Economic Costs of Alternative Monetary Policy Responses During Speculative Currency Attacks

Sheida Teimouri * Joachim Zietz †

March 6, 2016

Abstract

The outcome of a speculative attack on the foreign exchange rate can be classified into one of three cases: (i) immediate depreciation of the nominal exchange rate, (ii) successful defense, or (iii) failed defense of the currency. This paper explores which of these outcomes yields the lowest cost in terms of output and unemployment in the short and medium run. Our empirical analysis focuses on a sample of 73 emerging and developing countries over the 1960-2011 period. Our results indicate that the least costly policy response to a speculative attack is to allow an immediate depreciation. The results suggest that, on average and in contrast to the previous literature, an immediate depreciation is associated with the lowest output loss and unemployment in the short run and it is expansionary in the medium run. A defense, even when successful, entails higher unemployment and output contraction in the medium run. Similar to earlier studies, failed defenses entail large output losses and a significant increase in the unemployment rate.

Keywords : Exchange rate, speculative attack, currency crisis, monetary policy.

JEL code: F31, E52, E58.

*Department of Economics, College of Business Administration, University of Wisconsin-La Crosse, 1725 State Street, La Crosse, WI, 54601. Email: steimouri@uwlax.edu. Tel: 608-785-5296. This author will be the corresponding author.

†EBS Business School, EBS Universität für Wirtschaft und Recht, Gustav-Stresemann-Ring 3, D-65189 Wiesbaden, Germany. Email: joachim.zietz@ebs.edu. Tel: 615-895-6027.

1 Introduction

One of the main policy dilemmas that countries under a speculative currency attack face is whether to defend their exchange rate or allow it to depreciate.[1] Depending on the central bank's ability and willingness to defend the currency, the pressure on the foreign exchange rate can lead to three types of outcomes, (i) immediate depreciation of the nominal exchange rate, (ii) successful defense, or (iii) failed defense of the currency.[2] In this paper, we examine the costs associated with each of these outcomes in terms of output loss and increased unemployment over the short and medium run.

Most of the literature on speculative currency attacks has been focused on their underlying causes. One can distinguish approximately three strands of the literature. The first generation models of currency crises (Flood and Garber, 1984; Krugman, 1979) focus on poor economic fundamentals, such as high budget deficits and an overvalued currency, as the root cause of speculative pressure on currencies. Second generation models, as pioneered by Obstfeld (1996), tie currency crises to the credibility of monetary authorities rather than economic fundamentals. In particular, speculation is triggered by doubts about the commitment of the central bank to maintain the exchange rate peg. These doubts are fueled by signals that the central bank is concerned about the unemployment cost of a currency defense. Finally, the third generation models of speculative currency attacks emphasize the role of financial market fragilities, as triggered by over-borrowing by banks and currency mismatch in the balance sheets of firms and banks (Aghion et al., 2001; Burnside et al., 2004; Chang & Velasco, 2001; Diaz-Alejandro, 1985; Dooley, 2000; Krugman, 1999; McKinnon & Pill, 1995; Velasco, 1987).

Next to the literature that deals with the causes of speculative currency attacks, numerous studies focus on the proper response of monetary authorities in the case of a currency attack. The theoretical literature is mainly concerned with the conditions under which monetary policy can prevent a devaluation.[3] Most of the corresponding empirical literature also focuses on the ability

[1] Throughout this paper we use devaluation and depreciation interchangeably. By currency crises, we mean all episodes of extreme downward pressure on the foreign exchange value of a currency.

[2] As mentioned by Erler, Bauer, and Herz (2014, 2015), we cannot differentiate between the case where the central bank is no longer able to defend (the reserves are depleted) and where the central bank is no longer willing to defend its currency (due to the high cost to the economy). Thus, we refer to both of these episodes as failed (or unsuccessful) defenses.

[3] See Flood & Jeanne (2005), Lahiri & Vegh (2003), Rebelo & Vegh (2008) and Lahiri & Vegh (2007).

of monetary policy to counter a devaluation.[4] Except for a few studies (Eichengreen et al., 2003; Erler et al., 2014, 2015), little attention has been paid to the economic costs inflicted by monetary policy to prevent a devaluation, especially relative to the key alternative policy option, which is not to support the currency in the wake of a speculative attack. May be a restrictive monetary policy can indeed prevent a devaluation under certain circumstances. But does that imply that the monetary authorities should pursue this policy? There is no clear answer to this question unless the central bank is aware of the relative economic costs of the potential outcomes of its policy intervention or its lack thereof. In particular, a central bank needs to assess (a) the economic costs in terms of output loss and unemployment if a devaluation can indeed be prevented, (b) the costs if the defense happens to fail after all, and (c) the economic costs of an immediate depreciation. The purpose of this paper is to assemble empirical evidence on the relative costs of a currency defense from a large number of currency attacks. We start with 106 countries over the 1960-2011 period, but eventually, in an attempt to eliminate sources of heterogeneity across countries, our empirical analysis ends up focusing on 73 emerging and developing countries. The objective of our study is to provide central banks with a realistic assessment of the costs of alternative policy options to deal with a speculative currency attack.

Our study is most closely related to Eichengreen et al. (2003) and Erler et al. (2014, 2015), who examine the economic costs of different outcomes of currency attacks. In contrast to Eichengreen et al. (2003), we distinguish between the cases of an immediate depreciation and a failed defense (delayed depreciation). This allows for a more realistic assessment of policy options facing monetary authorities. Moreover, we consider the economic costs associated with each outcome of a speculative attack not only in the short run, but also in the medium run. Compared to Erler et al. (2014, 2015), we analyze a data set consisting of many more countries. Their study includes 32 emerging countries over the 1960-2011 period. For the sake of consistency, we look at the same time period but expand the dataset to more countries. The expanded coverage of countries has material consequences as it allows us to explore to what extent differences in the economic characteristics of countries imply differences in the costs of alternative policy actions in the wake of a speculative attack. Drawing on the experience of many more countries and, therefore, incorporating country heterogeneity has

[4]See Drazen (2003), Drazen & Hubrich (2006); Eijiffinger & Gorderis (2008), Eijffinger & Karatas (2012), Furman & Stiglitz (1998), Goderis & Ioannidou (2008), Hubrich (2000), and Kraay (2003).

the potential to sharpen our policy conclusions and to put previous ones into a new perspective.

We follow the methodology of Kraay (2003) for identifying three different outcomes of a currency crisis: successful defense, failed defense, immediate depreciation. We utilize the local projections method, initially proposed by Jorda (2005), to derive the short- and medium-run responses of output and unemployment to each of these three outcomes of a currency attack. The results suggest that, on average, an immediate depreciation is associated with the lowest output loss and unemployment in the short run and it is expansionary in the medium run. A currency defense, even when successful, entails higher unemployment and output contraction in the medium run.

Under a few circumstances, such as when the capital account is very open or the financial system is very well-developed, there exists a trade-off between a successful defense and an immediate depreciation. In these cases, immediate depreciations tend to be mildly contractionary in the short run, but expansionary in the medium run. A successful defense, by contrast, tends to avoid output contractions in the short run, but it is contractionary in the medium run. In evaluating this trade-off, one has to keep in mind that the decision of the monetary authorities is not between a successful defense and an immediate depreciation, but between a defense or an immediate depreciation. The empirical evidence suggests that the defense of a currency is not always successful (Kraay (2003)). If a defense fails, the consequences in terms of both output loss and unemployment are much worse than that of an immediate depreciation. Therefore, because the probability of a failed defense is not negligible, an immediate depreciation appears, on balance, to be the better policy option even for the group of countries with a very open capital account and a well-developed financial system.

The paper is organized as follows. In Section 2, we discuss the theoretical background and expected results. In Section 3, methodology and sources of data are introduced. Section 4 discusses the results and Section 5 provides a number of robustness checks. Section 6 concludes.

2 Theoretical background

2.1 The channels of monetary policy during currency attacks

The focus of this study is to examine the economic costs in terms of output and unemployment of two key alternative policy responses of monetary authorities to a speculative currency attack: (i) defend the currency but run the risk of having to give up on the defense later because it proves

unsustainable; (ii) do not attempt to defend the currency and allow the currency to depreciate immediately. The existing literature on currency attacks has shown that the ease with which a currency devaluation can be prevented depends on the economic environment at the time of the attack. Therefore, an analysis of the relative costs of alternative policy actions needs to be clear about the key economic channels by which monetary policy action or inaction can impact the economy during a speculative currency attack. Without being aware of the channels of impact, it is difficult or impossible to interpret any empirical results.

Let us start with monetary policy inaction, which is the case of an immediate depreciation. Sudden depreciations can affect the economy through a number of channels. Depreciations typically increase both the level and volatility of inflation, they generate economic uncertainty, and they may reduce central bank credibility if low and stable inflation or a stable exchange rate are explicit objectives. If nominal wages are sticky, a depreciation reduces real wages and may lower consumption and, therefore, aggregate demand. As a consequence, unemployment tends to go up. However, the reduction in real wages may help limit the increase in unemployment. Another channel through which a depreciation can affect the economy is through its impact on the balance sheets of the private sector, including those of banks. It is a well-known fact that firms and banks in emerging and developing economies cannot borrow abroad in domestic currency (i.e. original sin).[5] As a result, they often take on foreign denominated debt, while much of their revenue is denominated in domestic currency. The situation is commonly referred to as currency mismatch. When currency mismatches are present, a depreciation deteriorates the balance sheets of indebted firms and banks, increases the rate of default, and contracts the economy (Aghion et al., 2001; Burnside et al., 2004; Krugman, 1999). On the supply side, a depreciation increases the cost of imported intermediate inputs and thus the cost of production. Depreciations can also be expansionary, at least in the short run (Gupta et al., 2007) and to the extent that nominal depreciations translate into real depreciations. Real depreciation of exchange rate increases the competitiveness of the economy and boosts the exports.

Next, we consider the channels through which a currency defense is operating. A central bank facing speculative pressure on its currency can attempt to defend it by raising interest rates or by depleting its stock of foreign exchange reserve. The rationale for raising short-term interest rates

[5]See Eichengreen et al. (2002)

is to make the assets that are denominated in the domestic currency more attractive to hold.[6] However, raising domestic interest rates is not costless. Because it increases the lending rates to firms and households, it will reduce investment and consumption. For leveraged corporations, higher interest rates translate into increased debt service on their loans, lower profits, and lower net worth. In the presence of credit constraints, a lower net worth limits a firm's ability to borrow and invest. That is likely to lower future output and raise future unemployment. Higher interest rate also increase the debt service of the government and may also curtail its investments, for example into infrastructure, education or other areas of importance for future growth. Lastly, higher interest rate can cripple a fragile banking system, lead to a credit crunch, and further dampen the confidence in the economy (Lahiri and Vegh, 2007).

Based on historical evidence, an attempt by monetary authorities to defend the currency against a speculative attack is not always successful. The third outcome for the central bank to consider is, therefore, a combination of defensive actions at the beginning of a speculative attack episode and the ultimate outcome of a devaluation. We call this outcome a failed defense. A failed defense can have the adverse effects of a defense and a depreciation rolled into one. One would expect the consequences of this outcome to be more severe than those of either a successful defense or an immediate depreciation.

