Review of World Economics
https://doi.org/10.1007/s10290-021-00422-5

ORIGINAL PAPER

The "exorbitant privilege" and "exorbitant duty" of the United States in the international monetary system: implications for developing countries

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Accepted: 29 May 2021

Abstract

The international monetary system may be viewed as a global insurance system, where the United States enjoys the "exorbitant privilege" of a positive yield differential on its external assets and liabilities during normal times, in exchange for the "exorbitant duty" of valuation losses in the form of wealth transfers to the rest of the world during crisis periods. Evidence for 76 economies and 1995–2019 indicates that some other major developed economies also enjoy an exorbitant privilege, though without suffering an exorbitant duty. By contrast, most developing economies neither have an exorbitant privilege nor benefit from wealth transfers. Developing economies as a group recorded negative return differentials and valuation losses during 2010–2019, implying a total return differential of about minus three percentage points between developing and developed economies and an annual average resource transfer from developing economies of about $800bn, or 3.3 per cent of their GDP. Econometric analysis linking crisis insurance strategies and yield differentials indicates that permanent swap arrangements, reserve holdings and regional monetary arrangements can contain negative yield differentials. Developed economies could make part of past resource transfers available to developing economies to finance recovery from the COVID-19 crisis and achieving the 2030 Agenda for Sustainable Development.

Keywords International financial integration · Yield differentials · Valuation effects · Currency hierarchy

JEL Classification F32 · F33 · F36 · F63 · E44

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Published online: 10 June 2021

1 Introduction

The debate on financial globalization often juxtaposes the expected advantages and risks of capital flows (e.g. Akyüz, 2017; Erten et al., 2019; Gallagher, 2015; Ghosh et al., 2017). However, persistent capital flows also increase the size and alter the composition of the stocks of foreign assets and liabilities, and there is a lack of evidence on the pattern of associated income streams and valuation effects.

This paper explores the yield and valuation patterns of the foreign asset and liability positions for a broad sample of countries. Using standard statistical and econometric tools, the paper addresses two main questions. First, how do the yield and valuation patterns of developed economies compare to those of developing economies, and what do these patterns imply for the transfer of resources from developing economies and the positions of these countries in the international monetary and financial system (IMFS)? Second, how are the various layers of the current global financial safety net (GFSN) correlated with the yield differentials in different investment categories? Addressing these questions allows to gauge the overall costs and benefits of rising external assets and liabilities that the current settings of the IMFS and the GFSN imply for developing economies, as well as to indicate what policy measures might reduce these costs. The latter is particularly important for resource mobilization to finance recovery from the COVID-19 crisis and achieving the 2030 Agenda for Sustainable Development.

The paper is related to several strands of the literature. Most existing studies on the size and structure of external balance sheets emphasize the role of the United States at the centre of the IMFS. Holding risky foreign assets and providing safe and liquid liabilities to the rest of the world (e.g. Gourinchas & Rey, 2014) gives the United States the "exorbitant privilege" of earning excess returns on its external balance sheet in normal times, but makes it also acquire the "exorbitant duty" of suffering valuation losses during crises, when the value of its risky assets plummets and the value of its safe liabilities increases (e.g. Gourinchas et al., 2017). This "exorbitant duty" has been interpreted as the United States providing insurance payments to the rest of the world in form of a wealth transfer during crisis periods.[1] Gourinchas et al. (2012) show that not all countries benefit equally from this wealth transfer and that cross-country patterns of valuation changes during crisis periods are associated with cross-country differences in the degree of dollar shortages.

A second strand indicates that the exorbitant privilege of the United States is reflected in developing economies as the cost of holding foreign-exchange reserves. This cost can be expressed in various ways, depending on a country's access to international financial markets, but generally reflects the wedge between the low return earned on low-risk and liquid reserve assets and some (typically higher) borrowing or opportunity cost to the domestic economy (e.g. Rodrik, 2006).

[1] Adler and Garcia-Macia (2018) argue that this set-up makes the United States provide insurance against global income shocks. Farhi and Maggiori (2018) interpret the "exorbitant privilege" as a monopoly rent in the form of an endogenous safety premium on reserve assets.

A third group of studies assesses yield and valuation patterns and emphasizes that valuation channels, rather than the trade balance, increasingly determine the sustainability of countries' external positions (Adler & Garcia-Macia, 2018; Gourinchas et al., 2019). However, these studies pay little attention to developing economies and their position in the IMFS. Fourth, Darvas and Hüttle (2017) also examine the relative impacts of yield differentials and valuation changes on the sustainability of external positions. They focus on developed economies and disaggregate external asset and liability positions, arguing that foreign direct investment (FDI) is the main determinant of yield differentials between the United States and other countries (see also Curcuru et al., 2013). Finally, Akyüz (2018) provides evidence on the size and composition of external balance sheets of four developed and nine emerging-market economies for the period 2000–2016 and examines the ensuing transfer of resources from emerging-market to developed economies.

This paper employs the empirical approaches used by Akyüz (2018), Darvas and Hüttle (2017) and Gourinchas and Rey (2014) and makes two main contributions. The first novelty is the use of disaggregated external asset and liability positions and related income streams and valuation changes with a focus on developing economies. This exercise reveals several asymmetries in the IMFS that the existing literature does not address. While it is well-known that the United States stands out in combining the exorbitant privilege and the exorbitant duty, this paper shows that several other developed economies also enjoy positive yield differentials but did not suffer valuation losses during the global financial crisis (GFC). It also shows that, by contrast, developing economies generally record negative yield differentials and about two-third of them also experienced valuation losses during the GFC. Negative yield differentials and net valuation changes combined implied a total return differential of about minus three percentage points between developing and developed countries and an average annual resource transfer from the 36 developing economies of about $800 billion over the period 2010–2019, equivalent to about 3.3 per cent of these countries' combined GDP.

