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## **An Evaluation of the Contractionary Devaluation Hypothesis**

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## AN EVALUATION OF THE CONTRACTIONARY DEVALUATION HYPOTHESIS

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## Abstract\*

Recent empirical and theoretical literature on the impact of real exchange rate devaluations on economic performance questions the traditional expansionary effect generated within standard Mundell-Fleming models. Contractionary devaluations may arise when firms face maturity or currency mismatches that, when faced with real exchange rate depreciations, lead to balance-sheet effects that erode firms' wealth and lead to an output contraction. While some authors show that the standard Mundell-Fleming result may hold even in the presence of currency mismatches, others point out that, if the balance sheet effect is large enough, devaluations can be contractionary. Using a large panel of 57 countries across the world and various newly constructed measures of dollarization, we test whether the balance sheet effect hypothesis has been relevant during the past decades in explaining economic downturns. Additionally, we explore the channels through which devaluations can be contractionary; in particular, we explore whether investment and consumption decisions are negatively affected by exchange rate devaluations under currency mismatches.

**Keywords:** Currency depreciation; Debt composition; Balance sheet effects

**JEL:** E0; F0; G32

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## 1. Introduction

Throughout his sharp writings and lucid presentations on Latin American economies, Professor Werner Baer has shown a vivid interest on the exchange rate policy and its growth and welfare consequences. In particular, he has been consistently concerned about how macroeconomic strategies shape the income distribution and the level of unemployment in developing countries.<sup>1</sup>

Part of the research on macroeconomic adjustment has focused on the role of exchange rates. As a key relative price in the economy, the real exchange rate may not only alter the country's external balance but also other more socially sensitive variables such as income distribution, poverty, and employment. This explains the relentless effort on the part of scholars and policymakers to provide a reliable answer to whether real devaluations boost or hinder economic growth. A better understanding of this link would certainly have useful implications for the exchange rate, fiscal and monetary policies. This paper contributes to this debate by offering new empirical macro-level evidence on the impact of real exchange rate devaluations on growth for a large sample of countries during the 1976-2003 period, using newly constructed measures of dollarization and various interaction effects.

Table 1 summarizes the complex effects that real devaluations bring on economic activity. Let us consider the following flows across domestic sectors that include exportable and non-tradeable producers, as well as households – we rule out the government for simplicity (the effect, if any, would be similar to that on a non-tradeable producer) and the domestic financial sector by taking it as a mere intermediary between households and firms. It is expected that any decline in current and prospective cash flows for firms and households will translate into a decline of aggregate investment and consumption, respectively.

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<sup>1</sup> See, for example, Baer and Maloney (1997) or Amman and Baer (2003).

**Table 1. Real Devaluation Effects on Sectoral Cash Flows**

| <b>Foreign currency-denominated variables</b> | <b>Exportable producing firms</b> | <b>Nontradeable producing firms</b> | <b>Households</b> |
|---|-----------------------------------|-------------------------------------|-------------------|
| <i>Trade Channel</i>                          |                                   |                                     |                   |
| Exportable Goods                              | +                                 | -                                   | -                 |
| Imported Goods                                | -                                 | -                                   | -                 |
| <i>Financial Channel</i>                      |                                   |                                     |                   |
| Gross Debt                                    | -                                 | -                                   | -                 |
| Gross Assets                                  | +                                 | +                                   | +                 |

The traditional view positing that a real devaluation improves the trade balance emerges from the first two rows, which show that exportable producers are better off after the devaluation. Not only does the supply of exports increase but also a depressed aggregate demand for imports for consumption and investment purposes ensues and, as long as, the Marshall (1923)-Lerner (1944) conditions are satisfied, a real devaluation will have a positive effect on the trade balance. Subsequent developments such as the popular Mundell (1963)-Fleming (1962) model adopted this approach, implying that devaluations are expansionary. Of course, as shown in the first two columns of the upper panel in Table 1, this model assumes that the beneficial revenue effect for tradeable producing industries outweighs the detrimental one for nontradeable producers and the negative impact on the tradeable sector that arises from the more expensive imported inputs.

