Output Costs of Currency Crises: Shocks, Policies and Cycles

Nakatani, Ryota

International Monetary Fund

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Shocks and Output during Currency Crises

Ryota Nakatani

International Monetary Fund

Address: 700 19th Street, N.W., Washington, D.C. 20431

E-mail: nakatani.ryouta@gmail.com

Tel.: +1 (202) 623-6042

Fax: +1 (202) 623 6220

Biography: Dr. Nakatani is an Economist at the International Monetary Fund. He has abundant experience in the study of more than 20 countries and has published 4 peer-reviewed journal articles about currency crises. He has delivered many presentations and lectures on economic forecasting and macroeconomic policies to governments, central banks, and international institutions. He previously led the main macroeconomic model team as the Deputy Director of the Research and Statistics Department of the Bank of Japan. Dr. Nakatani finished his Ph.D. degree in 2 years at the University of California. He has outstanding analytical skills in applying theoretical models for policy design.

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Abstract

This paper studies output declines during currency crises based on the theoretical model by Nakatani (2016, 2017a), highlighting the role of shocks that trigger crises. Using panel data on 49 developing countries, we find that both productivity shocks in the real sector and shocks to the country's risk premium in financial markets affect the output costs of currency crises, which are 4% of GDP on average and 8% for severe crises. During severe currency crises in Asian and Latin-American countries, both productivity shocks and exchange rate overvaluation were found to be important factors in explaining large output losses.

Keywords: Growth; Currency Crisis; Productivity; Risk Premium; Exchange Rate Overvaluation; Developing Countries

JEL Classification: E32; F41; F43; G15; O47

1 Introduction

After the recent global financial crisis, the effects of financial crises on output growth have attracted more attention from researchers (e.g., Romer and Romer, 2017; Reinhart and Rogoff, 2013). In this paper, we analyze the output costs of a currency crisis, which is one type of financial crisis that has frequently occurred since the 1970s (Laeven and Valenica, 2014). Many empirical studies on the output costs of currency crises have focused on the recovery from output declines or medium-term and long-term output losses, but no literature has cast a spotlight on the sources of shocks that led to the crises. Against this backdrop, it would be interesting to understand the sources of shocks that led to currency crises. Our research contributes to the literature by focusing on shocks that can lead to currency crises. Although economic theories predict that different types of shocks can trigger currency crises, only empirical analysis can quantify the different effects of each shock on output, and this has not been previously analyzed. For example, Céspedes, Chang and Velasco (2004) developed a theoretical model in which an external shock in the international financial markets increases a country's risk premium, which in turn worsens the balance sheets of firms and leads to a currency crisis. Another model developed by Caballero and Krishnamurthy (2001) shows that a production shock can cause a currency crisis that is induced by liquidity problems under binding international and domestic collateral constraints. Nakatani (2016, 2017a) developed a model in which both financial shocks and productivity shocks can trigger currency crises through the deteriorating balance sheets of firms and banks. Therefore, it is also interesting to connect the theories to empirical studies by focusing on the roles of shocks during currency crises.

Recently, Nakatani (2017bc, 2018) used Nakatani's (2016, 2017a) model to empirically analyze the effects of different shocks on exchange rates and the probability of a currency crisis. This model has several advantages. It can well explain currency crises occurring in countries with foreign currency debt, it can be applied to both fixed exchange rate regimes and flexible exchange rate regimes, and it can study the effects of several types of shocks and analyze the possibility of multiple equilibria. Following the theory, Nakatani (2017bc, 2018) focused on two types of shocks, including shocks to a country's risk premium in the financial markets and productivity shocks in the real sector. He found that both shocks significantly affect exchange rate dynamics and the probability of a currency crisis. Furthermore, the model well explains past major currency crises in Asian and Latin-American countries. Specifically, the Nakatani (2016, 2017a) model shows that the equilibrium is determined by the intersection of two curves that simultaneously determine the exchange rate and output. Thus, it is natural to analyze the effects of shocks to both exchange rates and output. Although Nakatani (2017b) analyzed the effects of shocks on exchange rates and Nakatani

(2017c, 2018) analyzed their effects on the probability of a currency crisis (from the viewpoint of multiple equilibria), no literature has analyzed the effects on output. In this regard, we empirically analyze the effects of the aforementioned two shocks on output by applying the data and estimation methods developed by Nakatani (2017bc, 2018).

Using unbalanced panel data on 49 emerging markets and developing countries from 1980 to 2011, we examine different definitions of currency crises, including the 'standard' currency crisis and the 'severe' currency crisis. Our results show that the output costs of a currency crisis is approximately 4% on average and approximately 8% for a severe crisis. We also find that although both types of shocks affect output dynamics, the sizes of their effects are different. Namely, productivity shocks appear to be more important for output declines during past famous currency crises that occurred in emerging markets. By contrast, risk premium shocks amplify the output costs during currency crisis periods, but the size of this effect was very small during the past selected emerging market crises. In addition to productivity shocks, we found that business cycles and the economic adjustments associated with overvalued exchange rates also had large effects on output declines during past major currency crises in Asia and Latin America.

