DISCUSSION PAPER SERIES

DP15170
(v. 4)

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INTERNATIONAL MACROECONOMICS AND FINANCE

ISSN 0265-8003

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Discussion Paper DP15170
First Published 17 August 2020
This Revision 08 March 2021

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This Discussion Paper is issued under the auspices of the Centre's research programmes:

- International Macroeconomics and Finance

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JEL Classification: F32, F34, G15

Keywords: currency mismatch, Balance sheet effects, COVID-19, Coronavirus, Valuation

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Acknowledgements
We thank Michael Klein, Gian Maria Milesi-Ferretti, Kristin Forbes, Sebnem Kalemli-Ozcan, Roland Beck seminar participants at the BdF-ECB Workshop on International Capital Flows and the IMF Annual Research Conference 2020 for suggestions, constructive conversations, and helpful comments. We thank Ted Liu for research assistance. All errors are ours. The views in this paper are solely of the authors and do not necessarily represent the views of the Federal Reserve Bank of San Francisco, or any other person affiliated with the Federal Reserve System, the International Monetary Fund, or CEPR.

External Balance Sheets and the COVID-19 Crisis*†

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February 27, 2021

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1 Introduction

Flight to safety in times of economic turmoil is now well documented and understood in the literature (see, for example, Hartmann, Straetmans, and Vries, 2004; and Beber, Brandt and Kavajecz, 2009).[1] Akin to other crisis experiences, during the early stages of the COVID-19 crisis in the first quarter of 2020, flight to safety was accompanied by a rapid appreciation of "safe haven" currencies, especially the U.S. dollar. As a counterpart, values of many emerging economies' currencies have declined considerably (Corsetti, Lloyd and Marin, 2020). By the end of 2020 many global asset markets recovered their initial losses, but some currencies continued to depreciate against major global currencies (Figure 1). History teaches us that sharp unexpected changes in exchange rates and other asset prices are likely to produce significant valuation changes for the net foreign asset positions.[2] Such valuation changes have a direct impact on a country's cost of capital and ability to borrow, with indirect and persistent effects on real economy, largely through their effect on investment (Aguiar, 2005; Ghironi, Lee, and Rebuci, 2015).

Until recently, it was hard to measure the contribution of the exchange rate movements to changes in aggregate external balance sheets at a global scale due to the lack of information on the currency breakdown of external asset and liability positions.[3] A recent data set (Bénétrix, Gautam, Juvenal, and Schmitz, 2019) containing the currency composition of the stocks of assets and liabilities makes this exercise possible. This data set is largely based on non-confidential actual data compiled from a survey the IMF sent to country authorities. We rely on this data set to accurately measure currency-induced valuation effects, which also allows us to compute the contribution of asset price-induced valuation effects through a reconciliation of the stocks of external balance sheet positions and flows implied by the current account (Lane and Milesi-Ferretti, 2001; Gourinchas and Rey, 2007, 2014; Forbes, Hjortsoe, and Nenova, 2017).

We analyze separately two time periods: first quarter of 2020 (from January 1 to March 31) and full year 2020. This is because in the first quarter of 2020 (2020Q1) there was a significant drop in most asset prices accompanied by the flight to safety and resulting appreciation of the U.S. dollar, the Japanese yen, and, to a lesser extent, other safe haven currencies. Many but not all of these trends reversed starting April 2020. Our sample includes 48 economies, both advanced and emerging. We study overall external balance sheet positions as well as individual asset classes: debt, which we break down into portfolio debt, direct investment debt, and other investment mostly representing bank lending and borrowing; and equity, which we breakdown into portfolio and direct investment. While many countries' external balance sheets tend to have net foreign currency liabilities, resulting in currency-induced losses following a domestic currency depreciation, the opposite is true for equity. Equity liabilities are denominated in the currency of the host country

[1] This is documented also in Baele, Bekaert, Inghelbrecht, and Wei (2019).

[2] Balance sheet effects of currency depreciations, in particular, drew attention following the Asian financial crisis in 1997-98 (see, for example, Corsetti, Pesenti, and Roubini, 1999).

[3] The first effort to obtain the currency breakdown of the international investment position was by Lane and Shambaugh (2010). However, the most updated dataset is only available up to 2012.

(domestic currency) while equity assets are mostly denominated in foreign currencies. As a result, any depreciation of the domestic currency will lead to currency-induced improvements in equity positions on countries' external balance sheets.[4]

We begin our analysis by constructing an index of exposure of each country's external balance sheet to exchange rate movements, following Lane and Shambaugh (2010), as of the beginning of 2020, prior to the onset of the COVID-19 crisis. We test whether currency exposure was in any way linked to the extent of currency depreciation in 2020Q1. We find that countries with larger potential balance sheet losses from a weakening of their domestic currency experienced a smaller depreciation in 2020Q1. This indicates that following prior large depreciation episodes, countries most vulnerable to currency depreciation made currency composition of their external balance sheets more resilient. In fact, Bénétrix, Lane, and Shambaugh (2015) show that prior to the Global Financial Crisis of 2008-09 many emerging markets shifted towards positive net foreign currency positions.

Next we calculate changes in external net liabilities resulting from exchange rate changes between January 1, 2020, and March 31, 2020, as well as between January 1, 2020, and December 31, 2020. Importantly, in addition to considering changes in domestic exchanges rate *vis-à-vis* the U.S. dollar, we also consider movements between four major currencies: U.S. dollar, British pound, the euro, and Japanese yen.[5] We find that during 2020Q1, when the U.S. dollar appreciated with respect to most currencies, the U.S. experienced large currency-induced losses on its external balance sheet positions, due to its equity position. Other countries with substantial losses were Switzerland, Turkey, and Japan. Most countries experienced either gains or very small changes. The situation changed substantially by the end of 2020, when the U.S. dollar depreciated against most currencies in our sample. During the full year of 2020, currency-induced valuation losses were observed on external balance sheets of many countries, while the U.S. showed overall external balance sheet gains, again, due to its equity positions. In terms of portfolio vs. direct investment equity, we find that both contributed nearly equally for most countries. Similarly, while direct investment debt positions tend to be small, the contribution of portfolio debt and other investment positions was roughly equal for most countries.

Because in past crises emerging markets proved to be most vulnerable to currency-induced external balance sheet effects, we discuss separately their 2020 experience and compare it to the Asian Financial Crisis of 1997-98.[6] We find that during the Asian Financial crisis Indonesia, Thailand, and South Korea experienced substantial currency-induced losses following rapid depreciations of their currencies. In 2020Q1 these countries experienced either minor changes (in Indonesia foreign exchange reserves were sufficient to almost exactly offset losses) or gains (Thailand and Korea), de-

[4]Cavallo and Tille (2006) and Gourinchas, Rey, and Govillot (2010) show that, as a result, in times of global economic stress there is a net transfer from the U.S. to the rest of the world on external equity positions.

[5]We count as global currencies the "big four" currencies according to Aizenman, Cheung, and Qian (2020).

[6]For example, Gourinchas, Rey, and Truempler (2012) show that during the flight to safety observed during the Global Financial Crisis of 2008-09 China, Russia, Hong Kong, and Singapore experienced substantial currency-induced valuation losses.

spite substantial depreciation of their currencies. This is consistent with our findings that countries most prone to depreciation had less currency mismatch on their external balance sheets.

Finally, we combine our calculations of currency-induced balance sheet effects with information on external balance sheet positions at the beginning of 2020, at the end of 2020Q1, and data on current accounts in 2020Q1.[7] The differences between the change in net international investment positions and current account consists of valuation changes in the external balance sheet. Valuation changes could be due to changes in exchange rates, the currency-induced valuation effects we calculated, or due to changes in prices of assets and liabilities held in the portfolio. We observe all but asset prices and are therefore able to compute asset-price valuation changes as a residual.[8]

We find that for many countries currency-induced valuation effects mitigated losses resulting from asset price declines that occurred in 2020Q1.[9] In the U.S., currency-induced valuation losses in 2020Q1 contributed 19 percent to total valuation losses during this time period, once again showing the role of the U.S. as a global insurer during flight-to-quality episodes (Gourinchas, Rey, and Govillot, 2010). We also find that most countries that experienced excess capital outflows in 2020Q1 also experienced valuation gains, which mitigated the impact of outflows on their net external balance sheet positions. In contrast to Bénétrix et al. (2015), however, we do not find that valuation effects, currency-induced or total, had an overall stabilizing effect on external balance sheet positions: many countries with excess capital inflows in 2020Q1 also experienced valuation gains.

One important caveat of our analysis is that aggregate positions may mask substantial currency mismatches on balance sheets of individual institutions or for more granular asset classes.[10] While we do not have access to institution-level data, we observe some of these aggregation issues by analyzing separately debt and equity: for many countries we find that currency-induced valuation effects on debt and on equity offset each other.

In addition to providing analysis of the most recent episode of a widespread movement in exchange rates, our paper extends the geographical scope of the literature that analyzes the impact of valuation effects on the external balance sheets while providing a comprehensive analysis of overall external positions with details by asset class. Past studies either relied on estimates of currency composition of external balance sheets (Lane and Shambaugh, 2010; Bénétrix et al., 2015) or had a limited set of countries in their analysis, such as Forbes, Hjortsoe, and Nenova (2017). Thanks to the new data set, we are able to use actual data, rather than estimates, of currency composition of external positions by asset class for a large sample of countries.[11]

[7] For detailed analysis of the capital flows at the onset of the COVID-19 crisis, see Avdjiev, McGuire, and Von Peter (2020).

[8] Technically, the residual also includes statistical discrepancy.

[9] At the time of this draft, the end of the year data for current account and international investment positions for 2020 was not yet available for most countries in our sample.

[10] By focusing on aggregate external balance sheets we also miss any effects of domestic dollarization as described in Luca and Petrova (2008) and Fidrmuc, Hake, and Stix (2013) for the case of transition economies.

[11] Please see Appendix for the exact list of data sources.

The remainder of the paper is organized as follows. Section 2 describes the data. Section 3 presents the methodology. The calculations of currency-induced valuation effects are shown in Section 4 and stock-flow reconciliation in Section 5. Section 6 concludes. The Appendix provides additional details on the data and supplemental charts.

2 Data

Our data set combines information on the stock of assets and liabilities of portfolio debt, other investment, FDI debt, FDI equity, portfolio equity as well as reserves, the currency composition of those items, and exchange rates for a sample of 48 countries.[12]

Stocks data at the end of 2019 are sourced from the External Wealth of Nations data set by Lane and Milesi-Ferretti (2007).[13] Exchange rates at daily frequency are sourced from Datastream. COVID-19 statistics and data on government responses are obtained from Coronavirus Government Response Tracker database.[14]

The currency composition of gross assets and liabilities builds on a novel data set on currency exposures published by the IMF.[15] The main source of currency composition data is a survey sent to country authorities by the IMF Research Department in collaboration with the Statistics Department. The survey requested data on the main components of the international investment position (IIP) broken down into five main currencies (i.e. U.S. dollar, euro, Japanese yen, British pound and renminbi), domestic currency (when different from the previous five), and "other currencies" which include all the other foreign currencies not included in the previous categories. Country authorities responded to the survey on a voluntary basis and around 55 percent of countries reported some data. Currency composition data are only available through 2017, but Bénétrix et al. (2019) show that the breakdown has been very persistent in the last 10 years. Thus, we apply 2017 currency weights to 2019 stocks.

Tables A.1, A.2, and A.3 detail the sources of currency composition data for each country in 2017 for debt assets, debt liabilities, and equity, respectively. Actual data on the currency breakdown of portfolio debt assets was obtained from the IMF survey and complemented with the data reported in the Coordinated Portfolio Investment Survey (CPIS).[16] For the eleven countries for which actual data are not available, estimates from the IMF dataset are used.[17]

[12] See Tables A.1, A.2, and A.3 in the Appendix for details on the country coverage.

[13] We use gross asset and liability positions for each of the two asset classes considered. Technically, these positions are "gross net" positions, net of repayments.

[14] Data are found at https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker. Daily data are available and we use March 31, 2020, to measure the state of COVID-19 spread (proxied by the number of COVID-19 related deaths) and government response in the first quarter of 2020.

[15] See Bénétrix et al. (2019). Public data are available at:
https://www.imf.org/en/Publications/WP/Issues/2019/12/27/Cross-Border-Currency-Exposures-48876.

