rates of immediate depreciations (10.6%) and unsuccessful interventions (12.3%). The pre-crisis growth rate of imports is significantly higher for unsuccessful interventions (10.0%) compared to immediate depreciations (5.9%) and successful interventions (7.7%). In the case of the exchange rate regime we also find some evidence for pre-crisis differences.¹¹ Successful interventions are associated with somewhat less flexible exchange rate regimes (ERA index of 7.2) than immediate depreciations (9.5) and unsuccessful defenses (9.2). Taken together, the summary statistics do not point to major pre-crisis differences in fundamentals between the three types of currency crises.

In contrast, the test statistics indicate that there are considerable differences in post-crisis macroeconomic developments between on the one hand successful defenses and immediate depreciations and on the other hand unsuccessful interventions. For instance, real growth is highest in the case of successful defenses (5.4%), immediate depreciations seem to be an “intermediate case” (2.9%) and unsuccessful defenses show the lowest value (0.2%).

Differences can also be found for inflation, consumption, investment, export and import growth, unemployment rate, and the nominal exchange rate as well as the real effective exchange rate. In the case of inflation, the depreciation events, i.e. immediate depreciations and unsuccessful interventions, are associated with significantly higher inflation than successful defenses. The increase in inflation is especially strong in case of unsuccessful interventions.

Consumption and investment both show the highest growth rates for successful interventions (5.7% and 7.2%). Immediate depreciations are associated with an intermediate development with a growth of consumption and investment of about 3%, while they severely decline in the wake of an unsuccessful defense (−0.2% and −7.3%). In the case of exports we find significantly higher growth rates for successful interventions (8.3%) than for immediate depreciations (4.9%) and unsuccessful interventions (4.7%). Concerning imports, the growth rate is again the highest for successful interventions (9.4%), while immediate

¹¹We use the ERA fine classification, ranging from 1 to 15 – from de facto pegged to de facto floating (see [Ilzetzki et al., 2008](#)).

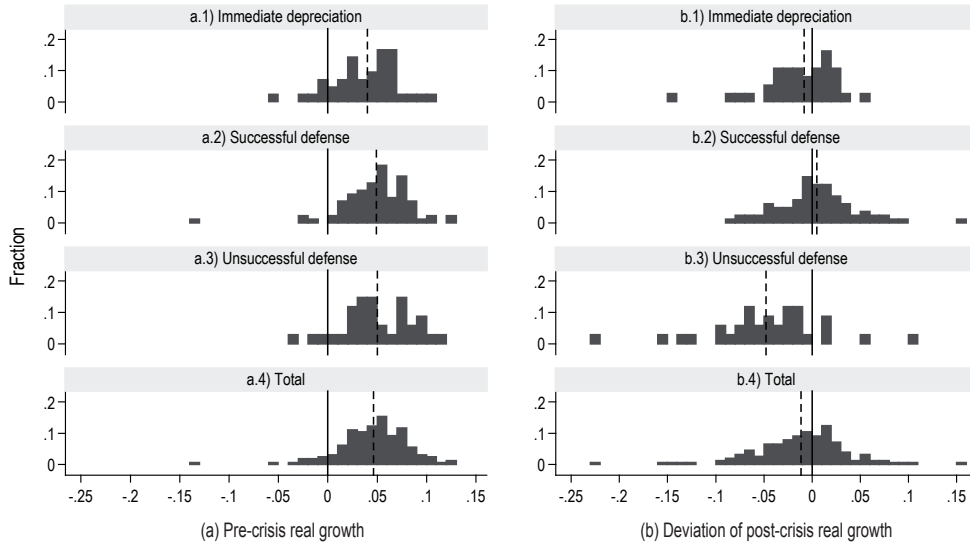


Figure 3: Currency crises and real growth (dashed lines indicate the respective crisis mean).

depreciations show an intermediate development with a post-crisis growth rate of 4.3%. On the contrary, unsuccessful defenses are accompanied by a fall in imports of about -4.2% . The unemployment rate is on average the lowest in the case of a successful defense of the exchange rate (6.4%).

To gain further insights in the differences between the various types of crises, figure 3 provides further information on the costs of currency crises, namely on changes in output growth. The left panel exhibits the distribution of pre-crisis values while the right panel displays the distribution of the post vs. pre-crisis differences.¹² The left panel of figure 3 supplements the summary statistics of table 1. In particular the distribution of real growth rates is not significantly different between the three types of crises. However, when comparing post-crisis output performance (right panel of figure 3), significant differences become apparent.

In case of an immediate depreciation and a successful defense only minor deviations of growth can be seen. On average output growth deviates from pre-crisis trend by -0.8 percentage points for immediate depreciations and by $+0.5$ percentage points for successful

¹²Regarding the definition of the pre-crisis and post-crisis period see footnote 9.

defenses (see histogram 3b.1 and 3b.2). The deviations from pre-crisis growth in the case of unsuccessful interventions are on average -4.8 percentage points and particularly widespread as well as strongly skewed towards negative deviations (see histogram 3b.3). Most of the crises – approximately 85% – are contractionary.

To summarize, we only find few differences between macroeconomic fundamentals in the pre-crisis period with respect to the three types of crises while in the post-crisis period considerable differences are apparent. We take this finding as a first indication that crisis management – in particular the decision of the central bank to defend or to not defend – might be crucial for the economic development after a speculative attack.¹³ Successful attempts to defend the exchange rate are associated with the best result in terms of output growth, while failed interventions are followed by the highest economic costs in terms of output losses. Immediate depreciations, i. e. abstaining from an intervention, are associated with an “intermediate” development.

3. Empirical analysis

The empirical analysis is based on two complementary approaches. Firstly, we examine the impact of the three types of currency crises on real growth, inflation, current account and private capital inflows in a panel VAR framework to explicitly take into account the interdependencies between these macroeconomic fundamentals. Secondly, a univariate panel autoregressive approach complements the panel VAR analysis in order to evaluate the dynamic responses of various macroeconomic variables – in particular we take a deeper look at the components of aggregate demand.

¹³It is also worth mentioning that the pre-crisis differences almost disappear while the post-crisis differences are still observable and statistically significant when removing country and time specific effects. This further indicates that the central bank’s crisis management could be an important determinant of the economic costs of currency crises.

3.1. A panel VAR approach

Our benchmark panel VAR model is given by:

$$X_{it} = \Gamma(L)X_{it} + F(L)K_{it} + \omega_i + d_t + \epsilon_{it}, \quad (1)$$

where X_{it} is a vector of stationary¹⁴ variables, namely real growth, inflation, current account, and private capital inflows. Generally, the criteria influencing the consequences of currency crises are overall economic stability, defensive power in economic terms and financial means for the defense. We thus choose four variables measuring these characteristics. Real growth serves as an indicator for economic stability and defensive power. Low inflation implies stable monetary policy in the past and thus a stable monetary system. Positive current account and high private capital inflows indicate both soundness of the economy and financial means to defend the currency. Size itself is an ambiguous variable as larger countries on the one hand have a higher defensive power but on the other hand also might attract a larger number of speculators. We thus omit a size variable like GDP and use current account and private capital inflows as ratios to GDP.

K_{it} is a vector of predetermined dummies describing the respective crisis type; $\Gamma(L)$ and $F(L)$ are matrix polynomials in the lag operator with $\Gamma(L) = \Gamma_1 L^1 + \Gamma_2 L^2 + \dots + \Gamma_q L^q$ and $F(L) = F_1 L^1 + F_2 L^2 + \dots + F_q L^q$, and ϵ_{it} is a vector of idiosyncratic errors. We additionally control for time-constant but cross-sectional varying effects (ω_i) as well as time-varying but cross-section constant factors (d_t).¹⁵ In our estimations we restrict the number of endogenous variables to four in order to prevent over-parameterization. Based on the

¹⁴We checked the stationarity of variables using several panel unit root tests. Precisely we implemented standard panel unit root test, namely the augmented Dickey and Fuller test (1979) (ADF), the Phillips and Perron test (1988) (PP), the Levin, Lin and Chu test (2002) (LLC) as well as the Im, Pesaran and Shin test (2003) (IPS). Additionally, to take potential dependencies between the panel individuals into account we implemented the test suggested by Pesaran (2007) (PESCADF). As in every case the null hypothesis of non-stationarity can be rejected, all test statistics indicate stationarity of variables (see table B.3).

¹⁵Since we include individual specific and time specific effects, we implicitly allow for shifts in the individual specific intercepts as well as in the time intercepts (see Baltagi, 2006, p. 177). Additionally, we have tested whether the economic impact of the three types of crises differ between “old type” and “modern type” currency crises. In particular, we have checked if the economic crisis effects as estimated in our VAR approach differ for the periods prior and after 1990 (and 1995, respectively). However, the empirical evidence (available upon request) does not indicate any structural break.

Lagrangian Multiplier (LM) test for autocorrelation in the residuals, we set the lag length to three.

Since we allow for individual heterogeneity, least squares estimation of equation (1) would yield biased coefficients. Therefore, we apply the panel VAR technique suggested by [Love and Zicchino \(2006\)](#). In order to remove the country fixed effects we use forward mean-differencing (Helmert’s transformation).¹⁶ This procedure transforms all variables in deviations from forward means.¹⁷ Moreover, it has the advantage of preserving the orthogonality between the transformed variables and the lagged regressors (see [Arellano and Bover, 1995](#), p. 41). Thus, we are able to use the lagged regressors as instruments and to estimate the coefficients by system GMM.

To identify the currency crises shocks and to simulate the corresponding impulse response functions we assume that currency crisis shocks affect real growth, inflation, current account and private capital inflows only with a lag.¹⁸ Moreover, ensuring that the respective crisis types have only lagged effects provides a natural way to avoid potential endogeneity problems. The alternative approach, namely to derive restrictions on parameters and temporal correlations among the three types from a theoretical model, does not seem to be feasible as we are not aware of an adequate theoretical model concerning the interdependencies between the different types of crises.

Based on the estimated crisis coefficients of the panel VAR model given in (1) we simulate impulse responses of real growth, inflation, current account and private capital inflows to different shocks, namely the three types of currency crises (see figures 4 and 5 and table C.5).¹⁹

¹⁶Our model also allows for time specific effects. We remove these effects by subtracting the means of each variable for each period. As the employed empirical framework assumes cross sectional independence, the removing of those time effects is a simple way to mitigate potential dependencies due to common factors (see [Levin et al., 2002](#), p. 13).