The organizational structure of this paper includes a review of the literature in which we briefly summarize and discuss the empirical literature on the output costs of currency crises and the theoretical literature on generational currency crisis models. Then, we explain the methodology and data used in this article and discuss our empirical results and their implications for past emerging market crises. Finally, we conclude the work.

2 Literature Review

The empirical literature on currency crises has tried to measure output losses during the crises. Using a panel data set of 24 emerging-market economies covering the 1975–1997 period, Hutchison and Noy (2002, 2005) found that currency crises reduce output by approximately 5–8%, whereas Hutchison and Noy (2006) found a 2–3% reduction. Bordo, Eichengreen, Klingebiel and Martinez-Peria (2001) found that the average output loss from currency crises was approximately 6% for 56 sample countries over the period from 1973–1997. Gupta, Mishra and Sahay (2007) considered currency crises that occurred in 91 developing countries during the period from 1970–2000 and found that the average contractionary effect of currency crises on output was approximately 5%. Recently, Basistha and Teimouri (2015) found that output declined by an average of 4% during currency crises between 1970 and 2005. Other studies focused on output recovery after currency crises or medium-term output losses (Hong and Tornell, 2005; Cerra and Saxena, 2008; Bussière, Saxena and Tovar, 2012; Wan and Jin, 2014; Teimouri and Brooks, 2015).

Theoretical currency crisis models show the various factors that can lead to crises, including inconsistencies among fiscal, monetary and exchange rate policies (1st-generation model of Krugman, 1979), the expectation of investors (2nd-generation model of Obstfeld, 1996), and financial frictions (3rd-generation model[1]) such as the foreign currency denominated debt of firms (Nakatani, 2017a) or commercial banks (Nakatani, 2016). In this study, in addition to macroeconomic policies such as monetary and fiscal policies, financial and/or real shocks trigger currency crises and reduce output (the mechanism through which shocks transmit to the real economy is explained in the next section). Recently, a new type of balance of payments crisis model (4th-generation model) was developed by Nakatani (2017d) in which a negative commodity price shock leads to a balance of payments crisis in a resource-rich economy.

Despite a growing number of empirical studies, there is still a missing link between theoretical models and empirical analyses on currency crises. For example, it is theoretically assumed that a shock can lead to currency crises. However, no empirical research has analyzed the effects of shocks on currency crises except for Nakatani (2017bc, 2018). Nakatani (2017b) empirically analyzed the effects of real and financial shocks on exchange rates, and Nakatani (2017c, 2018) studied the effects of these shocks on the probability of a currency crisis. However, the literature has never studied the effects of the shocks on output during the crises. Against this background, this paper analyzes the effects of shocks on output during currency crises by applying the method developed by Nakatani (2017bc, 2018). The details of the methodology are explained in the next section.

3 Methodology and Data

Following Nakatani (2017bc, 2018), we use Nakatani's (2017a) model to analyze the effects of shocks during currency crises. Several merits of this model were emphasized in the introduction. The model shows that output and the nominal exchange rate are determined by the intersection of two curves: the Interest-Parity-LM (IPLM) curve and the Wealth curve. These curves are depicted in two dimensions: the output on the horizontal axis and the nominal exchange rate on the vertical axis.

The IPLM curve is a downward-sloping, convex curve characterized by the money market equilibrium and central bank's behavior. If there is a positive shock to the country's risk premium, the IPLM curve shifts upward, and this can cause a currency crisis equilibrium. The economic intuition is that the abrupt deterioration in investors' perception about a country's gross foreign debt can lead to an increase in the country's risk premium. This in turn depreciates the national currency because of the interest parity condition. A depreciation of domestic currency leads to an increase in the debt burden denominated in foreign currency, which in turn lowers the output via reduced investment if the country has a large foreign currency debt. By contrast, if the country has a large export sector, the currency depreciation increases export revenues, which boosts output. Therefore, it is not clear whether the risk premium shock can theoretically decrease or increase output. Thus, it is a pure empirical issue to test the effects.

On the other hand, the Wealth curve is characterized by the behavior of firms. It is also downward sloping but concave. The model predicts that if there is a negative productivity shock, the Wealth curve shifts to the left, which may also generate a currency crisis equilibrium. A relevant economic intuition is that the unanticipated negative productivity shock reduces output, profits, retained earnings, net worth and investments of the firms and results in extremely low output and a corresponding lower need for money (i.e., depreciation of the domestic currency) in the next period.