[16] Table 2 of CPIS includes the currency of denomination of portfolio debt assets for a subset of countries.

[17] The estimation methods are described in Bénétrix et al. (2019).

The currency composition of portfolio debt liabilities is also reported in the IMF survey. In the absence of actual data we fill the gaps using "synthetic data" obtained from two sources. For a subset of countries, the currency breakdown is from the Bank of International Settlements (BIS) International Debt Statistics. Since the BIS does not report the currency composition of domestically issued debt securities and there is no information on non-resident holdings of such securities, the share of domestic currency debt could be underestimated for emerging economies. To control for this, the share of debt denominated in domestic currency is taken from Arslanalp and Tsuda (2014) and the foreign currency shares are computed based on BIS international issuance data.

The main component of other investment assets and liabilities is bank-related. Therefore, the actual survey data was complemented with the currency of denomination of banks' cross-border positions reported to the BIS Locational Banking Statistics.

We distinguish between the equity and debt components of FDI. For both items we use actual data from the IMF Survey and estimated data from Bénétrix et al. (2019). Actual data on the currency breakdown of portfolio equity assets was obtained from the IMF survey and complemented with the currency mix data reported in the Coordinated Portfolio Investment Survey (CPIS).[18] For the twelve countries for which actual data are not available, estimates from the IMF dataset are used.[19] Equity liabilities (both portfolio and FDI) are assumed to be denominated in the currency of the host country. Therefore, the total size of equity liabilities is assumed to be denominated in domestic currency. As a result, there is no foreign-currency exposure from equity liabilities.

There are a number of countries who make the currency composition of reserves publicly available. For those countries, actual data on the currency composition of reserves were obtained from non-confidential sources. For the countries for which the currency composition of reserves is confidential, we used estimates from Bénétrix et al. (2019). The following countries publish the currency composition of reserves in publications from their Central Bank or Ministry of Finance (the sources of data are in parenthesis): Canada (Department of Finance Canada), Chile (Central Bank of Chile), Colombia (Banco de la República), Peru (Central Bank of Peru), Poland (National Bank of Poland), Sweden (Riskbank), Switzerland (Swiss National Bank), United Kingdom (Bank of England), USA (US Treasury), and Uruguay (Central Bank of Uruguay).[20] The IMF Currency Composition of Official Foreign Exchange Reserves (COFER) keeps track of the currency composition of reserves of its member countries. Although COFER data for individual countries are strictly confidential, since 2016 a small group of countries report an optional SDR breakdown by currency

[18] Table 2 of CPIS includes the currency of denomination of portfolio equity assets for a subset of countries.

[19] The estimation methods are described in Bénétrix et al. (2019).

[20] For the United Kingdom we use the combined currency shares of the Bank of England and the UK Government (which includes other foreign currency assets such as claims *vis-á-vis* residents); for the USA we use the combined currency share of the Open Market Account (SOMA) at the Board of Governors of the Federal Reserve System and the US Treasury Exchange Stabilization Fund (ESF); for Chile we use the combined currency share in the liquidity and the investment portfolio of the central bank. Finally, the Central Bank of Peru reports the US dollar share of reserves and in their Annual Report they highlight that the reserve assets denominated in currencies other than the US dollar are mostly denominated in euros.

in the reserves template, which is publicly available.[21] These countries are: Australia, Belgium, Brazil, Finland, Germany, Ireland, Netherlands, Norway, and Portugal. For these 9 countries we use the currency breakdown from the reserves template. Finally, for Czech Republic and Russia we obtain information on the currency composition of reserves from the ECB publication "The International Role of the Euro."

For the purpose of this exercise, for each country, we focus on four global currencies: the U.S. dollar (USD), the British pound (GBP), the euro (EUR), and the Japanese yen (JPY), in addition to domestic currency. These currencies combined account for 92% of the total stock of external portfolio debt assets and liabilities and for 92% of other external investment assets and liabilities.

3 Methodology

We conduct our analysis of valuation effects resulting from currency and asset price dynamics in two steps. First, we measure currency-induced valuation effects for total net foreign liabilities and separately for individual asset classes. Second, we reconcile differences between changes in net foreign asset positions (stocks) and capital flows and obtain total valuation effects. The total valuation effects can be broken down into a currency-induced component which are our estimates of currency-valuation effects and valuation effects due to changes in asset prices, which we compute as a residual.

3.1 Measuring Currency-Induced Valuation Effects

In order to evaluate the size of the balance sheet effect of exchange rate changes, we compute a measure of valuation effects on gross stocks of net foreign liabilities (NL) as proposed by Lane and Shambaugh (2010):[22]

$$VALNL_{i,t}^{FX,c} = \%\Delta I_{i,t}^{F,c}(A_{i,t-1}^{c} + L_{i,t-1}^{c}), \tag{1}$$

where $VALNL_{i,t}^{FX,c}$ indicates the currency-induced valuation effect (in US. dollars) driven by currency movements for country i and asset class c. $\%\Delta I_{i,t}^{F,c}$ is the percentage change in the financial exchange rate index during the period t for asset class c and $A_{i,t-1}^{c}$ and $L_{i,t-1}^{c}$ are the end-of-period $t-1$ gross stock of external assets and liabilities in asset class c expressed in current U.S. dollars.

The financial exchange rate index provides a measure of the sensitivity of country's external balance sheets to currency movements and is given by

$$I_{i,t}^{F,c} = I_{i,t-1}^{F,c}(1 + \sum_{j} \omega_{ij,t-1}^{F,c} \%\Delta E_{ij,t}), \tag{2}$$

[21] http://data.imf.org/?sk=E6A5F467-C14B-4AA8-9F6D-5A09EC4E62A4

[22] Note that Lane and Shambough (2010) compute valuation effects on net foreign assets while we compute the effects on net foreign liabilities.

where $\%\Delta E_{ij,t}$ is the percentage change in the bilateral end-of-period nominal exchange rate between the currency of country i and the foreign currency j between $t-1$ and t, and

$$\omega^{F,c}_{ij,t} = \omega^{L,c}_{ij,t} s^{L,c}_{i,t} - \omega^{A,c}_{ij,t} s^{A,c}_{i,t}, \tag{3}$$

where

$$\omega^{L,c}_{ij,t} = \frac{L^c_{ij,t}}{\sum_j L^c_{ij,t}}, \quad \omega^{A,c}_{ij,t} = \frac{A^c_{ij,t}}{\sum_j A^c_{ij,t}}, \quad s^{L,c}_{i,t-1} = \frac{L^c_{i,t-1}}{A^c_{i,t-1} + L^c_{i,t-1}}, \quad s^{A,c}_{i,t} = \frac{A^c_{i,t}}{A^c_{i,t} + L^c_{i,t}},$$

$L^c_{ij,t}$ and $A^c_{ij,t}$ are the amount of foreign liabilities and foreign assets, respectively, denominated in currency j in asset class c. By construction $s^{A,c}_{i,t} + s^{L,c}_{i,t} = 1$.

We conduct our analysis individually for two main asset classes, debt and equity. We further break down these into sub-classes: portfolio and direct investment equity; portfolio debt, direct investment debt, and other investment, which mainly reflect bank transactions. We also analyze total aggregated assets an liabilities, which we denote by dropping a superscript c in our notation.

We evaluate a country's external balance sheets sensitivity to proportional changes of domestic currency values relative to all foreign currencies as $\mathcal{M}_{i,t} = \sum_j \omega^F_{ij,t}$, which simplifies to

$$\mathcal{M}_{i,t} = \omega^L_{i,t} s^L_{i,t} - \omega^A_{i,t} s^A_{i,t} = \sum_j \omega^L_{ij,t} s^L_{i,t} - \sum_j \omega^A_{ij,t} s^A_{i,t}, \tag{4}$$

where shares of foreign liabilities and foreign assets denominated in any foreign currency, $\omega^L_{i,t}$ and $\omega^A_{i,t}$ are computed for total assets and total liabilities. We use this measure of external balance sheet sensitivity to exchange rate movements to understand the importance of currency mismatch in explaining the magnitude of currency depreciation at the onset of the crisis.

We rely on Lane and Shambough (2010) approach to measuring valuation effects because this is the approach taken in international finance literature (see Forbes et al., 2017; Gourinchas et al., 2010). However, given that we observe net foreign liabilities and their currency composition at the beginning of the period in consideration as well as exchange rates at the beginning and at the end of the time period in consideration, we can simply calculate the change in home currency value of total portfolio for each country. We show that this simple "accounting" approach yields results that are very similar to the benchmark calculations we use.[23]

In order to assess the importance of the currency induced valuation effects for each individual country we also compute the measure in equation (1) relative to GDP, as follows.

$$\frac{VALNL^{FX,c}_{i,t}}{GDP_{i,t-1}} = \%\Delta I^{F,c}_{i,t} \frac{(A+L)^c_{i,t-1}}{GDP_{i,t-1}}, \tag{5}$$

where both valuation effects and GDP are measured in U.S. dollars.

[23] Differences are due to non-linearities in the Lane and Shambough (2010) calculations.

The sign of the effects of a currency depreciation would depend on whether a country has a long or short position in foreign currency. The magnitude will be determined by the depreciation rate and the size of the external balance sheet.

3.2 Total Effects using Stock-Flow Reconciliation

By definition, changes in net foreign asset positions (NFA) are composed of international financial transaction, which net out to be equal to the current account (CA) and changes in valuation of existing positions. There are two sources of valuation changes — those due to changes in asset prices and those due to changes in exchange rates. While we can compute currency-induced valuation changes as discussed in the previous section ($VALNFA^{FX}_{i,t} = -VALNL^{FX}_{i,t}$), we cannot measure asset-price-related valuation changes ($VALNFA^{P}_{i,t}$) because we don't have asset-level details and because not all assets are valued at market prices. We do, however, observe net foreign asset positions and current account, and can therefore compute asset-price-related valuation changes as a residual from the identity

$$NFA_{i,t} - NFA_{i,t-1} = CA_{i,t} + VALNFA^{P}_{i,t} + VALNFA^{FX}_{i,t} \tag{6}$$

for each country in our sample.[24]

4 Currency-Induced Valuation Effects in 2020

At the onset of the COVID-19 crisis, during the first quarter of 2020, flight to safety was accompanied by a rapid appreciation of "safe haven" currencies, especially the USD. As a counterpart, values of many emerging economies' currencies have declined considerably (left panel, Figure 1). This was a period characterized by substantial turmoil and capital outflows from many emerging economies. Asset markets started to stabilized in April 2020 and the configuration of currencies' depreciation by the end of 2020 is quite different (right panel, Figure 1).

The JPY slightly strengthened initially and continued to strengthen throughout the year, appreciating by 5 percent against the USD for 2020 overall. By contrast, while the euro depreciated initially, by the end of 2020 it gained value against the USD. Some emerging economies' currencies depreciated considerably at the beginning of the COVID-19 crisis but subsequently gained value so that by the end of 2020 their currencies did not suffer a large depreciation. Such is the case, for example, for South Africa, Mexico, and Colombia. These countries witnessed an initial depreciation of over 20 percent and an end-of-year depreciation of less than 5 percent. In other countries, such as Malaysia and Korea, the initial depreciation was more than offset by end-of-year revaluations. Conversely, some other countries' currencies depreciated throughout 2020. While the Argentinean

[24] Note that the measurement of the valuation terms is subject to measurement error, since stock positions and flows are typically measured from different sources. Therefore, any errors or revisions will be included in ($VALNFA^{P}_{i,t}$).

peso and the Turkish lira depreciated by 8 and 12 percent respectively initially, by the end of 2020 their currencies depreciated by 40 and 25 percent, respectively. Given the differences in the currencies' behavior at the onset of the crisis and by the end of 2020, we compute the currency-induced valuation effects for the first quarter of 2020 as well as for the end-of-year.

In this section we analyze the impact of exchange rate movements on the value of total external liabilities in the first quarter of 2020 as well as during the entire year. We then discuss the contribution of different asset classes to the effects on total portfolios: first separating debt and equity and then breaking each of them down into asset sub-classes. In addition, we focus on emerging economies and provide comparison to currency-induced valuation effects observed during 1997-98 Asian crisis. Finally, we test whether the amount of currency depreciation experienced in the first quarter of 2020, at the onset of the COVID-19 crisis, was associated with the currency mismatch on external balance sheets, proxied by the Lane and Shambaugh (2010) measure of foreign currency exposure defined as net foreign liabilities denominated in foreign currency as a proportion of the aggregate balance sheet.