¹⁷Formally, the transformation is given by: $x_{it}^h = \delta_t [x_{it} - 1/(T-t)(x_{i(t+1)} + \dots + x_{iT})]$ with $t = 1, \dots, T-1$, and where $\delta_t = \sqrt{(T-t)(T-t+1)}$ (see, e. g., [Arellano and Bover, 1995](#), p. 41).

¹⁸Furthermore, we assume that there are no effects from the macroeconomic variables to the crisis dummies. This assumption is supported by several robustness checks. They indicate that – in general – the macroeconomic performance does not increase the crisis probability (see tables D.12 and D.13).

¹⁹As recommended by [Sims and Zha \(1999\)](#), the interpretation of the impulse response functions presented in this paper is based on error bands with coverage .68 instead of conventional significance levels.

As most parameters appear to be statistically significant for unsuccessful interventions, the results point to noticeable macroeconomic consequences only in case of an unsuccessful defense. In contrast, the economic development in the aftermath of immediate depreciations and successful interventions does not seem to be accompanied by severe real effects.

Regarding output, the simulation results indicate that the three types of currency crises give rise to two distinct patterns (see upper part of figure 4). On the one hand, the impulse response function for an unsuccessful defense shows a clear V-shaped drop (-5.1 percentage points) and recovery of real growth, implying a highly persistent impact on the output level in the aftermath of the crisis. On the other hand, successful interventions and immediate depreciations are not followed by distinct changes in output. In the case of an immediate depreciation the change in the real growth is insignificant, while the successful defense even is associated with positive, partly significant output effects.

Inflation is again characterized by different responses to the three types of crises (see lower panel of figure 4). Both immediate depreciations and unsuccessful interventions appear to be associated with higher inflation during the post-crisis period. While immediate depreciations show a prolonged period of higher inflation rates of up to 8 percentage points above trend, unsuccessful defenses are followed by a strong one time inflation peak of about 13 percentage points. No significant effects are found in the case of successful interventions.

Regarding current account effects, we find a particularly strong response in the case of unsuccessful interventions (see upper part of figure 5). The current account improves persistently and shows the largest effect of about 4 percentage points one year after the crisis, thereby mitigating the decline in output. No changes are apparent for successful interventions and immediate depreciations.

In the case of private capital inflows, the three types of crises again are associated with diverging developments. While capital inflows show no significant response in the case of successful interventions, they show a light positive evolution for the immediate depreciation scenario. In contrast, they strongly decline in case of unsuccessful interventions and only recover slowly – which might be related to increased uncertainty concerning the future economic development – suggesting a loss of confidence among investors (see, e. g., [Radelet](#)

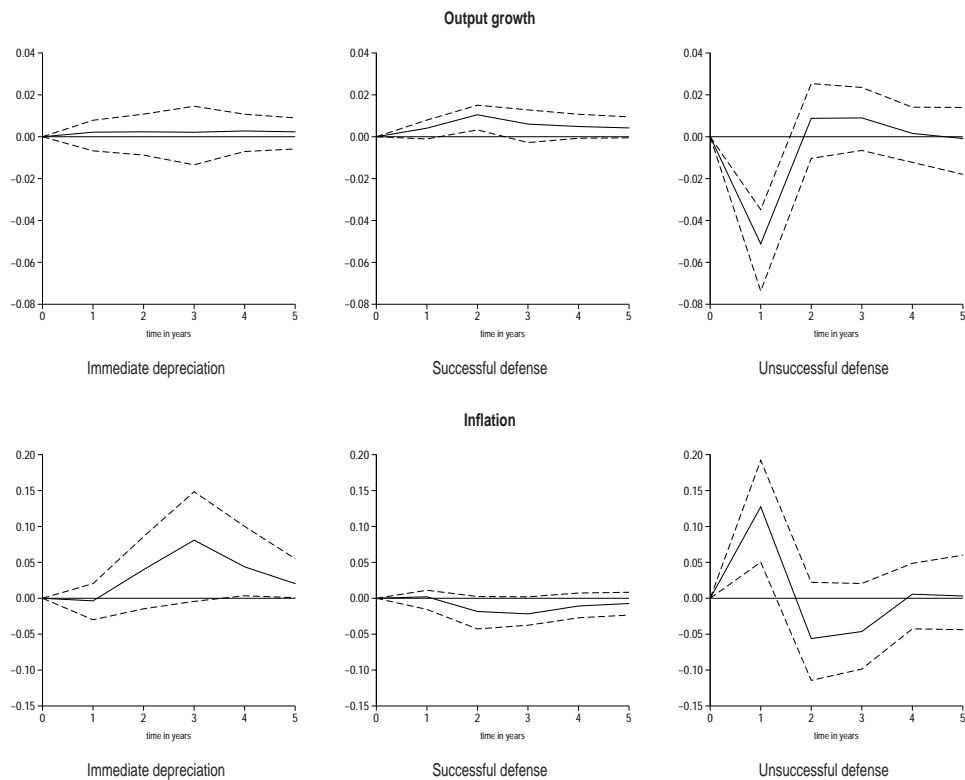


Figure 4: Impulse responses of output growth and inflation to currency crises.

and Sachs, 1998).

The impulse response functions reflect the quite different policy approaches taken by central banks in the face of a speculative attack. In the case of successful defenses the central bank follows a policy that is consistent with a stable exchange rate and is thereby able to basically neutralizing the effect of the speculative attack. In the case of an immediate depreciation the central bank voluntarily abandons the exchange rate regime without intervening. Additionally, she tends to implement an expansionary monetary policy which can be inferred from the higher (tolerated) inflation rates, possibly to support real growth. This strategy may be considered as a distinct alternative monetary policy compared to defending the domestic currency. In contrast, the impulse response functions show a somewhat inconsistent monetary policy in case of an unsuccessful defense (delayed depreciation). Specifically, the intervention policies are not expansionary enough to prevent a recession and not restrictive enough to stabilize the exchange rate and/or to prevent inflation. Among speculators this

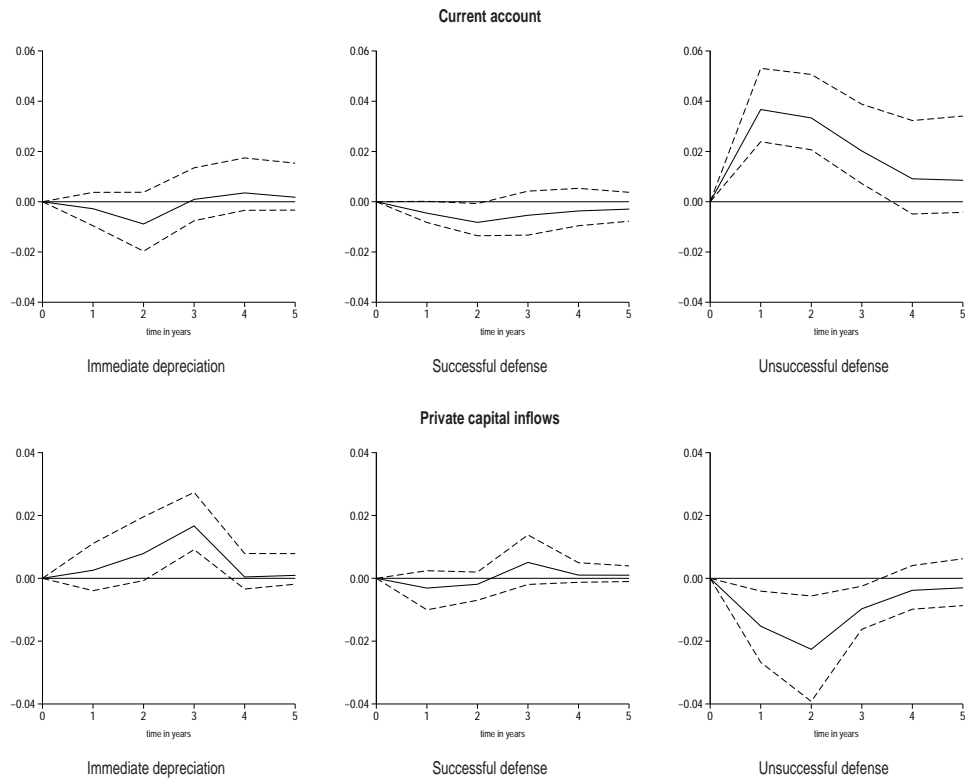


Figure 5: Impulse responses of current account and private capital inflows to currency crises.

inconsistency could raise expectations about future inflation as well as a potential depreciation. As a consequence, the intervention measures to defend the exchange rate turn out to be ineffective (see also [Hong and Tornell, 2005](#), p. 77).

Taken together, the findings from the impulse response functions indicate that central banks can heavily influence the economic costs of currency crises. They have in principle two options to notably reduce the costs of currency crises, either successfully defending the exchange rate or to refrain from interventions. The decision to defend the exchange rate is risky. If the central bank intervenes she can either succeed and achieve the best result in terms of overall economic performance, or she can fail and face the worst case scenario. Abstaining from an intervention, i. e. allowing an immediate depreciation, typically results in an “intermediate” economic post-crisis development.

3.2. Macroeconomic dynamics of currency crises

In a next step we complement the panel VAR with a univariate panel autoregressive approach to gain further insights in the adjustment processes associated with the three types of currency crises and the potential role of central banks in mitigating the costs of currency crises. In estimating the univariate panel autoregressive model we follow [Cerra and Saxena \(2008\)](#), [Bussière et al. \(2010\)](#) and [Kappler et al. \(2011\)](#), and simulate impulse responses of several macroeconomic variables – in particular various components of aggregate demand – for the three different types of currency crises.

Our benchmark model is given by:

$$x_{it} = \alpha_i + \omega_t + \sum_{j=1}^3 \beta_j x_{it-j} + \sum_{k=1}^3 \sum_{s=1}^3 \alpha_{ks} D_{kit-s} + \epsilon_{it},$$

where x_{it} denotes the macroeconomic variable of interest in country i in year t . The dummy variable D_{kit-s} takes on the value one if a k type currency crisis occurs in country i in year $t-s$. We additionally control for time (ω_t) and country specific effects (α_i). The i. i. d. error term is denoted by ϵ_{it} . We estimate an autoregressive model in x of order three, as we do not find any significant coefficients beyond the third lag for most indicators. Moreover, we use a common lag length for all model specifications in order to ensure a consistent basis for comparison of impulse response functions of the different macroeconomic indicators (see [Kappler et al., 2011](#), pp.13). Furthermore, heteroscedasticity consistent standard errors are computed. To avoid potential endogeneity problems we only allow for lagged effects of currency crises. To examine the crisis dynamics, namely the deviation from the no-crisis trend behavior, we again simulate impulse response functions to shocks of the different types of crises.