Thus, in our empirical analysis, the main explanatory variables are these two shocks (the shock to the country's risk premium and the productivity shock). In addition to these two shocks, we also include monetary policy and fiscal policy variables among the explanatory variables because macroeconomic policies can also affect output. The regression equation that determines the relationship between the shocks and output is defined as:

$$y_{i,t} = \beta_0 + \beta_1 y_{i,t-1} + \beta_2 i_{i,t} + \beta_3 g_{i,t} + \beta_4 IPLMshock_{i,t} + \beta_5 Wshock_{i,t} + \beta_6 Crisis_{i,t}$$

$$+\beta_7(Crisis_{i,t} \times IPLMshock_{i,t}) + \beta_8(Crisis_{i,t} \times Wshock_{i,t}) + \beta_9 Z_{i,t} + \varepsilon_{i,t}$$

where $y_{i,t}$ is growth of real GDP for the i th country at time t; $i_{i,t}$ is the interest rate policy (the change in the policy interest rate); $g_{i,t}$ is the fiscal policy measured by the budget balance as a percentage of GDP; $IPLMshock_{i,t}$ is the change in the country's risk premium that shifts the IPLM curve[2]; $Wshock_{i,t}$ is the productivity shock that shifts the Wealth curve[3]; $Crisis_{i,t}$ is a dummy variable equal to unity if the country has a currency crisis and zero otherwise; $Z_{i,t}$ is the control variables; and $\varepsilon_{i,t}$ is an error term. The lag of the GDP growth rate is included in the explanatory variable because GDP growth rates are highly persistent. The control variables include the change in the ratio of short-term external debt to GDP, the deviation of GDP growth[4], the exchange rate overvaluation and the ratio of foreign reserves to imports. Most variables, such as real GDP and fiscal variables, are taken from the International Monetary Fund's (IMF) World Economic Outlook database. Nakatani (2014, 2017b) includes the details, construction and sources of the data. The summary statistics for each variable are shown in Table 1. The interpretations of the coefficient for each explanatory variable are discussed in the next section.

From the econometric perspective, a potential problem in this analysis arises from the possible endogeneity of policy and other variables. For example, if central banks determine policy interest rates after they observe some shocks that are not captured by the W-shock or the IPLM-shock, the ordinary least squares estimation of the regression equation results in inconsistent estimators for all coefficients. To solve this problem, we use the instrumental variable method. We employ the lagged variable as an instrument because this variable appears to be both strongly correlated with the current policy variable and exogenous in the sense that it is predetermined before the shock occurs in the current period. Following Nakatani (2017b), we use the Arellano and Bond (1991) two-step generalized method of moments estimator with the small sample correction proposed by Windmeijer (2005) in our estimation because it is asymptotically efficient and robust to initial conditions and the distributions of the error term. Furthermore, we use a collapsing method developed by Roodman (2009) to avoid the problem of too many instruments generated by the moment conditions, which weakens the Hansen overidentification test (Bowsher, 2002).

The sample in this study covers 49 emerging markets and developing countries from 1980 to 2011 (Table 2).[5] As in the case of Nakatani (2017b), the results of the panel unit root tests indicate that all variables are stationary at the 5% significance level. Currency crisis dates are determined by the exchange market pressure index, defined as a weighted average of the monthly real effective exchange rate depreciation percentage and the monthly international reserve losses percentage weighted such that the two components equal sample volatility (Kaminsky and Reinhart, 1999). Both monthly series are taken from the IMF's

International Financial Statistics.[6] We examine several definitions of currency crisis episodes because the definition may matter. A currency crisis year is defined as when the index exceeds the mean plus two country-specific standard deviations (with/without a 24-month window). A 'severe currency crisis' year is defined as the index exceeding the mean plus three country-specific standard deviations (with/without a 24-month window).

4 Empirical Results

The estimation results are presented in Tables 3–6. Table 3 is the estimation with the IPLM-shock, whereas Table 4 checks the effects of the W-shock. Table 5 is the result of the estimation that includes both types of shocks. Table 6 is a robustness check that controls for exchange rate regimes. In most results, the lagged GDP growth rates are positive and statistically significant at the 5% level, showing the inertial effects of output. The results for other explanatory variables are discussed below.

As for policy variables, both coefficients on the interest rate policy and fiscal policy have the expected signs and are highly statistically significant in most specifications. For example, Tables 4-6 show that a 1 percentage point increase in the policy interest rate is associated with an approximately 0.2 percentage point lower output growth. The positive coefficient of the fiscal variable suggests that a good fiscal situation is associated with higher economic growth. Regarding the reserve management policy, coefficients on the ratio of foreign reserves to imports are statistically significant at the 1% level in all columns of Tables 3-4 and in the results for standard currency crises (columns (10), (13) and (14) in Tables 5-6). This variable captures a feature of the 1st-generation models, and it is consistent with their theories. The positive coefficient on the reserves-to-import ratio means that if a country does not have enough foreign reserves to cover imports, the shortage of foreign exchanges hinders economic activity and growth (Nakatani, 2017d).

Next, we discuss one of the key results of this paper about the effects of two shocks on output. The results presented in Tables 3-6 show that the coefficients on both the IPLM-shock and the W-shock are positive and statistically significant at the 1% level (in normal times without the interaction term of the crisis dummy) in all specifications. The IPLM-shock is positively correlated with output growth in normal times. This implies that the export channel is more important than the foreign currency debt channel in normal times. In other words, if there is an increase in a country's risk premium, this leads to a depreciation of domestic currency, which in turn increases net exports, as was theoretically demonstrated by Nakatani (2017a). For instance, column (10) in Table 5 suggests that a 1 percentage point increase in the IPLM-shock is associated with an approximately 0.08 percentage point higher GDP growth. By contrast, the W-shock is positively correlated with output dynamics, and this is also consistent with the theory.