2.2 Empirical Background

The empirical evidence on the economic costs associated with currency crises (or speculative attacks) is mixed. Gupta et al. (2006) examine the post-crisis growth rates of output after currency crises and conclude that 40% of these crises lead to an output expansion. By contrast, Cooper (1971), Edwards (1989), Morley (1992), and Hutchison and Noy (2005) find currency crises to be contractionary in the short-run. Using a dynamic approach, Cerra and Saxena (2008) report a permanent output loss of about 4.5 percent following currency crises. Bussiere et al. (2012) use a similar methodology and explore the dynamics of output around episodes of large currency depreciations (currency crashes). They find that most of the output costs associated with these

[6]Central banks often have to increase the lending rates to very high levels for a considerable length of time to discourage speculation against their currencies. For instance, to avoid the Swedish Krona from being devalued, the Riksbank increased overnight lending rates to 500% on September 17, 1992. Similarly, Hong Kong increased overnight interest rates from 7% to 250% to maintain its peg in the aftermath of the Asian crisis of 1997.

episodes occur prior to these events. They conclude that, taken on its own, a currency depreciation is in fact expansionary.

One possible reason for such a disparity in conclusions is that the definition of what constitutes a currency crisis is different in each of these studies. For example, Cerra and Saxena (2008) use the Exchange Market Pressure Index (EMPI), which combines depreciation and defense episodes, to identify currency crisis episodes. By contrast, Bussiere et al. (2012), only focus on large depreciation episodes, which correspond to our immediate depreciation or failed defense episodes. Erler et al. (2014, 2015) and Eichengreen et al. (2003) are the only papers attempting to distinguish among the costs associated with different outcomes of speculative attacks (currency crises). Eichengreen et al. (2003) contrast successful defense episodes and depreciations. In effect, they combine immediate depreciations and failed defense episodes into one. They conclude that only depreciations are associated with output cost. Erler et al. (2014, 2015) go one step further and consider all three possible outcomes of speculative attacks, an immediate depreciation, a successful defense, and a failed defense. Their results suggest that a successful defense yields the best post-crisis outcome in terms of output growth while an immediate depreciation is the intermediate scenario. Our study puts the study of Erler et al. (2014, 2015) into a new perspective by sticking to three possible outcomes of speculative attacks, but by including a considerably larger set of countries and by paying special attention to nonlinearity and heterogeneity across countries in the response to speculative attacks.

2.3 Heterogeneity across major country groups

A key point that we want to emphasize in this study is that the impact of monetary policy action or inaction in response to a speculative currency attack is likely to be perceptively different between high-income countries on the one hand and emerging or developing countries on the other. The heterogeneity in their response is tied to structural characteristics that differentiate these two groups of countries. For example, balance sheet impacts arising from currency mismatch are likely to be less important for the group of high-income countries. Better integration into the world economy and higher levels of trade openness in high-income countries, can materially impact the trade benefits of depreciations. Generally better institutions in high-income countries and, along with that, a more credible central bank may obviate the need to increase short-term interest rates to extremely high

levels to convince speculators of the central bank's commitment to maintain the exchange rate. Thus, a defense in high-income countries can be associated with smaller output contractions.

The response of unemployment to monetary policy actions in the wake of a speculative currency attack is also likely to be different in high-income countries compared to developing or emerging countries. As shown by Calvo et al. (2012), the labor market adjustment following financial shocks in advanced economies tends to be mainly through higher unemployment since World War II, rather than through lower real wages. In other words, recoveries from financial crises tend to be of the jobless type in high-income countries. For instance, following the failed defense of the Finnish Markka in 1992, the unemployment rate in Finland rose to around 17 percent by 1994. Seven years later, the unemployment rate was still above 9 percent (9.78), despite the marked recovery of output owing to significant export growth. The rise in unemployment following a depreciation is expected to be far more muted in emerging or developing economies as real wages are likely to decrease. The drop in real wages is a result of developing countries having typically more difficulties in containing the rise in inflation following a depreciation. This may be a direct consequence of central banks having less credibility than in most high-income countries. But it can also be tied to the empirical fact that the exchange rate pass-through from nominal exchange rate to domestic prices is higher in emerging and developing countries than in high-income countries.

In the group of emerging and developing countries, we also expect to find significant differences between countries with a history of hyperinflation and all others. For example, lower central bank credibility can mean that former hyperinflation countries need to be more aggressive in defending the domestic currency to prove their commitment to the fixed exchange rate. Therefore, a currency defense can be much more costly in these economies. Moreover, a history of hyperinflation may have changed the price setting behavior in such a way that makes the benefits of a depreciation less appealing. For instance, in hyperinflation-type countries contracts are likely indexed to inflation and, thus, nominal wages quickly catch up with price increases. Moreover, a depreciation of the nominal exchange rate may not even translate into a real depreciation. Therefore, the export competitiveness channel through which depreciations can boost output may not be as effective in these countries. Firms and banks in these countries are also less likely to borrow abroad in domestic currency. This exposes them to the currency mismatch and balance sheet problems associated with foreign denominated debt. As a result, depreciations can be more contractionary in these countries

than in other emerging and developing countries.

Based on the above discussion, we split our sample into three groups: (i) high-income countries, (ii) emerging and developing countries with no history of hyperinflation, and (iii) emerging and developing countries with a history of hyperinflation. We largely follow the World Bank classification of high-income countries to categorize a country as "high-income". We deviate from the World Bank list by including only those high-income countries that were OECD members for the majority of our sample period. Therefore, a country such as Korea, which joined the organization in 1996, or Argentina, which is considered high-income in the World Bank classification but is not a member of OECD, do not belong to our group of high-income countries.

High-income countries, as defined for our sample, experienced relatively fewer episodes of speculative pressure. Furthermore, the majority of immediate depreciation episodes in these countries is concentrated between 1960-1973, which is the Bretton Woods era. In our hyperinflation group, we count only 9 countries. This small sample makes the results far from conclusive, although it appears certain that the outcomes of speculative attacks differ considerably from those of other countries. For these reasons, our study will focus on the 73 developing and emerging countries in the third group.[7] Even with the elimination of high-income and hyper-inflation countries, this group contains significantly more countries than have been analyzed in any similar previous study so far.[8]

2.4 Heterogeneity within the group of emerging and developing countries

Separating developing and emerging countries from high-income countries is a key step to take if one analyzes a large number of countries. However, it does not mean that the remaining 73 countries are truly homogeneous in all respects that are potentially of relevance for analyzing the policy response to a currency attack. We further explore the possibility of behavioral heterogeneity *within* this group of countries by checking to what extent key structural characteristics can affect the results. We examine in this context the impact of the level of capital openness and the level of

[7] We eventually exclude two outlier countries which experienced structural adjustment program during the sample period. Please see the data section for details.

[8] Eichengreen et al. (2003) include more countries, but they only consider two outcomes of speculative attacks: depreciations (immediate or delayed) and defense. The study by Erler et al. (2014, 2015) considers 32 emerging countries for the 1960-2011 period.

financial development.[9]

Countries with a high level of capital openness tend to be characterized by a larger presence of foreign investors, both of the portfolio and real asset type. In terms of real asset investments, one would expect these investors to be more present in relatively capital intensive industries than domestic employers.[10] How these investors react to a currency crisis (or speculative attack) and its accompanying rise in uncertainty should be important for both output and employment. Domestic borrowers in countries with high levels of capital openness are likely to have more ready access to foreign lenders. This would typically imply that a good part of their borrowing is in foreign currency, which opens them up to the balance sheet effects associated with depreciations.[11]

A country with a high level of financial development, as measured by the credit provided to the private sector by depository money banks (as a percentage of GDP), should be more resilient to a currency crisis as the banking system should be less prone to collateral constraints and a credit crunch. However, to the extent that a larger Credit/GDP ratio is an indicator of high leverage of the private sector, potentially combined with many foreign currency denominated loans, a currency crisis could exacerbate defaults, output losses and unemployment. This is akin to what happened during the East Asian crisis of 1998: the domestic banking system received large capital inflows, which were used by banks to finance domestic lending.

3 Data and Methodology

Data are mainly obtained from the *World Bank Database* or the *International Monetary Fund* CD ROM. We use monthly data for the nominal exchange rate (defined as the domestic currency price of the German Mark for European countries and the US dollar for other countries), foreign exchange reserves, and interest rate spreads (over the Federal Funds Rate or Germany's discount rate). We annualize the crisis dates because the data for the unemployment rate and GDP are not available at a monthly frequency for the majority of the countries in our sample.[12] The choice of countries is

[9] As discussed later, we do this through interaction terms rather than by splitting up the sample. The latter approach is marred by the fact the incidence of currency attacks and their potential outcomes is not equally distributed across the country categories that one may wish to analyze.

[10] This is because capital has intrinsic value and can serve as a collateral, whereas labor cannot.

[11] For instance, Magud et al. (2014) find that during episodes of capital inflows, bank credit is larger and its composition leans toward foreign currency in countries with less flexible foreign exchange regime.

[12] Annualizing the data means that we assign a crisis dummy equal to one when there is an outcome of the specified type in a particular country in at least one month of a given year . This is common practice in the literature (see,

based on the availability of data. We select all countries with at least 10 consecutive years of data for the real GDP series. Given this condition, we end up with 106 countries. In addition, we select the 1960-2011 period mainly to be consistent with the earlier empirical literature (Erler et al., 2014, 2015). However, we also check the robustness of our results for the post Bretton Woods era (1980-2011). The data for the unemployment rate are from the *World Economic Outlook (WEO)* and are available only for the 1980-2011 period. That is another reason why we check the robustness of our results for this time period. However, our main results are based on the 1960-2011 period in order to make full use of the available GDP data.

Our group of high-income countries includes those that were OECD members before 1995 (identified as high-income OECD in what follows). It includes the following 22 countries: Austria, Australia, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, Great Britain, Greece, Ireland, Iceland, Italy, Japan, the Netherlands, Norway, New Zealand, Portugal, Sweden, and the United States. We consider a country to have a hyperinflation history if the average annual inflation rate in that country during the sample period is higher than 50%. This implies that a country must have experienced very high levels of inflation over the sample period. Our list of hyperinflation countries includes Argentina, Bolivia, Brazil, Chile, Indonesia, Liberia, Nicaragua, Peru, and Zimbabwe. We remove two outliers, Rwanda and Nigeria, from the list of our countries. Both of these countries go through a structural adjustment program during the sample that is identified as an immediate depreciation in our sample. After excluding high-income OECD and hyperinflation countries, we end up with 73 developing and emerging countries in our sample. All the results in this study are reported for these 73 countries.[13] The results for the other two groups (high-income OECD and hyperinflation) are reported only in the Appendix.

3.1 Outcomes of currency attacks

Our methodology for crisis identification closely follows that of Kraay (2003), with two differences. Kraay (2003) only considers two types of outcome for currency attacks: successful attacks, which correspond to our immediate depreciation or failed defense outcomes; and unsuccessful attacks, which correspond to our successful defense outcomes. We modify his definitions to account for

for example, Hong and Tornell (2005)).

[13]See the Data Appendix (excel file) for the list of these countries.

three outcomes of currency attacks. In addition, Kraay (2003) considers a defense to be successful if it deters a subsequent devaluation for at least three months. We consider a defense to be successful if it deters a devaluation for at least 12 months.