4.1 Effects on Aggregate Net Liabilities

We use the measure $VALNL_{i,t}^{FX,c}$ described in equation (1) to compute changes in net liabilities that are due to currency movements between January 1 and March 31, 2020 as well as for the entire year 2020. Figure 2 shows our calculations for the change in aggregate net liabilities in billion U.S. dollars for 2020Q1 (left panel) and the full year 2020 (right panel). The results in terms of changes in net liabilities as a percentage of GDP are shown in Figure 3. In both cases, dark and light bars combined depict changes in aggregate net liabilities but the light bars exclude foreign currency reserves. The countries are sorted from largest valuation losses (i.e. increase in net liabilities) to higher gains.

At the onset of the COVID-19 crisis, in 2020Q1, the largest valuation losses in billion U.S. dollars were experienced by the United States ($188 billion). This is consistent with the notion of "exorbitant duty" first documented by Gourinchas et al. (2012), who demonstrate that the U.S. provides insurance to the rest of the world in times of global economic stress. Japan and Switzerland also experienced valuation losses in 2020Q1 ($90 billion and $51 billion, respectively). In contrast, we find that Russia, the United Kingdom, and Norway enjoyed the largest currency-induced valuation gains. By the end of 2020 the configuration of exchange rate movements shifted the picture of currency-induced valuation effects. In fact, by the end of 2020 the countries which show the largest currency-induced valuation losses are China, Ireland, Japan, and Switzerland, while the largest valuation gains are registered in the United States, Russia and Brazil.

In order to have a sense of the economic importance of these effects, it is useful to measure the currency-induced valuation effects relative GDP (Figure 3). We find that relative to GDP the largest currency-induced valuation losses in 2020Q1 were experienced by Hong Kong, Switzerland, and Turkey (9.4, 7.2, and 2.3 percent of GDP, respectively). At the same time, currency-induced

valuation gains for Norway, Singapore, and Russia have exceeded 10 percent of their respective GDPs. By the end of 2020, the largest currency-induced valuation losses as a share of GDP were observed in Ireland, Switzerland, and Netherlands (36, 18, and 13 percent of GDP, respectively) and were driven by the appreciation of euro and Swiss Franc against the U.S. dollar. The largest gains were more modest in magnitude and the largest gains were observed in Argentina, Russia, and Hong Kong.[25]

We check the sensitivity of our results to an alternative calculation of currency-induced valuation effects using a simple accounting method. We take foreign assets and liabilities at the end of 2019 and compute the difference between their domestic currency values at the beginning and at the end of 2020Q1 and 2020. For cross-country comparisons, we convert these values to U.S. dollars using the exchange rates at the end of 2020Q1 and the end of 2020, respectively. Figure 4 plots the results of this calculation (*y-axis*) against the Lane-Shambaugh method based on the calculation of financial exchange rates (*x-axis*). By and large, the results are concentrated around the 45 degree line, suggesting that both methods are broadly comparable.

4.2 Results by Asset Class

The aggregate results analyzed above may mask a substantial degree of heterogeneity across asset classes. It could be that some countries experienced gains on net equity positions and losses on net debt positions or vice-versa. Furthemore, portfolio assets may have different currency exposures than direct investment assets. Therefore, in this subsection we present our results disaggregated by asset class. We report our results in terms of billions of U.S. dollars with results as a share of GDP reported in the Appendix.

Figures A.2-A.4 report the corresponding currency-induced valuation effects (in billions of U.S. dollars) for different asset classes. Figure A.2 presents the breakdown between debt (comprising an aggregate of portfolio debt, other investment and, FDI debt) and equity (which includes both portfolio and FDI equity). Figures A.3 and A.4 include more disaggregated results for debt and equity components, respectively.

A number of important features emerge from these charts. For the United States, losses observed at the onset of the COVID-19 crisis (2020Q1) arise from the $250 billion increase in net equity liabilities, equally split between portfolio and FDI equity. Some of these losses are offset by $60 billion gains on external debt positions, predominantly portfolio debt. This is exactly what we would expect from a broad U.S. dollar appreciation. Because the U.S. dollar depreciated against most major currencies by the end of 2020, the pattern of currency-induced valuation effects for the U.S. also reversed, resulting in more than $600 billion gains on external equity positions, partially offset by $245 billion losses on external debt positions.

[25]To limit the number of charts, we present the rest of our measures in U.S. dollars. All corresponding charts as a share of GDP are presented in the Appendix.

The pattern of currency-induced valuation effects going in the opposite direction for debt and equity positions is observed for a number of countries, with gains and losses nearly canceling each other out for Mexico, Brazil, Colombia, Australia, and Canada. For other countries, such as Japan, Switzerland, and Russia, debt and equity positions are exposed to currency movements in the same way.

In terms of the composition of the effect on external debt positions (Figure 6), both portfolio debt and other investments play an important role, while the role of FDI debt is very limited. For most countries, portfolio debt and other investment tend to have the same direction of exposure to currency movements. A notable exception is the U.K., where the currency-induced valuation effects on portfolio debt and other investments almost exactly offset each other.

Because equity liabilities are always denominated in domestic currencies while equity assets are denominated in foreign currencies (except in the euro area), currency-induced valuation gains and losses follow the pattern of currency movements directly. Interestingly, for most countries direct investment and portfolio equity positions are equally important (Figure A.4). Notable exceptions are Russia, Brazil, and Mexico, where direct investment equity positions dominate the effect.

4.3 Emerging Economies and Historical Comparisons

During the COVID-19 crisis several governments have applied fiscal stimuli to support consumption during the lockdowns (see, for example, Arellano et al., 2020). In this context, emerging economies faced additional challenges given their perennial problem of a large external debt and susceptibility to debt crises. With a history of borrowing heavily in foreign currency (Eichengreen et al., 2007), these trends could raise questions about emerging markets' vulnerability to sharp currency movements. In a scenario of large debt accumulation and high exchange rate volatility, the currency composition of external assets and liabilities could either play a mitigating or amplifying role. A mitigating effect would be present if in response to a domestic currency depreciation a country does not suffer large valuation losses or enjoys valuation gains. By contrast, an amplifying effect would be present when valuation losses increase the value of external net liabilities.

The aggregate currency-induced balance sheet losses during the early stage of the COVID-19 economic crisis for emerging economies were modest in magnitude, despite the fact that some currencies depreciated substantially. Part of this effect is driven by gains in equity positions offsetting losses in debt positions. The gains in equity positions are unsurprising given that equity liabilities are denominated in domestic currency, while equity assets are denominated in foreign currencies, and currencies of emerging economies depreciated against global currencies.

Consider emerging economies that experienced a large weakening of their domestic currencies in 2000Q1: Brazil, Colombia, Mexico, South Africa, and Turkey. Of these countries, the only one which suffered aggregate valuation losses at the onset of the crisis is Turkey ($17 billion or 2.3 percent of GDP). In the other countries the valuation gains on equity and reserve holdings largely

compensated for the valuation losses on the debt positions. Turkey, however, exhibited substantial currency-induced valuation losses on their external debt portfolio (nearly $30 billion) and relatively small valuation gains on equity positions ($3.4 billion).[26] By contrast, in Brazil, which in absolute terms shows the largest currency-induced valuation loss on the debt component ($92 billion), these losses were offset by $86 billion. currency-induced valuation gains on equity positions (driven mainly by FDI equity). Similarly, Mexico had valuation losses on debt positions ($52 billion) driven by an increase in net portfolio debt liabilities, which were offset by $43 billion gains on equity positions. While these patterns are consistent with emerging economies foreign debt dollarization, there are some exceptions: despite substantial depreciations, Argentina, Uruguay, South Korea, and Thailand experienced small currency-induced valuation gains on their external debt positions in 2020Q1.

It is notable that South-East Asian countries which during the Asian Financial Crisis of 1997-98 suffered large valuation losses (Indonesia, Korea, Philippines, and Thailand), show for the most part moderate currency-induced valuation losses or even gains during COVID-19 crisis, despite substantial currency depreciations in these countries. As a reference, Figure A.1 in the Appendix, shows currency depreciations as well as currency-induced valuation losses for these countries during the 1997-98 Asian Financial Crisis. First, we observe much larger currency depreciations in the 1990s, which resulted from overvalued currencies prior to the collapse of their fixed exchange rate regimes. Second, we see large balance sheet losses due to dollarization of external liabilities that substantially exceeded the amount of foreign exchange reserves, the fact well documented in the literature (Corsetti et al., 1999). It appears that these countries substantially improved their management of external balance sheet in terms of currency composition in the two decades following the Asian Financial Crisis.

4.4 Currency Mismatch and Exchange Rate Depreciation

As Figure 1 shows, currency depreciation in the first quarter of 2020 varied dramatically across countries. This can be explained by a variety of reasons, including the rate of COVID-19 infections, lockdown measures, economic stimulus. Here we test a hypothesis that currency mismatch in external balance sheets prior to the COVID-19 crisis is associated with the amount of currency depreciation observed in the first quarter of 2020, before the asset markets were reassured by broad fiscal stimulus measures. We test this hypothesis by estimating the following cross-section regression:

$$\Delta E_{i,USD} = \alpha + \beta_0 \mathcal{M}_i + \beta_1 CD_i + \beta_2 ES_i + \beta_3 FX + \varepsilon_i, \tag{7}$$

where CD_i is the cumulative count of COVID-19 related deaths in country i on March 31, 2020, which we use to measure to spread of COVID-19 to country i; ES_i is the index of cumulative economic support enacted in country i by March 31, 2020. $\mathcal{M}_i$ is measuring external balance sheet

[26] Additional offset came from gains on foreign reserves holdings.

currency mismatch as of the end of 2019, excluding foreign reserves,[27] and $\Delta E_{i,USD}$ is domestic currency i depreciation against the U.S. dollar between December 31, 2019 and March 31, 2020. FX is the amount of foreign exchange reserves held at the end of 2019 relative to the sum of total external assets and liabilities. We limit the cross-section to countries that were net borrowers in terms of their overall foreign asset positions, excluding reserves. We estimate this regression for $\mathcal{M}_i$ evaluated for total assets and total liabilities, regardless of the asset class.

The results are reported in Table 1. We can see that higher currency mismatch, i.e. more exposure of net liabilities to currency depreciation, is associated with less depreciation. That is, countries that stood to gain from their home currency depreciation experienced more depreciation than countries that stood to lose. On it's own, our measure of currency mismatch of the external balance sheet explains 12 percent of total variation in the amount of currency depreciation.

This result is robust to controlling for foreign exchange reserves, the number of COVID-19 related deaths, and the economic support index. The ratio of foreign exchange reserves to total net liabilities does not enter the regression significantly and does not add any explanatory power. The number of COVID-19 related deaths enters the regression with a coefficient that has a counter-intuitive sign but is statistically significant. Finally, economic support index is, as expected, associated with less currency depreciation. The last two variables increase explanatory power of the regression substantially.

This finding is consistent with precautionary management of external balance sheets: countries with higher exchange rate volatilities and higher risk of capital outflows accumulated net external foreign currency assets and net external domestic currency liabilities, partly achieved by an increased share of equity liabilities. We believe this is one of the reasons that emerging markets did not experience large currency-induced valuation losses during the flight-to-quality in 2020Q1.

5 Stock–Flow Reconciliation and Total Valuation Effects

Currency induced valuation effects are only one part of the total valuation effects which also comprise valuation effects resulting from changes in the asset prices. We use equation (6) to compute total valuation effect, which we further break down into $VALNFA^{FX}$ and $VALNFA^{P}$. Note that the latter is calculated as residual and therefore includes, in addition to valuation effects resulting from asset price movements, any measurement errors. This decomposition of changes in external asset positions is known in the literature as stock–flow reconciliation, because valuation effects account for the difference between changes in asset positions and asset flows.

Table 2 presents the stock-flow reconciliation for 2000Q1.[28] The first column shows the current

[27] For this part of our analysis we exclude foreign exchange reserves because we analyse their impact separately.