As a second novelty, the paper provides an econometric analysis that relates yield differentials on several investment categories to policy options regarding crisis insurance strategies—accumulating reserves, engaging in swap arrangements, and adhering to regional financial arrangements (RFAs)—and that applies the concept of "currency hierarchy". This concept starts from the recognition that currencies of developing economies do usually not, or only marginally, perform the three international functions of money, i.e. unit of account (invoicing currency), means of payment (transaction currency) and store of value (investment and reserve currency). Differences in the ability of currencies to perform these three functions make them assume different degrees of liquidity, with the dollar being the most liquid currency and positioned at the top of what has been called "currency pyramid" (Cohen, 1998) or "currency hierarchy" (Andrade & Prates, 2013). Currencies of other core advanced economies are presumed to occupy intermediate ranks, and currencies of developing economies rungs at the bottom. To compensate for differences in liquidity, assets in less liquid currencies need to offer higher total returns to be attractive to international investors. Developing economies can achieve this by offering higher yields or higher valuation gains than developed economies.

The results of this analysis indicate a positive relationship between reserves and yield differentials on both total and safe investment categories, as well as a positive correlation of permanent swap arrangements and regional monetary arrangements (such as the Chiang Mai Initiative Multilateralization, CMIM) with yield differentials on total external assets and liabilities. This indicates that financial integration by developing economies that allows for riskier investment categories, such as portfolio investment, should be accompanied by institutional reform that includes developing economies in swap arrangements with ready access to dollar liquidity, including through regional monetary arrangements.

The analysis of the exorbitant privilege and the exorbitant duty focuses on a broad sample of 76 economies during 1995–2019. The main motivation for starting the sample period in 1995 is evidence that points to the mid-1990s as the beginning of the functioning of the IMFS as an insurance scheme with sizable resource transfers between countries: while the net external position of the United States became increasingly long in risky and short in safe assets starting in the mid-1980s, it is only since the mid-1990s that the net external position of the rest of world has been long in safe and short in risky assets (Gourinchas et al., 2019), and it was for the first time in 1995 when the share of risky assets in all assets exceeded the share of liquid liabilities in the total liabilities of the United States (Gourinchas & Rey, 2007). Moreover, the current level of global financial integration was essentially reached by the mid-1990s, and the second half of the 1990s marks a surge in the global stock of external assets and liabilities and a change in their composition from debt to equity, as well as a change in the structure of the GFSN with reserve accumulation for precautionary motives and engaging in regional monetary arrangements, such as the CMIM, assuming significant importance.

Given that the above literature does not use a standard country sample, the empirical analysis in this paper departs from the 49 country sample used in Adler and Garcia-Macia (2018) and IMF (2017a, 2019) and adds the other countries included in Ghosh et al. (2017), except Lebanon, Panama, Venezuela and Vietnam, for which no comprehensive data are available. Instead, the following developing economies are added to increase the coverage of developing economies on which this paper focuses: Bangladesh, Ghana, Madagascar, Mauritius, Senegal, and the United Republic of Tanzania. As a result, the current sample comprises 76 economies—36 developing economies, 7 transition economies, and 33 developed economies of which 11 in Central and Eastern Europe (see the "Appendix" for detail).[2]

This country sample covers about 94 per cent of global output in 2019. It contains all the major advanced economies, a broad set of developing and transition economies that includes all the major ones (such as Brazil, China, India, Russian Federation, and South Africa), as well as developed economies that experienced large capital flow reversals during the GFC and for which comprehensive data are available (such as the Baltics and Hungary). It also contains all the major countries included in the MSCI ACWI + Frontier Markets Index and those included in the Institute of International Finance Capital Flows report country sample. The sample does not

[2] The terminology and classification of countries follows the categories of the United Nations.

include many small developing economies as these tend to remain financially closed and would bias the overall results.

The paper proceeds as follows. Section 2 describes the methodology. Section 3 presents statistical patterns regarding the size and composition of external asset and liability positions and their return characteristics. Section 4 undertakes the econometric estimation, and Section 5 concludes. The "Appendix" details the country sample and data sources, and the online appendix provides additional tables and charts, as well as country-specific evidence.

2 Methodology

Accounting identities, as used by Adler and Garcia-Macia (2018), Akyüz (2018) and Gourinchas and Rey (2014) allow for an assessment of the yield and valuation pattern of external portfolios. The net foreign asset (*NFA*) position (at market value) of a country in period *t* is the difference between its gross external assets *A* and its gross external liabilities *L*, i.e. $NFA_t = A_t - L_t$. Assuming a country's external trade account to be balanced, i.e. the difference between the exports and imports of goods and services to be zero, the change in its NFA-position between *t−1* and *t* reflects the total return on its external balance sheet, where the total return is the sum of valuation changes (*VC*) that can be attributed to exchange-rate and asset-price movements, and the differential in the yield on the country's gross external assets and on its gross external liabilities as reflected by the income account (*IB*).[3] Accordingly,

$$NFA_t = NFA_{t-1} + IB_t + VC_t + OC_t + SD_t \tag{1}$$

where *OC* denotes other changes and *SD* denotes the statistical discrepancy of the balance of payments, both of which are assumed to be zero.[4]

Disaggregating the income account into investment income (*II*) and other income and assuming other income to be zero, a country's total return on assets is

$$r_t^A = \frac{II_t^A + VC_t^A}{NFA_{t-1}^A} = i_t^A + vc_t^A \tag{2}$$

and its total return on liabilities is

$$r_t^L = \frac{II_t^L + VC_t^L}{NFA_{i-1}^L} = i_t^L + vc_t^L \tag{3}$$

Total return can be disaggregated into yield differentials, i.e.

[3] The sum of the trade account and the income account constitutes the current account.

[4] To the extent that measurement problems cause *OC* and *SD* to deviate from zero, the problems may, nonetheless, be similar across countries. Hence, they may affect the size of country-specific changes but not alter their cross-country comparability (see also Darvas and Hüttle 2017 and Gourinchas and Rey 2014). See Curcuru et al. (2013) and Vicard (2019) for discussion of potential reasons for and impacts of $OC \neq 0$.

$$i_t^{diff} = i_t^A + i_t^L \tag{4}$$

and valuation differentials, i.e.

$$vc_t^{diff} = vc_t^A + vc_t^L \tag{5}$$

Regarding valuation changes on assets (VC_t^A), i.e.

$$VC_t^A = A_t - A_{t-1} - CA_t - CI_t \tag{6}$$

there is a capital gain (loss) if assets increase more (less) than the sum of the current account (CA) and capital inflows (CI).