An income effect adds to the previous substitution effect: as far as nominal wages do not fully adjust to the new price level, household disposable income is negatively affected, with a deleterious impact on aggregate consumption coming from the inflation in the tradeable consumption basket.<sup>2</sup> Diaz-Alejandro (1965) and Krugman and Taylor (1978) give theoretical support to this early contractionary devaluation mechanism brought about by income distribution

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<sup>2</sup> It must be noted that while the price of tradeables normally keeps track of the exchange rate in an open economy, non-tradeables might also do so in dollar-indexed economies.

considerations. Lizondo and Montiel (1988) and Larrain and Sachs (1986) are in-depth explorations within this framework.

Modern contributions have placed more emphasis on a financial channel rather than on the standard trade channel. In light of the dollarization process taking place in a number of emerging economies over the last decades, this research stresses the mismatch between foreign currency denominated debt and domestic currency denominated revenues (see, among others, Krugman (1999), Céspedes et al. (2004), and Frankel (2005)). Going back to Table 1, this is reflected in the first line of the lower panel. Nevertheless, it must be borne in mind that the sign and magnitude of the effect is linked to the net, as opposed to the gross, foreign denominated debt. Looking at the second row of the lower panel, gross assets might be owned by firms and households in countries having suffered massive capital flights in the past. Moreover, when it comes to domestic dollarization, it is clear that dollar denominated debts are partly financed with dollar denominated instruments.

The rest of the paper reviews the related empirical evidence (Section 2) and discusses our findings (Section 3). Some conclusions close.

## **2. Empirical Literature Review**

The critical role of the exchange rate in the economy, especially during currency and financial crises, has stimulated a substantial empirical research effort. We start with some macro-level evidence. Edwards (1986) finds a moderate short-run effect and no long-run effect of exchange rate depreciations on GDP level and growth for a panel of 12 developing countries. Kamin and Klau (1998) find similar results for a sample of 27 developing and industrialized countries. More recent contributions focus on financial factors arising from currency mismatches that turn real devaluations contractionary. These papers argue that balance sheet effects are the cause of the contractionary effect of devaluations in emerging countries since the 1990s.<sup>3</sup> In short, a depreciation in the real exchange rate, increases the value of financial obligations in foreign currency vis-à-vis the value of revenues in domestic currency, causing liquidity and solvency problems that hinder growth possibilities for firms.

Regarding country case studies, Amman and Baer (2003) contend that Brazil's devaluation in 1999 had a positive growth effect, as some analysts claim in regard to the post-2001 crisis

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<sup>3</sup> See Galindo, Panizza and Schiantarelli (2003) for an empirical survey.

Argentine experience. In contrast Bonomo et al. (2003) find that in firms with high liability dollarization those results are reversed. Domac (1997) reaches the same conclusion looking at the Turkish economy over 1960-1990.

Recently, many empirical studies resort to micro-level data to assess the impact of real exchange rate depreciations in the presence of currency mismatches. These studies have analyzed the impact of real exchange rate fluctuations on the dynamics of investment and employment. Bleakley and Cowan (2002) use a sample of 480 firms from five Latin American countries (Argentina, Brazil, Chile, Colombia and Mexico) during 1991-1999, to test if real exchange rate devaluations have influenced investment decisions. They do not find conclusive evidence regarding a contractionary effect of exchange rate depreciations on investment.

Further country specific work summarized by Galindo et al. (2003) find different results. In a study of Mexican firms, Pratap et al. (2003) find that exchange rate depreciations have a negative effect on firm performance, measured using the investment rate. This result confirms previous research on Mexico by Aguiar (2005) and Martinez and Werner (2002). Carranza et al. (2003), Galiani et al. (2003), Echeverry et al (2003), and Benavente et al (2003) find similar results for Peru, Argentina, Colombia and Chile, respectively.<sup>4</sup>

In a study analyzing the effect of real exchange rate depreciations on employment in the presence of liability dollarization, Galindo, Izquierdo and Montero (2005) use a panel dataset on industrial employment and trade for 9 Latin American countries, and find that real exchange rate depreciations impact employment growth positively in countries with high trade openness, but this effect is reversed as liability dollarization increases. In industries with high liability dollarization, the overall impact of real exchange rate depreciations is negative.

### **3. Empirical Methods and Results**

Building on a standard growth regression, and in light of recent firm-level evidence and the cumbersome relationship between devaluations and growth, we incorporate interaction terms to evaluate the contractionary devaluation hypothesis in a cross-country econometric framework. We test whether the presence of dollar denominated debt is important for the effect of real depreciations on GDP growth estimating the following model:<sup>5</sup>

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<sup>4</sup> Harvey and Roper (1999) find that balance sheet effects played a significant role in propagating the crisis.