[28] The country groups are as follows. Other Europe: DNK, NOR, SWE, CZE, HUN, and POL; Other Advanced: AUS, NZL, and ISR; Emerging Asia: IDN, PHL, and THA; Other LATAM: ARG, CHL, PER, URY; ROW: EGY, PAK, MAR. Data for Malaysia are missing due to lack of official data for 2020Q1.

account (CA), a flow, in 2020Q1, while the second column reports the changes in net foreign asset positions between 2020Q1 and 2019Q4. The currency-induced valuation effects are presented in columns (3)-(6) and are broken down into those originating from equity positions (FDI equity and portfolio equity) and debt positions (FDI debt, portfolio debt and other investment). Total currency-induced valuation effects comprise these two categories plus foreign exchange reserves. Asset price valuation effects and total valuation effects are reported in columns (7) and (8), respectively. The last column shows the share of currency-induced valuation effects in total valuation effects.

Two important observations stand out from this table. First, valuation effects are substantial but there is heterogeneity in terms of how much is due to exchange rate movements *vis-à-vis* asset price effects. For the U.S., which is the country with largest valuation losses in billion U.S. dollars, currency induced valuation effects represent only 19 percent of the total valuation effects. By contrast, for some economies, such as Hong Kong, Korea, China and Colombia, valuation effects arising from exchange rate fluctuations account for over 50 percent of total valuation effects. Second, some economies, such as the United Kingdom and Russia, experienced losses from asset price valuation which were more than offset by gains from exchange rate movements. In others, including Canada, Singapore, and the Euro Area, the exchange rate gains only partially offset the losses from asset price declines.

Valuation changes can either have a buffering or amplifying effect on the international investment position.[29] The former would be the case if net borrowers enjoy valuation gains and net lenders valuation losses. Figure 8 plots the relationship between the change in current account balance in 2020Q1 and total and currency-induced valuation effects. We can see that most countries that experienced deterioration of their current accounts in 2020Q1 experienced valuation gains in their external positions, which for these countries mitigated the impact of capital outflows on their external balance sheet positions. Notable exceptions are Hong Kong, Singapore, Denmark, and Switzerland. This does not mean, however, that all valuation effects were stabilizing. In fact, most countries that experienced a relative improvement in current account in 2020Q1 also experienced valuation gains, both improving their net international investment positions.

6 Conclusion

In this paper we quantify the magnitude of the valuation effects on aggregate external balance sheets for 48 countries during the first year of the COVID-19 economic crisis. We analyze the onset of the crisis (2020Q1) separately from overall effects in 2020. Relying on new data, we are able to measure the valuation effects that are due to currency movements, by asset class.

We find that, while valuation losses were large for some countries (the U.S. in particular served its role as a global insurer in 2020Q1), many emerging markets fared better than in the past

[29] For example, Bénétrix et al. (2015) found a mitigating effect during the Global Financial Crisis.

flight-to-quality episodes, with some even experiencing valuation gains. This was likely at least partly due to an increased share of equity assets and liabilities, which serve as a hedge against currency depreciation. In terms of debt, for many emerging markets currency-induced valuation losses were modest. Perhaps overcoming "original sin" by both governments and private sector borrowers in recent decades helped reduce currency mismatches on external balance sheets for many countries (Aizenman, Jinjarak, Park, and Zheng, 2020; Hale, Jones, and Spiegel, 2020). We leave the investigation of the dynamics of currency mismatch and asset class composition of external balance sheets over last two decades to future research.

Although our results are encouraging, it is important to keep in mind that our analysis is aggregated and does not account for individual institutions that may have had large currency mismatches on their balance sheets at the beginning of 2020 are likely to have experienced substantial losses, given the large and unexpected depreciation of some currencies.

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Table 1: Currency mismatch and depreciation (2020Q1)

	(1)	(2)	(3)	(4)
Currency Mismatch	-0.15**	-0.15**	-0.13*	-0.13*
	(0.067)	(0.068)	(0.063)	(0.074)
FX Reserves		-0.055		-0.17
		(0.18)		(0.18)
COVID-19 Deaths			-0.0088	-0.010*
			(0.0052)	(0.0054)
Economic Support			-0.069	-0.083*
			(0.041)	(0.043)
Constant	0.099***	0.093***	0.14***	0.16***
	(0.015)	(0.024)	(0.022)	(0.034)
Observations	32	32	32	32
Adjusted R^2	0.12	0.094	0.26	0.25

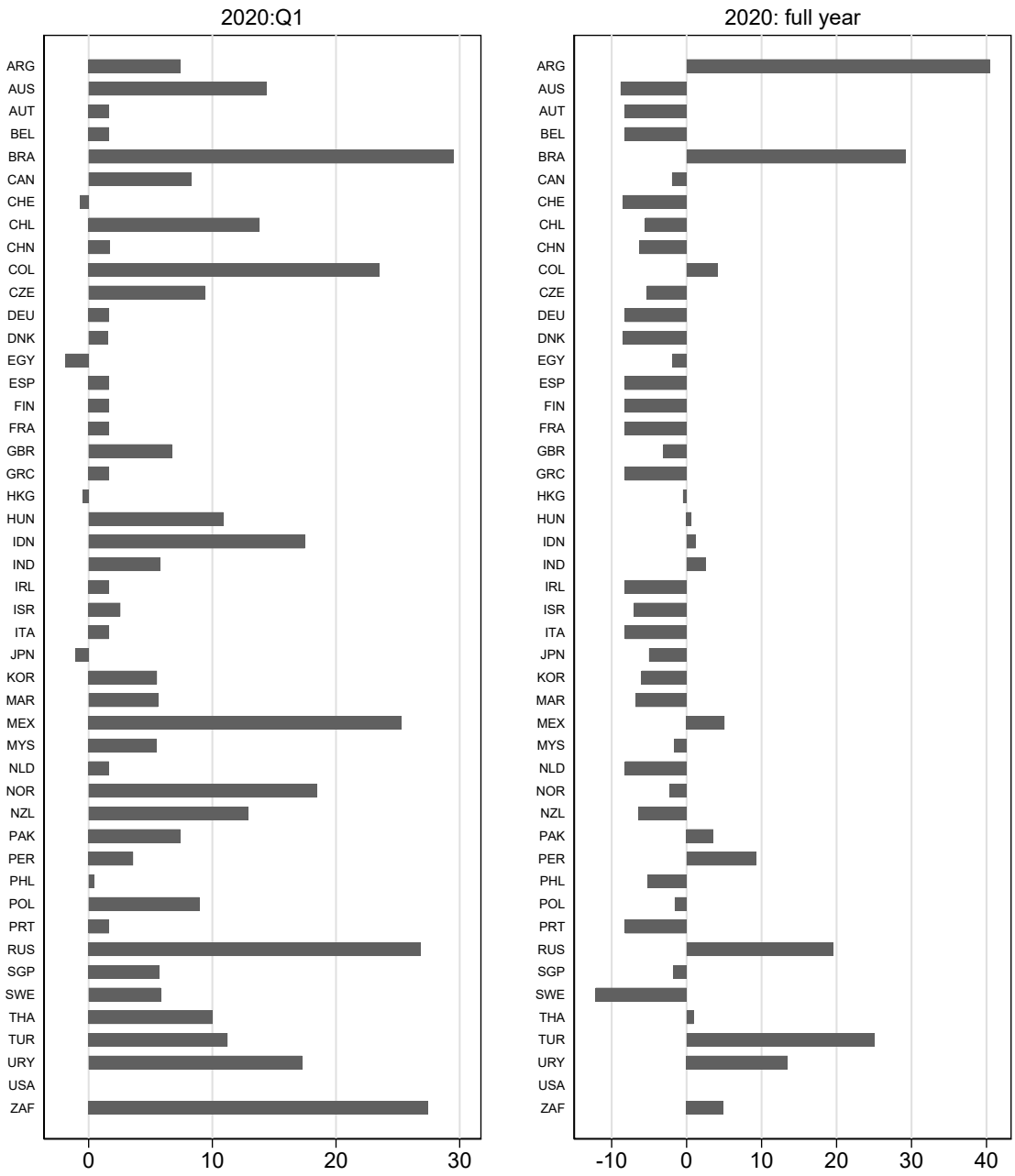
Notes: This table shows the results of the regression in (7). Dependent variable is depreciation of domestic currency vs. the U.S. dollar from January 1, 2020 to March 31, 2020. Only countries for which total external liabilities exceeded total external assets excluding foreign exchange reserves were included in the sample. Currency mismatch is measured as in Lane and Shambaugh (2010) — aggregate foreign currency exposure presented in equation (4). Foreign exchange reserves are limited to the amount held in foreign currency and are expressed as a share of total net external liabilities. The cumulative number of COVID-19 related deaths is in 1000s, Economic Support Index is between 0 and 1; both are measured as of March 31, 2020, as provided by the Coronavirus Government Response Tracker. Standard errors are in parentheses, *, **, and *** indicate significance at 10, 5, and 1%-level, respectively.

Table 2: Stock-Flow Reconciliation (2020Q1)

	CA	Δ NFA	FX valuation			Price Valuation	Total Valuation	FX Valuation/Total
			total	debt	equity			
United States	-98	-1113	-188	62	-250	-827	-1015	19%
Canada	-12	-111	163	-30	187	-262	-99	-165%
United Kindom	-23	163	189	5	175	-3	186	101%
Switzerland	15	-88	-51	-6	-32	-52	-103	50%
Russia	22	164	226	50	67	-84	142	159%
Japan	52	112	-90	-26	-43	149	59	-152%
Hong Kong	-1	-1	-35	-9	-21	35	0	-100%
Singapore	12	-43	62	28	24	-116	-54	-114%
Korea	13	64	51	10	22	0	51	99%
China	-34	13	40	9	1	7	47	84%
India	1	51	12	-11	3	39	50	23%
South Africa	-1	59	29	-12	29	30	59	49%
Turkey	-8	39	-17	-29	3	64	47	-37%
Brazil	-18	344	89	-92	86	273	362	25%
Mexico	-4	124	33	-52	43	96	128	26%
Colombia	-3	12	13	-12	14	2	15	88%
Euro Area	155	37	22	27	-9	-140	-118	-18%
Other Europe	27	-159	221	6	183	-408	-187	-118%
Other Advanced	10	117	64	-67	118	43	107	60%
Emerging Asia	5	178	24	-20	10	149	172	14%
Other Latin America	0	1	39	1	27	-38	1	4262%
ROW	-4	7	-3	-4	0	15	12	-27%