To relate the empirical results of the univariate panel autoregressive models with the panel VAR approach of the previous section [3.1](#), we start with estimating univariate panel autoregressive models for output growth, inflation, capital account and private capital inflows. [Figure 6](#) reports the simulated impulse response functions which are very similar to the results from the panel VAR approach. We take these similarities as an indication that uni-

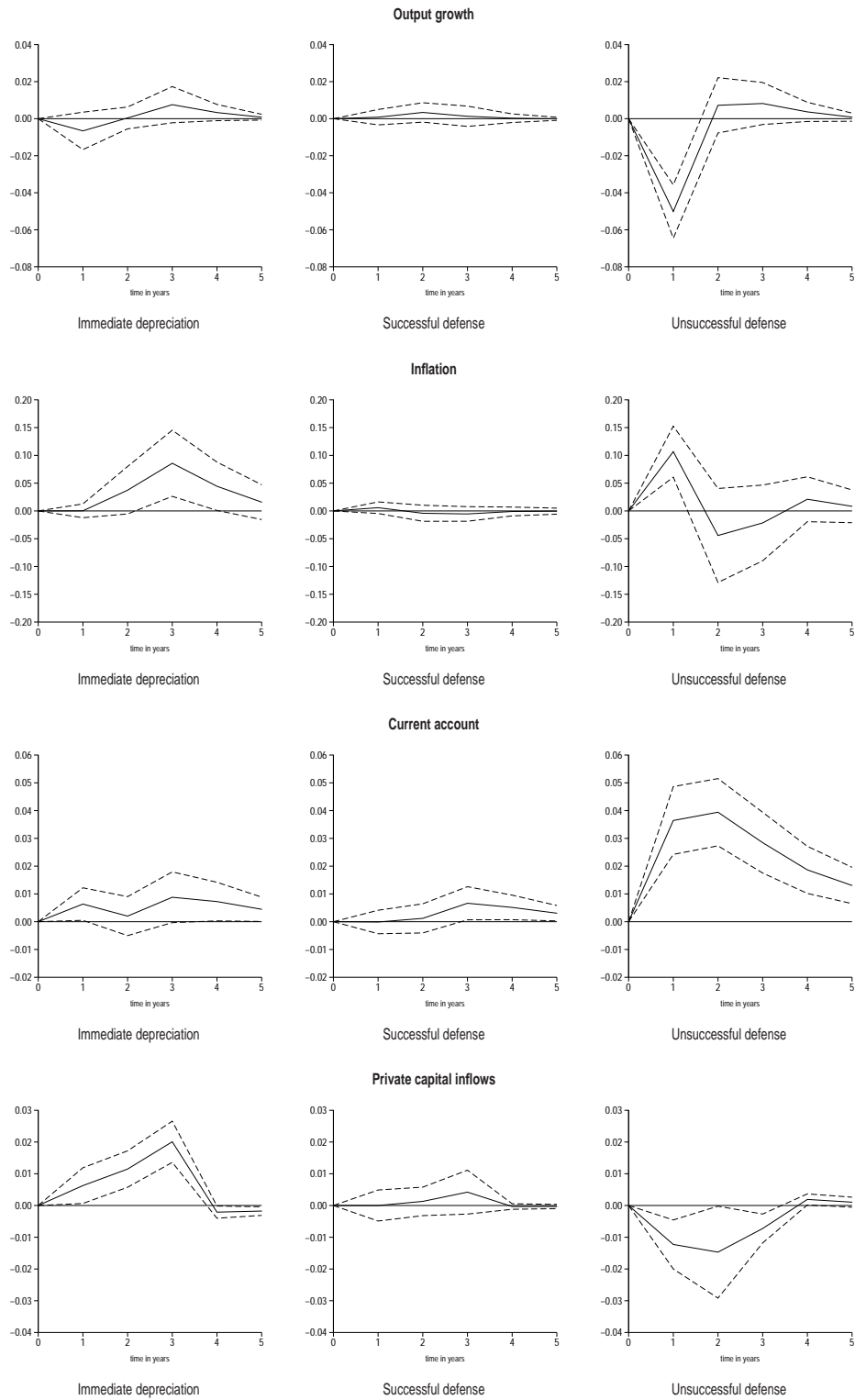


Figure 6: Impulse responses of output growth, inflation, current account, and private capital inflows to currency crises.

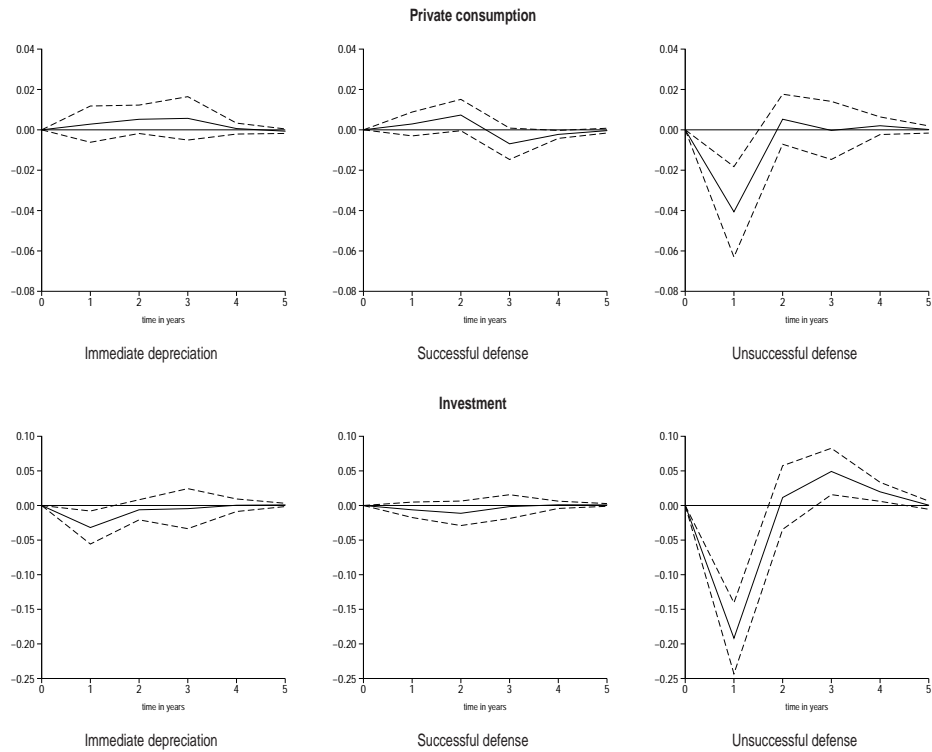


Figure 7: Impulse responses of private consumption and investment to currency crises.

variate panel autoregressive models are quite informative on the macroeconomic dynamics of currency crises and focus in the following on a number of other important macroeconomic variables, such as private consumption, investment, exports, imports, debt-to-GDP ratio, and unemployment rate.

Figure 7 shows that the consumption and investment effects of currency crises clearly differ between the three types and reflect the respective output effects (see figure 6). In particular, in case of unsuccessful interventions both consumption and investment growth fall, possibly due to increased uncertainty among households and investors. For immediate depreciations and successful interventions the consumption impulse response functions do not show any significant changes. Concerning investment growth, immediate depreciations seem to be associated with a weak decline in investment growth in the first post-crisis year, while no significant effects are found in the aftermath of successful interventions.

In the case of export and import growth, the three types of crises are associated with

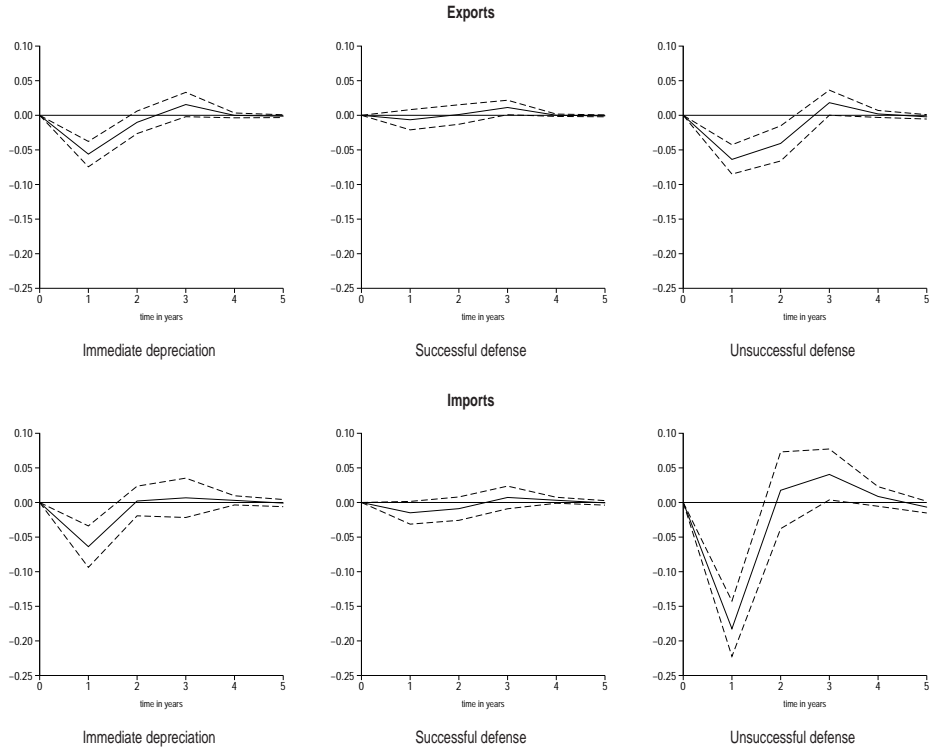


Figure 8: Impulse responses of exports and imports to currency crises.

diverging developments. While both exports and imports show no significant responses in the case of successful interventions, they both decline in the post-crisis period in the case of immediate depreciations and unsuccessful interventions. For immediate depreciations and unsuccessful defenses the drop in export growth is about -6 percentage points, whereas the decline in export growth seems to persist longer in the case of unsuccessful interventions (see figure 8). The differences in imports are even more pronounced. Import growth strongly declines by about -18.5 percentage points in case of an unsuccessful defense and by about -6.4 percentage points in the case of immediate depreciations. The decline in imports for these two depreciation events can be primarily explained by higher import prices caused by the nominal depreciation of the domestic currency (see table 1). Furthermore, in case of an unsuccessful defense, the decrease in output growth additionally contributes to a slow down of imports. However, it might come as a surprise that for an unsuccessful defense we also observe a decline in export growth even though the economy faces a real depreciation (see