<sup>5</sup> We use dollar debt and dollarization as a shortcut for foreign currency debt.



$$GROWTH_{i,t} = \alpha + \beta_1 X_i + \beta_2 Z_{i,t} + \gamma DRER_{i,t-1} + \delta DOLL_{i,t-1} + \phi(DRER_{i,t-1} * DOLL_{i,t-1}) + \varepsilon_{i,t}$$

where the dependent variable is the growth rate of GDP per capita measured in PPP dollars (we use PPP dollars in order to avoid an automatic relationship between GDP growth and changes in the real exchange rate),  $X$  is a matrix of country-specific time-invariant characteristics (which we will later substitute with country fixed effects),  $Z$  is a matrix of country-specific time-variant characteristics,<sup>6</sup>  $DRER$  is the percentage change in the real exchange rate (we use the bilateral real exchange rate with respect to the US dollar, with a positive sign indicating a depreciation), and  $DOLL$  is a measure of dollarization to be precisely defined momentarily. Our coefficients of interest are  $\gamma$  and  $\phi$ . As the standard Mundell-Fleming model assumes that devaluations are expansionary, we expect  $\gamma$  to be positive, but the balance sheet effect literature suggest that the expansionary effect of devaluations should be smaller in countries with high levels of dollarization and hence we expect  $\phi$  to be negative.

We use three measures of dollarization: external dollarization, and two alternative measures of domestic dollarization. We define external dollarization as follows:

$$\text{External Dollarization} = \text{OSIN} * \text{External Debt} / \text{GDP}$$

where OSIN is the Original Sin measure built by Eichengreen, Hausmann and Panizza (2005), which measures the currency composition of external debt (we use their OSIN3 index, where 1 corresponds to a fully dollarized external debt) and EXTERNAL DEBT/GDP is the country's total external debt measured as a share of GDP. As OSIN has limited over time variability, all the overtime variability of External Dollarization comes from External Debt/GDP. External Dollarization takes high values for countries which have high levels of external debt and for which there is no international market for local currency debt (for instance, Argentina) and has low values for countries that have low levels of external debt (such as Guatemala) and hence have low value of external debt or countries (such as South Africa) for which there is a substantial market of domestic currency international debt and hence have low values of OSIN.

Note that we obtain our external debt data from the World Bank's Global Development Finance (GDF) database. As GDF does not report data for industrial countries, we assume that

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<sup>6</sup> We use the same set of country characteristics used by Levy-Yeyati and Sturzenegger (2002): Investment over GDP, Population and Population Growth, Secondary Enrollment, lagged Government Consumption, Civil Liberties, change in Terms of Trade, the Frankel and Romer index of openness, and three regional dummies.

these countries have zero external debt and, hence, we implicitly assume that they do not have external dollarization. In the robustness analysis, we will explore the consequences of this assumption.

We define domestic dollarization 1 as the share of dollar bank deposits of GDP. Formally:

$$\text{Domestic dollarization1} = \text{Deposit Dollarization} * (\text{Bank Deposits}/\text{GDP}).$$

We obtain data on deposit dollarization from the database assembled by Levy-Yeyati (2006). In order to expand our number of observations, we assume that domestic dollarization is constant within countries.<sup>7</sup>

Our second measure of domestic dollarization (Domestic Dollarization 2)) is what Calvo et al. (2005) call Domestic Liability Dollarization (DLD), this measure is similar to the previous one but rather than focusing on the structure of bank liabilities (i.e., deposits), it focuses on the structure of bank assets (i.e. loans). In particular, Calvo et al. (2005) build the domestic dollarization measure as follows. For industrial economies they use BIS reporting banks' local asset positions in foreign currency as a share of GDP. For emerging economies, they add dollar deposits and bank foreign borrowing (IFS line 26c) and then assume that banks match their liabilities with their assets:

$$\text{Domestic Dollarization2} = \text{Loan Dollarization} * (\text{Bank Loans}/\text{GDP}).$$

We estimate the model using an unbalanced panel of 57 countries (22 industrial and 35 developing) over the 1976-2003 period. Column 1 of Table 2 reports our baseline regression for external dollarization (we estimate the equation using a random effects model). As expected, we find that real depreciations are associated with higher growth. The effect is economically significant as the point estimates suggest that, in countries with no external dollarization, a 20 percent real devaluation is associated with an increase in per capita GDP growth of approximately half a percentage point. We also find that external dollarization does reduce the expansionary effect of devaluations. In particular, the point estimates suggest that in countries where external dollarization is greater than 0.84 (countries that have dollar denominated external debt greater than 84 percent of GDP), currency devaluations become contractionary. This

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<sup>7</sup> Our results do not change if we relax this assumption.

corresponds to the top decile of the distribution of observations in the whole sample and to the top 20 if we restrict the sample to developing countries.