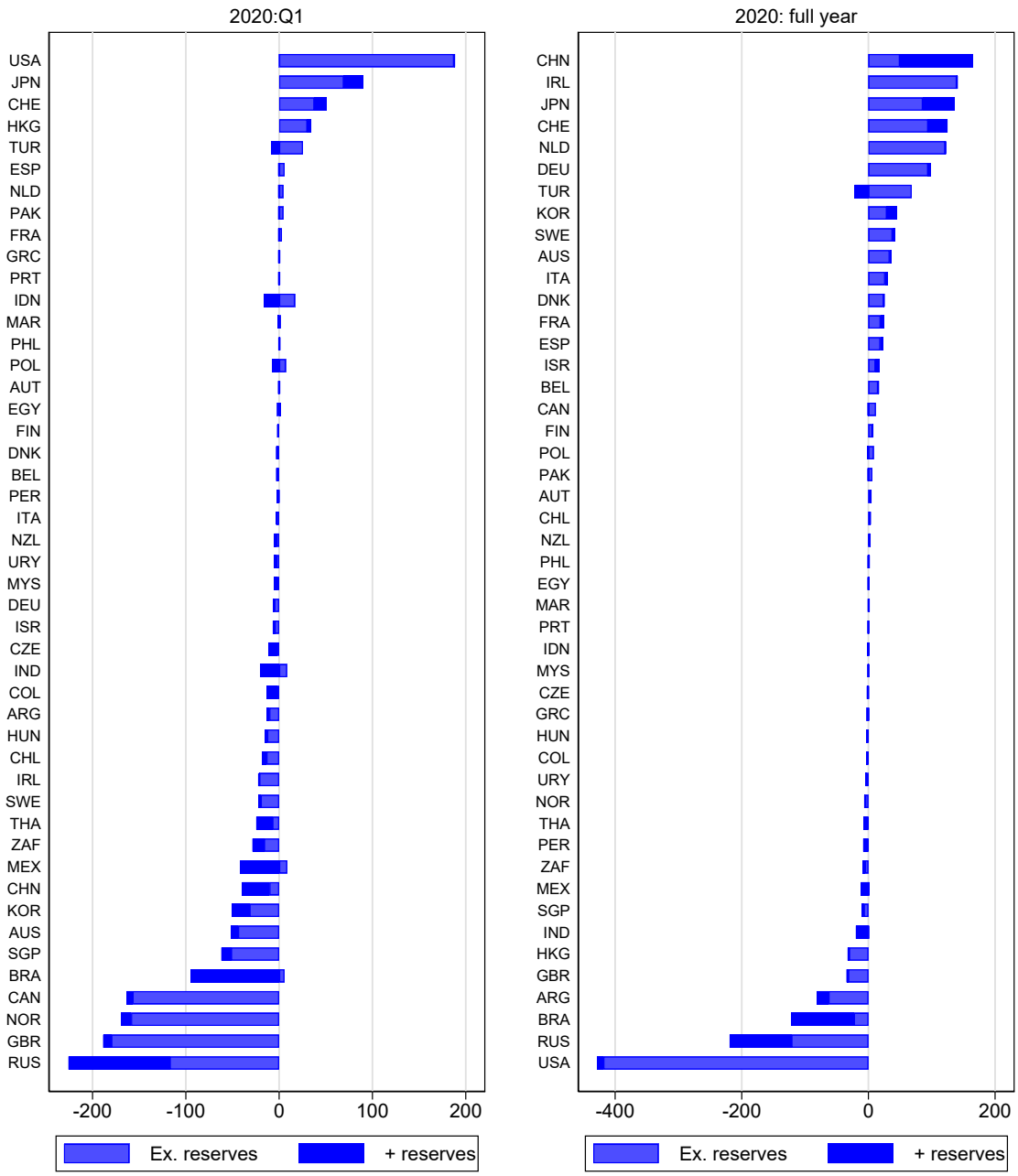
Notes: This table shows the stock-flow reconciliation described in equation 6. The CA denotes the current account in 2020Q1; Δ NFA is the change in net foreign assets positions between 2019Q4 and 2020Q1; FX valuation includes currency-induced valuation effects and are broken down into equity (FDI equity and portfolio equity), debt (FDI debt, portfolio debt and other investment), and total which includes the previous two categories plus foreign exchange reserves; Price valuation includes the valuation effects arising from changes in asset prices as well as other factors; and Total valuation is equal to the sum of FX valuation and Price valuation. The last column shows the share of valuation changes accounted for by exchange rate effects. The country groups are as follows. Other Europe: DNK, NOR, SWE, CZE, HUN, and POL; Other Advanced: AUS, NZL, and ISR; Emerging Asia: IDN, PHL, and THA; Other LATAM: ARG, CHL, PER, URY; ROW: EGY, PAK, MAR. Columns (2)-(7) are in billion U.S. dollars.

Figure 1: Exchange Rate Dynamics



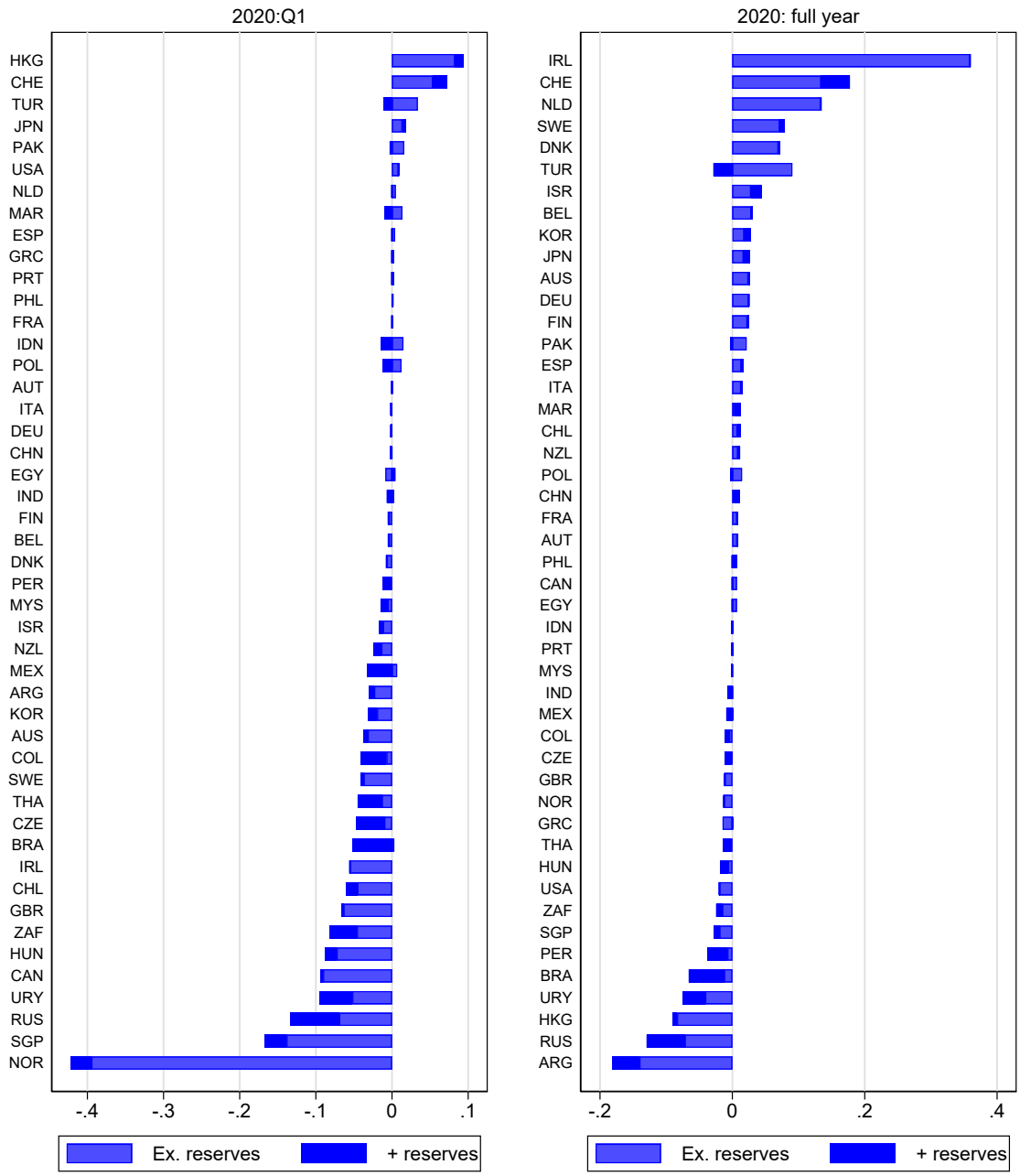
Notes: The bars represent percentage depreciation of the currency of each listed country against the U.S. dollar. The left panel reports the depreciation from close of January 1, 2020 through close of March 31, 2020 while the right panel shows the depreciation from close of January 1, 2020 through close of December 31, 2020. The number is zero for the U.S. dollar and the USA is listed for completeness. Data labels use International Organization for Standardization (ISO) country codes and are listed alphabetically. Exchange rates are sourced from Datastream.

Figure 2: Change in Aggregate Net Liabilities (Billion U.S. dollars)



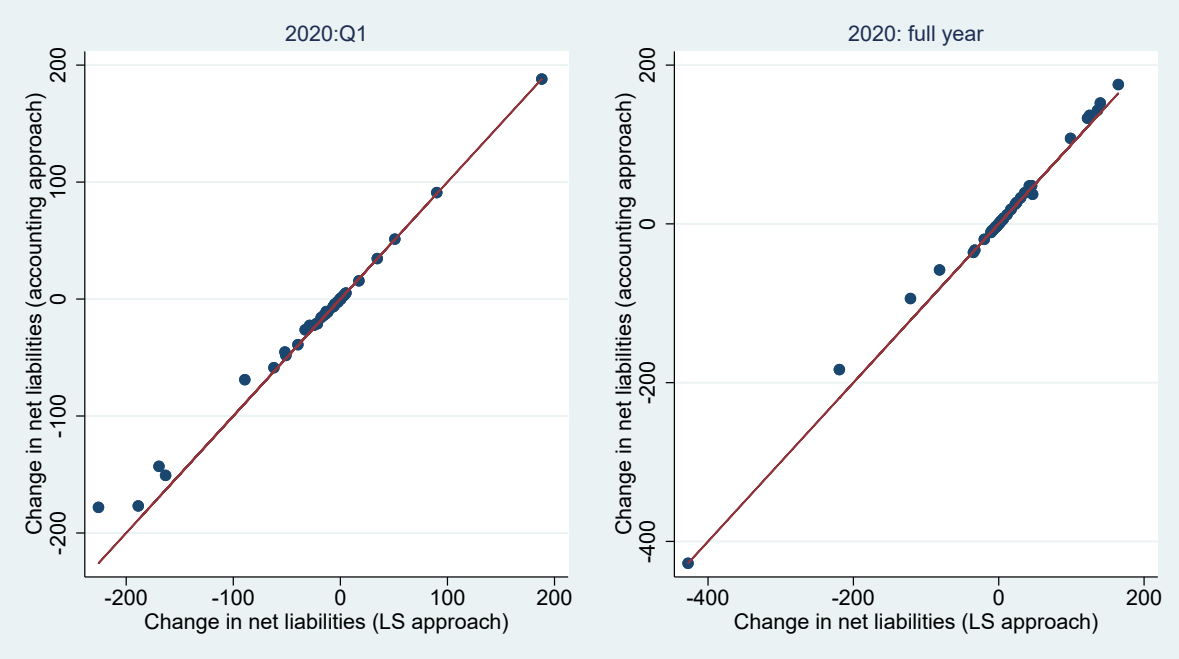
Notes: The bars represent changes in net liabilities due to currency-induced valuation effects (in billion USD). See text for methodology and original data sources. Countries' ISO codes are listed in order of the impact of exchange rate changes on net external liabilities so that the largest valuation losses are at the top and the largest valuation gains at the bottom. Results for 2020Q1 are in the left panel and for the full year 2020 in the right panel. Light bars exclude reserves and dark bars combined with light bars include them.

Figure 3: Change in Aggregate Net Liabilities (Share of GDP)



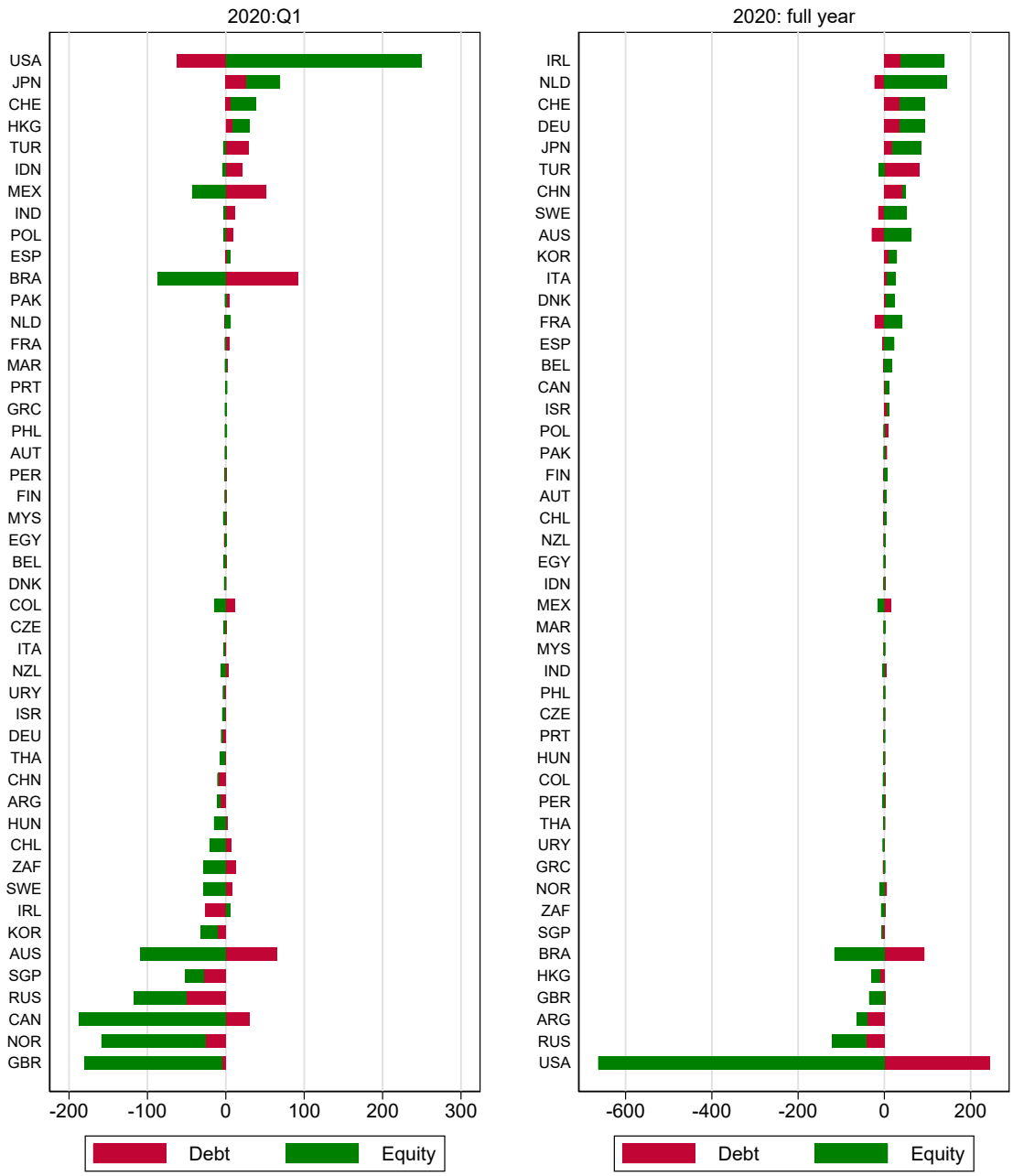
Notes: The bars represent changes in net liabilities due to currency-induced valuation effects (in percent of GDP). See text for methodology and original data sources. Countries' ISO codes are listed in order of the impact of exchange rate changes on net external liabilities so that the largest valuation losses are at the top and the largest valuation gains at the bottom. Results for 2020Q1 are in the left panel and for the full year 2020 in the right panel. Light bars exclude reserves and dark bars combined with light bars include them.