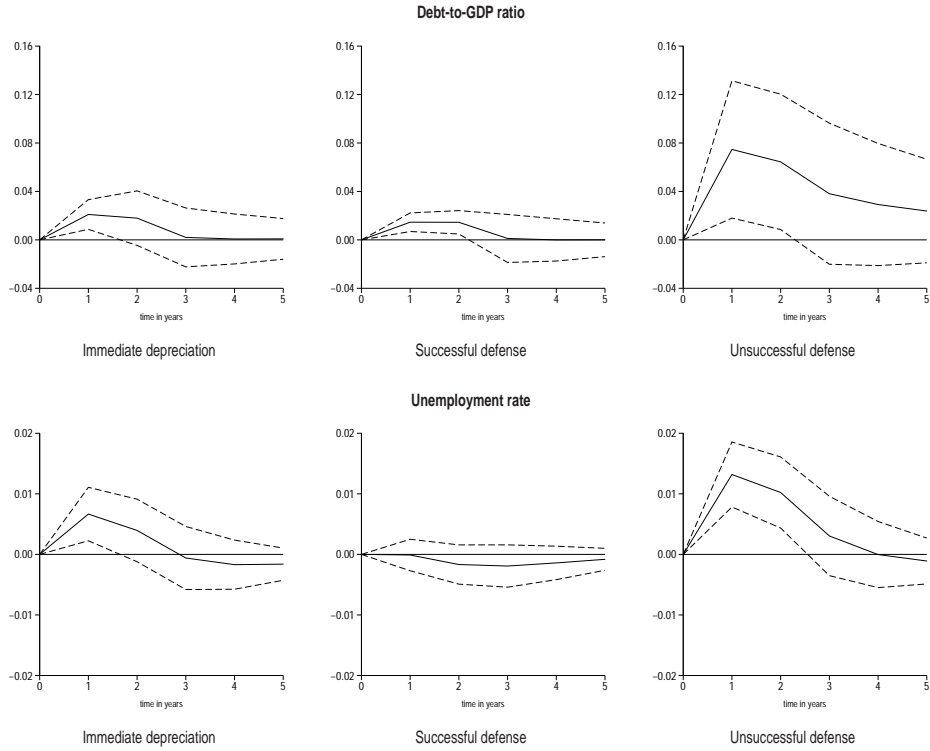


Figure 9: Impulse responses of debt-to-GDP ratio and unemployment rate to currency crises.

table 1), which should improve the economy’s competitiveness. Indeed, the results indicate that the increased exchange rate volatility and the subsequently greater uncertainty which follows a depreciation event (immediate depreciation or unsuccessful defense) might lead importers and exporters to reduce their trading activities (see, e. g., [Ma and Cheng, 2005](#)).

Concerning the debt-to-GDP ratio we again find the strongest crisis impact in case of an unsuccessful defense. While immediate depreciations and successful defenses are associated with an increase between 1 and 2 percentage points, unsuccessful defenses are followed by a debt-to-GDP ratio that is up to 8 percentage points above trend in the aftermath of a crisis.²⁰

The evolution of the unemployment rate in the wake of a currency crisis is also characterized by differences between the three types. Again, no significant effects are found in the case of successful interventions. On the contrary, immediate depreciations and unsuccessful

²⁰Please note that the rise in the debt-to-GDP ratio is primarily driven by the drop in output. When taking this output effect into account the increase in debt is similar for the three types of currency crises.

interventions are both associated with higher unemployment during the post-crisis period. While immediate depreciations show a slight increase of about 0.7 percentage points, unsuccessful defenses are followed by an unemployment rate that is about 1.3 percentage points above trend.

Taken together, the more differentiated analysis confirms that the central bank can neutralize a speculative attack in the case of a successful defense. This type of crisis event does not seem to be associated with any economic costs. Yet, intervening to stabilize the exchange rate can not be considered a free lunch. Instead, there is the risk that the intervention is prone to be unsuccessful leading to the worst of the three scenarios with a deeper recession, higher unemployment and higher debt. If the monetary authority instead decides to let the currency depreciate without trying to defend it, the economy is likely to only face a mild recession. In general, monetary authorities that pursue a consistent policy, i. e. either implementing a credible exchange rate anchor or immediately giving in to a speculative attack, seem to fare best. Unsuccessful defenses seem to be the result of inconsistent policies, i. e. first defending the exchange rate with restrictive monetary policy and subsequently giving in to the speculative attack followed by an expansionary monetary policy. Due to negative expectational effects associated with the loss of the nominal exchange rate anchor, high economic costs are the likely result (see also [Eichengreen and Rose, 2003](#)).

3.3. Robustness analysis

The stylized facts presented in section 2 indicate that the likelihood of the different types of currency crises does not depend on the pre-crisis economic development. Only if there is no – or at least only weak – evidence that the pre-crisis macroeconomic development is fundamental for the different types of currency crises is it likely that the different post-crisis outcomes are associated with the crisis management of the monetary authority (see also [Eichengreen and Rose, 2003](#)). Therefore, we perform additional regression analyses to examine whether the pre-crisis economic development is associated with the three different types of crises. Specifically, we test whether macroeconomic fundamentals increase the probability of (i) an immediate depreciation, (ii) a successful defense, (iii) an unsuccessful

defense or (iv) a currency crisis in general. Please note, that it is not the aim of this paper to explain the occurrence of a specific crisis type with respect to the underlying economic development. The occurrence of a crisis type is in particular subject to the research on early warning indicators. Interestingly, this vast empirical literature illustrated time and again, that macroeconomic variables are notoriously inapt and unreliable in predicting speculative attacks. This could in our context also be interpreted as evidence that macroeconomic fundamentals are not informative for the occurrence of the three types of currency crises and also that central banks' crisis management might play an important role for the costs of currency crises. Nonetheless, in order to further clarify this issue, we perform panel logit regressions for each type of crisis separately as well as the aggregated crisis definition. We test whether real growth, inflation, private capital inflows or current account imbalances increase the probability of either an immediate depreciation, a successful defense, an unsuccessful defense or a currency crisis in general. If the economic development does not influence the crisis probability then it is likely that monetary authority's crisis management plays a major role.²¹ Tables [D.12](#) and [D.13](#) in the appendix display the estimation results. Column 1 reports the results for all crises aggregated, while columns 2 – 4 contain the results for each specific type of crisis. In general, the empirical evidence indicates that the pre-crisis macroeconomic performance does not increase the crisis probability (see table [D.12](#)), since the lagged parameters of the different indicators in each regression are jointly insignificant. Only a few individual lags are statistically significant. When further controlling for current and forecasted economic developments (see table [D.13](#)), we also do not find systematic differences in the occurrence of a crisis event between the three different types. All in all, the panel logit regressions seem to indicate that central banks' policies essentially determine the economic development through crises.

To further check that our results are not driven by potential correction mechanisms originating from previous crises we increase the time window concerning the singular event status of a currency crisis. In particular we make sure, that no other crisis event takes place

²¹In order to avoid endogeneity problems we do not include exchange rate changes and monetary policy tools related indicators, as these variables are already mirrored by the respective crisis type.

two years before and two year after an identified currency crisis, i. e. currency crises have to be at least three years apart to be considered as a crisis event. Also, we increased the time span that determinates whether an intervention is considered to be either successful or unsuccessful from 12 to 24 months. Additionally, we checked our results if we do not apply a time window at all, i. e. we analyze every identified currency crisis. The results again depict that unsuccessful defenses are associated with severe macroeconomic consequences, while immediate depreciations can be characterized by an “intermediate” development.²² No remarkable macroeconomic effects can be observed in case of successful interventions.²³

Moreover, to check the robustness of the impulse response functions, we perform a number of sensitivity checks for possible contagion either due to contemporaneous banking and/or debt crises or currency crises in other countries. As pointed out by, among others, [Reinhart and Rogoff \(2009\)](#) and [Laeven and Valencia \(2012\)](#) currency crises frequently occur together with banking and debt crises. We control for these twin and triple crises effects in order to isolate the economic consequences that can be attributed to one of the three specific currency crisis events. In our sample 36 out of 163 currency crises are accompanied by banking crises, 14 coincide with debt crises, and 7 involve both banking and debt crises. [Tables D.6 – D.8](#) summarize the impulse response functions of the macroeconomic indicators of interest to the three types of currency crisis shocks when controlling for the occurrence of banking and debt crises. The empirical results indicate that successful interventions and immediate depreciations are not accompanied by noticeable negative effects. In contrast, unsuccessful defenses again are associated with a significant worsening of the fundamentals.

²²The respective estimation results are available upon request.

²³It is worth mentioning that the employed empirical framework assumes homogeneous slope coefficients across the individuals and cross sectional independence. However, due to the occurrence of global/common as well as national shocks these assumptions could be violated, resulting in biased estimation results (see, e. g., [Belke et al., 2011](#)). To address these issues we additionally applied the Pooled Mean Group (PMG) estimator ([Pesaran et al., 1999](#)) and the Common Correlated Effects (CCE) estimator ([Pesaran, 2006](#)). The results remain qualitatively unchanged except for private capital inflows that do no longer show any significant response. However, the estimation results still confirm and underline the aspect that unsuccessful interventions are associated with high economic costs, particularly in terms of lower real growth and higher inflation. Besides those different estimators we also repeated our baseline estimations and dropped countries from our sample randomly. The obtained results again show that unsuccessful interventions are associated with high economic costs. The results are available upon request.

Another aspect that is worth controlling for are contagion effects from currency crises in other countries. [Kaminsky and Reinhart \(2000\)](#), [Fratzscher \(2003\)](#), and [Dreher et al. \(2006\)](#) emphasize that financial crises can be triggered by crises in other countries. We check our empirical results for potential contagion effects by including a dummy variable that takes on the value one if a currency crisis occurs somewhere else in the sample at the same time. [Table D.9](#) indicates that in general the crisis effects are somewhat weaker when taking contagion effects into account. However, qualitatively the results remain unchanged.

Moreover, we control for the influence of the exchange rate regime. For instance, it is not unlikely that the institutional arrangement in which a central bank has pursued her policy influences her reputation and the expectation of speculative traders and other economic agents and thus in turn affects future interventions. To control for this impact we include an additional dummy variable describing the exchange rate regime in place. The respective estimation results are shown in [table D.10](#). Again, unsuccessful interventions are characterized by distinct macroeconomic consequences, while immediate depreciations tend to be associated with an “intermediate” development. No remarkable effects can be observed for successful interventions. However, when controlling for the impact of the exchange rate arrangement with respect to the three different types of currency crises, the underlying estimation results point to weak differences.²⁴ The results indicate that if interventions fail the growth effects are particularly severe if the central bank tries to stabilize an exchange rate that was de facto floating during the pre-crisis period. Monetary authorities who do not pursue a consistent policy, i. e. unsuccessfully pegging a former floating exchange rate, suffer relatively high economic costs.