Column 2 repeats the experiment by focusing on domestic dollarization (again we use random effects). In this case, we still find that the coefficients have the right sign but they are not statistically significant. This is consistent with the fact, underlined in Section 1, that domestic dollar debts are partially held by residents, particularly depositors, so the aggregate effect of a real exchange rate devaluation is unclear.

Column 3 uses the measure of domestic liability dollarization assembled by Calvo et al. (2005). This reduces the sample to 29 countries (18 industrial and 11 developing), but we still find a large negative effect of depreciations in countries with high levels of domestic liability dollarization. In particular, the point estimates indicate that the effect of depreciations gets negative for countries with values of domestic liability dollarization higher than 0.5, which is just above the median value for DLD in our sample.

In column 4, we repeat the experiment of Column 1, but substituting the time invariant country-specific variable with a set of country fixed effects, with results remaining mostly unchanged. This is done in order to control for a variety of country specific effects that might have been ignored in the empirical specification. We still find that devaluations are expansionary in countries with low levels of external dollarization and contractionary in countries with high levels of external dollarization. Column 5 repeats the experiment of column 2 using fixed effects, but even though the coefficients have the correct sign, they are not statistically significant. Column 6 repeats the experiment of column 3 using fixed effects without finding major changes. In all cases, we include an interaction term of real depreciation with the trade openness coefficient under the hypothesis that the former will have more powerful effects in more open economies, and this is confirmed in columns 3 and 6.