Figure 4: Comparison of Change in Aggregate Net Liabilities (Billion U.S. dollars)



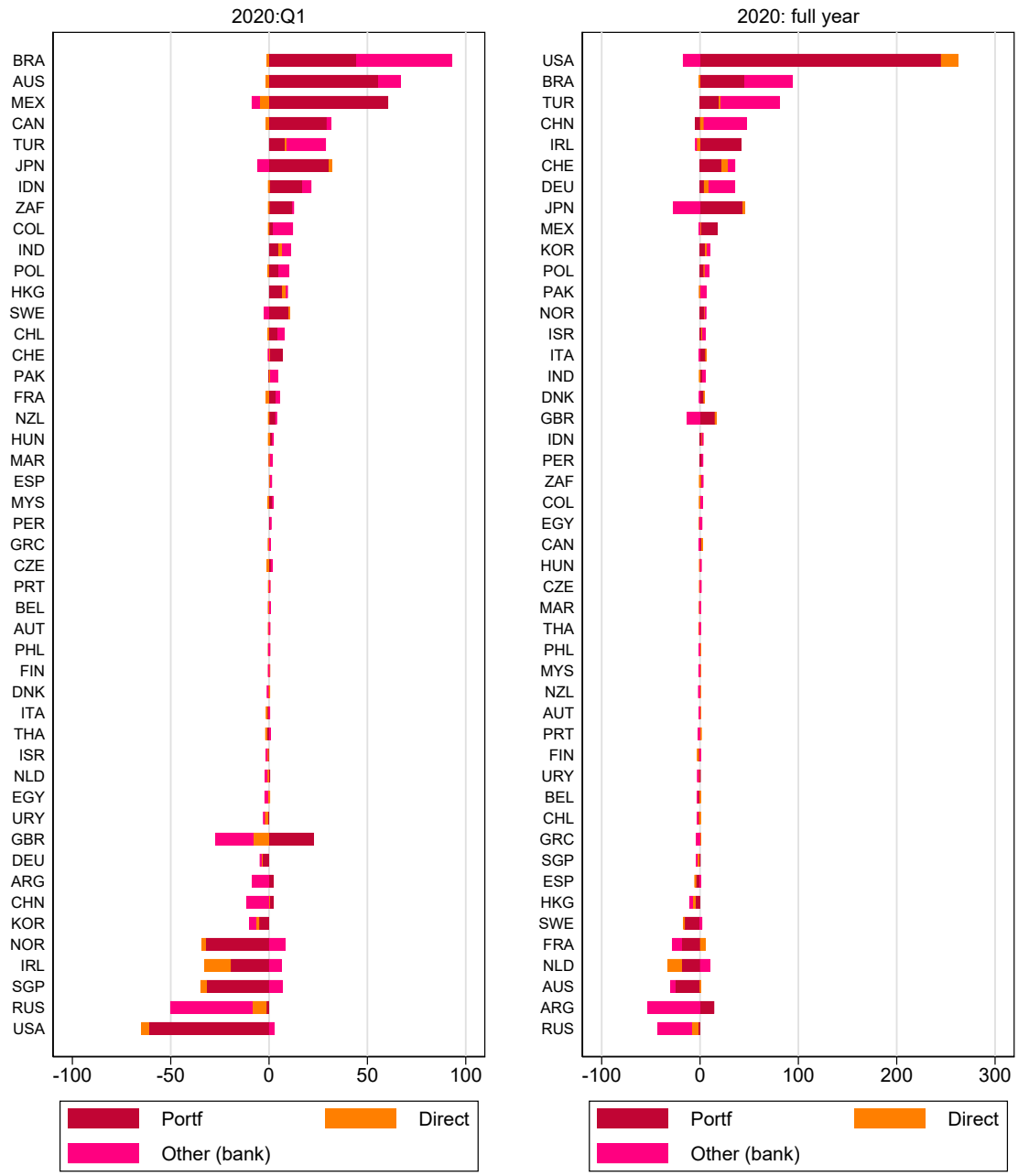
Notes: The charts compare the changes in net liabilities due to currency-induced valuation effects (in Billion U.S. dollars) using the Lane-Shambaugh methodology (*x-axis*) and an accounting methodology (*y-axis*). The left panel presents the results for 2020Q1 while the right panel includes the full year 2020. See text for methodology and original data sources.

Figure 5: Change in Net Liabilities. Debt-Equity Breakdown (Billion U.S. dollars)



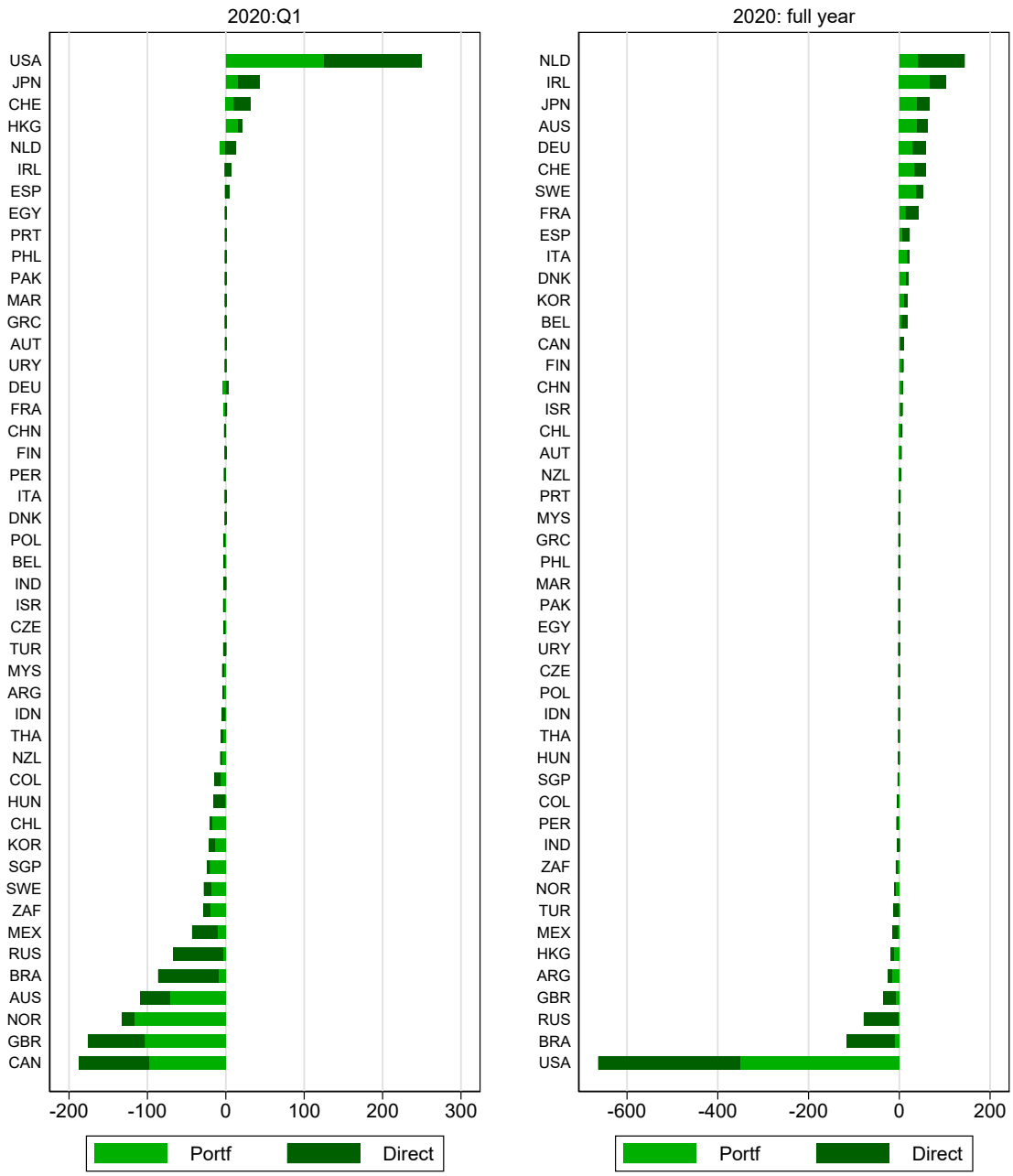
Notes: The bars represent changes in net liabilities due to currency-induced valuation effects (in Billion U.S. dollars). Red denotes changes in debt net liabilities (and includes portfolio debt, other investment, and FDI debt), while green denotes changes in equity net liabilities (comprising portfolio equity and FDI equity). See text for methodology and original data sources. Countries' ISO codes are listed in order of the impact of exchange rate changes on net external liabilities so that the largest valuation losses are at the top and the largest valuation gains at the bottom. Results for 2020Q1 are in the left panel and for the full year 2020 in the right panel.

Figure 6: Change in Debt Net Liabilities (Billion U.S. dollars)



Notes: The bars represent changes in net liabilities due to currency-induced valuation effects (in Billion U.S. dollars). Red, pink and orange denote changes in portfolio debt, other investment, and FDI debt net liabilities, respectively. See text for methodology and original data sources. Countries' ISO codes are listed in order of the impact of exchange rate changes on net external liabilities so that the largest valuation losses are at the top and the largest valuation gains at the bottom. Results for 2020Q1 are in the left panel and for the full year 2020 in the right panel.

Figure 7: Change in Equity Net Liabilities (Billion U.S. dollars)



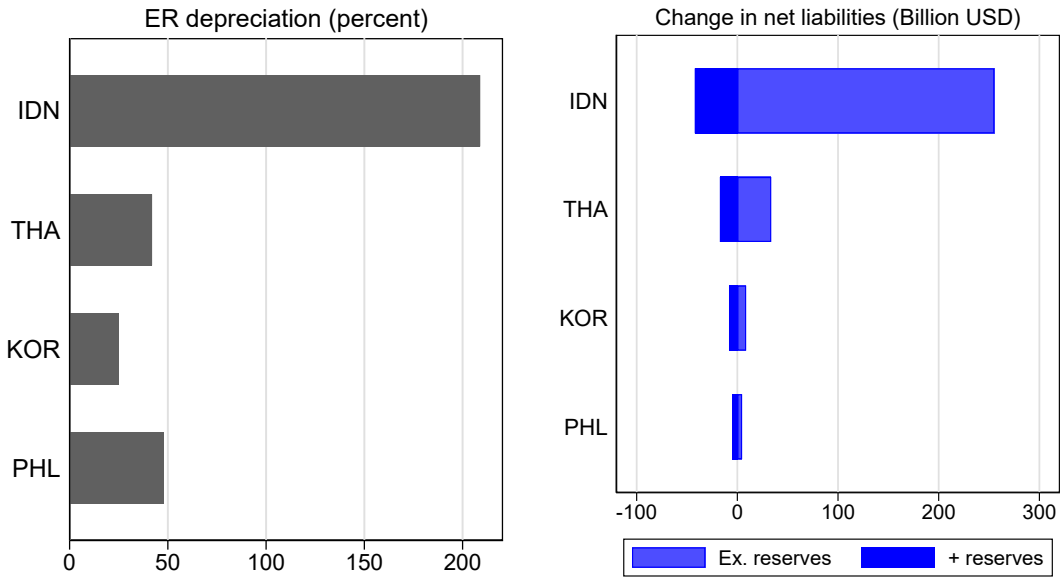
Notes: The bars represent changes in net liabilities due to currency-induced valuation effects (in Billion U.S. dollars). Light green denotes changes in equity net liabilities while dark green indicates changes in FDI equity net liabilities. See text for methodology and original data sources. Countries' ISO codes are listed in order of the impact of exchange rate changes on net external liabilities so that the largest valuation losses are at the top and the largest valuation gains at the bottom. Results for 2020Q1 are in the left panel and for the full year 2020 in the right panel.