Immediate Depreciation. We define immediate depreciations as episodes (i) for which large nominal depreciations are preceded by a period of a relatively stable nominal exchange rate and (ii) which do not coincide with any currency defense in the 12-month window around the depreciation episode. Kraay (2003) defines the set of large depreciations as

$$\{(i,t)|de_{i,t} > k_i \text{ and } \bar{de_{i,t}} < \bar{k_i}\},$$

where i represents the country and t the month of the crisis; $de_{i,t}$ is the monthly percentage change in the nominal exchange rate, k_i is the minimum level of acceptable depreciations (5% for high-income OECD and 10% for all other countries), $\bar{k_i}$ is the threshold for the maximum exchange rate volatility before a depreciation (1% for high-income OECD and 2.5% for all other countries), and $\bar{de_{i,t}}$ is the average absolute percentage change in the exchange rate during the 12 months prior to the currency crisis.[14] From the large depreciation episodes that can be identified according to the above definition, we eliminate those that coincide with a currency defense in a 12-month window (see the definition of a defense below). We also eliminate any depreciation episode preceded by a large depreciation in any of the previous 12 months in order to avoid double-counting prolonged depreciation episodes.[15]

Successful Defense. We follow Kraay (2003) and focus on all episodes of *sustained* foreign reserve losses or *sustained* spikes in the interest rate spread (over the US Federal Funds rate or Germany's discount rate) during periods of a stable exchange rate. More specifically, we define r_{it} as the level of non-gold reserves in constant US dollars in country i and period t, and $\overline{r_{it-3}}$ as the average level of reserves in the 3 months prior to period $t-3$. The set of *sustained* foreign exchange reserve loss episodes is $\{(i,t)|\ \min(r_{i,t-3,\ldots,r_{i,t+3})}$ and $r_{it} < h_i.\overline{r_{i,t-3}}\}$, where h_i is a threshold determining the minimum size of the loss in reserves as a fraction of average reserves in the 3 months before period

[14] The thresholds for large exchange rate variations roughly correspond to the mean plus 2.5 standard deviations of the monthly exchange rate fluctuations in the corresponding sub-samples (see Kraay (2003)).

[15] For European countries in the sample, depreciation is versus the Deutschmark for the period 1960-1999 and versus the US dollar after 1999 (introduction of Euro). For the remaining countries, the depreciation is always against the US dollar.

$t-3$. Following Kraay (2003), we set h_i to 1.25 for high-income OECD countries and 1.5 for all other countries. The set of *sustained* spikes in nominal interest rate spreads are defined similarly. The threshold determining the minimum size of upward spikes in spreads is set to 0.75 for high-income OECD countries and 0.5 for other countries. We exclude any defense episode that is followed by a large depreciation of the monthly nominal exchange rate (5% for high-income OECD and 10% for other countries) in the next 12 months. In addition, defense episodes that are preceded by other successful defenses in any of the prior 12 months are excluded to avoid double counting the same defense as two different ones.

Failed Defense. A failed defense is defined as an episode of *sustained* foreign reserve losses or *sustained* spikes in the interest rate spread (over the US Federal Funds rate or Germany's discount rate) during periods of a stable exchange rate that is followed by a large depreciation of the monthly nominal exchange rate (5% for high-income OECD and 10% for other countries) in the next 12 months. Failed defense episodes that are preceded by another failed defense in any of the prior 12 months are excluded.

As discussed by Kraay (2003), in many countries, especially developing ones, monthly fluctuations in reserves or interest rates are reversed in the following month. Hence, many of these fluctuations are not related to episodes of speculative pressure, yet may be classified as currency attacks. That is why using a simple weighted average of monthly fluctuations in interest rates and the reserves index, as used by Erler et al. (2014, 2015), is not followed in this study. By focusing on sustained increases (decreases) in interest rate spreads (foreign exchange reserves), we reduce the likelihood of mis-classifying unsustainable monthly fluctuations as currency defenses (failed or successful).

Once we allocate each speculative currency attack to one of our three types of crisis outcomes, we construct a dummy variable for each outcome: immediate depreciation (DI), successful defense (DS), and failed defense (DF). A given dummy variable is equal to one when there is an outcome of the specified type in a particular country in a given year, otherwise the dummy variable is zero.

To make sure that the effects of one type of crisis outcome are not contaminated by adjacent currency crises in a given country, we follow Erler et al. (2014, 2015) by applying a one-year window in defining our crisis dummy variables. In practice, this means that we exclude all crises with overlapping windows. For example, if there is a successful defense in year T that is followed by

a failed defense in year $T+1$, we exclude both of these crises from our empirical analysis. In Section 5, we relax this restriction and include all identified crises in our analysis to check the robustness of the results. Our main results remain robust to this change.

Based on our definitions, we identify 58 episodes of a failed defense, 202 immediate depreciations, and 294 episodes of a successful defense in our sample of 106 countries over the 1960-2011 period. When we exclude hyperinflation countries and high-income OECD countries from our sample, we end up with 73 developing and emerging countries and the number of speculative attack episodes shrinks to 28 episodes of a failed defense, 134 immediate depreciations, and 187 episodes of a successful defense.

Our identification scheme picks up many familiar episodes of currency crises. For example, we capture the collapse of the European Monetary System (EMS) in 1992 (notably in Finland, Sweden, Italy, and the United Kingdom) as well as the currency crises in several East Asian countries in 1997 (Korea, Indonesia, and the Philippines) as failed defense episodes. We identify Argentina's successful defense in 1994 in the aftermath of the Mexican currency crisis and the Spanish devaluation of 1992.[16]

3.2 Estimation issues

Our empirical approach follows the methodology proposed by Jorda (2005) and recently used by Teulings and Zubanov (2009) and Furceri and Zdziencka (2012a, 2012b). It consists of deriving Impulse Response Functions (IRFs) for output and unemployment from local projections,

$$y_{i,t+k} - y_{i,t} = \eta_i + \vartheta_t + \sum_{j=1}^{q} \phi_{jk} \Delta y_{i,t-j} + \beta_{1k} DI_{i,t} + \beta_{2k} DF_{i,t} + \beta_{3k} DS_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$U_{i,t+k} - U_{i,t} = \eta_i + \vartheta_t + \sum_{j=1}^{q} \phi_{jk} U_{i,t-j} + \beta_{1k} DI_{i,t} + \beta_{2k} DF_{i,t} + \beta_{3k} DS_{i,t} + \varepsilon_{i,t}. \quad (2)$$

Equations 1 and 2 are estimated separately for each k, $k = 1, ..., 8$, where $y_{i,t}$ is the log of real GDP and $U_{i,t}$ is the unemployment rate. *DI*, *DF*, and *DS* are dummy variables that identify an immediate depreciation, a failed currency defense, and a successful defense, respectively. Lag q is chosen to remove autocorrelation in the residual term and is set at 2; ϕ_{jk} captures the persistence

[16] Please see the Appendix for the list of identified currency attacks.

of real output growth and the unemployment rate.[17] Country fixed effects are identified by η_i and time fixed effects by ϑ_t. The β_{1k}, β_{2k}, β_{3k}, measure the cumulative impact of an immediate depreciation, a failed currency defense, and a successful defense on the dependent variable for each future period k. The IRFs are obtained from the estimated equations by plotting the estimated coefficients $\beta_{1k}, \beta_{2k}, \beta_{3k}$ for $k = 1, \ldots, 8$. For example, for $k = 4$, β_{14} represents the cumulative percentage change in the level of real output (or in the change in the unemployment rate) four years after an immediate depreciation and β_{24} measures the respective change four years after a failed defense.[18]

Potential reverse causality is avoided by estimating changes in the dependent variable (output or unemployment) in the years that follow the different outcomes of currency crises (see Furceri and Zdziencka, 2012a, 2012b). The presence of a lagged dependent variable and country fixed effects may bias the estimation of β_k and ϕ_{jk} in small samples (Nickell (1981) bias). However, this bias is small for samples with long time dimensions, as in this and similar studies. To address heteroskedasticity, we estimate all equations using White's robust standard errors.[19] Moreover, to increase the efficiency of the estimates, we follow Jorda's (2005) suggestion and recursively include the residuals of the stage $s-1$ local projection as a regressor in the stage s local projection.

An alternative approach to estimating the output cost of different outcomes of currency speculation is to derive cumulative impulse responses from a standard ARDL equation for output growth and the unemployment rate (see Cerra & Saxena, 2008; Erler et al., 2014, 2015; Furceri & Mourougane, 2012). The IRFs calculated from this standard method are sensitive to the number of autoregressive lags in the model. Our estimation strategy does not suffer from such an issue since lagged values of the dependent variable enter only as controls in our specifications and are not used to calculate the IRFs. Thus, the bias arising from misspecification of lags of the dependent variable will not carry over. The approach is also more robust to inclusion of interaction terms. Another advantage of our projection method is that we do not need to use Monte-Carlo simulations to compute confidence bands, as they derive directly from the standard errors of the β_k.

[17] Two lags proved sufficient to remove autocorrelation in the error term. However, we checked the robustness of results using more lags of the dependent variable. The results are very robust to the inclusion of more lags.

[18] All countries in the sample have at least 10 years of consecutive real GDP data.

[19] The results are identical using Newey West or Driscoll and Kraay standard errors.

4 Estimation results

We present the results with the help of graphs of the cumulative response of real output and unemployment for each of the three possible outcomes of a currency crisis: (i) successful defense, (ii) failed defense (delayed depreciation), and (iii) immediate depreciation. The graphs indicate point estimates of the response and 90 percent error bands.

4.1 General results

Figure 1 shows the response of output and unemployment for all 106 countries of the sample, which includes high-income and hyperinflation countries. We show these overall results primarily to have a point of comparison with earlier studies that do not present sub-samples of relatively homogeneous countries, such as Eichengreen et al. (2003). Figure 1 suggests that a successful defense has very little impact on output, but increases unemployment perceptively, especially in the medium run. A failed defense entails far worse consequences for both output and unemployment, at least for a horizon of up to five years. An immediate depreciation dominates the other two outcomes. For the first 4 years, output declines less than in the case of a successful defense; after 4 years, output grows significantly. Unemployment increases somewhat initially, but declines after 4 years, as output increases.

The results of Figure 1 suggest that immediate depreciations have the least costly consequences. They are associated with no significant output loss in the short run and are expansionary in the medium run, possibly due to the export growth channel. Successful defenses also have economic costs; they arise in the form of a distinctly increasing unemployment rate in the medium run. Why would unemployment increase after a successful defense? This economic reaction is likely tied to a number of conditions: a worsening of credit market conditions in the form of both higher interest rates and increased collateral requirements, which reduces investment and thus the future output. In addition, higher interest rates aggravates the asymmetric information and likely leads financial intermediaries to channel credit disproportionately to capital intensive industries, as physical capital- not labor - can serve as a collateral. As discussed by Calvo et al. (2012), this leads to a reduction in the employment content of a unit of output and unemployment, especially if real wages are rigid.