**Table 2: Base Line Regressions**

Dependent Variable: GDP Per Capita Growth Rate

|   | (1)                  | (2)                  | (3)                  | (4)                 | (5)                 | (6)                  |
|---|----------------------|----------------------|----------------------|---------------------|---------------------|----------------------|
| Gross Fixed Capital Formation / GDP                   | 0.168<br>[0.021]***  | 0.189<br>[0.028]***  | 0.205<br>[0.040]***  | 0.195<br>[0.028]*** | 0.191<br>[0.034]*** | 0.333<br>[0.077]***  |
| Population Growth                                     | -0.002<br>[0.002]    | 0.002<br>[0.003]     | -0.005<br>[0.004]    | 0.000<br>[0.003]    | 0.004<br>[0.002]*   | -0.009<br>[0.008]    |
| Log(GDP Per Capita 1974)                              | -0.008<br>[0.002]*** | -0.008<br>[0.003]*** | -0.005<br>[0.004]    |                     |                     |                      |
| Secondary Schooling / Total Population                | 0.010<br>[0.010]     | 0.022<br>[0.017]     | 0.019<br>[0.016]     | -0.011<br>[0.017]   | -0.005<br>[0.019]   | 0.049<br>[0.065]     |
| Log(Population)                                       | 0.001<br>[0.001]     | 0.002<br>[0.001]     | -0.002<br>[0.002]    | 0.007<br>[0.010]    | -0.004<br>[0.010]   | 0.035<br>[0.066]     |
| Government Consumption Growth                         | 0.025<br>[0.013]*    | 0.031<br>[0.013]**   | 0.033<br>[0.021]     | 0.020<br>[0.014]    | 0.025<br>[0.014]*   | 0.009<br>[0.023]     |
| Freedom Index   | -0.003<br>[0.001]**  | -0.004<br>[0.002]**  | -0.002<br>[0.003]    | -0.002<br>[0.002]   | -0.001<br>[0.002]   | 0.002<br>[0.005]     |
| Δ Terms of Trade                                      | 0.007<br>[0.014]     | -0.011<br>[0.013]    | 0.058<br>[0.045]     | 0.010<br>[0.014]    | -0.010<br>[0.012]   | 0.058<br>[0.045]     |
| Δ Real Exchange Rate                                  | 0.028<br>[0.016]*    | 0.007<br>[0.015]     | -0.021<br>[0.018]    | 0.029<br>[0.016]*   | 0.002<br>[0.015]    | -0.016<br>[0.020]    |
| Openness  | 0.028<br>[0.009]***  | 0.026<br>[0.010]**   | -0.022<br>[0.017]    | 0.036<br>[0.013]*** | 0.026<br>[0.013]**  | 0.010<br>[0.030]     |
| Δ Real Exchange Rate * Openness                       | -0.033<br>[0.060]    | -0.039<br>[0.082]    | 0.514<br>[0.140]***  | -0.031<br>[0.060]   | -0.016<br>[0.087]   | 0.440<br>[0.134]***  |
| External Dollarization [t-1]                          | -0.009<br>[0.004]**  |                      |                      | -0.007<br>[0.005]   |                     |                      |
| Δ Real Exchange Rate * External Dollarization [t-1]   | -0.028<br>[0.013]**  |                      |                      | -0.031<br>[0.014]** |                     |                      |
| Domestic Dollarization [t-1]                          |                      | 0.0000<br>[0.000]    |                      |                     |                     |                      |
| Δ Real Exchange Rate * Domestic Dollarization [t-1]   |                      | 0.0000<br>[0.001]    |                      |                     | 0.000<br>[0.001]    |                      |
| Domestic Dollarization 2 [t-1]                        |                      |                      | -0.030<br>[0.030]    |                     |                     | -0.061<br>[0.047]    |
| Δ Real Exchange Rate * Domestic Dollarization 2 [t-1] |                      |                      | -0.504<br>[0.060]*** |                     |                     | -0.477<br>[0.056]*** |
| SAFRICA Dummy   | -0.014<br>[0.007]*   | -0.018<br>[0.007]*** |                      |                     |                     |                      |
| LATAM Dummy   | -0.003<br>[0.004]    | -0.006<br>[0.004]    | 0.003<br>[0.007]     |                     |                     |                      |
| ECA Dummy   | -0.005<br>[0.009]    | 0.000<br>[0.009]     | 0.003<br>[0.016]     |                     |                     |                      |
| Observations  | 1416                 | 1324                 | 289                  | 1416                | 1324                | 289                  |
| Number of Countries                                   | 57                   | 56                   | 29                   | 57                  | 56                  | 29                   |
| Estimation Method                                     | Random Effects       | Random Effects       | Random Effects       | Fixed Effects       | Fixed Effects       | Fixed Effects        |

Robust standard errors in brackets

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

In Table 3 we explore the consequences of our assumption that industrial countries have no external dollarization (without reporting, from now on, the whole control set and focusing on external dollarization and the only significant domestic dollarization measure –Domestic dollarization2). We do this in two ways. In columns 1 and 2 we interact real depreciation with a dummy variable that takes value one for industrial countries (column 1 uses random effects and column 2 uses fixed effects).<sup>8</sup> This should allow us to separate the effect of dollarization from that of being an industrial country. We find that this interaction has a negative and not significant

<sup>8</sup> The regressions include the same set of controls as in Table 1, but in order to save space we only report the variables of interest.

coefficient,<sup>9</sup> but what is more interesting for our purposes is that the coefficients of  $\gamma$  and  $\phi$  are unchanged (if anything  $\phi$  increases in absolute value). Our second strategy consists of dropping all industrial countries from the sample (columns 3 and 4 of Table 3 use random and fixed effects, respectively): once more the results are unchanged. Table 3B repeats the experiment using domestic dollarization, and again we find that the results are robust to dropping industrial countries. Notice that the domestic dollarization measure correctly captures the possibility of liability dollarization in industrial countries and in this case we observe that the  $\text{drer*IND}$  interaction has the expected positive sign.