For the remainder of this paper, we discuss the results for the output costs of a currency crisis, which is our main topic of this paper. We can think of these costs as an output decline caused by an abrupt shift of the equilibrium from a good equilibrium with a high level of output to a crisis equilibrium with an extremely low output (Nakatani, 2016, 2017a). The coefficient of the currency crisis dummy is always negative and statistically significant at the 1% level in all specifications in Tables 3-5 and at the 5% level in Table 6 except in the last column (16). We find that its size is different between the standard currency crisis definition and the severe crisis definition. For example, Table 5 shows that the output costs of currency crises are approximately 4–5% of GDP, whereas the costs are much larger at 7–8% for severe currency crises. Thus, we can conclude that the definition of a currency crisis matters for output costs. The countries that experience high pressure on their exchange rates and reserves (which is the definition of a severe currency crisis) have large output costs. These estimated output costs of currency crises are in line with the existing empirical studies discussed in the literature review section.

Furthermore, this paper aims to capture the effects of each shock on output during currency crises. The interaction term of the currency crisis dummy with the IPLM-shock is negative and statistically significant at the 5% level in columns (3), (10), (13) and (14). This supports the theory of a currency crisis in which a positive risk premium shock induces currency depreciation, thereby increasing the burden of foreign currency denominated debt, as shown by Nakatani's (2016, 2017a) model. For example, column (10) of Table 5 implies that a 1 percentage point increase in the IPLM-shock is associated with a 0.04 percentage point lower output growth during the currency crisis period. Combined with the results of the positive coefficient on the IPLM-shock during normal times, we can conclude that the effects of the IPLM-shock are positive on output through increased net exports during tranquil times. However, the effects become negative during currency crises because the drastic depreciation of domestic currency increases the foreign currency debt burden and requires balance sheet adjustments. This implies that the negative balance sheet channel of currency depreciation dominates under the circumstance of dramatic currency depreciation, which comes from the valuation effect of debt denominated in foreign currency. Moreover, the positive export channel is limited because firms might face supply constraints and not be so quick to dramatically increase the production of export goods. We will calculate examples of the relative impacts of the IPLM-shock in the next section using the historical data from selected Asian and Latin-American currency crises.

By contrast, the coefficient on the interaction term of the currency crisis dummy with the W-shock is always negative and statistically significant at the 5% level in all specifications in Tables 4-6. This is interesting because it implies that if the country has a negative productivity shock during currency crises, this shock lowers output as in normal times, although the effects are somewhat smaller during currency crises. However, we should note that the overall effect of W-shock is the sum of the coefficients on W-shock with and without the interaction term of the currency crisis. Thus, we will measure the output costs of currency crises by controlling for the source of shocks (i) using the average size of two shocks during crises in the next paragraph and (ii) by applying our results for past major emerging market crises in the next section.

To precisely measure the output costs of currency crises, we need to calculate the total output losses of the crises using the three coefficients on the explanatory variables that include a currency crisis dummy. We multiply the coefficient of the interaction term of the currency crisis dummy with the W-shock presented in column (10) of Table 5 by the mean value of productivity shock during currency crises shown in Table 1. Thus, we find that the average productivity shock during the currency crisis period increases output costs by 0.14 percentage points. The same procedure for the interaction term of the crisis dummy with the IPLM-shock shows that the IPLM-shock has an additional 0.14 percentage points amplifying effect on output costs. By combining these calculations with the coefficient on the currency crisis dummy variable in column (10) of Table 5, the total output costs for a standard currency crisis is 4.2%. The same calculation based on column (12) of Table 5 yields that the output costs for a severe currency crisis are 7.9% due to the 0.38% amplifying effect from the IPLM-shock and 0.51% mitigating effect from the large negative W-shock.

Finally, the estimated results for an important control variable can be discussed as follows. One of the key factors that has been analyzed in the 3rd-generation models of currency crises (including Nakatani's (2016, 2017a) model) is short-term external debt. The coefficients on the change in short-term external debt to GDP ratio are always negative and statistically significant at the 1% level in all tables. This means that an increase in external leverage is associated with a lower economic growth rate, which is consistent with the prediction of the 3rd-generation models of currency crises.

For a robustness check, we conduct a further analytical exercise that considers exchange rate regimes. The sample country and period of the data in this paper include different exchange rate regimes because the Nakatani (2016, 2017a) model can analyze both a floating exchange rate regime and a pegged exchange rate regime. However, in practice, the effects of shocks and macroeconomic policy may differ across exchange rate regimes. Thus, here, we analyze these effects using a subset of data with comparable exchange rate regimes. As most of the data are floating exchange rate regimes, we show the results excluding pegged regimes. Following Klein and Shambaugh (2008), we use the exchange rate regime classification of the IMF that is widely used in the literature. Table 6 shows the results based on the floating exchange rate regimes. The results shown in Table 6 suggest that the significance and the size of each coefficient do not substantially change from Table 5. The exception is that the output costs of a currency crisis are approximately 6% of GDP for floating exchange rate regimes and are slightly larger than the results of all samples in Table 4. This is consistent with the findings by Nakatani (2017c, 2018) that showed that floating exchange rate regimes are more vulnerable to shocks. Thus, we can conclude that the coefficients in the benchmark estimation are robust and not as sensitive to the cases when we consider exchange rate regimes.