Finally, we additionally control for the strength of speculative attacks approximated by the attack duration. In particular we include a variable that measures the time span between the first intervention and the last intervention in case of a successful defense or between the first intervention and the significant depreciation in case of an unsuccessful defense (see [table D.11](#)). Compared to our main results of [section 3](#) the results are mostly

²⁴The full results are available upon request.

identical. Taken together, the empirical results of the robustness checks (see tables D.6 – D.11) indicate that the results of section 3 are robust and remain qualitatively unchanged. Over all the robustness checks suggest a significant worsening of fundamentals particularly in case of unsuccessful interventions.

4. Conclusions

Currency crises can have very different economic outcomes, that range from busts – as is the typical perception of policy makers and the public – to even booms. Which development an economy takes in the course of a currency crisis seems to depend in a fundamental way on the central banks’ crisis management. In case of a speculative attack the central bank can either intervene in the foreign exchange market or she can abstain from countermeasures. If the central bank intervenes she can either succeed or suspend her intervention policy giving rise to three distinct crisis events, namely immediate depreciation, unsuccessful defense and successful defense.

The empirical analysis indicates that a central bank has two options to substantially reduce the costs of currency crises, (i) an immediate depreciation and (ii) a successful defense. In case of a successful defense the central bank can even expect to completely neutralize the effect of a speculative attack without any negative side effects such as a stabilization recession. In contrast unsuccessful defenses tend to be associated with high costs in terms of output loss in the range of about –5 percentage points.

With the decision to intervene in the foreign exchange market a central bank can achieve the best result in terms of output growth if she is successful. This outcome could be referred to a real victory. However, interventions could turn into a pyrrhic victory when the stabilizing interventions are suspended, either voluntarily or – due to lack of reserves for example – involuntarily. The economy then faces the worst result in terms of output loss. If the central bank does not intervene in the case of a speculative attack, i. e. if she lets the domestic currency depreciate immediately, she can expect an “intermediate” economic development with little economic costs in terms of output loss. Not intervening and accepting the subsequent depreciation in case of a speculative attack might thus be an attractive

option for a risk-averse central bank.

Our analysis also implies that to not differentiate between the different types of crises is likely to bias policy recommendations in favor of exchange rate interventions. Analyses which intermingle the different types of currency crises typically overestimate the costs of immediate depreciations as the high costs of unsuccessful defenses dominate the relatively low costs of immediate depreciations and successful defenses. Subsequently, monetary authorities are inclined to intervene “too often” rather than to immediately give in to a speculative attack.

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References

- Arellano, M., Bover, O., 1995. Another look at the instrumental variable estimation of error component models. *Journal of Econometrics* 68 (1), 29–51.
- Baltagi, B. H., 2006. Panel data econometrics: theoretical contributions and empirical applications. Emerald Group Publishing Limited.
- Bauer, C., Erler, A., Herz, B., 2012. The dynamics of currency crises – defending the exchange rate is a risky decision. Discussion Papers in Economics 06/12, University of Bayreuth.
- Bauer, C., Herz, B., 2007. Does it pay to defend? the dynamics of financial crises. Discussion Papers in Economics 06/07, University of Bayreuth.
- Belke, A., Dobnik, F., Dreger, C., 2011. Energy consumption and economic growth – new insights into the cointegration relationship. *Energy Economics* 33 (5), 782–789.
- Bussière, M., Saxena, S. C., Tovar, C. E., 2010. Chronicle of currency collapses: Re-examining the effects on output. BIS Working Papers 314, Bank for International Settlements.
- Calvo, G. A., Reinhart, C. M., 2000. When capital inflows suddenly stop: Consequences and policy options. In: Kenen, P. B., Swoboda, A. K. (Eds.), *Key Issues in Reform of the International Monetary and Financial System*. International Monetary Fund, Washington, D. C., pp. 175–201.
- Cerra, V., Saxena, S. C., 2008. Growth dynamics: The myth of economic recovery. *American Economic Review* 98 (1), 439–457.
- Chiodo, A. J., Owyang, M. T., 2002. A case study of a currency crisis: the russian default of 1998. *Federal Reserve Bank of St. Louis Review* (Nov), 7–18.
- Daniëls, T. R., Jager, H., Klaassen, F., 2011. Currency crises with the threat of an interest rate defence. *Journal of International Economics* 85 (1), 14–24.
- Dickey, D. A., Fuller, W. A., 1979. Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association* 74 (366), 427–431.

- Dreher, A., Herz, B., Karb, V., 2006. Is there a causal link between currency and debt crises? *International Journal of Finance & Economics* 11 (4), 305–325.
- Eichengreen, B., Rose, A. K., 2003. Does it pay to defend against a speculative attack? In: Dooley, M. P., Frankel, J. A. (Eds.), *Managing Currency Crises in Emerging Markets*. NBER Chapters. National Bureau of Economic Research, pp. 61–86.
- Eichengreen, B., Rose, A. K., Wyplosz, C., 1994. Speculative attacks on pegged exchange rates: An empirical exploration with special reference to the European monetary system. NBER Working Paper 4898, National Bureau of Economic Research.
- Fratzscher, M., 2003. On currency crises and contagion. *International Journal of Finance & Economics* 8 (2), 109–129.
- Gupta, P., Mishra, D., Sahay, R., 2007. Behavior of output during currency crises. *Journal of International Economics* 72, 428–450.
- Hong, K., Tornell, A., 2005. Recovery from a currency crisis: some stylized facts. *Journal of Development Economics* 76 (1), 71–96.
- Ilzetzki, E. O., Reinhart, C. M., Rogoff, K. S., 2008. Exchange rate arrangements entering the 21st century: Which anchor will hold? Data available at <http://www.carmenreinhart.com/research/publications-by-topic/exchange-rates-and-dollarization>, Mimeo.
- Im, K. S., Pesaran, M. H., Shin, Y., 2003. Testing for unit roots in heterogeneous panels. *Journal of Econometrics* 115 (1), 53–74.
- Kaminsky, G. L., Reinhart, C. M., 2000. On crises, contagion, and confusion. *Journal of International Economics* 51 (1), 145–168.
- Kappler, M., Reisen, H., Schularick, M., Turkisch, E., 2011. The macroeconomic effects of large exchange rate appreciations. ZEW Discussion Papers 11-016, ZEW – Center for European Economic Research.
- Klaassen, F., Jager, H., 2011. Definition-consistent measurement of exchange market pressure. *Journal of International Money and Finance* 30 (1), 74–95.
- Laeven, L., Valencia, F., 2012. Systemic banking crises database: An update. IMF Working Papers 12/163, International Monetary Fund.
- Lahiri, A., Végh, C. A., 2007. Output costs, currency crises and interest rate defence of a peg. *Economic Journal* 117 (516), 216–239.
- Levin, A., Lin, C.-F., Chu, C.-S. J., 2002. Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of Econometrics* 108 (1), 1–24.
- Love, I., Zicchino, L., 2006. Financial development and dynamic investment behavior: Evidence from panel var. *The Quarterly Review of Economics and Finance* 46 (2), 190–210.
- Ma, Z., Cheng, L., 2005. The effects of financial crises on international trade. In: Ito, T., Rose, A. K. (Eds.), *International Trade in East Asia*, NBER-East Asia Seminar on Economics, Volume 14. NBER Chapters. National Bureau of Economic Research, pp. 253–286.
- Pesaran, M. H., 2006. Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica* 74 (4), 967–1012.
- Pesaran, M. H., 2007. A simple panel unit root test in the presence of cross section dependence. *Journal of Applied Econometrics* 22 (2), 265–312.
- Pesaran, M. H., Shin, Y., Smith, R. J., 1999. Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association* 94 (446), 621–634.
- Phillips, P. C. B., Perron, P., 1988. Testing for a unit root in time series regression. *Biometrika* 75 (2), 335–346.
- Radelet, S., Sachs, J. D., 1998. The East Asian financial crisis: Diagnosis, remedies, prospects. *Brookings Papers on Economic Activity* 29 (1), 1–90.
- Ranci ere, R., Tornell, A., Westermann, F., 2006. Decomposing the effects of financial liberalization: Crises vs. growth. *Journal of Banking & Finance* 30 (12), 3331–3348.
- Reinhart, C. M., Rogoff, K. S., 2009. *This Time is Different: Eight Centuries of Financial Folly*. Princeton University Press.
- Sims, C. A., Zha, T., 1999. Error bands for impulse responses. *Econometrica* 67 (5), 1113–1155.

Appendix A. The (not-so-trivial) definition of currency crises

Our crisis differentiation is based on a stylized version of the monetary model of the exchange rate (see, e. g., [Eichengreen et al., 1994](#); [Klaassen and Jager, 2011](#)). On the basis of significant exchange rate changes and significant interventions we identify the specific crisis events, namely immediate depreciation, successful defense and unsuccessful defense, by applying the subsequent set of rules (see [Bauer et al., 2012](#)):

- 1.a A depreciation is significant if it is larger than the average of the exchange rate changes during the previous 12 months plus two times the standard deviation of these changes. Additionally, the exchange rate change has to be greater than 5%.²⁵ All means and standard deviations in this study are calculated time and country specific.
- 1.b Analogously, an intervention is considered to be significant if the INTX exceeds the average value during the previous 12 months plus three standard deviations.²⁶
- 2.a A successful defense in year T is defined as a significant intervention in month s of year T without a significant depreciation during the subsequent 12 months.
- 2.b An unsuccessful defense in year T is defined as a significant intervention in month s of year T followed by a significant depreciation during the subsequent 12 months.
- 2.c An immediate depreciation in year T is defined as a significant depreciation without a significant intervention during the preceding 12 months.

²⁵Increases of the exchange rate of less than 5% are not classified as significant depreciations even if they exceed the standard deviation threshold, e. g. in a strictly managed exchange rate regime (see [Bauer et al., 2012](#)). In fact, a managed exchange rate regime is typically announced with a respective exchange rate band (see, for example, [Ilzetzki et al., 2008](#)).

²⁶We apply a more restrictive threshold than in the case of depreciations to account for central banks' adjustments of reserve holdings that are due to portfolio alignment only and are not due to intentional intervention in the foreign exchange market.