In what follows, we restrict our analysis to the group of 73 emerging and developing countries without a history of hyperinflation during the sample period. We omit the high income OECD countries because they are less prone to speculative attacks and less interesting from a policy standpoint. We omit the hyperinflation countries because the sample is small, which makes it difficult to distill conclusive results.[20]

Figure 2 presents the average output and unemployment response of the 73 countries in our sample that do not belong to either the high-income traditional OCED countries or the countries with a history of hyperinflation. We observe that a successful defense tends to lower output and raise unemployment in the medium run. As discussed before, this is most likely because higher interest rates can deteriorate the balance sheet of leveraged firms and reduce their net worth and their ability to borrow in the future. This likely lowers investment and thus future output and raises future unemployment. A failed defense has very pronounced negative effects on output and unemployment over the first 4 years. The observed decline in output can be attributed to the adverse effect of higher interest rates along with uncertainty and balance sheet effects that accompany a sudden depreciation. It appears that, on average, countries recover in the medium run, even in the case of a failed defense. An immediate depreciation has on average a positive impact on output, especially after 4 years, and no significant impact on unemployment, except perhaps around year 2 after the depreciation. The medium run unemployment response to depreciation episodes is very muted, even in the case of a failed defense. As discussed earlier, this is likely because real wages are bearing the brunt of the adjustment to the shock in the labor market. From the point of economic policy, an immediate depreciation appears to be the preferable policy option for a developing or emerging market country. It entails no short or medium run output loss and a better unemployment response than even a successful currency defense. This is in line with the results of Bussiere et al. (2012) who finds currency crashes to be in fact expansionary. However, our results are different from those of Erler et al. (2014, 2015) who find a successful defense to be associated with the least output cost. The difference in our results can be attributed to our larger sample of countries, a different identification of speculative attack outcomes, and a different estimation method.

[20]For the interested reader, we report the key results for these countries in the Appendix, Figures 10 and 10. The results are in line with our expectations discussed in section 2.1.

4.2 Conditional paths of GDP and the unemployment rate

A possible concern with our estimation results so far is that our measurements of the impact of currency crises on output and unemployment could be subject to endogeneity bias. We have addressed only one source of potential endogeneity, reverse causality, by predicting changes in output and unemployment for the years that *follow* a currency crisis. A different source of endogeneity could arise if certain variables affect both the type of response of the monetary policy authorities and the post-crisis performance of the economy. If we exclude these variables from the regression, they will be part of the error term. Thus, our error term would be correlated with the crisis type (our independent variables *DI*, *DF* and *DS*) and would bias our parameter estimates. For example, when the economy is weak and unemployment is high, a speculative attack on the currency is more likely to occur and it is more likely to result in a depreciation because the central bank is reluctant to raise interest rates in a recession to defend the currency. Therefore, a recession affects both the response of the monetary authority to a speculative attack (whether to defend or devalue the currency immediately) and the post-crisis performance of output and unemployment.

Put differently, the outcomes of speculative attacks are endogenous and depend on the macroeconomic conditions prior to the attack. These same macroeconomic conditions could also drive the output and unemployment dynamics after a speculative attack. In short, we cannot rule out endogeneity of the dummy variables *DI*, *DF* and *DS* that capture our three responses to a speculative attack. Now consider the case where the pre-existing problems in the economy are driving the output and unemployment dynamics that are observed after a currency attack. Then, controlling for a rich set of contemporaneous and lagged covariates should make our dummy variables insignificant. In other words, by including the variables that represent the state of the economy prior to the attack, we make it less likely for *DI*, *DF* and *DS* to survive as independent drivers of the observed output and unemployment dynamics *after* the currency attack. If they remain significant, they should pick up the changes in GDP and the unemployment rate that are not explained by prior economic conditions.[21] As a consequence, one could conclude that the type of response of the monetary authorities to a speculative attack does indeed matter in determining the ultimate cost of the currency attack.

[21] See Jorda et al. (2013) for a similar approach to the endogeneity issue.

In line with the above argument, we re-estimate equations 1 and 2 while controlling for a set of contemporaneous and 1-year lagged values of government expenditures (as percentage of GDP), investment (as percentage of GDP), a dummy variable representing episodes of banking crises and a dummy variable for recessionary episodes.[22]

We include the government expenditure ratio as a proxy for the budget deficit, since the data for budget deficits are spotty and only available after 1991 for most of the countries in our sample. High government expenditures can make a country vulnerable to currency attacks, as discussed in the first generation of studies on currency crises. The investment ratio controls for the possibility of over-investment fueled by the banking system or/and capital flows prior to currency attacks, which is a focal point of third generation studies on currency crises. If a currency attack occurs in the middle of an ongoing recession, it is doubtful that the monetary authorities are willing to defend their currency. A defense would entail higher interest rates and a likely worsening of the recession. A very similar argument holds for a currency attack during a banking crisis.

Including all control variables reduces the sample to 24 episodes of a failed defense, 169 episodes of a successful defense, and 102 immediate depreciation episodes. The relatively low incidence of failed defenses in this sample is somewhat unfortunate as it leads to less precision in the results. This can be seen in Figure 3, which summarizes the estimation results.

Figure 3 is again limited to the set of 73 countries that were also considered in Figure 2. Figure 3 reveals some short-term output loss for the case of an immediate depreciation. But the point estimates are statistically not significant from zero. Otherwise, the graphs corroborate the conclusions drawn from Figure 2: an immediate depreciation is the preferable policy option in case of a speculative currency attack. The strong similarity in results between Figures 2 and 3 suggests that the endogeneity concern for our variables *DI*, *DF* and *DS* is not severe. It also suggests that monetary authority actions can impact the economic costs brought about by a speculative currency attack. The decision to defend or not to defend has material consequences and is worthwhile to study.

[22]The banking crisis dummy is obtained from Laeven and Valencia (2012) and is equal to unity at the start of a systemic banking crisis. For the identification of recessionary episodes, we use the algorithm of Bry and Boschan (1971). This algorithm identifies local minima in real GDP (in levels). Each minimum is labeled as a trough and the preceding local maximum as a peak. The recession dummy is equal to unity from peak to trough.

4.3 Accounting for differences among developing countries

We analyze the impact of capital openness and the level of financial development on the set of 73 developing and emerging market countries. To ensure that we cover a sufficient number of currency crises, we make use of the unconditional equations that do not control for the contemporaneous and lagged variables discussed in the previous section. We consider this a reasonable trade-off because we established that including the controls does not materially change our conclusions. To allow for a sufficient number of observations, we also do not sub-sample the data set, but integrate the country characteristics into the estimating equations via interaction terms as in Equations 3 and 4:

$$y_{i,t+k} - y_{i,t} = \eta_i + \vartheta_t + \sum_{j=1}^{2} \Phi_{jk} \triangle y_{i,t-j} + \beta_{1k} DI_{i,t} + \beta_{2k} DF_{i,t} + \beta_{3k} DS_{i,t} + \theta_{i,t}.C_{i,t}$$
$$\gamma_{1k}.DI_{i,t}.C_{i,t} + \gamma_{2k}.DF_{i,t}.C_{i,t} + \gamma_{3k}.DS_{i,t}.C_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$U_{i,t+k} - U_{i,t} = \eta_i + \vartheta_t + \sum_{j=1}^{2} \Phi_{jk} U_{i,t-j} + \beta_{1k} DI_{i,t} + \beta_{2k} DF_{i,t} + \beta_{3k} DS_{i,t} + \theta_{i,t}.C_{i,t}$$
$$\gamma_{1k}.DI_{i,t}.C_{i,t} + \gamma_{2k}.DF_{i,t}.C_{i,t} + \gamma_{3k}.DS_{i,t}.C_{i,t} + \varepsilon_{i,t} \quad (4)$$

where C_{it} represents the country characteristic of interest (capital openness or financial development). Equations 3 and 4 are specified to allow capital openness or financial development to change the dynamic impact of our three crisis dummy variables *DI*, *DF* and *DS*. Equations 3 and 4 are estimated separately with the capital openness interactions and with the financial development interactions. We use the Chinn-Ito capital openness index as our proxy of capital openness (KAOPEN). This index is the first standardized principle component of binary variables that codify the presence of restrictions on cross-border transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Our measure of financial development is the private credit provided by depository money banks as a percentage of GDP; it is taken from the Financial Global Development dataset.

The cumulative impact of each outcome of speculative attack on output (or unemployment)

now varies with the level of capital openness (financial development). For instance, the impact of immediate depreciation (DI) on output in period k is now: $\beta_{1k}+\gamma_{1k}.C_{i,t}$. We evaluate this impact at three values of capital openness (financial development): (1) one standard deviation above the mean of capital openness (financial development); (2) average capital openness (financial development); and (3) one standard deviation below the mean of capital openness (financial development).[23] Therefore, we obtain a separate path for output and unemployment depending on whether a country has an average, a high, or a low level of capital openness (financial development). Following Furceri and Zdzienicka (2012a), we highlight the statistical significance of the results by allowing the paths (or IRFs) to differ from the average effect only when the interaction term is statistically significant. This implies that the three paths collapse into one when the interaction term is insignificant.

The estimation results are displayed in Figures 4 and 5. The response of a country with above average levels of capital openness (financial development) is indicated by dotted lines in Figures 4 and 5; the response of a country with below average levels by the broken lines.

Figure 4 indicates that the output response to a speculative attack is different depending on how freely capital moves across boarders. After a successful defense, output declines significantly less in countries with fewer barriers to cross-boarder capital movements. As discussed before, a currency defense requires the central bank to undertake contractionary policies, such as raising the interest rate (lending rate) in the economy. Higher capital openness provides alternative sources of financing to firms to support their operations and investments. This applies in particular to foreign investors who are producing in the country and these are more prevalent in countries with open capital markets. To the extent that the domestic credit crunch is compensated with the foreign credit, there maybe indeed little loss in output in the wake of a currency defense. Unemployment, by contrast, rises more strongly in these countries that have more open capital markets. This again be related to the fact that foreign companies are much more prevalent in these countries. These companies are typically producing in a more capital intensive manner than domestic producers and are less affected by tightening collateral requirements. Domestic, labor intensive companies, by contrast, are negatively affected (Calvo et al., 2012), especially because any monetary tightening to prevent a devaluation has to be likely more forceful in countries that are relatively open.

[23]For example, Colombia, Ethiopia and India are in the *low capital openness* group; Egypt, South Korea and the Philippines are in the group of countries with *medium capital openness*; Hong Kong, Malaysia, Mexico, Oman, and Uruguay are in the *high capital openness* category.

Following a failed defense or an immediate depreciation, countries with a higher level of capital openness experience higher output loss. One part of the negative response of output to deprecations must be related to the balance sheet problem that arises because domestic producers are likely to have more foreign denominated loans in countries with open capital markets. The other part is likely to derive from the fact that depreciations generate uncertainty, especially for foreign investors. They may re-evaluate their commitment to the country. This may be the case in particular if the depreciation follows an attempt to defend. In this case, foreign investors may start to fear for the value of their investments in the longer run and may decide to leave. Such a move is likely to reduce output perceptively and for a while, assuming that foreign companies produce in a relatively capital intensive manner. However, to the extent that the slack is taken up by domestic producers in the medium run, the rate of unemployment could actually diminish.[24] This is consistent with the significant drop in unemployment for capital open countries after a failed defense that is shown in Figure 4. Overall, It seems that in the short run an immediate depreciation for countries with a high level of capital openness is more costly than a successful defense. But in the medium run, an immediate depreciation is expansionary with no significant increase in the unemployment rate. Despite of the short run cost associated with immediate depreciations in these countries, one has to keep in mind that the decision is between an immediate depreciation and a defense, and the defense can fail. In case the defense fails, the output loss is much higher.