Similarly, valuation changes on liabilities (VC_t^L) are

$$VC_t^L = L_t - L_{t-1} - CI_t \tag{7}$$

and there is a capital gain (loss) if gross liabilities increase less (more) than capital inflows. The change in the NFA-position (NA_t-NA_{t-1}) equals the sum of the current account (CA_t) and valuation changes (VA_t), and there is a net capital gain (loss) if the NFA-position changes more (less) than the current account.

Distinguishing three investment categories j—FDI, portfolio equity, and other (including debt, reserves and derivatives)—a positive yield differential may arise from a return effect (higher returns on assets than on liabilities within an investment category) and from a composition effect (more higher-yield investment categories on the asset than on the liability side). Following Curcuru et al. (2010), the yield differential can accordingly be disaggregated as follows:

$$i_t^{diff} = \sum_{j=1}^{N} \frac{i_j^A + i_j^L}{2}\left(w_j^A - w_j^L\right) + \sum_{j=1}^{N} \frac{w_j^A + w_j^L}{2}\left(i_j^A - i_j^L\right) + \in \tag{8}$$

where the first term denotes the composition effect, i.e. the sum of the average of the returns on the assets and liabilities for the investment category multiplied by the differences between the average weights of each investment category in assets and liabilities. The composition effect is zero when the various investment categories have the same weight on the assets as on the liability side. The second term denotes the return effect, i.e. the sum of the average weight of the investment category in assets and liabilities multiplied by the differences between average asset and liability returns within each investment category. The return effect is zero when each investment category has the same average return on assets as on liabilities. The third term, ε, is a residual that reflects the difference between the yield differential calculated on total assets and liabilities and the yield differential calculated as the sum of return and composition effects. As discussed by Curcuru et al. (2010), this residual may reflect timing effects, such as when reallocations between investment categories cause annual data on the weights and returns of investment categories not to move together. This would be the case, for example, when within a given year foreign holders continue disinvestment in developing country equity markets even after valuations on these markets reached their bottom, or when developing countries

continue accumulating dollar reserves even when dollar-denominated bonds start to underperform.[5]

Combining yield and valuation differentials, total return differentials can be expressed as follows:

$$r_t^{diff} = i_t^{diff} + vc_t^{diff} \tag{9}$$

Making the related calculations requires certain assumptions, such as that *OC* and *SD* are zero, and the recognition that there is a discrepancy between assets and liabilities at the global level—which Zucman (2013) attributes to non-recorded assets held in offshore accounts.

3 A statistical assessment of external balance sheets

This section provides a statistical assessment of external balance sheets for the period 1995–2019 and the 76 economies listed in the "Appendix".

3.1 Stocks of gross external assets and liabilities

Increasing global financial integration has been accompanied by the rapid expansion of gross foreign asset and liability positions. In developing countries, the sharp increase in capital flows since 1995 has translated into an eight-fold increase in developing economies' stock of external liabilities and a 16-fold increase in their stock of external assets (Fig. 1).[6] This increase was interrupted only by the decline in portfolio equity and debt liabilities in 2008, 2015 and 2019, as well as by a reduction in foreign-exchange reserves in 2015. The almost continuous increase also means that close to 95 per cent of developing economies' gross external assets and close to 90 per cent of their gross external liabilities outstanding in 2019 was accumulated since 1995.

The strong contemporaneous expansion of gross assets and liabilities implies that a large amount of the increase in developing economies' external assets are linked to their external liabilities, i.e. they are borrowed in the sense that their counterpart is increased external liabilities that, in one form or another, generate outward income transfers. The strong contemporaneous expansion of gross assets and liabilities has also caused income receipts and payments from external stocks to gain significant

[5] Tracking timing effects requires data at more than annual frequency. Such data are not available for the large sample used here.

[6] On the methodology and assumptions used for the estimation of gross foreign asset and liabilities positions, see Lane and Milesi-Ferretti (2018). Interpreting these numbers should recognize that the distinction between FDI and portfolio equity is somewhat arbitrary, and that FDI statistics consider retained earnings as being reinvested and loans and advances between parent companies and their foreign affiliates as direct equity rather than debt, though it is not possible to determine whether this is actually the case (Akyüz, 2017). Moreover, according to Damgaard et al. (2019), almost 40 per cent of global FDI positions is financial investment passing through corporate shells with no real activity involved. For discussion on the accuracy of recorded portfolio flows, see Coppola et al. (2019).

importance for the current account of the balance of payments. A sizable deficit in net international investment income may now arise not only when external liabilities exceed external assets—as is the case in Fig. 1 for the group of developing economies—but also when the rate of return on foreign assets is below that on foreign liabilities.

3.2 The composition of gross external assets and liabilities

A situation when the return on gross external liabilities, i.e. investment income payments (II^L), exceeds the return on gross external assets, i.e. investment income receipts (II^A), can result from composition effects, such as from a mismatch in the relative importance of debt and equity categories in gross external assets and liabilities. Equity is generally riskier and therefore carries a higher rate of return than debt. Regarding developing economies' gross external assets (online appendix table OA1 and country-specific figures), the period 1995–2019 saw a considerable shift from debt (foreign bond holdings, deposits held abroad and foreign-exchange reserves) to equity (FDI and portfolio equity).

The composition of developing economies' gross external liabilities (online appendix table OA2 and country-specific figures) recorded a similar shift from debt to equity. But the shift in the composition of liabilities was considerably larger and more widespread than that regarding assets, and it has implied a rising share of both FDI and portfolio equity.

Many of these changes resulted from deliberate policies that responded to the recurrent crises in the 1990s and early 2000s. Regarding liabilities, developing economies sought to reduce the share of debt by liberalizing FDI-regimes and by opening equity markets to non-residents. They also sought to reduce currency mismatches by opening bond markets to foreigners and by borrowing in domestic currency. This has been accompanied by an increased importance of securities relative to bank loans in financial flows to developing economies. These changes have improved the profile of their gross external liabilities and reduced vulnerability to the kind of shocks they had suffered in past crises. However, greater presence of foreigners in bond and equity markets has also increased the potential instability of exchange rates, with ensuing larger valuation changes, since surges in entry and exit of non-residents affect not only asset prices but also exchange rates (Akyüz, 2017).[7]

Regarding assets, a noteworthy phenomenon is the accumulation of reserves, mostly undertaken for precautionary reasons after the Asian financial crisis in 1997 (Aizenman & Lee, 2007). The primary precautionary purpose is to self-insure against a sudden capital-flow reversal or to mitigate its adverse effects. Yet, reserves are often used only sparely in crisis periods. Reserve holdings of emerging and developing economies declined by only 10 per cent during the GFC, compared to 20 per cent during the Asian crisis (Cabezas & De Gregorio, 2019). One reason for accumulating reserves while being reluctant to use them during crises may be that

[7] Increased vulnerability related to these changes has become known as "original sin redux" (Carstens & Shin, 2019).