AppendixB. Data

Table B.2: The data

Data	Description	Source
Output growth	Growth of GDP (constant), yoy	WDI
Inflation	Change in consumer price index, yoy	WDI
Current account	Sum of exports and imports as a share of GDP, ratio	WDI
Private capital inflows	Foreign portfolio investments in the resp. economy as a share of GDP, ratio	IFS
Private consumption growth	Household final consumption expenditure, etc. (constant)	WDI
Investment growth	Growth of gross fixed capital formation (constant), yoy	WDI
Export growth	Growth of exports of goods and services (constant), yoy	WDI
Import growth	Growth of imports of goods and services (constant), yoy	WDI
Debt-to-GDP ratio	Central government debt as a share of GDP	WDI
Unemployment rate	Unemployment, total (% of total labor force)	WDI
Real effective exchange rate	–	WMM
Nominal exchange rate	Exchange rate LC per EUR or USD	WMM, IFS
Change in M1	Change in money stock, yoy	WMM
Change in total reserves	Change in foreign exchange reserves, yoy	WMM, IFS
Exchange rate regime	Exchange rate arrangements fine classification	IRR
Short term interest rate	–	WMM, IFS
Dates on banking and debt crises	–	RR

Table B.3: Panel unit root tests

Panel unit root test	ADF	PP	LLC	IPS	PESCADF
Output growth	–15.10***	–16.50***	–13.13***	–16.28***	–10.22***
Inflation	–14.22***	–18.22***	–22.78***	–17.08***	–6.55***
Current account	–7.46***	–7.60***	–5.49***	–7.28***	–4.69***
Private capital inflows	–8.72***	–13.73***	–8.05***	–9.41***	–5.70***
Private consumption growth	–15.44***	–18.60***	–14.42***	–17.22***	–10.55***
Investment growth	–15.53***	–15.68***	–12.76***	–16.15***	–12.46***
Export growth	–16.43***	–19.62***	–15.82***	–18.75***	–12.95***
Import growth	–17.22***	–20.12***	–17.50***	–19.36***	–14.87***
Debt-to-GDP ratio	–2.62***	–2.26**	–6.39***	–2.79***	–1.28*
Unemployment rate	–4.68***	–1.77**	–4.01***	–4.50***	–2.26**

Notes: Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B.4: List of countries, anchor currencies and currency crises

Country (anchor)	Immediate depreciation	Successful defense	Unsuccessful defense
ARG (USD)	1981, 1982, 1983, 1987	1991, 1992, 1995, 1997 , 2006, 2007	1985, 1986, 1989, 2001
BRA (USD)	1964, 1965, 1968, 1981, 1986, 1987, 1988, 1991, 1999, 2001, 2004	1977 , 1980, 1989, 1997 , 2000, 2002	1966, 1967, 1975 , 1979, 1982, 1985, 1993, 2008
BUL (EUR)	1993, 1994	1998 , 2007, 2008	1996
CHI (USD)	1979, 2001, 2008, 2010	1977, 1981, 1995, 1998	1982, 1984
CHN (USD)	1986, 1994	1982, 1983, 1985, 1988, 1992, 1995, 2010	1984, 1989
COL (USD)	1985, 1997, 2002 , 2006, 2007	1986, 1992, 1993, 1994, 2005	1998, 2008
CZE (EUR)	1999	1997, 2004, 2008	
ECU (USD)	1983, 1985, 1988 , 1991	1984, 1986	1992, 1995, 1996, 1998
EST (EUR)		1997, 2000, 2001, 2005, 2007	
HKG (USD)		2002, 2004	
HUN (EUR)	1989, 1991 , 1994, 2003	1997, 1998, 2006, 2010	1995, 2008
IND (USD)	1966 , 1972, 1993, 1997	1973 , 1975, 1979, 1980, 1983, 1988, 1999, 2006	1990, 1995, 2008
IDN (USD)	2008	1983, 1985, 1986, 1988, 1994, 2001	1997
KOR (USD)	2000	1971, 1973, 1976, 1978, 1984, 1989 , 1991, 1992, 1995, 2005	1970, 1974, 1980, 1997, 2007
LVA (USD)	2010	1995, 2005	2008
LTU (USD)	2008, 2010	1993, 2005	
MAS (USD)	1975 , 1994	1970, 1972 , 1982, 1983, 1984, 1986, 1988, 1995, 2001, 2003, 2005, 2008, 2010	1997
MEX (USD)	1976, 1982	1978, 1986, 2006	1981, 1985, 1987, 1994, 1997, 1998, 2008
PAK (USD)	1972, 1993 , 1995, 1999, 2008	1966 , 1970, 1971, 1979, 1990, 1996, 2004, 2010	2000
PER (USD)	1967 , 1976, 1977, 1982, 1984, 1987	1962 , 1991, 1998, 2007	1975, 1981, 1983, 1985, 1986, 1988, 1990
PHI (USD)	1986, 2008	1987, 1989, 1990, 1992, 2003	1983, 1997, 2000
POL (USD)	1991, 1992, 1993, 1998, 2000, 2008, 2010	1996 , 2001, 2004	
RUS (USD)		1995, 2001, 2005	1997, 1998, 2009
SIN (USD)		1973 , 1979, 1980, 2001, 2004	1975, 1997
SVK (EUR)		1993, 1997, 2006, 2008	1998
SVN (EUR)	1992	1993, 2005, 2007	
RSA (USD)	1972, 1975 , 1983, 1985, 1996, 2000, 2001, 2004, 2008	1970, 1973, 1988, 1990, 1992	1981, 1984, 1998, 2006
SRI (USD)	1989, 1993, 1998	1980, 1981, 1983, 1987, 2006, 2009	2000
TWN (USD)	1997	1987, 1989, 1995, 2007, 2010	
THA (USD)	1981 , 1984	1977, 1978, 1983, 1988, 1995, 2000, 2001, 2004, 2008, 2010	1997
TUR (USD)	1986, 2001 , 2004, 2008	1998 , 2003	1987, 1991 , 1994, 1995, 2006
VEN (USD)	1984, 1986, 1992 , 1994, 1995, 2010	1990, 1996, 1998, 1999, 2000, 2005, 2007	1989, 2002 , 2004

Notes: The table reports all crisis events we found in our sample, while bold values denote those currency crises that are defined as single events and are therefore the basis for our analysis.

Appendix C. Regression results of the dynamic model

Table C.5: Main results of a panel VAR

Responses of	Output growth	Inflation	Current account	Private capital inflows
<i>Responses to:</i>				
Output growth _{t-1}	0.553*** (7.81)	-0.507** (-2.23)	-0.209*** (-2.60)	-0.001 (-0.02)
Output growth _{t-2}	0.140** (2.08)	0.213 (0.69)	0.027 (0.39)	0.058 (0.64)
Output growth _{t-3}	0.062 (0.91)	-0.011 (-0.05)	0.063 (1.00)	-0.003 (-0.06)
Inflation _{t-1}	0.012 (1.16)	0.624*** (2.69)	-0.003 (-0.41)	0.015*** (3.07)
Inflation _{t-2}	-0.004 (-0.37)	-0.197 (-1.00)	0.002 (0.48)	0.005 (1.13)
Inflation _{t-3}	-0.005 (-0.42)	0.204*** (4.05)	0.001 (0.20)	0.001 (0.07)
Current account _{t-1}	0.194 (0.85)	0.248 (0.44)	0.793*** (4.58)	-0.185 (-0.84)
Current account _{t-2}	0.000 (0.01)	-0.167 (-0.58)	-0.164** (-2.21)	0.133 (1.30)
Current account _{t-3}	-0.177 (-1.51)	0.066 (0.18)	0.132 (1.49)	-0.153 (-1.46)
Private capital inflows _{t-1}	0.034 (0.70)	-0.002 (-0.01)	0.108** (2.52)	0.020 (0.20)
Private capital inflows _{t-2}	-0.140*** (-2.96)	0.128 (0.75)	0.048 (1.29)	-0.058 (-0.67)
Private capital inflows _{t-3}	0.049 (0.99)	-0.046 (-0.22)	-0.036 (-0.78)	-0.012 (-0.14)
Immediate depreciation _{t-1}	0.002 (0.37)	-0.004 (-0.16)	-0.003 (-0.54)	0.003 (0.40)
Immediate depreciation _{t-2}	0.002 (0.23)	0.044 (1.06)	-0.006 (-0.81)	0.007 (0.87)
Immediate depreciation _{t-3}	0.002 (0.18)	0.057 (1.27)	0.007 (0.88)	0.015* (1.73)
Successful defense _{t-1}	0.004 (1.04)	0.002 (0.18)	-0.005 (-1.29)	-0.003 (-0.55)
Successful defense _{t-2}	0.009** (2.23)	-0.016 (-1.06)	-0.003 (-0.80)	-0.003 (-0.55)
Successful defense _{t-3}	0.001 (0.20)	-0.004 (-0.31)	0.003 (0.55)	0.004 (0.59)
Unsuccessful defense _{t-1}	-0.051*** (-3.21)	0.127** (2.00)	0.037*** (3.05)	-0.015* (-1.61)
Unsuccessful defense _{t-2}	0.029** (2.28)	-0.171** (-1.93)	-0.004 (-0.73)	-0.017 (-1.44)
Unsuccessful defense _{t-3}	0.005 (0.52)	0.029 (0.65)	0.006 (0.80)	-0.006 (-1.00)
Country fixed effects	Yes			
Time fixed effects	Yes			
Obs.	466			
Countries	32			

Notes: The VAR model is estimated by system GMM. Heteroscedasticity consistent t-statistics are in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.10.