5 Applications for Emerging Market Crises

From now, we analyze output declines during currency crises using the coefficients estimated in the previous section. We decompose the output declines observed during the selected currency crises in emerging markets into our explanatory variables in the regression to assess the nature of each currency crisis from the viewpoints of the three generational currency crisis models. We select five Asian and Latin-American countries that experienced well-known currency crises in the 1990s: Thailand, the Philippines, and Malaysia in 1997-98, Brazil in 1991 and Mexico in 1995. For the Asian crisis, it began in Thailand in 1997 and later spilled over to neighboring countries in 1998. Thus, we focus on the output declines in

1997 for Thailand and 1998 for the Philippines and Malaysia because the latter two countries experienced large output declines in 1998 rather than in 1997. We use the estimation results shown in column (10) of Table 5 for two reasons. First, this definition of a currency crisis is most commonly used in the literature. Second, all estimated coefficients in this specification are statistically significant at the 5% level.

Figure 1 shows the results of the decomposition of output declines into factors highlighted in the theoretical currency crisis models. In the figure, monetary policy (interest rate policy) and fiscal policy are aggregated as a "policy" category. In Figure 1, the "W-shock" (or the "IPLM-shock") is combined with the effects from productivity shocks (or risk premium shocks), including the effects calculated from the coefficient on the W-shock (or the IPLM-shock) plus the coefficient on the interaction of the corresponding shock and currency crisis dummy. Output changes associated with exchange rate adjustments (i.e., the exchange rate overvaluation and the reserve-to-import ratio) are shown as "exchange rate" in Figure 1. Furthermore, deviations of the GDP growth and lagged GDP growth rates are categorized as "business cycle" in the figure.

The overall picture shows that productivity shocks in the 3rd-generation models and the exchange rate overvaluation in the 2nd-generation models were important factors explaining output declines in these crisis episodes. For example, in Thailand, approximately half of the output declines in 1997 were explained by the W-shock (the productivity shock). Other factors that contributed to the declines were business cycles and the output costs associated with the currency crisis (currency crisis dummy). For the Philippines and Malaysia, the main contributions to the output declines (starting with the most significant) were productivity shocks (which accounted for approximately one-third of the overall output decline), exchange rate overvaluation, and the cyclical factors of the economy. Note that our EMPI defines the currency crisis as occurring in 1997 for these two countries but not in 1998 if we use the 24-month window. Hence, the output costs estimated by the crisis dummy are not included in the figure. By contrast, the Latin-American crises demonstrate that the main causes of output declines were features of the 2nd-generation models (such as the overvaluation of exchange rates), which is consistent with the literature (Nakatani, 2017b; Cole and Kehoe, 1996). In these countries, in addition to the W-shock and business cycle, the effects from fiscal policy also contributed to the output contraction because the countries experienced fiscal consolidation during the crisis periods. Our results are consistent with the findings by Nakatani (2017c, 2018) that showed that negative productivity shocks are key triggering factors for severe currency crises.

What is most striking in our results is that although we observed statistically significant effects from the IPLM-shock, the impacts are very small in terms of output declines. This is a stark contrast to the finding by Nakatani (2017b) that the effects of IPLM-shocks on exchange rates are sizable. Combining these results for the effects of the IPLM-shock on the exchange rate and output, our results imply that the curvature of the Wealth curve in Nakatani's (2017a) model is steep because the shift of the IPLM curve has a large impact on the exchange rate but a small effect on output. As shown in Nakatani (2017a), this is the case when the economy has a large foreign currency denominated debt.

6 Conclusion

This article analyzed the output costs of currency crises based on the theoretical currency crisis model by Nakatani (2016, 2017a). Following this theory, we focused on two shocks: the IPLM-shocks and the W-shocks. Nakatani (2017a) showed that the IPLM-shock induces currency depreciation due to the interest parity condition, and its impact on output is purely an empirical question. This is because currency depreciation boosts net exports and increases the debt burden denominated in foreign currency. By contrast, the theory always predicts a positive relationship between the W-shock and output. The main contribution of this paper is to control, clarify and quantify the effects of these two shocks on output declines during currency crises.

Our findings can be summarized as follows. First, we found that output costs are approximately 4% of GDP for standard currency crises and 8% of GDP for severe currency crises after we control the effects of shocks. Second, we found that both the W-shocks and the IPLM-shocks can influence output dynamics, but their impacts are different. Namely, in terms of the size of output declines, the effects of the W-shocks are much larger than those of the IPLM-shocks. Third, we found an interesting contrast for the effects of the IPLM-shocks between normal periods and currency crisis periods. Specifically, the IPLM-shock increases the output during normal times but reduces output during crises. This implies that an export channel prevails in normal periods, while the balance sheet channel dominates during currency crisis periods. Fourth, applying our estimated coefficients on factors contributing to past prominent emerging market crises, we found that the W-shocks, exchange rate overvaluation, and business cycles are more important factors for output declines than the effects of macroeconomic policies. The results presented in Figure 1 agree with the orthodox view that features of the 3rd-generation models (i.e., productivity shocks) well explain Asian currency crises and those of the 2nd-generation models (i.e., overvalued exchange rates) explain Latin-American crises to a large extent.