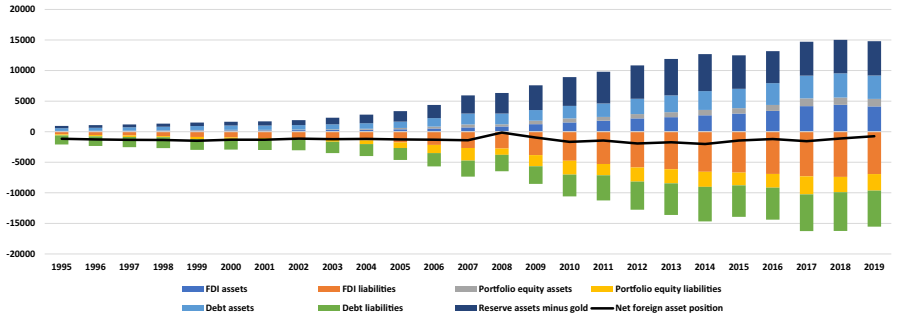

Fig. 1 Stocks of gross external assets and liabilities, group of selected developing countries, 1995–2019, $ billion. *Source*: Author's calculations; for data sources, see "Appendix". *Note*: Negative numbers indicate stocks in the domestic economy held by non-residents. The numbers reflect data for the 36 developing countries listed in the "Appendix". For country-specific evidence, see online appendix

large stocks of reserves act as a signal of financial strength, i.e. the ability to access foreign-exchange liquidity, and deter currency speculation (Cabezas & De Gregorio, 2019). Moreover, they may ensure a higher grading by rating agencies, thereby reducing the risk premium on a country's external liabilities.

Nevertheless, reserve stocks have sometimes been judged "excessive" based on traditional measures, such as the levels needed to cover imports or to roll over short-term (up to one year) external debt (the so-called "Greenspan-Guidotti" rule of reserve adequacy). Financial openness, desired exchange-rate stability and the size of the domestic banking system are additional considerations in determining the adequacy of reserves. In crisis situations, policymakers attempting to avoid or mitigate currency depreciation may need to counter a large and sudden withdrawal of liquid domestic deposits (i.e. "sudden capital flight") in addition to stemming depreciation pressure from sudden stops and reversal of capital inflows.

Accordingly, reserve adequacy may be assessed by combining the Greenspan-Guidotti rule with a metric reflecting financial vulnerability. One such composite metric is adding a percentage of broad money (M2), typically set at 20 per cent as the size of domestic financial liabilities, that could potentially be converted into foreign currency and cause asset-price and exchange-rate pressure (Obstfeld et al., 2010). Another is adding the current-account balance when it records a deficit, intended to reflect the full potential 12-month external financing need (IMF, 2017b). The asymmetric treatment of the current-account balance in the latter metric reflects that surplus countries tend to have "earned" reserves, i.e. with no counterpart in increased external liabilities, that may have been accumulated for other than precautionary reasons. One example would be countries with large non-renewable resources choosing to hold their savings designed to ensure intergenerational equity in reserves rather than in alternative investment vehicles.

Focusing on developing economies and comparing the period before (Fig. 2a) with that after the GFC (Fig. 2b) indicates an increase in actual reserve holdings,

as well as in the three metrics for reserve adequacy.[8] In most countries and for both periods, actual reserves were broadly adequate to cover imports and the Greenspan-Guidotti rule extended by the current-account deficit. By contrast, for many countries they reserves appear insufficient to cover financial vulnerability, and their metric regarding short-term debt plus 20 per cent of broad money also recorded the largest average increase (2.6 percentage points of GDP) between the two periods. Notable exceptions include Cameroon, Madagascar, Malaysia, Mexico, Nigeria, Peru, the Philippines, Senegal, Thailand, and Uruguay where reserves in the post-GFC period exceed all adequacy metrics by some margin.

It is also noteworthy that, in the pre-GFC period, reserves in the Republic of Korea appeared broadly adequate even on the financial vulnerability metrics. This contrasts with the fact that despite using a large share of its sizable reserves during the GFC, the country was able to stabilize its financial markets in October 2008 only after the Bank of Korea entered into bilateral swap agreements with the United States, Japan, and China (Aizenman & Pasricha, 2010). This points to very different effectiveness of these two policies designed to mitigate foreign-currency funding problems. It may also partly explain why central banks hesitate to draw on their reserves to address financial turmoil, including because healthy levels of reserves in the Republic of Korea may have been a key determinant for the Federal Reserve to enter in a bilateral swap agreement with the Bank of Korea.

3.3 Net risky and net safe holdings of external assets

Changes in the composition of gross external assets and liabilities also lead to changes in net risky and net safe holdings of external assets. Comparing the evolution of these net positions for the United States and the 36 developing economies covered in this paper shows that the United States have registered a net positive position in risky assets and a net negative position in safe assets during almost the entire period 1995–2019 (Fig. 3). Being a creditor in risky and a debtor in safe external assets reflects the function of the United States as the issuer of the main reserve currency and global provider of liquidity. By contrast, developing economies have recorded net negative positions of risky assets during most of this period—driven by the increase in their holdings of FDI and portfolio equity liabilities exceeding that of FDI and portfolio equity assets—and, since 2003, a net positive position in safe assets—driven by their accumulation of foreign-exchange reserves and a decline in their debt liabilities (see the online appendix figures for country-specific evidence). Being a creditor in safe and a debtor in risky assets suggests that the return that developing economies pay on their external liabilities exceeds the return that they earn on their external assets, i.e. an income transfer from developing economies.

[8] The evidence shown for the post-GFC period extends only up to 2018, as at the time of writing (September 2020) data on short-term external debt was not available for 2019.