Appendix D. Robustness analysis

Table D.6: Behavior of macroeconomic indicators after different crisis events controlled for twin crises effects (occurrence of currency and banking crises)

Year after crisis	1	2	3	4	5
<i>Output growth</i>					
Immediate depreciation	0.002	0.000	0.009	0.003	0.001
Successful defense	0.001	0.001	0.003	0.001	0.000
Unsuccessful defense	-0.038	0.006	0.012	0.003	0.001
<i>Inflation</i>					
Immediate depreciation	-0.011	0.005	0.069	0.058	0.017
Successful defense	-0.006	-0.010	-0.013	-0.008	-0.004
Unsuccessful defense	0.098	-0.004	-0.005	0.027	0.026
<i>Current account</i>					
Immediate depreciation	0.006	0.005	0.022	0.018	0.011
Successful defense	-0.003	-0.001	0.010	0.008	0.005
Unsuccessful defense	0.022	0.034	0.037	0.026	0.018
<i>Private capital inflows</i>					
Immediate depreciation	0.013	0.019	0.022	0.001	0.001
Successful defense	0.006	0.004	-0.001	0.000	0.000
Unsuccessful defense	-0.003	-0.009	-0.005	0.000	0.000
<i>Private consumption growth</i>					
Immediate depreciation	0.005	0.000	0.000	0.000	0.000
Successful defense	0.002	0.008	-0.004	-0.001	0.000
Unsuccessful defense	-0.024	0.005	-0.006	-0.001	0.000
<i>Investment growth</i>					
Immediate depreciation	-0.015	-0.023	-0.042	-0.011	0.001
Successful defense	-0.011	-0.016	-0.020	-0.004	0.001
Unsuccessful defense	-0.147	-0.002	0.013	0.006	0.000
<i>Export growth</i>					
Immediate depreciation	-0.067	-0.004	0.005	-0.002	0.000
Successful defense	-0.023	0.001	0.008	0.000	0.000
Unsuccessful defense	-0.064	-0.046	0.005	-0.003	-0.001
<i>Import growth</i>					
Immediate depreciation	-0.059	-0.010	-0.021	0.000	0.004
Successful defense	-0.029	-0.013	-0.002	0.003	0.001
Unsuccessful defense	-0.164	-0.001	0.007	0.008	0.000
<i>Debt-to-GDP ratio</i>					
Immediate depreciation	0.007	-0.008	0.001	0.001	0.001
Successful defense	0.015	0.010	0.000	0.000	0.000
Unsuccessful defense	0.044	0.016	0.018	0.016	0.013
<i>Unemployment rate</i>					
Immediate depreciation	0.004	0.001	0.000	0.000	0.000
Successful defense	0.001	-0.001	-0.001	-0.001	-0.001
Unsuccessful defense	0.007	0.004	0.000	0.000	-0.001

Notes: Shaded areas denote significant values at the 10 % level.

Table D.7: Behavior of macroeconomic indicators after different crisis events controlled for twin crises effects (occurrence of currency and debt crises)

Year after crisis	1	2	3	4	5
<i>Output growth</i>					
Immediate depreciation	0.001	0.002	0.011	0.004	0.001
Successful defense	-0.001	0.002	0.002	0.000	0.000
Unsuccessful defense	-0.038	0.010	0.011	0.002	0.001
<i>Inflation</i>					
Immediate depreciation	-0.032	0.018	0.059	0.035	0.005
Successful defense	-0.003	0.006	0.001	-0.003	-0.002
Unsuccessful defense	0.058	0.004	0.003	0.020	0.019
<i>Current account</i>					
Immediate depreciation	0.008	0.006	0.012	0.009	0.006
Successful defense	-0.001	0.000	0.008	0.006	0.004
Unsuccessful defense	0.028	0.035	0.023	0.015	0.010
<i>Private capital inflows</i>					
Immediate depreciation	0.008	0.013	0.020	0.001	0.000
Successful defense	0.004	0.001	-0.001	0.000	0.000
Unsuccessful defense	-0.008	-0.014	-0.007	-0.001	0.000
<i>Private consumption growth</i>					
Immediate depreciation	0.005	0.003	0.008	0.001	0.000
Successful defense	0.000	0.009	-0.002	-0.001	0.000
Unsuccessful defense	-0.024	0.009	0.000	0.000	0.000
<i>Investment growth</i>					
Immediate depreciation	-0.023	-0.004	-0.015	-0.004	0.001
Successful defense	-0.016	-0.009	-0.014	-0.003	0.001
Unsuccessful defense	-0.158	0.021	0.041	0.013	-0.001
<i>Export growth</i>					
Immediate depreciation	-0.063	-0.001	0.012	-0.001	0.000
Successful defense	-0.021	0.001	0.013	0.000	0.000
Unsuccessful defense	-0.065	-0.042	0.019	-0.001	0.000
<i>Import growth</i>					
Immediate depreciation	-0.059	-0.002	0.002	0.003	0.000
Successful defense	-0.030	-0.010	0.004	0.003	0.000
Unsuccessful defense	-0.167	0.006	0.033	0.011	-0.004
<i>Debt-to-GDP ratio</i>					
Immediate depreciation	0.007	0.008	0.003	0.002	0.002
Successful defense	0.019	0.021	0.011	0.008	0.007
Unsuccessful defense	0.040	0.037	0.018	0.015	0.013
<i>Unemployment rate</i>					
Immediate depreciation	0.006	0.004	0.001	0.000	0.000
Successful defense	0.002	0.000	-0.001	-0.001	-0.001
Unsuccessful defense	0.009	0.008	0.001	0.000	0.000

Notes: Shaded areas denote significant values at the 10 % level.

Table D.8: Behavior of macroeconomic indicators after different crisis events controlled for triple crises effects (occurrence of currency, banking and debt crises)

Year after crisis	1	2	3	4	5
<i>Output growth</i>					
Immediate depreciation	0.002	0.003	0.010	0.004	0.001
Successful defense	-0.001	0.002	0.000	0.000	0.000
Unsuccessful defense	-0.034	0.013	0.012	0.003	0.001
<i>Inflation</i>					
Immediate depreciation	-0.015	0.015	0.076	0.058	0.019
Successful defense	-0.005	-0.008	-0.007	-0.004	-0.002
Unsuccessful defense	0.079	0.014	0.020	0.034	0.026
<i>Current account</i>					
Immediate depreciation	0.008	0.005	0.011	0.009	0.006
Successful defense	-0.001	0.000	0.008	0.007	0.004
Unsuccessful defense	0.025	0.036	0.022	0.014	0.011
<i>Private capital inflows</i>					
Immediate depreciation	0.008	0.014	0.022	0.001	0.000
Successful defense	0.003	0.002	-0.001	0.000	0.000
Unsuccessful defense	-0.007	-0.014	-0.003	0.000	0.000
<i>Private consumption growth</i>					
Immediate depreciation	0.005	0.005	0.006	0.001	0.000
Successful defense	0.000	0.009	-0.004	-0.001	0.000
Unsuccessful defense	-0.021	0.011	0.002	0.000	0.000
<i>Investment growth</i>					
Immediate depreciation	-0.018	-0.009	-0.014	-0.003	0.001
Successful defense	-0.017	-0.013	-0.018	-0.004	0.001
Unsuccessful defense	-0.134	0.026	0.045	0.012	-0.001
<i>Export growth</i>					
Immediate depreciation	-0.064	-0.004	0.011	-0.001	0.000
Successful defense	-0.021	-0.002	0.012	0.000	0.000
Unsuccessful defense	-0.063	-0.036	0.019	-0.001	0.000
<i>Import growth</i>					
Immediate depreciation	-0.054	0.003	-0.001	0.002	0.000
Successful defense	-0.028	-0.008	0.002	0.003	0.001
Unsuccessful defense	-0.148	0.017	0.029	0.007	-0.004
<i>Debt-to-GDP ratio</i>					
Immediate depreciation	0.019	0.013	0.009	0.008	0.007
Successful defense	0.017	0.021	0.017	0.014	0.012
Unsuccessful defense	0.017	0.009	-0.011	-0.009	-0.007
<i>Unemployment rate</i>					
Immediate depreciation	0.005	0.003	-0.001	-0.001	-0.001
Successful defense	0.001	-0.001	-0.002	-0.001	-0.001
Unsuccessful defense	0.010	0.009	0.002	0.000	0.000

Notes: Shaded areas denote significant values at the 10 % level.

Table D.9: Behavior of macroeconomic indicators after different crisis events controlled for contagion effects

Year after crisis	1	2	3	4	5
<i>Output growth</i>					
Immediate depreciation	-0.001	0.000	0.000	0.000	0.000
Successful defense	0.001	0.003	-0.002	-0.001	0.000
Unsuccessful defense	-0.038	0.014	0.005	0.002	0.000
<i>Inflation</i>					
Immediate depreciation	0.013	0.041	0.077	0.040	0.015
Successful defense	0.006	-0.005	-0.012	-0.005	-0.001
Unsuccessful defense	0.119	-0.035	-0.025	0.018	0.009
<i>Current account</i>					
Immediate depreciation	0.003	0.001	0.011	0.009	0.006
Successful defense	-0.001	0.001	0.009	0.007	0.004
Unsuccessful defense	0.031	0.034	0.027	0.018	0.013
<i>Private capital inflows</i>					
Immediate depreciation	0.005	0.012	0.021	-0.002	-0.002
Successful defense	0.000	0.001	0.005	0.000	0.000
Unsuccessful defense	-0.014	-0.015	-0.005	0.002	0.001
<i>Private consumption growth</i>					
Immediate depreciation	0.009	0.004	0.000	-0.001	0.000
Successful defense	0.003	0.007	-0.010	-0.002	0.000
Unsuccessful defense	-0.033	0.008	-0.003	0.001	0.000
<i>Investment growth</i>					
Immediate depreciation	-0.018	-0.005	-0.013	-0.003	0.000
Successful defense	-0.003	-0.013	-0.010	-0.002	0.001
Unsuccessful defense	-0.175	0.022	0.042	0.017	0.000
<i>Export growth</i>					
Immediate depreciation	-0.040	-0.014	0.002	0.000	0.000
Successful defense	-0.004	-0.001	0.003	0.000	0.000
Unsuccessful defense	-0.046	-0.038	0.006	0.002	-0.001
<i>Import growth</i>					
Immediate depreciation	-0.043	0.002	-0.012	-0.001	0.002
Successful defense	-0.012	-0.011	-0.006	0.001	0.001
Unsuccessful defense	-0.159	0.030	0.027	0.004	-0.005
<i>Debt-to-GDP ratio</i>					
Immediate depreciation	0.001	0.004	-0.001	-0.001	-0.001
Successful defense	0.009	0.004	-0.004	-0.004	-0.004
Unsuccessful defense	0.052	0.032	0.029	0.023	0.018
<i>Unemployment rate</i>					
Immediate depreciation	0.003	0.002	0.000	-0.001	-0.001
Successful defense	-0.001	-0.003	-0.002	-0.001	0.000
Unsuccessful defense	0.010	0.006	0.002	0.000	-0.001

Notes: Shaded areas denote significant values at the 10% level.