Figure 8: Capital Flows and Valuation Effects

Notes: Horizontal axes on both charts show the difference between current account to GDP ratio in 2020Q1 (annualized) and its value in 2019 for each country. Vertical axis on the top chart is the ratio of currency-induced valuation effects reported in Table 2 with respect to 2019 GDP. Vertical axis on the bottom chart is the ratio of total valuation effects reported in Table 2 with respect to 2019 GDP. Green dots indicate emerging markets, blue dots indicate advanced economies. Country names are reported as ISO codes.

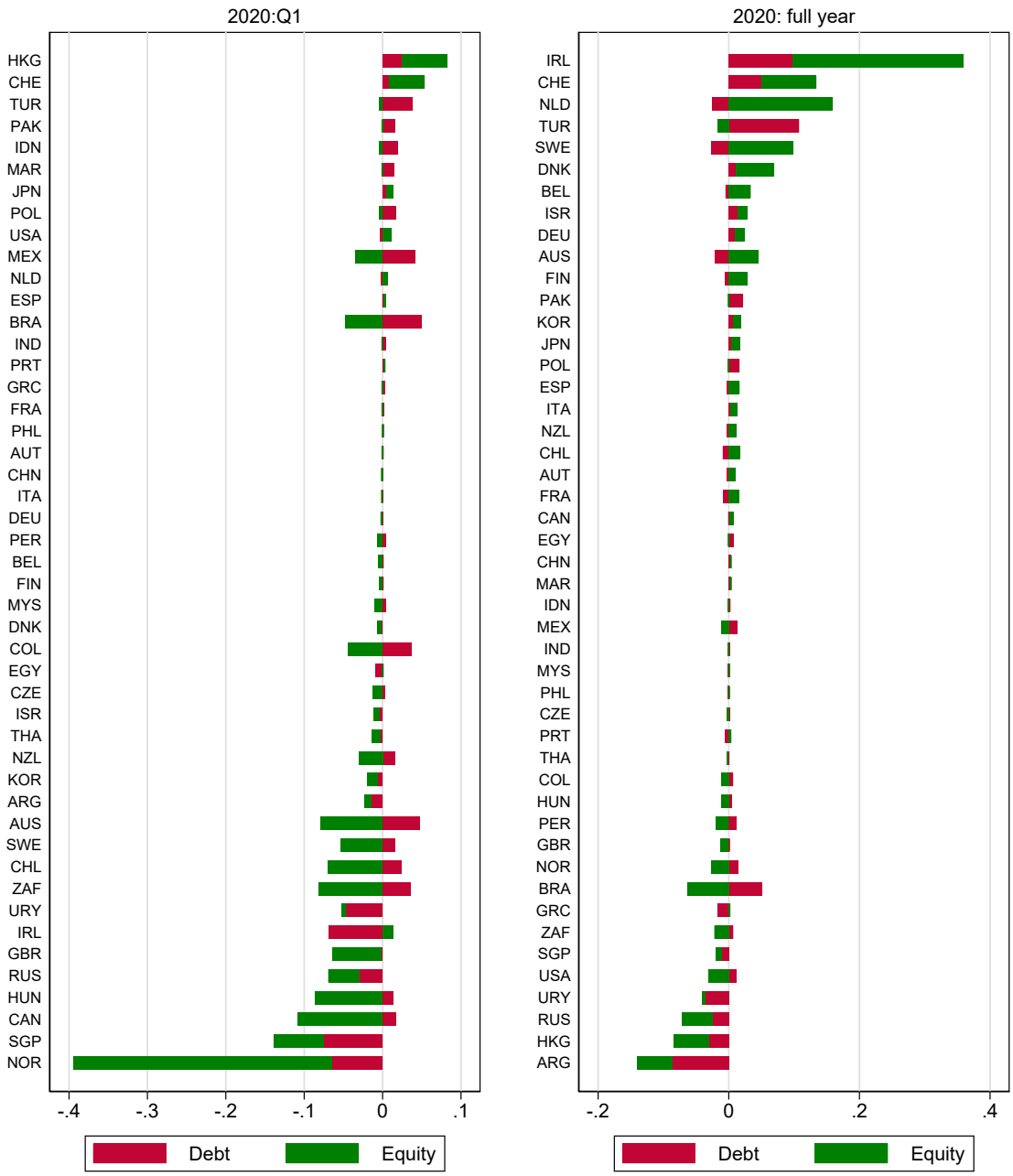
A Appendix

Figure A.1: Asian Financial Crisis 1997-98



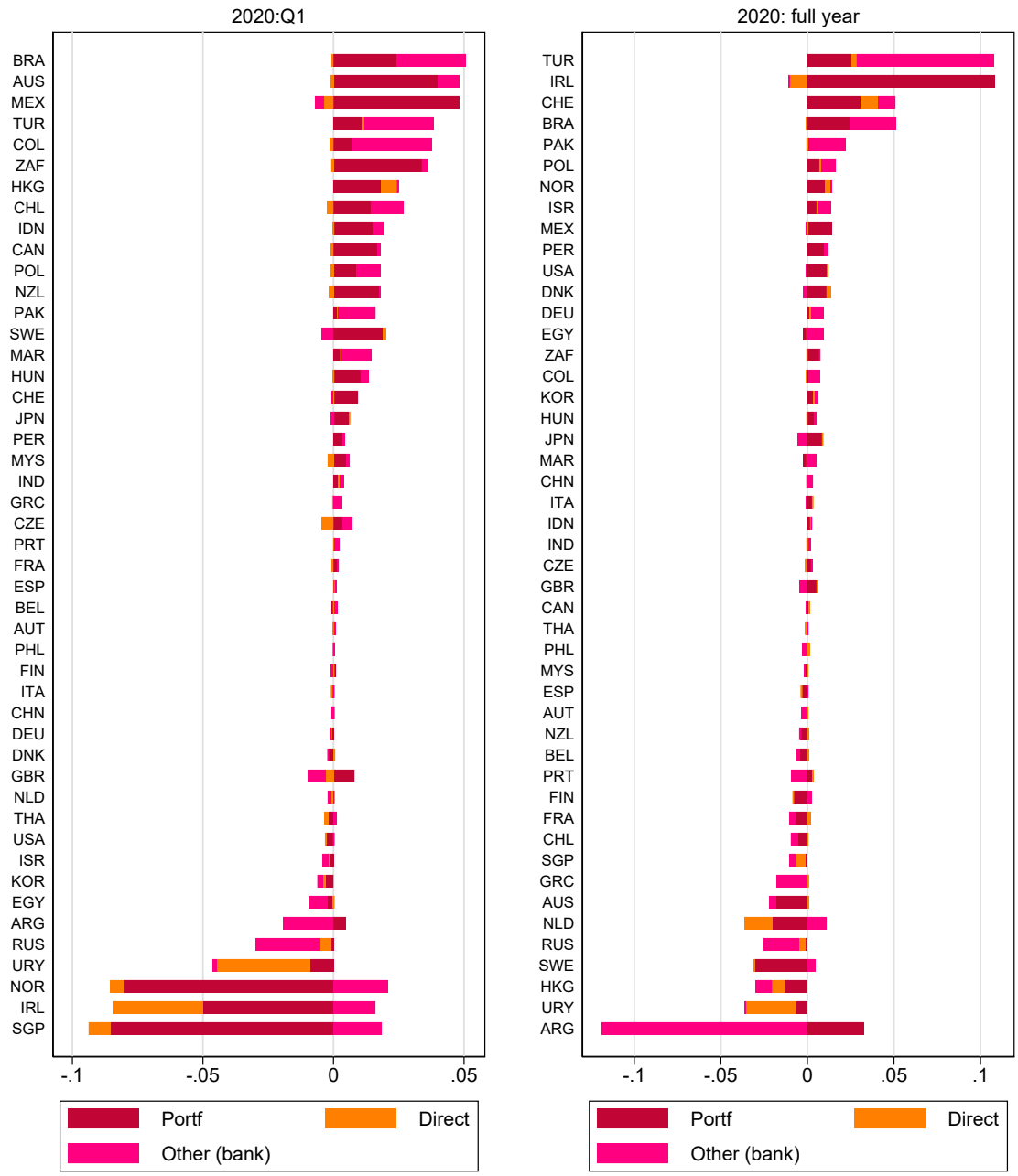
Source: The bars on the left chart represent percentage depreciation of the currency of each listed country against the U.S. dollar from June 30, 1997 to December 31, 1998. The bars on the right chart represent changes in net liabilities due to currency-induced valuation effects (in billion USD). See text for methodology and original data sources. Countries' ISO codes are listed in order of the impact of exchange rate changes on net external liabilities so that the largest valuation losses are at the top and the largest valuation gains at the bottom. Light bars exclude reserves and dark bars combined with light bars include them. Exchange rates are sourced from the International Financial Statistics (IFS).

Figure A.2: Change in Net Liabilities. Debt-Equity Breakdown (Share of GDP)



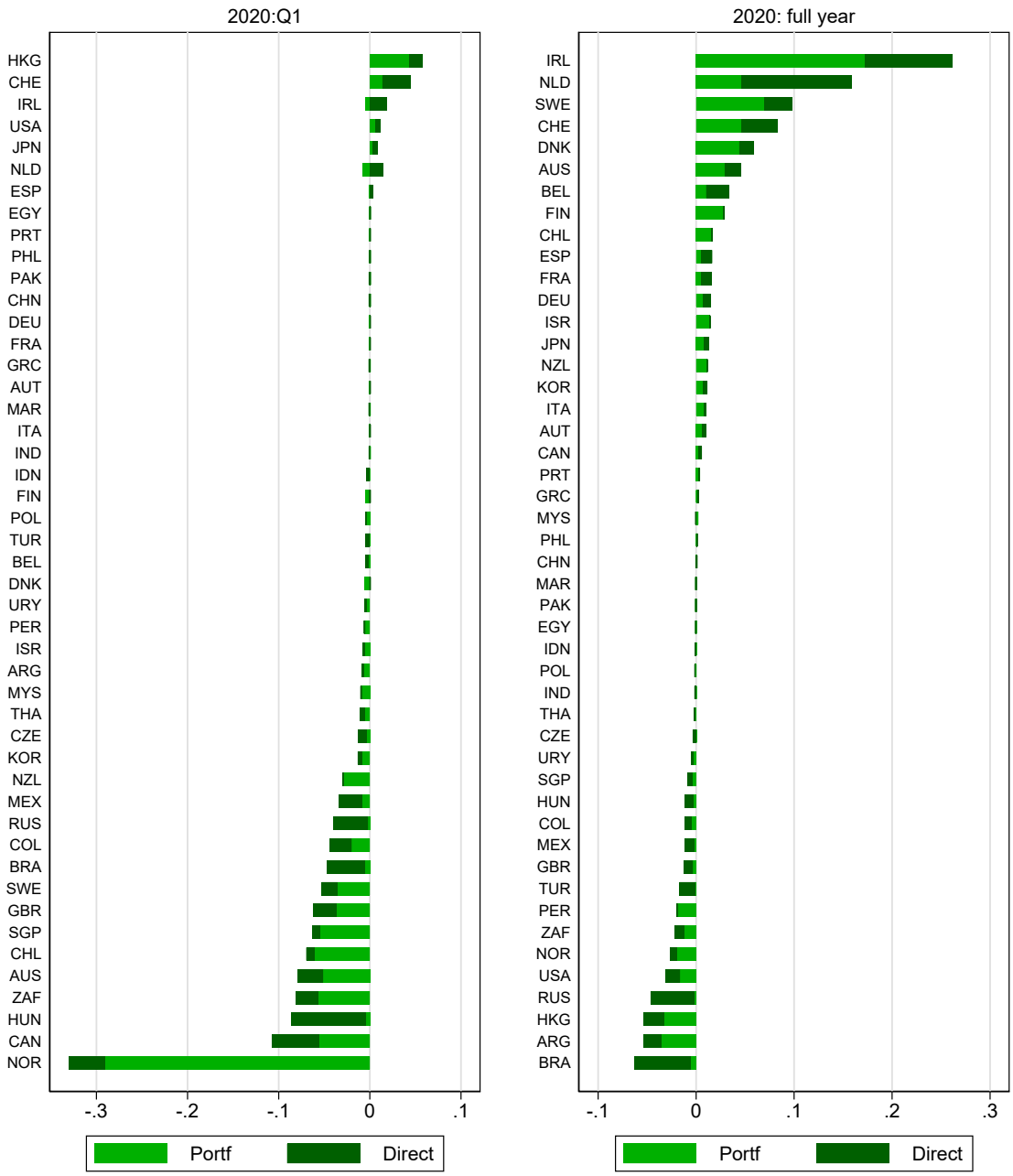
Notes: The bars represent changes in net liabilities due to currency-induced valuation effects as a share of GDP. Red denotes changes in debt net liabilities (and includes portfolio debt, other investment, and FDI debt), while green denotes changes in equity net liabilities (comprising portfolio equity and FDI equity). See text for methodology and original data sources. Countries' ISO codes are listed in order of the impact of exchange rate changes on net external liabilities so that the largest valuation losses are at the top and the largest valuation gains at the bottom. Results for 2020Q1 are in the left panel and for the full year 2020 in the right panel.