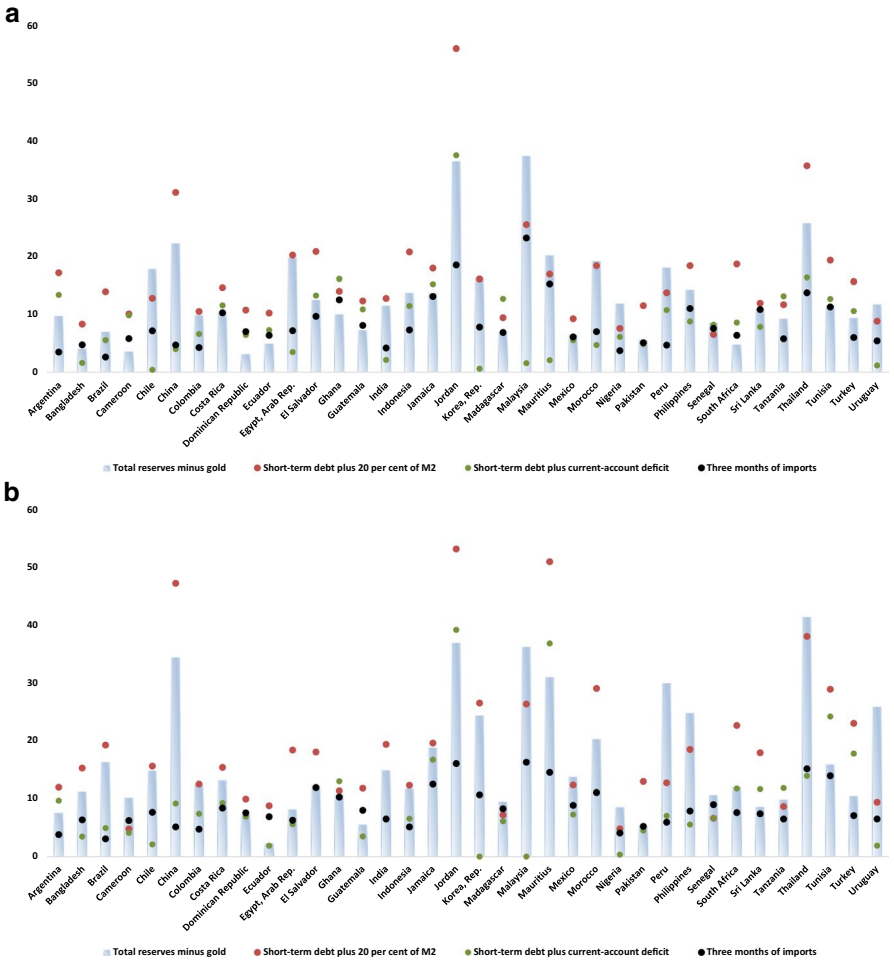

Fig. 2 a Reserve adequacy metrics and actual reserves, selected developing countries, 1995–2007 (per cent of GDP). **b** Reserve adequacy metrics and actual reserves, selected developing countries, 2010–2018 (per cent of GDP). *Source*: Author's calculations; for data sources, see "Appendix"

3.4 Returns on external assets and liabilities

To assess the size of this income transfer, it is useful to compare the yield on gross external assets with that on gross external liabilities. Developing economies experienced sizable negative yield differentials over the entire period 1995–2019 (Table 1, columns 1–4, and online appendix table OA3). The average yield differential was within a relatively stable range of about 2–3 percentage points but was about one percentage point larger over the period 2010–2019 than before the GFC. Moreover, the yield differentials during these two sub-periods are quite similar across the 36 developing economies, as there is relatively little difference between the group average and median numbers.

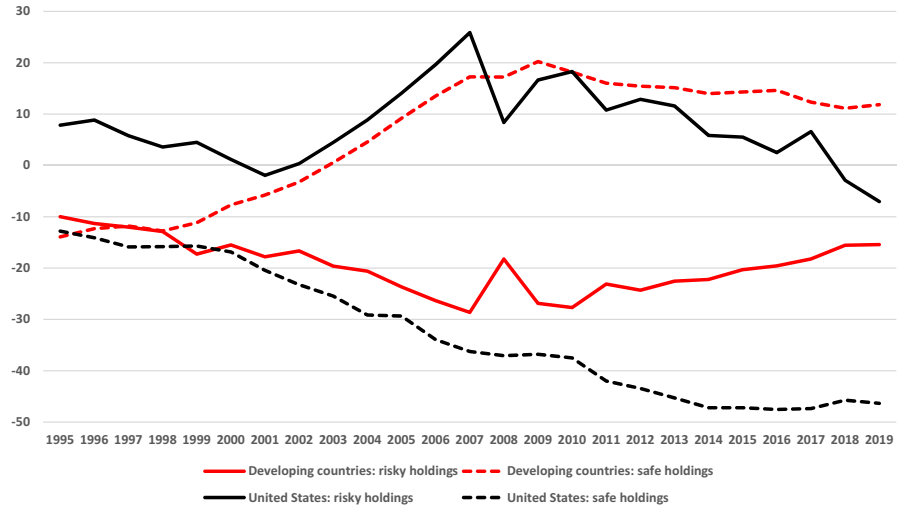

Fig. 3 Net risky and net safe holdings of external assets, United States and selected developing countries, 1995–2019 (per cent of GDP). *Source*: Author's calculations; for data sources, see "Appendix". Notes: Net risky holdings = portfolio equity assets + FDI assets – (portfolio equity liabilities + FDI liabilities); net safe holdings = reserve assets + debt assets – debt liabilities. The numbers for developing countries reflect data for the 36 countries listed in the "Appendix". For country-specific evidence, see online appendix

Yield differentials have also been negative for transition economies and developed countries in Central and Eastern Europe. In the other developed countries, by contrast, the yield differential has on average been slightly positive over the period 1995–2019, with this differential being larger after than before the GFC. Moreover, on average, the group of other developed countries received higher yields on their gross assets and paid lower yields on the gross liabilities than the other country groups (online appendix table OA3).