Figure 5 depicts the response of output and unemployment for countries with different levels of financial development. For a failed defense or an immediate depreciation, the decline in output is larger for a country with a higher level of financial development. This is a common finding in the financial crisis literature. For instance, Kroszner et al. (2007) and Furceri and Zdziencka (2012a) find banking crises to be more costly in countries with higher levels of financial development. This type of reaction is likely tied to the fact that countries with a well-developed financial system attract more capital inflows prior to the crisis, and thus, the balance sheet impact of a depreciation is more pronounced once the currency depreciates. Comparing the results for an immediate depreciation to those for a successful defense, one can observe a trade-off in the timing of the output loss. A successful defense entails no immediate output loss for countries with high levels of financial

[24] A reduction in unemployment is all the more likely because a depreciation likely increases the competitiveness of the country and the export sector can expand.

development. But in the medium run, there is a perceptible output loss. This sequence is reversed for immediate depreciations: there is an immediate output loss, but a significant gain in output in the medium run. As for unemployment, it appears safe to say that immediate depreciations dominate any attempt to defend the currency, be that attempt successful or not. Overall , there is no reason to believe that the level of financial development changes the earlier conclusion that an immediate depreciation is the least costly response to a currency attack.

5 Robustness Checks

In this section we check the robustness of our results. First, we change the definition of a successful defense to a defense that prevents a devaluation for 24 months, rather than only 12 months. Figure 6 represents the results. Similar to Section 4.2, we control for contemporaneous and 1-year lagged values of government expenditure (as a percentage of GDP), investment (as a percentage of GDP), a dummy variable representing episodes of banking crises and a dummy variable for recessionary episodes. The results are in line with our previous conclusions and even strengthen them. It is worth mentioning that changing the definition of a successful defense changes the number of failed defense episodes (51 episodes versus 29 episodes). Now, it is more apparent that failed defenses entail the largest cost in terms of output. Successful defenses are mildly contractionary in the medium run, and an immediate depreciation is still associated with the lowest cost in terms of output and unemployment.

Next, we include all identified currency crisis episodes into our estimates, rather than excluding overlapping crises, as has been done so far. We run equations 1 and 2 (including the control variables) and present the results in Figure 7. Our conclusions still hold up.

Alternatively, we limit the sample to the 1980-2011 period to exclude the Bretton Woods era and to make sure that the sample starting year is the same for both GDP and the unemployment rate. The path of output and unemployment conditioned on a set of contemporaneous and lagged variables is depicted in Figure 8. The figure indicates that neither immediate depreciations nor successful defense are associated with a significant output loss in the short run. However, an immediate depreciation is, on average, expansionary in the medium run, while a successful defense is not. The standard errors around the path of output after a failed defense is wide as the sample

size is smaller now. There are only about 18 episodes of failed defenses for which the data for all control variables are available.

Finally, we check the robustness of the results by including more contemporaneous and 1-year lagged control variables in Equation (1) and (2). In particular, we add inflation, capital openness, trade openness, and the short term foreign debt to total external debt as additional control variables. The results are depicted in Figure 9. Our conclusions still do not change: immediate depreciations entail the lowest economic cost. Successful defenses are mildly contractionary in the medium run. [25]

6 Conclusions

A central bank that faces speculative pressure on the domestic currency has two options, either to defend the currency or to allow the currency to depreciate. Depending on the response of monetary authorities, three outcomes of a speculative attack are possible: (i) an immediate depreciation of the nominal exchange rate, (ii) a successful defense, or (iii) a failed defense of the currency, which triggers a delayed depreciation.

The objective of this study is to examine whether the response of monetary authorities to a speculative currency attack can affect the dynamics of output and unemployment after the attack. If so, which response, on average, is associated with the best economic performance in terms of output and unemployment in the short and medium run? Does the impact of the response of the monetary authorities to a speculative attack differ across countries with a high income, those with a history of hyperinflation and those with higher level of financial development or capital openness? In this paper, we carefully explore the answers to these questions. We start with a sample of 106 countries over the 1960-2011 time period, but we eliminate some sources of heterogeneity and countries from the empirical analysis. Therefore, the main empirical results are focused on 73 emerging and developing countries.

Our results suggest that an immediate depreciation is the least costly strategy for the most part. Under certain circumstance, such as for countries with higher level of financial development, there is a trade-off between a successful defense and an immediate depreciation. In the short-run, immediate

[25] Including more control variables reduces the sample size and affects the significance of our results.

depreciations tend to be mildly contractionary on average, but expansionary in the medium run. Successful defenses tend to avoid output contractions in the short run, but they are contractionary in the medium run. From a policy perspective, however, it is important to consider that the policy choice is not between a successful defense and an immediate depreciation, but between the decision to defend or an immediate depreciation. The decision to defend does not automatically mean the defense will be successful.[26] If the attempts to defend the currency fail, according to our results, there will be significantly negative consequences for both output and unemployment. From a policy perspective, it appears more reasonable to compare the results of immediate depreciations to the *expected* outcome of a currency defense. Since the expectation of a failed defense is non-negligible, the *expected* outcome of a currency defense appears worse than that of a successful defense. On balance, we therefore conclude that an immediate depreciation is a better policy option than an attempt to defend the currency.

Is our policy suggestion that an immediate depreciation may be a useful standard policy response for developing and emerging countries structurally flawed because it would invite massive currency speculation and, therefore, endanger the stability of the currency system as a whole? Will our policy recommendation not lead to a large number of immediate devaluations? We do not think so.

More speculative attacks and increasing instability in the currency system could be the result only if the conditions leading up to a currency attack did not materially change as a consequence of the likely policy (in)action of the monetary authorities. But we suggest that the conditions leading up to currency speculation will fundamentally change if every actor in the area of foreign exchange knows that an immediate depreciation is the standard response to a currency attack. We tie the expectation of a change in behavior to the fact that a key reason for moral hazard is removed. In particular, knowing that devaluations will be the standard policy response to a speculative currency attack, banks and firms would be far less willing to accumulate currency mismatches in their balance sheets. They would know that they will not be saved from the consequences of a devaluation by their central bank. That could remove one of the key causes of currency attacks. Similarly, central bank credibility will no longer be defined in terms of preventing a devaluation, which can swiftly

[26] In fact, empirical evidence suggests that the association between the actions of monetary policy authorities to defend the currency and the outcome of the defense is weak or nonexistent (see Kraay (2003)).

become untenable for lack of resources and which can, therefore, encourage even more intense speculation. Credibility would now be defined in terms of letting the currency devalue, which requires no resources on the part of the central bank. This would reduce in importance another potential cause of a speculative currency attack - doubts about the credibility of the central bank to defend. Finally, a standard policy of immediate depreciation should lower the potential of having a currency attack because of deteriorating fundamentals: to maintain an overvalued currency in the face of mounting budget deficits should become impossible. The government would not be able to borrow heavily abroad if it knew that the central bank would not support the currency in case of a speculative attack. Similarly, use of the inflation tax would be followed by an immediate depreciation.

Overall, we think that a shift toward an immediate depreciation policy for most developing or emerging countries in case of a speculative currency attack would lower rather than intensify the incidence of currency attacks because moral hazard issues associated with a policy preference for a currency defense would be gone. This adds to and strengthens our results that, based on historical experience, the expected outcome of a defense tends to have worse consequences for output and unemployment than an immediate depreciation.

References

Aghion, P., P. Bacchetta, and A. Banejree (2001). Currency crises and monetary policy in an economy with credit constraints. *European Economic Review 45*, 1121–1150.

Burnside, C., M. Eichenbaum, and S. Rebelo (2004). Government guarantees and self-fulfilling speculative attacks. *Journal of Economic Theory 119*(1), 31 – 63. Macroeconomics of Global Capital Market Imperfections.

Bussiere, M., S. C. Saxena, and C. E. Tovar (2012). Chronicle of currency collapses: Re examining the effects on output. *Journal of International Money and Finance 31*(4), 680–708.

Calvo, G. A., F. Coricelli, and P. Ottonello (2012). The labor market consequences of financial crises with or without inflation: Jobless and wageless recoveries. NBER working paper 18480.

Cerra, V. and S. Saxena (2008). Growth dynamics: The myth of economic recovery. *American Economic Review 98*(1), 493–457.

Chang, R. and A. Velasco (2001). A model of financial crises in emerging markets. *Quarterly Journal of Economics 116*, 489–517.

Cooper, R. N. (1971). *Government and Economic Development*, Chapter Currency Devaluation in Developing Countries,. Yale University Press.

Diaz-Alejandro, C. (1985). Good-bye financial repression, hello financial crash. *Journal of Development Economics 19*(1-24).

Dooley, M. P. (2000). A model of crises in emerging markets. *The economic journal 110*(460), 256–272.

Edwards, S. (1989). *Real Exchange Rates, Devaluation, and Adjustment*. MIT Press.

Erler, A., C. Bauer, and B. Herz (2015). To intervene, or not to intervene: Monetary policy and the costs of currency crises. *Journal of International Money and Finance 51*, 432–456.

Flood, R. P. and P. M. Garber (1984). Collapsing exchange-rate regimes: some linear examples. *Journal of international Economics 17*(1), 1–13.

Flood, R. P. and O. Jeanne (2005). An interest rate defense of a fixed exchange rate? *Journal of International Economics 66*, 471–484.

Furceri, D. and Z. A. (2012a). Banking crises and short and medium term output losses in developing countries: The role of structural and policy variables. *World Development 40*(12), 2369 – 2378.

Furceri, D. and Z. A. (2012b). The consequences of banking crisis for public debt. *International Finance 15*(3), 289– 307.

Furceri, D. and A. Mourougane (2012). The effect of financial crises on potential output: New empirical evidence from oecd countries. *Journal of Macroeconomics 34*(3), 822– 832.

Hutchison, M. M. and I. Noy (2005). How bad are twins? output costs of currency and banking crises. *Journal of Money, Credit and Banking 37*(4), 725– 752.

Jorda, O. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review 95*(1), 161–182.

Kraay, A. (2003). Do high interest rates defend currencies during speculative attacks? *Journal of International Economics 59*(2), 297–321.

Kroszner, R. S., L. Laeven, and D. Klingebiel (2007). Banking crises, financial dependence, and growth. *Journal of Financial Economics 84*(1), 187–228.

Krugman, P. (1979). A model of balance-of-payments crises. *Journal of money, credit and banking 11*(3), 311–325.

Krugman, P. (1999). *International finance and financial crises*, Chapter Balance sheets, the transfer problem, and financial crises, pp. 31–55. Springer.

Lahiri, A. and C. A. Vegh (2003). Delaying the inevitable: interest rate defense and balance of payments crises. *Journal of Political Economy 111*(2), 404–424.

Lahiri, A. and C. A. Vegh (2007). Output costs, currency crises, and interest rate defense of a peg. *Economic Journal 117*(516), 216–239.

Magud, N. E., C. M. Reinhart, and E. R. Vesperoni (2014). Capital inflows, exchange rate flexibility and credit booms. *Review of Development Economics 18*(3), 415–430.

McKinnon, R. I. and H. Pill (1997). Credible economic liberalization and overborrowing. *American Economic Review 87*(2), 189–193.

Morley, S. A. (1992). On the effect of devaluation during stabilization programs in ldcs. *The Review of Economics and Statistics 74*(1), 21–27.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrics 49*(6), 1417–126.

Obstfeld, M. (1996). Models of currency crises with self-fulfilling features. *European economic review 40*(3), 1037–1047.