Table 1: Summary Statistics

All Samples (Crisis Samples[1])	Mean	Std. Dev.	Min	Max
GDP Growth	9.03 (1.37)	14.66 (18.53)	-66.61 (-66.61)	69.31 (54.11)
Interest Rate Policy	-0.64 (3.01)	16.22 (13.23)	-269.74 (-23.25)	244.35 (88.00)
Fiscal Policy	-1.69 (-3.07)	4.25 (4.96)	-25.40 (-25.40)	32.83 (7.47)
IPLM-Shock	-1.36 (3.34)	21.53 (26.17)	-270.49 (-125.24)	138.61 (117.16)
W-Shock	0.71 (0.19)	4.15 (4.69)	-18.63 (-11.65)	21.77 (14.89)
Change in Short-term External Debt / GDP	-0.10 (-0.06)	2.94 (2.39)	-25.34 (-8.07)	22.98 (6.33)
Deviation GDP Growth	0.18 (-0.11)	3.75 (4.74)	-21.11 (-14.59)	18.03 (18.03)
Exchange Rate Overvaluation	-0.32 (2.26)	9.30 (17.27)	-72.69 (-25.17)	116.01 (116.01)
Foreign Reserves / Imports	0.61 (0.47)	0.49 (0.32)	0.00 (0.01)	4.04 (1.59)

[1] The summary statistics for samples classified as standard currency crises with a 24-month window are shown in parentheses.

Table 2: List of Countries

Algeria	Macedonia
Argentina	Malawi
Armenia	Malaysia
Belize	Mexico
Bolivia	Moldova
Brazil	Morocco
Bulgaria	Nicaragua
Burundi	Nigeria
Cameroon	Papua New Guinea
Central African Republic	Paraguay
Chile	Peru
China	Republic of the Philippines
Colombia	Romania
Democratic Republic of the Congo	Russia
Costa Rica	Sierra Leone
Dominican Republic	South Africa
Gabon	Thailand
Gambia	Togo
Georgia	Turkey
Ghana	Uganda
Grenada	Ukraine
Guyana	Uruguay
India	Venezuela
Indonesia	Zambia
Iran	

Table 3: Estimation Results for the IPLM-Shock

	(1)	(2)	(3)	(4)
Definition of Crisis	Currency Crises	Currency Crises with Window	Severe Crises	Severe Crises with Window
Lagged GDP Growth	0.133*** (0.018)	0.145*** (0.014)	0.131*** (0.014)	0.137*** (0.020)
Interest Rate Policy	-0.063*** (0.017)	-0.077*** (0.016)	-0.309* (0.016)	-0.060** (0.023)
Fiscal Policy	0.673*** (0.090)	0.656*** (0.089)	0.604*** (0.078)	0.589*** (0.084)
IPLM-Shock	0.027*** (0.005)	0.022*** (0.005)	0.024*** (0.005)	0.024*** (0.006)
Currency Crisis	-7.877*** (0.935)	-5.862*** (1.073)	-10.329*** (1.070)	-11.110*** (1.004)
Currency Crisis × IPLM-Shock	-0.019* (0.011)	0.010** (0.004)	-0.292*** (0.090)	-0.092 (0.062)
Change in Short-term External Debt / GDP	-0.463*** (0.103)	-0.456*** (0.095)	-0.377*** (0.100)	-0.462*** (0.115)
Deviation GDP Growth	1.475*** (0.083)	1.558*** (0.079)	1.521*** (0.070)	1.568*** (0.077)
Exchange Rate Overvaluation	0.196*** (0.029)	0.210*** (0.030)	0.205*** (0.024)	0.227*** (0.025)
Foreign Reserves / Imports	1.796*** (0.474)	2.203*** (0.577)	2.190*** (0.552)	2.341*** (0.568)
Constant	9.102*** (0.523)	8.286*** (0.518)	8.607*** (0.499)	8.221*** (0.483)
Number of Observations	600	600	600	600
Number of Countries	46	46	46	46
Arellano-Bond Test for AR(2) (p-value)	0.419	0.370	0.376	0.427
Hansen Test (p-value)	0.080	0.087	0.110	0.106

Significant at * (10%), ** (5%) and *** (1%) levels. Cluster-robust standard errors are in parentheses.