Country-specific evidence in online appendix table OA3 indicates that Jordan and Turkey are the only non-developed economies in the sample that recorded a slight average positive yield differential. However, annual data in the country-specific figures in the online appendix show that these countries also experienced negative yield differentials in a significant number of years. These figures also show that Japan and the United States are the only countries that experienced a positive yield differential throughout the period 1995–2019—on average by 1.7 percentage points for Japan and 1.3 percentage points for the United States. Some other developed countries—Denmark, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, Switzerland, and the United Kingdom—also experienced positive average yield differentials.

The United States shows the additional specific feature that—apart from Australia, Canada and New Zealand whose sizable positions in debt assets are likely to be related to intergenerational transfers of non-renewable natural-resource wealth and be invested in long-term, and therefore higher-yielding, instruments—is the only country that recorded positive yield differentials on its safe assets throughout

Table 1 Return differentials on gross external assets and liabilities, group averages, 1995–2019 (percentage points). *Source*: Author's calculations; for data sources, see "Appendix"

	Yields on gross assets minus yields on liabilities				Changes on gross assets plus changes on gross liabilities				Total return on gross assets minus total return on gross liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	1995–2007	2008–2009	2010–2019	1995–2019	1995–2007	2008–2009	2010–2019	1995–2019	1995–2007	2008–2009	2010–2019	1995–2019
Developing countries												
Group average	−2.2	−3.1	−3.1	−2.7	5.8	−4.6	−2.3	3.8	0.0	−4.4	−3.9	−3.3
Median	−2.1	−2.4	−3.1	−2.1	3.6	−1.3	−0.2	0.8	−3.0	−2.0	−3.3	−3.0
Transition economies												
Group average	−3.0	−3.7	−4.2	−4.0	1.7	−5.9	−3.4	−1.2	−7.6	−3.9	−1.4	−6.1
Median	−1.8	−3.7	−4.2	−2.1	−2.4	−5.3	−2.0	−4.8	−5.6	−3.2	0.1	−5.7
Developed countries in Central and Eastern Europe												
Group average	−2.5	−1.7	−2.6	−2.5	10.6	-7.2	−0.8	4.7	−1.4	−3.4	−1.4	−1.4
Median	−2.0	−2.4	−3.1	−2.0	9.8	−10.4	−1.1	4.3	−1.4	−4.3	−0.4	−2.1
Other developed countries												
Group average	−0.1	0.1	0.5	0.0	−12.4	−5.7	5.2	−4.6	−0.9	3.3	5.9	3.1
Median	0.0	−0.1	0.2	0.1	8.6	−3.6	−0.6	4.0	2.1	2.0	3.9	2.3

For country-specific evidence, see online appendix tables OA3, OA5 and OA6

the sample period (online appendix figures). This positive yield differential more than compensated the negative yield differentials on its risky assets in a significant number of years prior to the GFC.[9]

Splitting yield differentials into contributions from composition and return effects (Tables 2 and online appendix table OA4) indicates that the two effects are of approximately equal importance for developing economies. The composition effect is driven by the risky investment categories (FDI, portfolio equity), while the return effect relates about equally to FDI and the "other" investment category, i.e. safe investment instruments.[10] For the group of developed economies, by contrast, yield differentials are driven by return effects, from both FDI and portfolio equity, while FDI drives compositional effects, especially in developed economies in Central and Eastern Europe.

A comparison of yield differentials on FDI and on non-FDI categories for the period 2010–2019 (Fig. 4) does not support the hypothesis that the positive yield differentials on the external balance sheet of the United States is mainly determined by FDI (Curcuru et al., 2013; Darvas & Hüttle, 2017). While the United States recorded the largest positive yield differential on FDI, other developed countries, such as France and Germany, are not far behind. Moreover, the United States is also among the countries with the largest positive yield differential on non-FDI investment categories.

3.5 Valuation changes on external assets and liabilities

Turning to valuation changes (Tables 1, columns 5–8 and OA5), a notable feature is the significant volatility in annual valuation changes, as reflected by the large differences across time periods and between group average and median numbers.[11] There is mixed evidence for developing economies. As a group, they experienced small negative valuation changes during the crisis period of 2008–2009 (Table 1, column 6), but one-third of the 36 developing economies in the sample experienced positive valuation changes during this period (table OA5).[12] There is also significant

[9] While the country-specific figure for the United States in the online appendix shows the country's sizable positive yield differential for FDI, i.e. the finding underlined by Curcuru et al. (2013) and Darvas and Hüttle (2017), it also shows that the yield differential for the country's risky assets (combining FDI and portfolio equity) is negative for a large number of years prior to the GFC.

[10] The countries that in online appendix table OA4 record residuals exceeding 0.2 percentage points combine relatively small positions with relatively large and very volatile returns in the portfolio equity investment category, especially at the beginning of the sample period.

[11] Changes in the relative shares of assets and liabilities denominated in domestic and foreign currency also affect valuation changes. Juvenal et al. (2019) provide an indicator of aggregate foreign-currency exposure for the period 1990–2017 and 50 economies that, however, cover only about half of the countries which are considered here and not classified as developed economies. Moreover, given the focus on valuation changes in the period 2008–2009, changes in foreign-currency exposure over longer periods affect the reported results only marginally.

[12] The period 2008–2009 covers the most acute phase of the global financial crisis, following the collapse of Lehman Brothers in September 2008 and the ensuing ripple effects and responses by financial investors and policymakers.

Table 2 Contribution of composition and return effects to yield differentials, group averages, 1995–2019 (per cent) *Source*: Author's calculations; for data sources, see "Appendix"

	Return and composition effect	Contribution from composition effects				Contribution from return effects				Memo items	
		Total	FDI	Portfolio equity	Other	Total	FDI	Portfolio equity	Other	Total yield differential	Number of observations[a/]
Developing countries											
Group average	−2.6	46	37	21	−10	52	24	0	33	−2.6	22
Median	−2.1	41	30	12	−11	58	28	6	29	−2.1	22
Transition economies											
Group average	−4.1	63	51	38	−27	37	9	−19	47	−3.6	22
Median	−4.3	58	32	18	−24	42	22	−3	49	−3.5	24
Developed countries from Central and Eastern Europe											
Group average	−1.9	11	50	−18	−20	89	46	23	20	−2.4	21
Median	−1.9	15	42	−34	−14	85	47	14	21	−2.6	21
Other developed countries											
Group average	0.1	18	37	−17	−2	81	47	31	4	0.0	22
Median	0.1	28	40	−5	−2	72	46	20	4	0.1	22