**Table 3: Separating the Effect of Industrial Countries (Using External Liability Dollarization)**

| Dependent Variable: GDP Per Capita Growth Rate             |                |               |                |               |
|--|----------------|---------------|----------------|---------------|
|  | (1)            | (2)           | (3)            | (4)           |
| $\Delta$ Real Exchange Rate [t-1]                          | 0.031          | 0.03          | 0.037          | 0.032         |
|  | [0.017]*       | [0.018]*      | [0.021]*       | [0.021]       |
| Openness   | 0.031          | 0.035         | 0.041          | 0.047         |
|  | [0.009]***     | [0.013]***    | [0.016]***     | [0.025]*      |
| $\Delta$ Real Exchange Rate * Openness                     | -0.032         | -0.028        | -0.07          | -0.046        |
|  | [0.060]        | [0.060]       | [0.087]        | [0.086]       |
| External Dollarization [t-1]                               | -0.008         | -0.006        | -0.009         | -0.006        |
|  | [0.004]**      | [0.005]       | [0.004]**      | [0.005]       |
| $\Delta$ Real Exchange Rate * External Dollarization [t-1] | -0.03          | -0.032        | -0.03          | -0.032        |
|  | [0.015]**      | [0.016]**     | [0.015]**      | [0.016]**     |
| Industrial Countries                                       | 0.013          |               |                |               |
|  | [0.009]        |               |                |               |
| $\Delta$ Real Exchange Rate * Industrial Countries         | -0.008         | -0.005        |                |               |
|  | [0.016]        | [0.016]       |                |               |
| Observations   | 1416           | 1416          | 828            | 828           |
| Number of Countries  | 57             | 57            | 35             | 35            |
| Estimation Method  | Random Effects | Fixed Effects | Random Effects | Fixed Effects |

Robust standard errors in brackets. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Note: The regressions include the same controls as in table 1, but are not reported in order to save space. Detailed results are available upon request.

<sup>9</sup> While the negative coefficient may seem puzzling, this can be easily rationalized with the observation that we are forcing all industrial countries to have zero dollarization but some balance sheet effect are likely to be at work there and we would capture them if we could measure external dollarization in these countries. Since we cannot measure these effect the  $\text{DRER*IND}$  interaction just capture their average effect.

**Table 3b: Separating the Effect of Industrial Countries (Using Domestic Liability Dollarization 2)**

Dependent Variable: GDP Per Capita Growth Rate

|  | (1)                  | (2)                  | (3)                  | (4)                  |
|--|----------------------|----------------------|----------------------|----------------------|
| $\Delta$ Real Exchange Rate [t-1]                            | -0.021<br>[0.018]    | -0.015<br>[0.018]    | -0.037<br>[0.036]    | -0.018<br>[0.044]    |
| Openness   | -0.02<br>[0.018]     | 0.047<br>[0.038]     | -0.057<br>[0.155]    | 0.073<br>[0.197]     |
| $\Delta$ Real Exchange Rate * Openness                       | 0.479<br>[0.160]***  | 0.207<br>[0.174]     | 0.777<br>[0.623]     | 0.259<br>[0.817]     |
| Domestic Dollarization 2 [t-1]                               | -0.024<br>[0.031]    | -0.056<br>[0.047]    | 0.021<br>[0.047]     | 0.035<br>[0.065]     |
| $\Delta$ Real Exchange Rate * Domestic Dollarization 2 [t-1] | -0.506<br>[0.061]*** | -0.485<br>[0.056]*** | -0.522<br>[0.067]*** | -0.543<br>[0.072]*** |
| Industrial Countries   | 0.004<br>[0.017]     |                      |                      |                      |
| $\Delta$ Real Exchange Rate * Industrial Countries           | 0.012<br>[0.026]     | 0.06<br>[0.032]*     |                      |                      |
| Observations   | 289                  | 289                  | 112                  | 112                  |
| Number of Countries  | 29                   | 29                   | 11                   | 11                   |
| Estimation Method  | Random<br>Effects    | Fixed<br>Effects     | Random<br>Effects    | Fixed<br>Effects     |

Robust standard errors in brackets. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Note: The regressions include the same controls as in table 1, but are not reported in order to save space. Detailed results are available upon request.

Next, we explore the role of outliers. In columns 1 and 2 of Table 4, we estimate the model for our external dollarization measure (again using random and fixed effects) after dropping all observations where  $|\varepsilon_{i,t}| \geq 3\sigma_\varepsilon$ .<sup>10</sup> Again, we find that the coefficients are unchanged. Finally, we use the robust regression routine of STATA (this is the RREG command which uses two types of iterations to put less weight on outliers). In column 3 we run regular robust regression and in column 4 we also include a set of country fixed effects. The results are basically identical to those of our baseline regression. Table 4B repeats the experiment for domestic liability dollarization and again confirms the result.

<sup>10</sup> We proceed in two steps: estimate the model, recover the residual, compute their variance, and then re-estimate the model dropping all observations for which the above condition holds.