Table D.10: Behavior of macroeconomic indicators after different crisis events controlled for exchange rate regime effects

Year after crisis	1	2	3	4	5
<i>Output growth</i>					
Immediate depreciation	-0.013	0.001	0.011	0.006	0.002
Successful defense	-0.002	0.001	-0.004	-0.002	-0.001
Unsuccessful defense	-0.054	-0.003	0.003	0.005	0.002
<i>Inflation</i>					
Immediate depreciation	0.014	0.046	0.089	0.049	0.025
Successful defense	0.019	0.007	0.000	0.003	0.003
Unsuccessful defense	0.118	-0.048	-0.044	0.002	-0.001
<i>Current account</i>					
Immediate depreciation	0.012	0.017	0.019	0.014	0.009
Successful defense	0.001	0.001	0.007	0.006	0.004
Unsuccessful defense	0.037	0.042	0.026	0.017	0.013
<i>Private capital inflows</i>					
Immediate depreciation	0.008	0.018	0.024	-0.004	-0.003
Successful defense	0.001	0.004	0.005	-0.001	-0.001
Unsuccessful defense	-0.014	-0.013	-0.005	0.003	0.001
<i>Private consumption growth</i>					
Immediate depreciation	-0.005	0.000	0.012	0.003	0.000
Successful defense	-0.001	0.005	-0.010	-0.002	0.000
Unsuccessful defense	-0.048	0.004	0.004	0.007	0.000
<i>Investment growth</i>					
Immediate depreciation	-0.055	-0.024	-0.020	-0.002	0.002
Successful defense	-0.017	-0.020	-0.015	-0.003	0.001
Unsuccessful defense	-0.203	-0.026	0.047	0.027	0.006
<i>Export growth</i>					
Immediate depreciation	-0.045	0.010	0.009	-0.001	-0.001
Successful defense	0.000	0.008	0.012	0.000	-0.001
Unsuccessful defense	-0.056	-0.034	0.011	0.003	-0.001
<i>Import growth</i>					
Immediate depreciation	-0.085	-0.015	0.007	0.008	0.001
Successful defense	-0.025	0.001	0.009	0.003	-0.001
Unsuccessful defense	-0.200	-0.012	0.046	0.021	-0.003
<i>Debt-to-GDP ratio</i>					
Immediate depreciation	0.042	0.061	0.045	0.036	0.029
Successful defense	0.025	0.026	0.012	0.009	0.008
Unsuccessful defense	0.089	0.114	0.086	0.068	0.055
<i>Unemployment rate</i>					
Immediate depreciation	0.009	0.006	0.000	-0.002	-0.002
Successful defense	0.000	-0.003	-0.003	-0.002	-0.001
Unsuccessful defense	0.015	0.014	0.007	0.003	0.000

Notes: Shaded areas denote significant values at the 10% level.

Table D.11: Behavior of macroeconomic indicators after different crisis events controlled for strength effects of the speculative attack

Year after crisis	1	2	3	4	5
<i>Output growth</i>					
Immediate depreciation	-0.007	0.000	0.008	0.004	0.001
Successful defense	0.001	0.003	0.001	0.000	0.000
Unsuccessful defense	-0.052	0.006	0.009	0.004	0.001
<i>Inflation</i>					
Immediate depreciation	0.000	0.036	0.086	0.043	0.016
Successful defense	0.022	0.006	-0.004	0.001	0.003
Unsuccessful defense	0.125	-0.031	-0.017	0.023	0.012
<i>Current account</i>					
Immediate depreciation	0.007	0.002	0.010	0.008	0.005
Successful defense	0.000	0.002	0.007	0.005	0.003
Unsuccessful defense	0.034	0.037	0.027	0.018	0.012
<i>Private capital inflows</i>					
Immediate depreciation	0.007	0.011	0.018	-0.002	-0.002
Successful defense	-0.002	0.001	0.004	0.000	0.000
Unsuccessful defense	0.003	-0.016	-0.007	0.001	0.001
<i>Private consumption growth</i>					
Immediate depreciation	0.003	0.005	0.007	0.001	-0.001
Successful defense	0.008	0.009	-0.007	-0.003	-0.001
Unsuccessful defense	-0.060	0.001	0.000	0.003	0.001
<i>Investment growth</i>					
Immediate depreciation	-0.032	-0.007	-0.006	0.000	0.001
Successful defense	-0.015	-0.015	-0.001	0.002	0.001
Unsuccessful defense	-0.168	0.017	0.046	0.017	0.000
<i>Export growth</i>					
Immediate depreciation	-0.056	-0.009	0.019	0.000	-0.002
Successful defense	0.001	0.001	0.010	0.000	-0.001
Unsuccessful defense	-0.086	-0.042	0.019	0.002	-0.002
<i>Import growth</i>					
Immediate depreciation	-0.066	0.003	0.001	0.002	0.000
Successful defense	-0.024	-0.009	0.009	0.004	-0.001
Unsuccessful defense	-0.125	0.027	0.032	0.005	-0.006
<i>Debt-to-GDP ratio</i>					
Immediate depreciation	0.020	0.015	0.009	0.007	0.006
Successful defense	-0.012	-0.010	-0.018	-0.015	-0.012
Unsuccessful defense	0.012	0.010	-0.004	-0.005	-0.004
<i>Unemployment rate</i>					
Immediate depreciation	0.007	0.004	-0.001	-0.002	-0.002
Successful defense	-0.002	-0.004	-0.003	-0.002	-0.001
Unsuccessful defense	0.022	0.018	0.008	0.003	0.000

Notes: Shaded areas denote significant values at the 10% level.

Table D.12: Panel logit regression I

	all crises (1)	immediate depreciation (2)	successful defense (3)	unsuccessful defense (4)
Individual lags				
Real growth				
$t - 1$	2.665 (0.9)	-8.058 (-1.5)	8.530* (1.8)	12.316 (1.6)
$t - 2$	-7.663** (-2.2)	-8.886 (-1.3)	-7.384 (-1.5)	1.270 (0.2)
$t - 3$	2.285 (0.8)	8.205 (1.1)	2.354 (0.6)	0.814 (0.1)
All lags are zero (Chi2)	5.095	5.526	4.482	2.697
Prob.	0.165	0.137	0.214	0.441
Inflation				
$t - 1$	0.842 (1.4)	-0.307 (-0.1)	0.658 (0.6)	2.667* (1.9)
$t - 2$	-1.537 (-1.6)	-0.159 (-0.0)	-2.120 (-1.0)	-5.144* (-1.9)
$t - 3$	0.689 (1.5)	0.432 (0.2)	0.699 (1.0)	1.474* (1.7)
All lags are zero (Chi2)	3.364	0.137	1.305	4.671
Prob.	0.339	0.987	0.728	0.198
Current account				
$t - 1$	-2.373 (-0.7)	-12.087* (-1.8)	2.454 (0.5)	-1.424 (-0.2)
$t - 2$	3.819 (0.9)	8.607 (1.0)	2.180 (0.4)	9.569 (0.9)
$t - 3$	0.710 (0.2)	1.691 (0.3)	0.826 (0.2)	-19.425** (-2.0)
All lags are zero (Chi2)	1.825	4.125	1.943	4.703
Prob.	0.610	0.248	0.584	0.195
Private capital inflows				
$t - 1$	1.394 (0.5)	-0.733 (-0.1)	1.911 (0.5)	16.107 (1.4)
$t - 2$	2.739 (1.0)	21.573* (1.7)	-0.284 (-0.1)	-0.450 (-0.0)
$t - 3$	-0.370 (-0.1)	-5.041 (-1.0)	3.749 (0.9)	-6.767 (-0.7)
All lags are zero (Chi2)	1.186	3.632	0.894	2.294
Prob.	0.756	0.304	0.827	0.514
Country & time fixed effects	Yes	Yes	Yes	Yes
Obs.	644	259	425	233
Countries	32	20	30	19

Notes: Dependent variable: Binary variable that takes on the value one if a crisis occurs and zero otherwise. Z-values in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table D.13: Panel logit regressions II

	all crises (1)	immediate depreciation (2)	successful defense (3)	unsuccessful defense (4)
Individual lags				
Real growth				
$t + 1$ forecast	-62.128* (-1.7)	-31.030 (-0.4)	-110.348** (-2.1)	-120.636 (-1.3)
t	-4.121 (-1.3)	-10.632 (-1.4)	4.572 (0.8)	-26.287*** (-3.4)
$t - 1$	12.880** (2.3)	-0.950 (-0.1)	16.549** (2.0)	21.489 (1.4)
$t - 2$	-9.085** (-2.3)	-8.925 (-1.2)	-10.110* (-1.9)	-8.397 (-0.9)
$t - 3$	-0.185 (-0.1)	4.043 (0.5)	-0.579 (-0.1)	-3.122 (-0.3)
Inflation				
$t + 1$ forecast	-2.605 (-1.1)	-2.041 (-0.4)	-3.455 (-1.1)	-11.574* (-1.8)
t	0.130 (0.3)	-0.383 (-0.3)	-6.051 (-1.5)	3.259 (1.7)
$t - 1$	2.300 (1.6)	1.354 (0.3)	3.272 (1.6)	4.295 (0.8)
$t - 2$	-2.315** (-2.0)	-1.490 (-0.3)	-2.195 (-1.1)	-6.482 (-1.4)
$t - 3$	0.990* (2.0)	1.088 (0.5)	1.212 (1.6)	2.613* (1.7)
Current account				
$t + 1$ forecast	30.796 (1.6)	27.731 (0.7)	34.864 (1.2)	18.173 (0.3)
t	-8.685** (-2.4)	-16.508* (-1.9)	-6.846 (-1.3)	-34.387*** (-3.6)
$t - 1$	-10.278 (-1.1)	-22.288 (-1.1)	-9.830 (-0.7)	13.037 (0.5)
$t - 2$	5.632 (1.2)	15.967 (1.5)	3.712 (0.6)	10.814 (0.8)
$t - 3$	-2.790 (-0.7)	-2.630 (-0.3)	-1.472 (-0.3)	-25.050** (-2.2)
Private capital inflows				
$t + 1$ forecast	-30.623 (-0.6)	15.189 (0.1)	-70.047 (-0.9)	-19.370 (-0.2)
t	-9.585** (-2.6)	-16.974** (-2.5)	-9.474 (-1.6)	-13.887* (-1.8)
$t - 1$	-0.199 (-0.1)	2.385 (0.3)	-1.490 (-0.3)	37.905** (2.5)
$t - 2$	0.746 (0.2)	23.530 (1.5)	-2.952 (-0.6)	-16.231 (-1.6)
$t - 3$	0.973 (0.3)	-5.939 (-0.9)	3.731 (0.8)	-9.420 (-0.7)
Country fixed effects	Yes	Yes	Yes	Yes
Obs.	614	239	403	222
Countries	32	19	30	19

Notes: Dependent variable: Binary variable that takes on the value one if a crisis occurs and zero otherwise. Z-values in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.