[a]Years with contributions exceeding ± 500 per cent are excluded. Differences between the return and composition effect and the total yield differential caused by rounding and timing effects. A negative contribution indicates a contribution in the opposite direction relative to the overall return and composition effect. For country-specific evidence, see online appendix table OA4

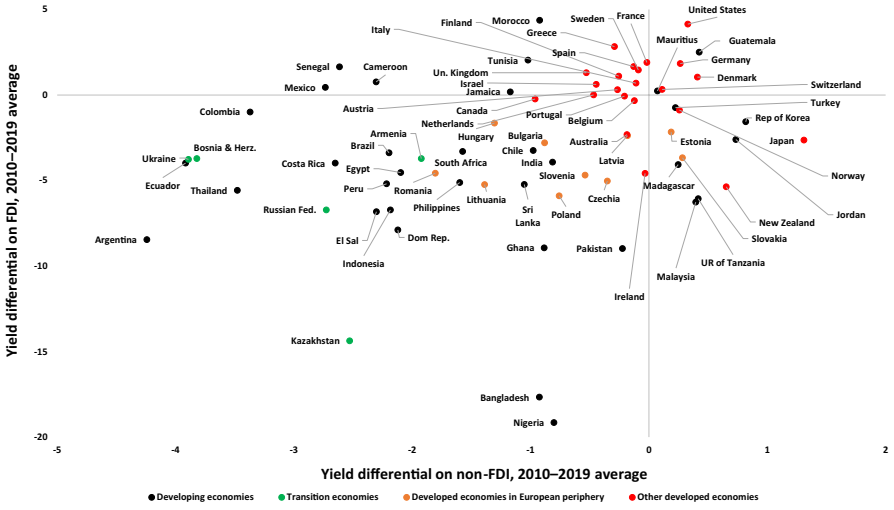

Fig. 4 Yield differentials on FDI and non-FDI investment categories, selected economies, 2010–2019, percentage points. *Source*: Author's calculations; for data sources, see "Appendix". *Note*: Croatia and Georgia are extreme outliers in the FDI-dimension and therefore not shown in the figure

variation for developed economies. Some of them experienced large positive valuation changes in 2008–2009 (e.g. Japan, Switzerland) while others (e.g. Canada, Sweden, United States) registered sizable negative valuation changes. This means that in terms of valuation changes and for the sample as a whole, there is only mixed support for the global insurance view, in the sense that many countries that recorded negative yield differentials over the period 1995–2019 also experienced valuation losses during the GFC.

On the other hand, the United States experienced significant negative valuation changes during the crisis period and positive valuation changes over the period 1995–2019 overall (online appendix table OA5). This evidence supports the argument of Gourinchas and Rey (2014) that the United States acts as a global insurer and provides wealth transfers to other countries during crisis periods. The figures for the United States in the online appendix indicate that this wealth transfer mostly operated through a collapse of the value of risky assets and that changes in the country's net foreign asset position in FDI and portfolio equity led to a deterioration of its NFA-position by 18 percentage points of GDP in 2008. They also indicate that this collapse in the value of foreign assets of the United States in 2008 was followed in 2009 by a sharp increase in the value of the United States' external liabilities (mostly debt held by other countries as foreign-exchange reserves). Stavrakeva and Tang (2018) show that these valuation changes in the external liabilities of the United States resulted from an appreciation of the dollar, associated with a "flight to safety" by financial investors.

Regarding the relationship between yield differentials and valuation changes, Fig. 5 shows that the data points of "other" developed economies are closely aligned along the vertical axis. This indicates that these countries record positive or only

slightly negative yield differentials, which apparently are largely independent of valuation changes during the GFC. By contrast, the data points of most developing and transition economies are aligned along the horizontal axis. This indicates that their valuation changes are relatively small and apparently largely independent of their yield differentials. With 24 developing economies in the bottom-left quadrant and 12 developing countries in the top-left quadrant, a trendline (not shown in the figure) for developing economies excluding the outliers Bangladesh, Jamaica and Nigeria is slightly below but close to parallel to the x-axis. By contrast, the vast majority of the major developed economies recorded positive yield differentials, and France, Italy, Japan and Switzerland are in the upper-right quadrant, combing positive yield differentials with valuation gains.

This evidence changes only little if valuation changes in 2008–2009 are compared with yield differentials on safe investment categories during the period 1995–2007 (online appendix figure OA1). Nevertheless, yield differentials are generally less negative and even positive for a range of developing economies, such as Argentina, Dominican Republic, Egypt, India, Malaysia, Peru, the Philippines, Republic of Korea, Sri Lanka, United Republic of Tanzania, and Uruguay. Of the 33 developing economies for which disaggregated return data are available for at least part of the period 1995–2007, only seven (Brazil, China, Colombia, El Salvador, Madagascar, Senegal, and Thailand) conform to the global insurance view, i.e. they combine negative yield differentials on safe investment categories during the pre-crisis period and positive valuation changes during 2008–2009.

The global insurance view of Gourinchas and Rey (2014) also suggests that valuation changes in the United States are sizable in terms of global output during crisis periods, while the country pays a relatively low yield on its external liabilities during normal times. Figure 6 shows that the United States experienced the by far largest negative valuation change as a share of global output during the GFC, while it also paid a relatively low yield on its external liabilities during period 1995–2019. However, some other large developed economies—France, Japan, and Switzerland—paid even lower or similar yields on their external liabilities but registered positive valuation changes during the GFC. Germany and the United Kingdom, and to a lesser extent Canada, the Netherlands and Sweden, also registered negative valuation changes during the GFC, while paying only slightly higher yields on the external liabilities than the United States during the period 1995–2007. This evidence suggests that—in terms of the global insurance view—the valuation changes in the external balance sheet of the United States during the GFC largely entailed wealth transfers to other developed countries but provided little insurance to developing and transition economies.[13]

[13] Excluding yield on FDI and linking yield on non-FDI liabilities with valuation changes causes only marginal changes.