**Table 4: The Role of Outliers (Using External Liability Dollarization)**

| Dependent Variable: GDP Per Capita Growth Rate             |                |               |                   |                                      |
|--|----------------|---------------|-------------------|--------------------------------------|
|  | (1)            | (2)           | (3)               | (4)                                  |
| $\Delta$ Real Exchange Rate [t-1]                          | 0.031          | 0.028         | 0.029             | 0.033                                |
|  | [0.013]**      | [0.013]**     | [0.011]***        | [0.011]***                           |
| Openness   | 0.027          | 0.043         | 0.019             | 0.046                                |
|  | [0.009]***     | [0.010]***    | [0.007]***        | [0.012]***                           |
| $\Delta$ Real Exchange Rate * Openness                     | -0.051         | -0.043        | -0.054            | -0.063                               |
|  | [0.055]        | [0.055]       | [0.048]           | [0.047]                              |
| External Dollarization [t-1]                               | -0.011         | -0.01         | -0.012            | -0.011                               |
|  | [0.002]***     | [0.002]***    | [0.002]***        | [0.002]***                           |
| $\Delta$ Real Exchange Rate * External Dollarization [t-1] | -0.026         | -0.029        | -0.024            | -0.029                               |
|  | [0.007]***     | [0.007]***    | [0.008]***        | [0.008]***                           |
| Observations   | 1390           | 1388          | 1416              | 1416                                 |
| Number of Countries  | 57             | 57            | 57                | 57                                   |
| Estimation Method  | Random Effects | Fixed Effects | Robust Regression | Robust Regression with Fixed Effects |

Robust standard errors in brackets. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Note: The regressions include the same controls as in table 1, but are not reported in order to save space. Detailed results are available upon request.

**Table 4b: The Role of Outliers (Using Domestic Liability Dollarization 2)**

| Dependent Variable: GDP Per Capita Growth Rate             |                |               |                   |                                      |
|--|----------------|---------------|-------------------|--------------------------------------|
|  | (1)            | (2)           | (3)               | (4)                                  |
| $\Delta$ Real Exchange Rate [t-1]                          | -0.025         | -0.013        | -0.026            | -0.022                               |
|  | [0.018]        | [0.020]       | [0.018]           | [0.016]                              |
| Openness   | -0.024         | 0.009         | -0.025            | 0.011                                |
|  | [0.017]        | [0.030]       | [0.021]           | [0.029]                              |
| $\Delta$ Real Exchange Rate * Openness                     | 0.52           | 0.386         | 0.505             | 0.369                                |
|  | [0.138]***     | [0.126]***    | [0.148]***        | [0.129]***                           |
| Domestic Dollarization 2 [t-1]                             | -0.032         | -0.056        | -0.037            | -0.017                               |
|  | [0.029]        | [0.042]       | [0.022]           | [0.030]                              |
| $\Delta$ Real Exchange Rate * Domestic Dollarization [t-1] | -0.499         | -0.493        | -0.477            | -0.433                               |
|  | [0.059]***     | [0.054]***    | [0.065]***        | [0.056]***                           |
| Observations   | 288            | 284           | 289               | 288                                  |
| Number of Countries  | 29             | 29            | 29                | 29                                   |
| Estimation Method  | Random Effects | Fixed Effects | Robust Regression | Robust Regression with Fixed Effects |

Robust standard errors in brackets. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Note: The regressions include the same controls as in table 1, but are not reported in order to save space. Detailed results are available upon request.

After having established that our baseline result is extremely robust, we now move to test whether the effect documented above goes through investment or consumption growth. In Table 5, we run a set of regression similar to those of Table 1 but with the growth rate of investment as the dependent variable. In columns 1 and 2, we carry out the regressions for external

dollarization (with random and fixed effects, respectively) concluding that the balance sheet effect is very strong. The effect of domestic dollarization is tested in columns 3 and 4, and the estimate turns out to be highly positive and significant at a 10-percent level. To save space, we do not present the consumption growth regressions (which are available upon request), but they decisively reject the presence of an effect as the one detected for GDP and investment growth.