Rebelo, S. and C. A. VÃ©gh (2008). When is it optimal to abandon a fixed exchange rate? *The Review of Economic Studies 75*(3), 929–955.

Teulings, C. N. and N. Zubanov (2014). Is economic recovery a myth? robust estimation of impulse responses. *Journal of Applied Econometrics 29*(3), 497–514.

Velasco, A. (1987). Financial and balance of payments crisis. *Journal of Development Economics 27*, 263–83.

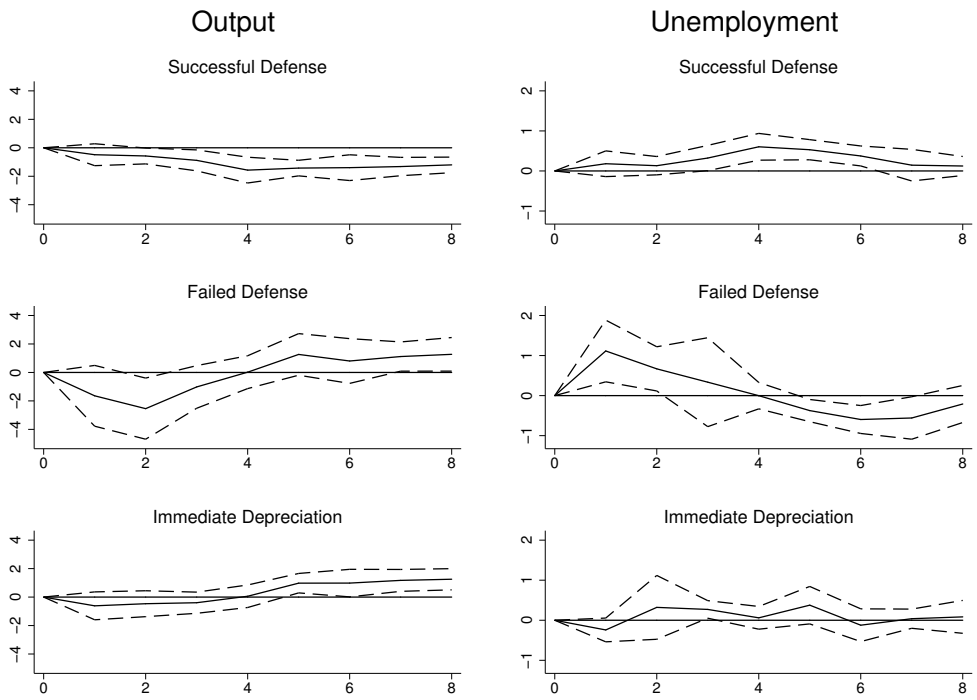
Figure 1: Unconditional path of real output and unemployment rate - All countries

The horizontal axis shows the years past the currency attack and the vertical axis represents the change in the variable of interest in percentage points. The sample includes all 106 countries and the sample period is 1960-2011. The path of real output and unemployment is estimated using equations 1 and 2. The dashed lines represent 90 percent confidence bands.

Figure 2: Unconditional path of real output and unemployment rate - 73 Developing and emerging countries

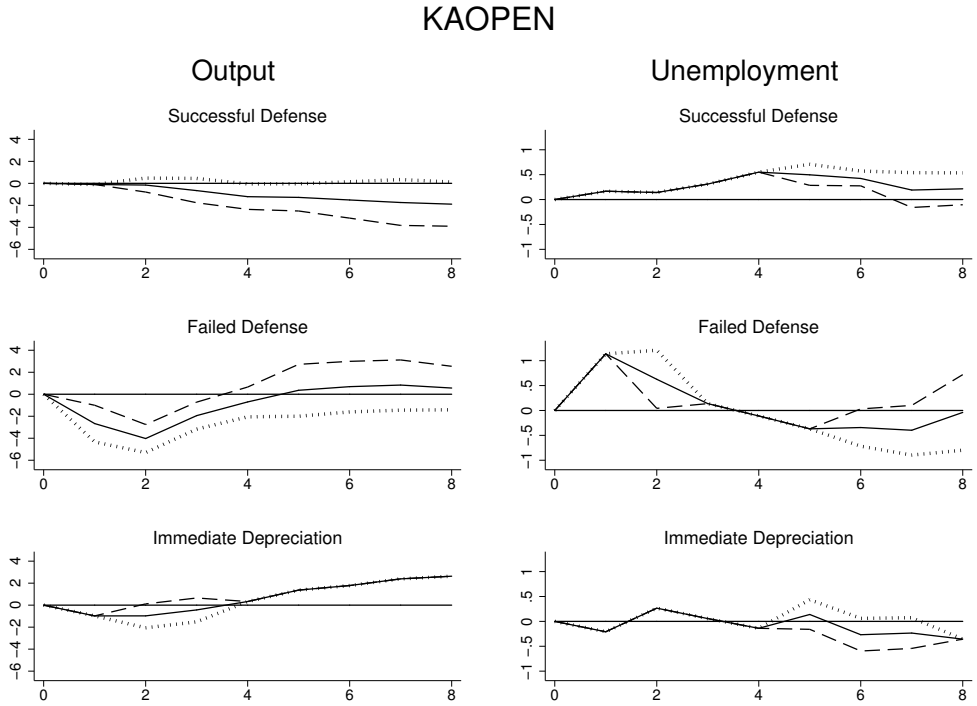
The horizontal axis shows the years past the currency attack and the vertical axis represents the change in the variable of interest in percentage point. The sample excludes countries with a history of hyperinflation and high-income OECD countries (73 countries). The sample period is 1960-2011 . The path of real output and unemployment is estimated using equations 1 and 2. The dashed lines represent 90 percent confidence bands.

Figure 3: Conditional path of real output and unemployment rate - 73 Developing and emerging countries countries



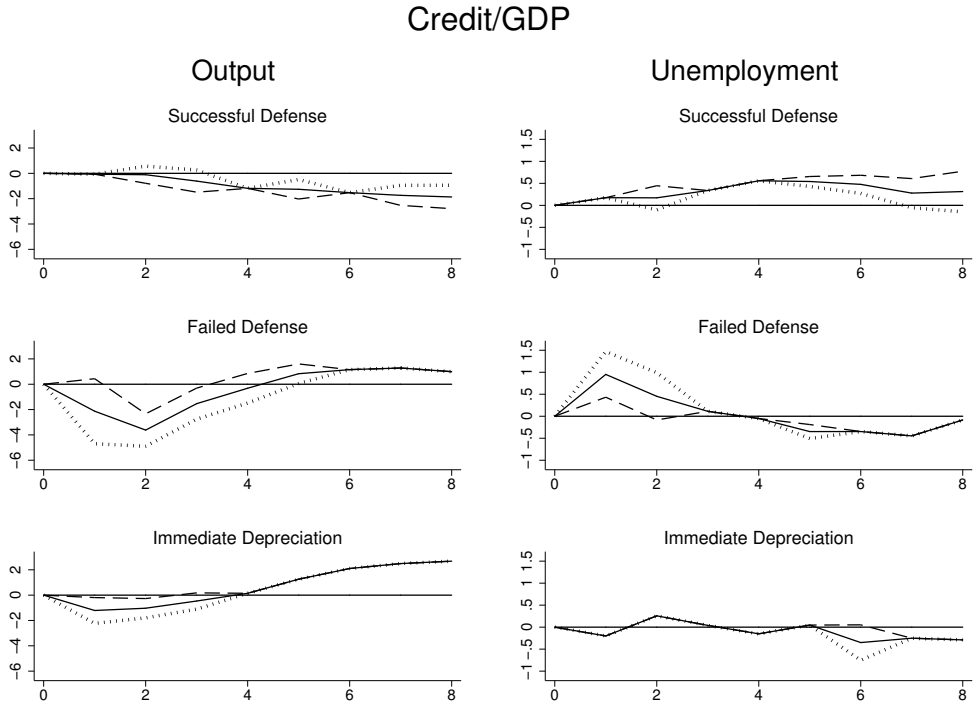
The horizontal axis shows the years past the currency attack and the vertical axis represents the change in the variable of interest in percentage points. The sample excludes hyperinflation and high income OECD countries. The sample period is 1960-2011. The path of real output and unemployment is estimated using equations 1 and 2 while controlling for contemporaneous and 1-year lags of government expenditure (% GDP), investment (% GDP), a dummy variable representing episodes of banking crises and a dummy variable for the recessionary episodes. The dashed lines represent 90 percent confidence intervals.

Figure 4: Conditional path of real output and unemployment rate - Impact of capital openness (KAOPEN)



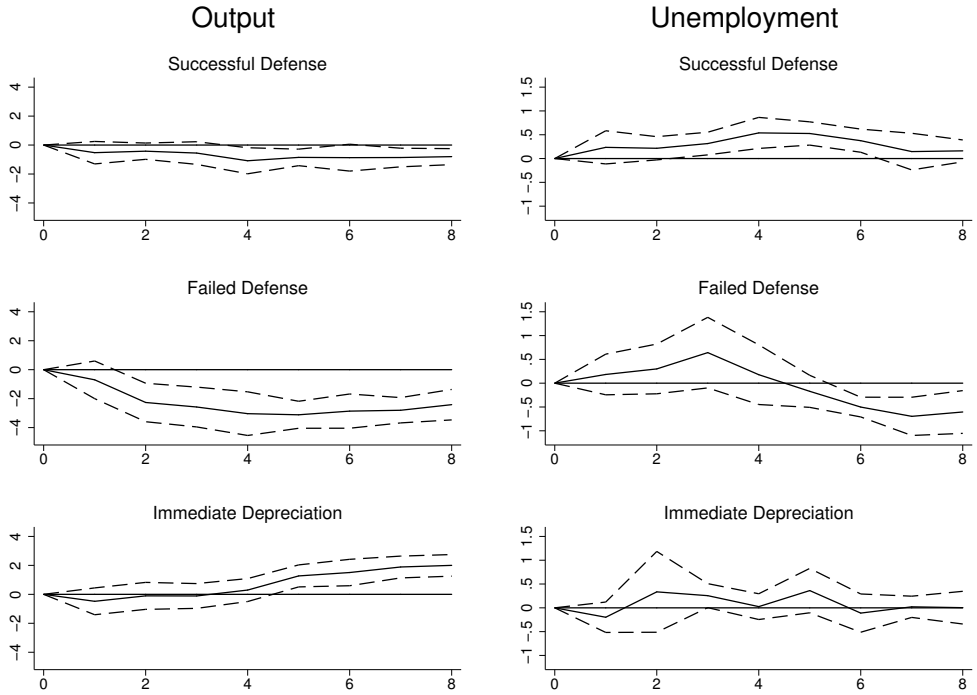
The horizontal axis shows the years past the currency attack and the vertical axis represents the change in the variable of interest in percentage points. The sample excludes hyperinflation and high income OECD countries. The sample period is 1960-2011. The path of real output and unemployment is estimated using equations 3 and 4. The impact of each outcome of speculative attack on the variable of interest is evaluated at three values of capital openness: (1) one standard deviation above the mean of capital openness measure (dotted line); (2) the mean of capital openness measure (solid line); and (3) one standard deviation below the mean of capital openness measure (dashed line). The statistical significance of the results is highlighted by allowing the paths (IRFs) to differ from the average effect only when the interaction term is statistically significant.