Figure A.3: Change in Debt Net Liabilities (Share of GDP)



Notes: The bars represent changes in net liabilities due to currency-induced valuation effects as a share of GDP. Red, pink and orange denote changes in portfolio debt, other investment, and FDI debt net liabilities, respectively. See text for methodology and original data sources. Countries' ISO codes are listed in order of the impact of exchange rate changes on net external liabilities so that the largest valuation losses are at the top and the largest valuation gains at the bottom. Results for 2020Q1 are in the left panel and for the full year 2020 in the right panel.

Figure A.4: Change in Equity Net Liabilities (Share of GDP)



Notes: The bars represent changes in net liabilities due to currency-induced valuation effects as a share of GDP. Light green denotes changes in equity net liabilities while dark green indicates changes in FDI equity net liabilities. See text for methodology and original data sources. Countries' ISO codes are listed in order of the impact of exchange rate changes on net external liabilities so that the largest valuation losses are at the top and the largest valuation gains at the bottom. Results for 2020Q1 are in the left panel and for the full year 2020 in the right panel.

Table A.1: Debt Assets and Reserves. Sources of Data

Country	Portfolio Debt Assets		Other Investment Assets		FDI Debt Assets		Reserves	
	Actual Data	Estimated Data	Actual Data	Synthetic Data	Actual Data	Synthetic Data	Actual Data	Estimated Data
Argentina	CPIS			BISLBS		IMFWP		IMFWP
Australia		IMFWP		BISLBS		IMFWP	Reserves Template	
Austria	CPIS			BISLBS		IMFWP		IMFWP
Belgium	Survey		Survey	BISLBS	Survey		Reserves Template	
Brazil	CPIS			BISLBS		IMFWP	Reserves Template	
Canada	Survey		Survey			IMFWP	Dept. Finance	
Chile	CPIS			BISLBS		IMFWP	CB	
China		IMFWP		BISLBS		IMFWP		IMFWP
Colombia	CPIS		Survey		Survey		CB	
Czech Republic	Survey		Survey		Survey		Int. Role of the Euro	
Denmark	Survey		Survey		Survey			IMFWP
Egypt	CPIS			BISLBS		IMFWP		IMFWP
Finland	Survey			BISLBS		IMFWP	Reserves Template	
France	Survey		Survey		Survey			IMFWP
Germany	Survey			BISLBS	Survey		Reserves Template	
Greece	Survey			BISLBS		IMFWP		IMFWP
Guatemala	Survey		Survey		Survey			IMFWP
Hong Kong SAR		IMFWP		BISLBS		IMFWP		IMFWP
Hungary	Survey		Survey		Survey			IMFWP
India	CPIS			BISLBS		IMFWP		IMFWP
Indonesia	CPIS			BISLBS				IMFWP
Ireland		IMFWP		BISLBS		IMFWP	Reserves Template	
Israel	CPIS			BISLBS		IMFWP		IMFWP
Italy	Survey		Survey		Survey			IMFWP
Japan	Survey			BISLBS		IMFWP		IMFWP
Korea	CPIS		Survey			IMFWP		IMFWP
Malaysia	CPIS			BISLBS		IMFWP		IMFWP
Mexico	CPIS			BISLBS		IMFWP		IMFWP
Morocco		IMFWP		BISLBS		IMFWP		IMFWP
Netherlands	Survey			BISLBS		IMFWP	Reserves Template	
New Zealand		IMFWP		BISLBS		IMFWP		IMFWP
Norway		IMFWP		BISLBS		IMFWP	Reserves Template	
Pakistan	CPIS			BISLBS		IMFWP		IMFWP
Peru	Survey	IMFWP		BISLBS		IMFWP	CB	
Philippines	CPIS			BISLBS		IMFWP		IMFWP
Poland		IMFWP		BISLBS		IMFWP	CB	
Portugal	CPIS			BISLBS		IMFWP	Reserves Template	
Russia	CPIS			BISLBS		IMFWP	Int. Role of the Euro	
Singapore		IMFWP		BISLBS		IMFWP		IMFWP
South Africa	CPIS			BISLBS		IMFWP		IMFWP
Spain	CPIS			BISLBS		IMFWP		IMFWP
Sweden	CPIS			BISLBS		IMFWP	CB	
Switzerland	Survey		Survey		Survey		CB	
Thailand	Survey		Survey		Survey			IMFWP
Turkey	CPIS		Survey		Survey			
United Kingdom		IMFWP		BISLBS		IMFWP	CB	
United States	CPIS			BISLBS		IMFWP	US Treasury	
Uruguay	CPIS			BISLBS		IMFWP	CB	

Notes: The table reports the sources of data for the currency composition of debt assets and reserves. Actual data are from the IMF survey and CPIS. Estimates are from the dataset on currency composition of the IIP published by the IMF Working Paper (IMFWP) Bénétrix et al. (2019). Synthetic data for other investment are from the BIS Locational Banking Statistics (denoted by BISLBS). CB denotes Central Bank.

Table A.2: Debt Liabilities. Sources of Data

Country	Portfolio Debt Liabilities		Other Investment Liabilities		FDI Debt Liabilities	
	Actual Data	Estimated Data	Actual Data	Synthetic Data	Actual Data	Synthetic Data
Argentina		AT & BIS		BISLBS		IMFWP
Australia		BIS		BISLBS		IMFWP
Austria		BIS		BISLBS		IMFWP
Belgium	Survey		Survey		Survey	
Brazil		AT & BIS		BISLBS		IMFWP
Canada	Survey		Survey			IMFWP
Chile		AT & BIS		BISLBS		IMFWP
China		AT & BIS		BISLBS		IMFWP
Colombia	Survey		Survey		Survey	
Czech Republic	Survey		Survey		Survey	
Denmark	Survey		Survey		Survey	
Egypt		AT & BIS		BISLBS		IMFWP
Finland	Survey			BISLBS		IMFWP
France	Survey		Survey		Survey	
Germany	Survey			BISLBS	Survey	
Greece	Survey			BISLBS		IMFWP
Guatemala	Survey		Survey		Survey	
Hong Kong SAR		BIS		BISLBS		IMFWP
Hungary	Survey		Survey		Survey	
India		AT & BIS		BISLBS		IMFWP
Indonesia	Survey		Survey		Survey	
Ireland		BIS		BISLBS		IMFWP
Israel		BIS		BISLBS		IMFWP
Italy	Survey		Survey		Survey	
Japan	Survey			BISLBS		IMFWP
Korea	Survey		Survey			IMFWP
Malaysia		AT & BIS		BISLBS		IMFWP
Mexico		AT & BIS		BISLBS		IMFWP
Morocco		BIS		BISLBS		IMFWP
Netherlands	Survey			BISLBS		IMFWP
New Zealand		BIS		BISLBS		IMFWP
Norway		BIS		BISLBS		IMFWP
Pakistan		BIS		BISLBS		IMFWP
Peru		AT & BIS		BISLBS		IMFWP
Philippines	Survey			BISLBS		IMFWP
Poland		AT & BIS		BISLBS		IMFWP
Portugal		BIS		BISLBS		IMFWP
Russia		AT & BIS		BISLBS		IMFWP
Singapore		BIS		BISLBS		IMFWP
South Africa		AT & BIS		BISLBS		IMFWP
Spain		BIS		BISLBS		IMFWP
Sweden		BIS		BISLBS		IMFWP
Switzerland	Survey		Survey		Survey	
Thailand	Survey		Survey		Survey	
Turkey	Survey		Survey		Survey	
United Kingdom		BIS		BISLBS		IMFWP
United States		BIS		BISLBS		IMFWP
Uruguay		AT & BIS		BISLBS		IMFWP

Notes: The table reports the sources of data for the currency composition of debt liabilities. Actual data are from the IMF survey. Estimates are from the dataset on currency composition of the IIP published by the IMF Working Paper (IMFWP) Bénétrix et al. (2019). Synthetic data for portfolio debt liabilities are from Arslanalp and Tsuda (2014) and the BIS International Debt Issuance Statistics (denoted by AT and BIS, respectively). Synthetic data for other investment are from the BIS Locational Banking Statistics (denoted by BISLBS).

Table A.3: Equity Assets. Sources of Data

Country	FDI Equity Assets		Portfolio Equity Assets	
	Actual Data	Estimated Data	Actual Data	Estimated Data
Argentina		IMFWP	CPIS	
Australia		IMFWP		IMFWP
Austria		IMFWP	CPIS	
Belgium	Survey		Survey	
Brazil		IMFWP	CPIS	
Canada		IMFWP	Survey	
Chile		IMFWP	CPIS	
China		IMFWP		IMFWP
Colombia	Survey		CPIS	
Czech Republic	Survey		Survey	
Denmark	Survey		Survey	
Egypt		IMFWP	CPIS	
Finland		IMFWP	Survey	
France	Survey		Survey	
Germany	Survey		Survey	
Greece		IMFWP	Survey	
Guatemala	Survey			IMFWP
Hong Kong SAR		IMFWP		IMFWP
Hungary	Survey		Survey	
India		IMFWP	CPIS	
Indonesia		IMFWP	CPIS	
Ireland		IMFWP		IMFWP
Israel		IMFWP	CPIS	
Italy	Survey		Survey	
Japan		IMFWP	Survey	
Korea	Survey		Survey	
Malaysia		IMFWP	CPIS	
Mexico		IMFWP	CPIS	
Morocco		IMFWP		IMFWP
Netherlands		IMFWP	Survey	
New Zealand		IMFWP		IMFWP
Norway		IMFWP		IMFWP
Pakistan		IMFWP	CPIS	
Peru		IMFWP	CPIS	
Philippines		IMFWP	CPIS	
Poland		IMFWP	CPIS	
Portugal		IMFWP	CPIS	
Russia		IMFWP	CPIS	
Singapore		IMFWP		IMFWP
South Africa		IMFWP	CPIS	
Spain		IMFWP	Survey	
Sweden		IMFWP		IMFWP
Switzerland	Survey		Survey	
Thailand	Survey		Survey	
Turkey	Survey		Survey	
United Kingdom		IMFWP		IMFWP
United States		IMFWP		IMFWP
Uruguay		IMFWP	CPIS	

Notes: The table reports the sources of data for the currency composition of equity assets. Actual data are from the IMF survey and CPIS. Estimates are from the dataset on currency composition of the IIP published by the IMF Working Paper (IMFWP) Bénétrix et al. (2019).