**Table 5: Investment Growth**

| Dependent Variable: Growth of Investment in PPP Dollars    |            |               |            |               |
|--|------------|---------------|------------|---------------|
|  | (1)        | (2)           | (3)        | (4)           |
| Population Growth  | 0.000      | 0.001         | 0.002      | -0.005        |
|  | [0.001]    | [0.002]       | [0.003]    | [0.006]       |
| Log(GDP Per Capita 1974)                                   | -0.002     |               | 0.000      |               |
|  | [0.001]**  |               | [0.002]    |               |
| Secondary Schooling / Total Population                     | 0.001      | -0.016        | 0.001      | 0.029         |
|  | [0.007]    | [0.013]       | [0.011]    | [0.036]       |
| Log(Population)  | 0.001      | 0.003         | 0.000      | 0.013         |
|  | [0.000]*   | [0.006]       | [0.001]    | [0.047]       |
| Government Consumption Growth                              | 0.023      | 0.021         | 0.000      | -0.001        |
|  | [0.007]*** | [0.008]***    | [0.014]    | [0.016]       |
| Freedom Index  | -0.002     | -0.002        | 0.001      | 0.003         |
|  | [0.001]**  | [0.001]*      | [0.002]    | [0.003]       |
| $\Delta$ Terms of Trade                                    | -0.033     | -0.032        | -0.012     | -0.008        |
|  | [0.008]*** | [0.008]***    | [0.027]    | [0.028]       |
| $\Delta$ Real Exchange Rate                                | -0.001     | -0.002        | -0.023     | -0.026        |
|  | [0.009]    | [0.009]       | [0.019]    | [0.020]       |
| Openness   | 0.011      | 0.018         | -0.004     | -0.013        |
|  | [0.005]**  | [0.007]**     | [0.011]    | [0.018]       |
| $\Delta$ Real Exchange Rate * Openness                     | 0.037      | 0.039         | 0.159      | 0.159         |
|  | [0.039]    | [0.042]       | [0.098]    | [0.099]       |
| External Dollarization [t-1]                               | 0.001      | -0.001        |            |               |
|  | [0.001]    | [0.002]       |            |               |
| $\Delta$ Real Exchange Rate * External Dollarization [t-1] | -0.026     | -0.025        |            |               |
|  | [0.004]*** | [0.004]***    |            |               |
| Domestic Dollarization [t-1]                               |            |               | -0.058     | -0.101        |
|  |            |               | [0.020]*** | [0.038]***    |
| $\Delta$ Real Exchange Rate * Domestic Dollarization [t-1] |            |               | -0.149     | -0.134        |
|  |            |               | [0.084]*   | [0.080]*      |
| SAFRICA Dummy  | 0.001      |               |            |               |
|  | [0.004]    |               |            |               |
| LATAM Dummy  | 0.001      |               | -0.002     |               |
|  | [0.002]    |               | [0.004]    |               |
| ECA Dummy  | -0.002     |               | -0.002     |               |
|  | [0.003]    |               | [0.007]    |               |
| Observations   | 1415       | 1415          | 289        | 289           |
| Number of Countries  | 57         | 57            | 29         | 29            |
| Estimation Method  | Random     | Random        | Random     | Random        |
|  | Effects    | Fixed Effects | Effects    | Fixed Effects |

Robust standard errors in brackets

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



## 4. Conclusions

In this paper we explore the role of liability dollarization on the way that real exchange rate devaluations impact economic growth. Our research follows recent research pieces that have shown that at a microeconomic level balance sheet effects arise in the presence of liability dollarization and leads to negative impacts of real exchange rate devaluations on firm performance. Our research complements the microeconomic research by showing how at a macro level the results hold and are economically significant.

We find that in countries with no external dollarization, a 20 percent real devaluation increases per capita GDP growth in approximately half a percentage point. As dollarization increases, the expansionary effect of devaluations diminishes. In countries where the external dollarization measure used in the text is greater than 0.84 (countries that have dollar denominated external debt greater than 84 percent of GDP), currency devaluations become contractionary. This corresponds to the top decile of the distribution of observations in the whole sample and to the top 20 if we restrict the sample to developing countries.

Similar results are obtained when using a measure of domestic liability dollarization. In short, for most of the developing country sample, the contractionary effect of devaluations seems to dominate the expansionary effect that is brought in through the standard trade channels of the Mundell-Fleming model. These results are robust to several specification changes, including separating the effect of industrial and developing countries, and dealing explicitly with possible outliers.

Our study also confirms that investment is the main channel through which the macroeconomic adjustment is achieved following a real exchange rate devaluation. Microeconomic research had shown that firms with dollarized liabilities adjust capital expenditure negatively when faced with devaluations while other firms respond positively. This paper shows that at the macro level the adjustment also comes through investment rather than consumption.

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