Figure 5: Conditional path of real output and unemployment rate - Impact of financial development level (Bank Credit-to-GDP ratio)



The horizontal axis shows the years past the currency attack and the vertical axis represents the change in the variable of interest in percentage points. The sample includes non-hyper inflation non-OECD countries. The sample period is 1960-2011. The path of real output and unemployment is estimated using equations 3 and 4. The impact of each outcome of speculative attack on the variable of interest is evaluated at three values of the level of financial development: (1) one standard deviation above the mean of financial development measure (dotted line); (2) the mean of financial development measure (solid line); and (3) one standard deviation below the mean of financial development measure (dashed line). The statistical significance of the results is highlighted by allowing the paths (IRFs) to differ from the average effect only when the interaction term is statistically significant.

Figure 6: Conditional path of real output and unemployment rate - 73 Developing and emerging countries (Change in the definition of a successful defense)



The horizontal axis shows the years past the currency attack and the vertical axis represents the change in the variable of interest in percentage point. The sample excludes countries with a history of hyperinflation and high-income OECD countries (73 countries). The sample period is 1960-2011. The path of real output and unemployment is estimated using equations 1 and 2 while controlling for contemporaneous and 1-year lags of government expenditure (% GDP), investment (% GDP), a dummy variable representing episodes of banking crises and a dummy variable for the recessionary episodes. The dashed lines represent 90 percent confidence intervals. The definition of a successful defense is one that prevents a depreciation for 24 months, rather than 12 months.

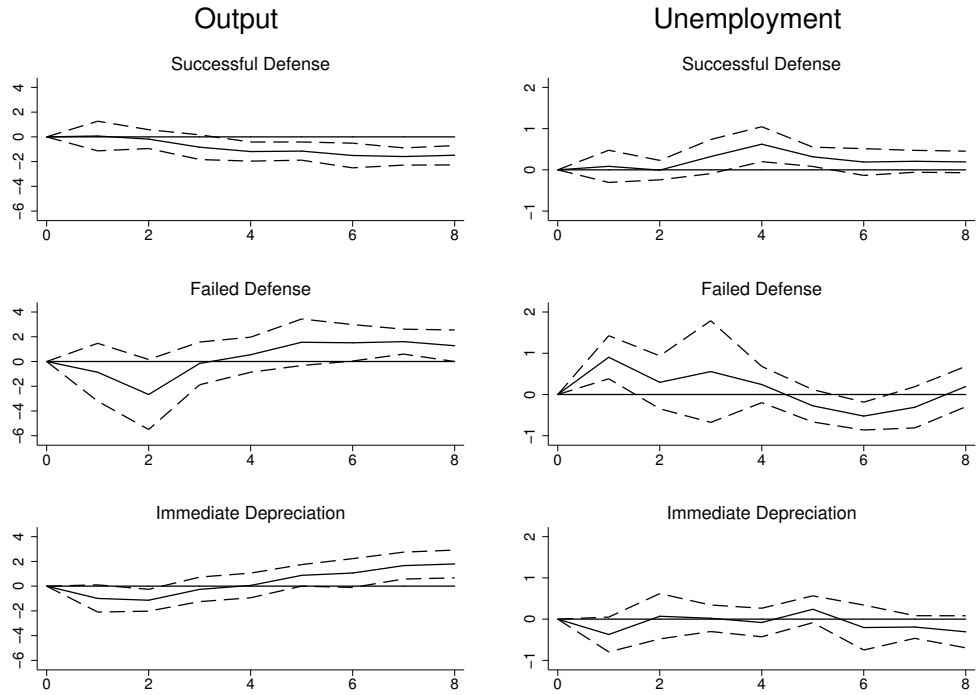
Figure 7: Conditional path of real output and unemployment rate - 73 developing and emerging countries (All crisis dates included)

The horizontal axis shows the years past the currency attack and the vertical axis represents the change in the variable of interest in percentage point. The sample excludes countries with a history of hyperinflation and high-income OECD countries (73 countries). The sample period is 1960-2011 . The path of real output and unemployment is estimated using equations 1 and 2 while controlling for contemporaneous and 1-year lags of government expenditure (% GDP), investment (% GDP), a dummy variable representing episodes of banking crises and a dummy variable for the recessionary episodes. The dashed lines represent 90 percent confidence intervals. All identified crisis dates are included, without excluding overlapping crises.

Figure 8: Conditional path of real output and unemployment rate - 73 Developing and emerging countries (1980-2011)

The horizontal axis shows the years past the currency attack and the vertical axis represents the change in the variable of interest in percentage points. The sample excludes countries with a history of hyperinflation and high-income OECD countries (73 countries). The sample period is 1980-2011. The path of real output and unemployment is estimated using equations 1 and 2 while controlling for contemporaneous and 1-year lags of government expenditure (% GDP), investment (% GDP), a dummy variable representing episodes of banking crises and a dummy variable for the recessionary episodes. The dashed lines represent 90 percent confidence intervals.

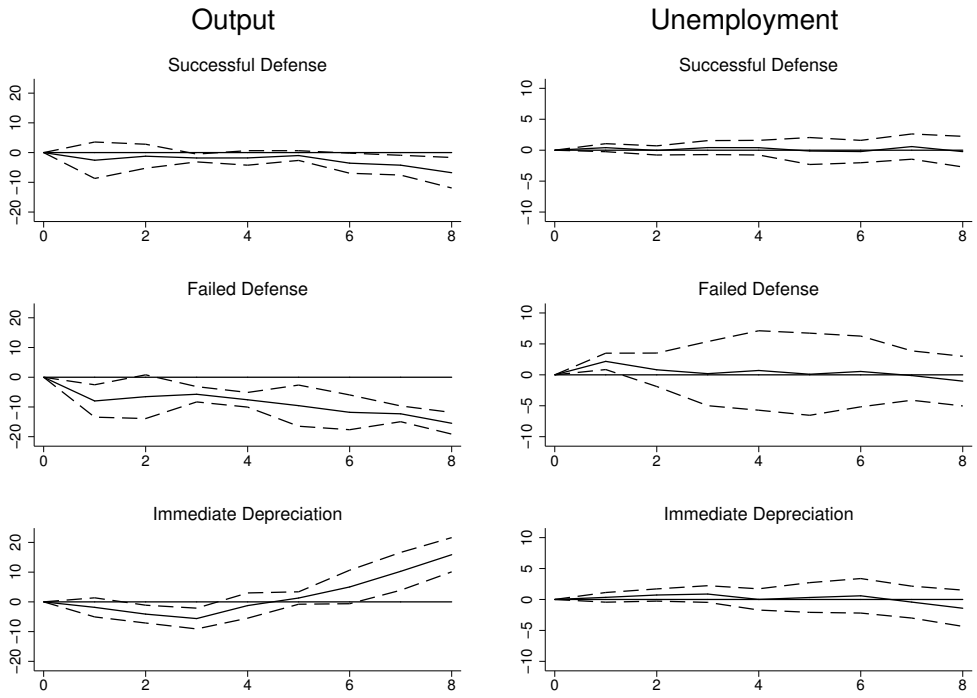
Figure 9: Conditional path of real output and unemployment rate - Including more control variables



The horizontal axis shows the years past the currency attack and the vertical axis represents the change in the variable of interest in percentage points. The sample excludes hyperinflation and high income OECD countries. The sample period is 1960-2011. The path of real output and unemployment is estimated using equations 1 and 2 while controlling for contemporaneous and 1-year lags of government expenditure (% GDP), investment (% GDP), short term foreign debt to total external debt, trade openness, capital openness, inflation rate, a dummy variable representing episodes of banking crises and a dummy variable for the recessionary episodes. The dashed lines represent 90 percent confidence intervals. The measure of trade openness is sum of exports and imports (% GDP) and the capital openness measure is the Chinn-Ito index(KAOPEN).

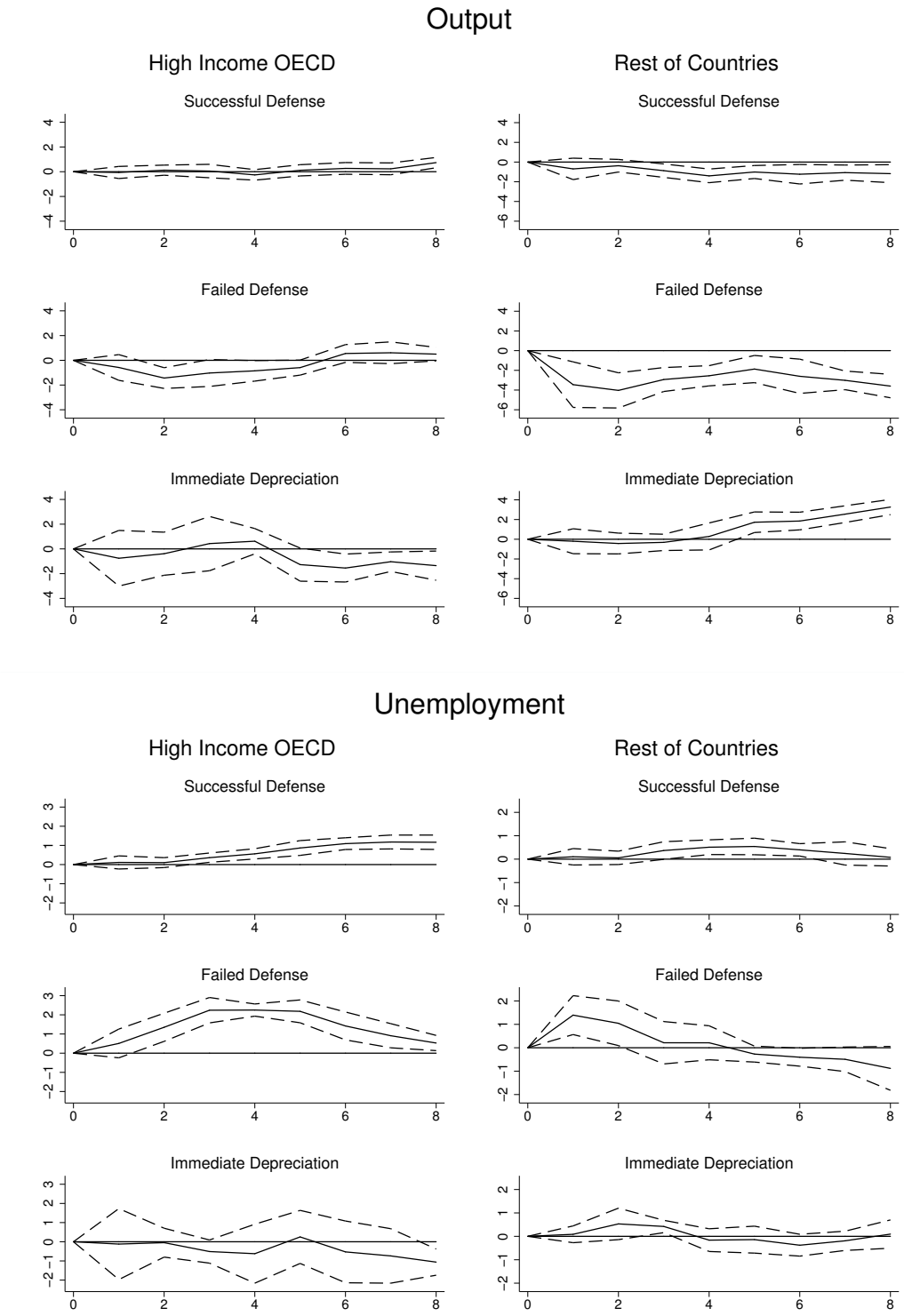
A Appendix for Review Purposes Only

Figure 10: Unconditional path of real output and unemployment rate - Hyperinflation countries



The horizontal axis shows the time and the vertical axis represent the change in the variable of interest in percentage points. The sample includes 9 countries with history of hyperinflation over the 1960-2011 period. The path of real output and unemployment is estimated using equations 1 and 2. The dashed lines represent 90 percent confidence bands. The sample period is 1960-2011.