Table 4: Estimation Results for the W-Shock

	(5)	(6)	(7)	(8)
Definition of Crisis	Currency Crises	Currency Crises with Window	Severe Crises	Severe Crises with Window
Lagged GDP Growth	0.068*** (0.015)	0.075*** (0.016)	0.073*** (0.013)	0.080*** (0.015)
Interest Rate Policy	-0.258*** (0.047)	-0.230*** (0.036)	-0.227*** (0.049)	-0.222*** (0.036)
Fiscal Policy	0.426*** (0.042)	0.430*** (0.043)	0.375*** (0.065)	0.370*** (0.060)
W-Shock	1.668*** (0.107)	1.654*** (0.157)	1.765*** (0.144)	1.732*** (0.148)
Currency Crisis	-4.578*** (1.074)	-4.378*** (1.111)	-8.615*** (1.419)	-9.396*** (1.298)
Currency Crisis × W-Shock	-0.583** (0.218)	-1.075*** (0.208)	-1.118*** (0.275)	-1.468*** (0.197)
Change in Short-term External Debt / GDP	-0.460*** (0.134)	-0.473*** (0.128)	-0.490*** (0.133)	-0.425*** (0.123)
Deviation GDP Growth	0.444*** (0.148)	0.523*** (0.178)	0.398*** (0.121)	0.473*** (0.153)
Exchange Rate Overvaluation	0.812*** (0.045)	0.808*** (0.046)	0.810*** (0.050)	0.801*** (0.052)
Foreign Reserves / Imports	3.224*** (0.969)	2.571*** (0.685)	2.125*** (0.669)	2.257*** (0.494)
Constant	7.087*** (0.596)	7.120*** (0.374)	7.441*** (0.495)	7.197*** (0.335)
Number of Observations	510	510	510	510
Number of Countries	35	35	35	35
Arellano-Bond Test for AR(2) (p-value)	0.334	0.242	0.140	0.122
Hansen Test (p-value)	0.149	0.128	0.134	0.157

Significant at * (10%), ** (5%) and *** (1%) levels. Cluster-robust standard errors are in parentheses.

Table 5: Estimation Results for the IPLM-Shock and the W-Shock

	(9)	(10)	(11)	(12)
Definition of Crisis	Currency Crises	Currency Crises with Window	Severe Crises	Severe Crises with Window
Lagged GDP Growth	0.089* (0.045)	0.092*** (0.023)	0.127*** (0.037)	0.123*** (0.034)
Interest Rate Policy	-0.214*** (0.049)	-0.231*** (0.055)	-0.173*** (0.055)	-0.175*** (0.044)
Fiscal Policy	0.370*** (0.149)	0.338*** (0.119)	0.256** (0.112)	0.259*** (0.107)
IPLM-Shock	0.071*** (0.016)	0.076*** (0.014)	0.065*** (0.016)	0.061*** (0.014)
W-Shock	1.651*** (0.159)	1.695*** (0.166)	1.527*** (0.130)	1.568*** (0.129)
Currency Crisis	-4.699*** (1.444)	-3.888*** (1.598)	-7.182*** (1.405)	-7.985*** (1.532)
Currency Crisis × IPLM-Shock	-0.037* (0.020)	-0.043** (0.020)	-0.260 (0.163)	-0.131 (0.099)
Currency Crisis × W-Shock	-0.564*** (0.378)	-0.765*** (0.220)	-1.446*** (0.382)	-1.664*** (0.411)
Change in Short-term External Debt / GDP	-0.616*** (0.152)	-0.648*** (0.076)	-0.639*** (0.142)	-0.683*** (0.133)
Deviation GDP Growth	0.496* (0.247)	0.521** (0.198)	0.736*** (0.186)	0.706*** (0.185)
Exchange Rate Overvaluation	0.802*** (0.060)	0.824*** (0.074)	0.720*** (0.046)	0.721*** (0.041)
Foreign Reserves / Imports	2.873 (3.711)	3.070*** (0.803)	4.517 (3.281)	3.914 (3.255)
Constant	7.328* (3.750)	6.877*** (0.584)	5.251 (3.241)	5.738* (3.143)
Number of Observations	427	427	427	427
Number of Countries	32	32	32	32
Arellano-Bond Test for AR(2) (p-value)	0.266	0.313	0.126	0.114
Hansen Test (p-value)	0.408	0.430	0.355	0.409

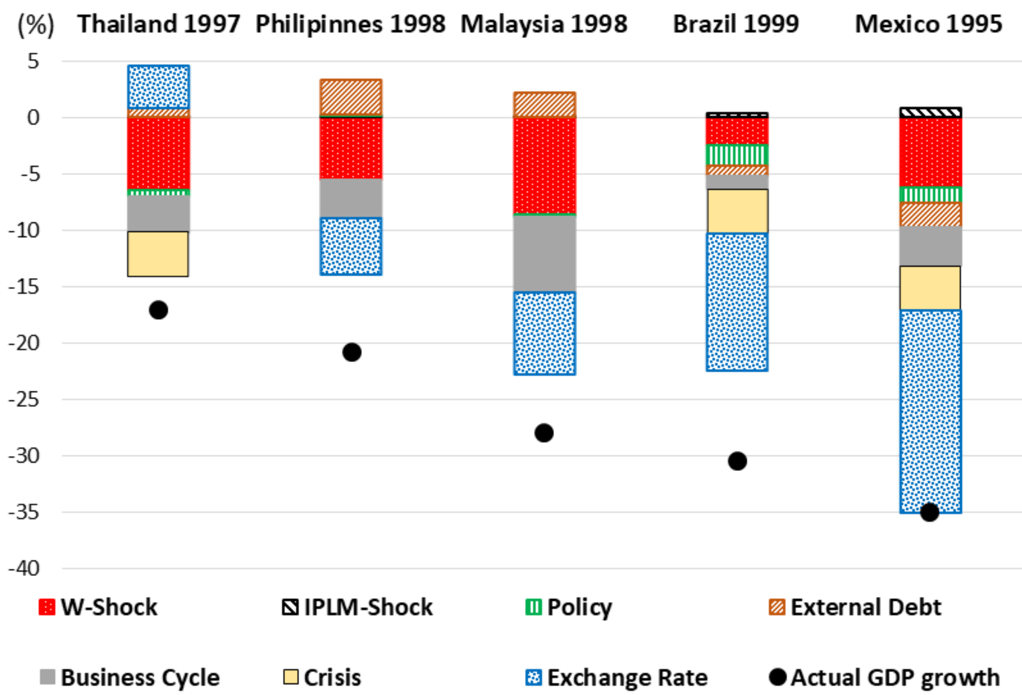
Significant at * (10%), ** (5%) and *** (1%) levels. Cluster-robust standard errors are in parentheses.