Figure 11: Path of real output and unemployment - High-income OECD versus the rest of countries



The sample period is 1960-2011.The horizontal axis shows the years past the currency attack and the vertical axis represents the change in the variable of interest in percentage points. The sample of high income OECD countries includes high income OECD countries (22 countries). The rest of countries includes all countries in the sample (including hyperinflation countries) besides high-income OECD countries (84 countries). The path of real output and unemployment is estimated using equations 1 and 2. The dashed lines are 90 percent confidence bands.

Table 1: Unconditional path of real output - All countries

	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	$t+6$	$t+7$	$t+8$
$\triangle GDP_{t-1}$	9.423**	21.146**	20.940**	19.291**	14.358**	10.760*	1.637	-0.786
	(4.274)	(3.001)	(1.593)	(1.746)	(4.223)	(5.913)	(3.237)	(2.009)
$\triangle GDP_{t-2}$	8.870**	5.657**	3.259	-0.648	-4.111	-11.729**	-11.760**	-10.592**
	(2.745)	(1.988)	(1.997)	(4.518)	(4.899)	(1.902)	(1.500)	(1.595)
DF	-2.231**	-2.732**	-1.693**	-1.213**	-0.768	-0.781	-0.895**	-1.098**
	(0.827)	(0.620)	(0.442)	(0.362)	(0.470)	(0.600)	(0.368)	(0.408)
DS	-0.456	-0.118	-0.478*	-0.897**	-0.499*	-0.609	-0.459	-0.336
	(0.410)	(0.263)	(0.263)	(0.265)	(0.263)	(0.381)	(0.307)	(0.357)
DI	-0.224	-0.469	-0.314	0.304	1.328**	1.367**	2.102**	2.702**
	(0.581)	(0.490)	(0.390)	(0.635)	(0.492)	(0.414)	(0.378)	(0.362)
Constant	3.376**	10.484**	14.643**	23.001**	28.420**	33.461**	39.020**	43.757**
	(0.635)	(0.545)	(0.519)	(0.559)	(0.818)	(0.786)	(0.609)	(0.608)
N	4656	4550	4446	4342	4237	4132	4027	3922

White standard errors are in parentheses. The sample period is 1960-2011. Fixed and time effects are included. DF, DS, and DI represent failed defense, successful defense, and immediate depreciation episodes, respectively. ** ,$p < 0.05$, $p < 0.1$,* . Dependent variable: Log (GDP). The sample includes 106 countries during 1960-2011 period.

Table 2: Unconditional path of unemployment rate - All countries

	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	$t+6$	$t+7$	$t+8$
$UnempRate_{t-1}$	-0.055	-0.203**	-0.333**	-0.471**	-0.601**	-0.719**	-0.827**	-0.930**
	(0.042)	(0.034)	(0.035)	(0.033)	(0.036)	(0.035)	(0.037)	(0.036)
$UnempRate_{t-2}$	-0.119**	-0.139**	-0.154**	-0.151**	-0.136**	-0.123**	-0.102**	-0.078**
	(0.036)	(0.034)	(0.033)	(0.031)	(0.040)	(0.041)	(0.032)	(0.031)
DF	1.161**	1.354**	1.205**	1.199**	0.881**	0.414**	0.063	-0.514**
	(0.300)	(0.354)	(0.352)	(0.224)	(0.159)	(0.199)	(0.192)	(0.251)
DS	0.123	0.076	0.363**	0.562**	0.749**	0.824**	0.840**	0.722**
	(0.131)	(0.106)	(0.115)	(0.110)	(0.135)	(0.119)	(0.162)	(0.129)
DI	0.013	0.322	0.119	-0.424*	-0.359	-0.744**	-0.656**	-0.431
	(0.227)	(0.294)	(0.129)	(0.247)	(0.242)	(0.288)	(0.232)	(0.278)
Constant	1.736**	2.833**	3.251**	4.198**	4.589**	5.146**	6.211**	7.236**
	(0.206)	(0.218)	(0.161)	(0.201)	(0.160)	(0.214)	(0.206)	(0.284)
N	1575	1512	1449	1386	1323	1260	1198	1136

Robust standard errors are in parentheses. The sample period is 1960-2011. Fixed and time effects are included. DF, DS, and DI represent failed defense, successful defense, and immediate depreciation episodes, respectively. ** ,$p < 0.05$, $p < 0.1$,* . Dependent variable: unemployment rate.

Table 3: Unconditional path of real output -73 Developing and emerging countries

	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	$t+6$	$t+7$	$t+8$
$\triangle GDP_{t-1}$	6.331*	16.099**	14.606**	13.569**	13.006**	17.023**	13.216**	13.941**
	(3.746)	(4.132)	(1.999)	(1.945)	(2.626)	(2.038)	(1.552)	(1.869)
$\triangle GDP_{t-2}$	8.258**	5.026**	3.839**	4.508	8.034**	4.314**	5.143**	3.780*
	(4.136)	(2.396)	(1.690)	(2.754)	(1.875)	(1.631)	(1.945)	(2.069)
DF	-2.267*	-3.217**	-2.045**	-1.042*	0.074	-0.156	-0.161	0.017
	(1.230)	(1.001)	(0.758)	(0.547)	(0.708)	(0.808)	(0.533)	(0.599)
DS	-0.440	-0.381	-0.807**	-1.496**	-1.375**	-1.345**	-1.319**	-1.084**
	(0.379)	(0.283)	(0.373)	(0.420)	(0.271)	(0.520)	(0.370)	(0.347)
DI	0.018	0.488	0.702*	1.172**	2.246**	2.164**	2.257**	2.502**
	(0.596)	(0.465)	(0.383)	(0.399)	(0.362)	(0.496)	(0.392)	(0.414)
Constant	5.464**	10.919**	17.562**	22.575**	27.349**	31.269**	37.293**	42.200**
	(0.636)	(0.667)	(0.721)	(0.694)	(0.909)	(1.032)	(0.836)	(0.815)
N	3151	3078	3007	2936	2864	2792	2720	2648

Robust standard errors are in parentheses. The sample period is 1960-2011 and includes 73 countries. Hyperinflation and high income OECD countries are excluded. Fixed and time effects are included. DF, DS, and DI represent failed defense, successful defense, and immediate depreciation episodes, respectively. ** ,$p < 0.05$, $p < 0.1$,* . Dependent variable: Log (GDP)

Table 4: Unconditional path of unemployment rate - 73 developing and emerging countries

	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	$t+6$	$t+7$	$t+8$
$UnempRate_{t-1}$	-0.171**	-0.212**	-0.338**	-0.456**	-0.568**	-0.635**	-0.634**	-0.716**
	(0.075)	(0.096)	(0.037)	(0.044)	(0.047)	(0.038)	(0.055)	(0.037)
$UnempRate_{t-2}$	-0.004	-0.109	-0.116**	-0.102**	-0.070*	-0.064	-0.116**	-0.087**
	(0.079)	(0.087)	(0.026)	(0.040)	(0.041)	(0.044)	(0.037)	(0.031)
DF	1.085**	0.624**	0.138	-0.139	-0.463**	-0.457*	-0.581**	-0.247
	(0.460)	(0.225)	(0.559)	(0.153)	(0.151)	(0.256)	(0.246)	(0.213)
DS	0.181	0.145	0.311*	0.598**	0.608**	0.456**	0.194	0.191
	(0.166)	(0.110)	(0.161)	(0.170)	(0.144)	(0.125)	(0.197)	(0.124)
DI	-0.284*	0.242	0.123	-0.050	0.279	-0.118	-0.024	-0.022
	(0.152)	(0.363)	(0.110)	(0.143)	(0.220)	(0.214)	(0.134)	(0.209)
Constant	1.741**	3.451**	4.021**	5.147**	5.865**	5.158**	6.550**	6.023**
	(0.452)	(0.365)	(0.338)	(0.563)	(0.508)	(0.558)	(0.370)	(0.342)
N	1347	1282	1217	1152	1087	1022	957	892

Robust standard errors are in parentheses. The sample period is 1960-2011 and includes 73 countries. Hyperinflation and high-income OECD countries are excluded. Fixed and time effects are included. DF, DS, and DI represent failed defense, successful defense, and immediate depreciation episodes, respectively. ** ,$p < 0.05$, $p < 0.1$,* . Dependent variable: unemployment rate.

Table 5: Conditional path of real output -73 developing and emerging countries

	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	$t+6$	$t+7$	$t+8$
DF	-1.643	-2.545**	-1.019	0.019	1.266*	0.803	1.117**	1.272**
	(1.089)	(1.095)	(0.764)	(0.588)	(0.746)	(0.802)	(0.524)	(0.602)
DS	-0.486	-0.575**	-0.884**	-1.568**	-1.425**	-1.396**	-1.319**	-1.200**
	(0.392)	(0.284)	(0.375)	(0.462)	(0.279)	(0.462)	(0.329)	(0.279)
DI	-0.615	-0.465	-0.397	0.058	0.978**	0.982*	1.172**	1.254**
	(0.500)	(0.465)	(0.380)	(0.403)	(0.348)	(0.494)	(0.392)	(0.380)
N	2910	2841	2775	2708	2640	2573	2506	2438

White Standard Errors in parentheses. The sample includes 73 countries over the 1960-2011 period. The control variables include the contemporaneous and 1-year lags of government expenditure (% GDP), investment (% GDP), a dummy variable representing episodes of banking crises and a dummy variable for the recessionary episodes. ** ,$p < 0.05$, $p < 0.1$,*. Dependent variable: Log(GDP).

Table 6: Conditional path of unemployment- 73 developing and emerging countries

	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	$t+6$	$t+7$	$t+8$
DF	1.114**	0.668**	0.335	-0.002	-0.375**	-0.597**	-0.559**	-0.209
	(0.393)	(0.281)	(0.566)	(0.168)	(0.142)	(0.178)	(0.271)	(0.236)
DS	0.180	0.132	0.322**	0.604**	0.530**	0.375**	0.144	0.124
	(0.164)	(0.117)	(0.161)	(0.170)	(0.128)	(0.127)	(0.201)	(0.121)
DI	-0.242	0.322	0.270**	0.060	0.376	-0.123	0.039	0.084
	(0.152)	(0.407)	(0.112)	(0.145)	(0.238)	(0.209)	(0.122)	(0.210)
N	1290	1230	1171	1111	1050	990	930	869

White Standard Errors in parentheses. The sample includes 73 countries over the 1960-2011 period. The control variables include the contemporaneous and 1-year lags of government expenditure (% GDP), investment (% GDP), a dummy variable representing episodes of banking crises and a dummy variable for the recessionary episodes. ** ,$p < 0.05$, $p < 0.1$,*. Dependent variable: unemployment rate.