Table 6: Robustness Check: Estimation Results for Floating Exchange Rate Regimes

	(13)	(14)	(15)	(16)
Definition of Crisis	Currency Crises	Currency Crises with Window	Severe Crises	Severe Crises with Window
Lagged GDP Growth	0.076*** (0.024)	0.087*** (0.019)	0.076*** (0.025)	0.073*** (0.026)
Interest Rate Policy	-0.214*** (0.029)	-0.214*** (0.033)	-0.148*** (0.037)	-0.145*** (0.035)
Fiscal Policy	0.318*** (0.105)	0.279*** (0.098)	0.295** (0.115)	0.295** (0.112)
IPLM-Shock	0.071*** (0.006)	0.073*** (0.007)	0.049*** (0.014)	0.039*** (0.012)
W-Shock	1.601*** (0.125)	1.585*** (0.117)	1.577*** (0.102)	1.645*** (0.137)
Currency Crisis	-5.524*** (1.265)	-5.699*** (1.366)	-8.411** (4.096)	-9.426* (4.840)
Currency Crisis × IPLM-Shock	-0.035*** (0.010)	-0.022** (0.009)	-0.155 (0.177)	-0.134 (0.105)
Currency Crisis × W-Shock	-0.793*** (0.222)	--0.834*** (0.213)	-0.974*** (0.275)	-1.285*** (0.299)
Change in Short-term External Debt / GDP	-0.693*** (0.110)	-0.711*** (0.104)	-0.546*** (0.090)	-0.588*** (0.079)
Deviation GDP Growth	0.460*** (0.162)	0.477*** (0.155)	0.431*** (0.147)	0.398** (0.170)
Exchange Rate Overvaluation	0.847*** (0.039)	0.856*** (0.043)	0.810*** (0.045)	0.813*** (0.056)
Foreign Reserves / Imports	3.375*** (1.075)	3.003*** (0.905)	0.628 (1.982)	0.834 (1.965)
Constant	6.980*** (0.614)	6.877*** (0.559)	9.103*** (1.811)	8.845*** (1.780)
Number of Observations	394	394	394	394
Number of Countries	32	32	32	32
Arellano-Bond Test for AR(2) (p-value)	0.448	0.371	0.081	0.110
Hansen Test (p-value)	0.507	0.503	0.417	0.439

Significant at * (10%), ** (5%) and *** (1%) levels. Cluster-robust standard errors are in parentheses.

Figure 1: Output Declines in Selected Currency Crises



Notes

[1] Other types of 3rd-generation models include moral hazard caused by government guarantees (McKinnon and Pill, 1999; Corsetti, Pesenti and Roubini, 1999; Dooley, 2000; Dekle and Kletzer, 2002; Burnside, Eichenbaum and Rebelo, 2004; Schneider and Tornell, 2004, etc.), which is difficult to measure as a shock because it always takes several years for the over-borrowing syndrome to result in a crisis.

[2] The IPLM-shock is identified by Nakatani (2017b) as an error term resulting from regressing the country's risk premium (the interest rate spread over the U.S. rate) on its trend estimated by the Hodrick–Prescott filter and control variables. The control variables capture the effects from monetary policy (i.e., the central bank's policy interest rate differential over the US rate), development of the banking sector (i.e., the banks' assets to GDP), and governmental activity (i.e., the ratio of credit to the public sector to GDP).

[3] The W-shock is defined as the annual percentage change in total factor productivity. In practice, productivity shocks can be created by various factors. For example, many Japanese multinationals are investing in Asia (Tajika and Nakatani, 2008), and foreign direct investment affects productivity dynamics in the region (Nakatani et al, 2017).

[4] The deviation of real per capita GDP growth in a country from its average in the five preceding years.

[5] The number of sample countries decreased slightly from 51 in Nakatani (2017b) to 49 in this paper because we included an additional fiscal variable to control for the effects of fiscal policy on output.

[6] If a monthly real exchange rate variable is missing in this database, the data are taken from the Bank for International Settlement's monthly real exchange rates.

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