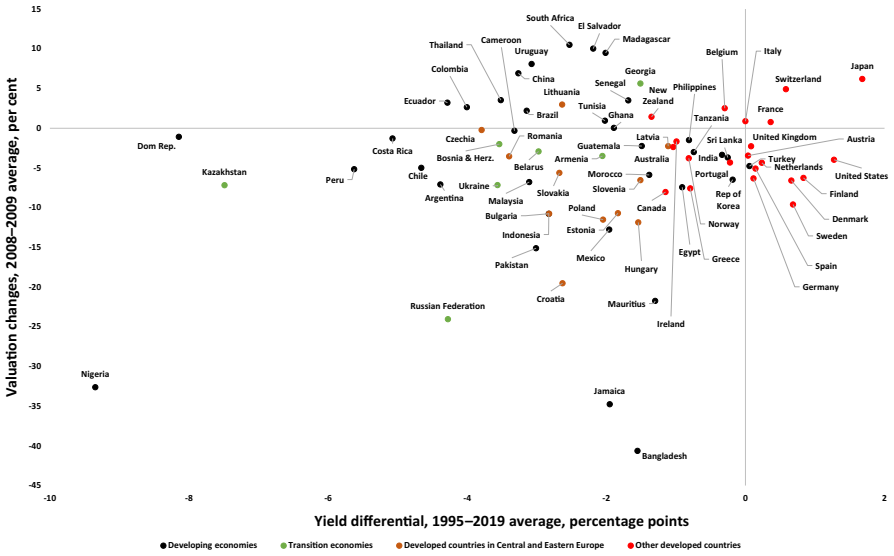

Fig. 5 Yield differentials, 1995–2019, and valuation changes as a share of GDP (2008–2009), selected economies. *Source*: Author's calculations; for data sources, see "Appendix". *Note*: Israel is an extreme outlier and therefore not shown in the figure

3.6 Total returns on external assets and liabilities

Turning to total rates of return, which combine yield differentials and valuation changes, the evidence largely shows the same pattern as that on yield differentials. Total rates of return are negative for developing and transition economies, as well as for developed economies in Central and Eastern Europe, while they are positive for other developed economies (Table 1, columns 9–12 and online appendix table OA6).[14] Over the period 2010–2019, the return differential between assets and liabilities for the 36 developing economies taken as a group is about minus 3.5 to minus 4 percentage points (Table 1, column 11), with the bulk of it due to yield differentials (Table 1, column 3) and the rest from valuation changes (Table 1, column 7). Moreover, the total rates of return on developed economies' gross external assets are often larger and those on their gross external liabilities smaller than those for developing and transition economies. For the period 2010–2019 on average, the 36 developing economies in the sample earned about one percentage point less on their gross external assets and paid two percentage points more on their gross external liabilities than the 33 developed economies in the sample, implying a total return differential of about minus three percentage points between developing and

[14] Table OA6 also shows that group average and median numbers for total rates of return diverge more than for yield differentials, again indicating significant volatility and cross-country differences in capital gains and losses.

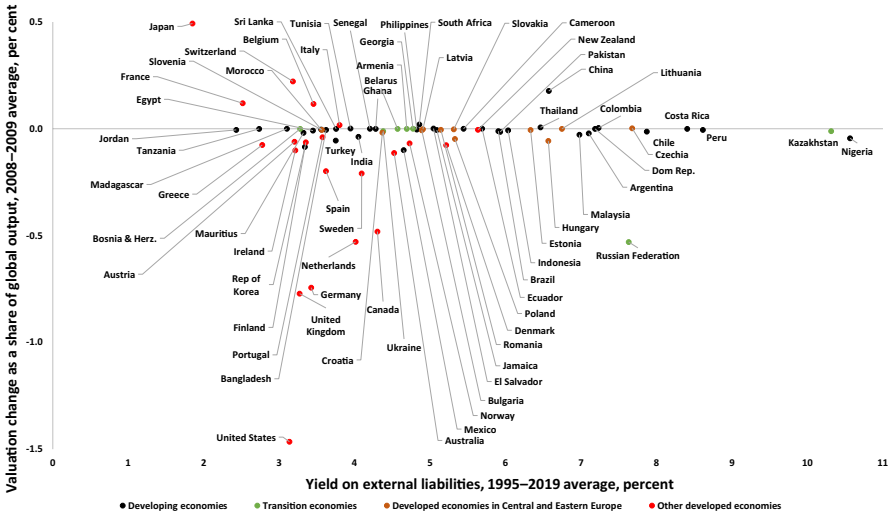

Fig. 6 Yield on external liabilities (1995–2019) and net valuation changes as a share of global output (2008–2009), selected economies (per cent). Source: Author's calculations; for data sources, see "Appendix"

developed economies.[15] Combining annual income transfers from yield differentials and annual wealth transfers from net valuation changes, this implies that for the period 2010–2019, the 36 developing countries recorded negative total net foreign asset returns amounting to about $800 billion on average per year, equivalent to about 3.3 per cent of these countries' combined GDP.[16]

3.7 Returns on NFA-positions and balance-of-payments sustainability

The strong increase in the stock of external assets and liabilities and the associated increase in the importance of total NFA-returns (defined as the balance on the income account plus net valuation changes) relative to traditional balance-of-payments changes through the trade balance raises the question as to whether total NFA-returns amplify or mitigate trade imbalances.

[15] This result is broadly in line with Adler and Garcia-Macia (2018) who analyze 52 economies for the period 1990–2015 and find that developing countries' total rates of return are five percentage points lower than those in developed countries. It is also consistent with Akyüz (2018) who analyzes nine emerging economies for the period 2000–2016 and finds a return differential of seven percentage points. In addition to the effects coming from different time periods, this larger number is mainly due to the inclusion of the Russian Federation in the group of emerging economies, with this country's negative return differential exceeding, often by a large margin, that of the vast majority of the developing country included in Table 1.

[16] Excluding China, the resource transfer amounts to about $585 billion on average per year, equivalent to about 4.3 per cent of the remaining 35 countries' GDP.

Excluding the outliers Ireland, Netherlands, and Switzerland, there is a slight negative relationship between trade balances and total NFA-returns for the period 1995–2019 which suggests an overall stabilizing effect on the balance of payments (Fig. 7). This is true in particular as some of the world's largest economies either combine trade deficits with positive NFA-returns—such as France, South Africa, the United Kingdom, and the United States which are in the upper-left quadrant of Fig. 7—or combine trade surpluses with negative NFA-returns—such as Brazil, China, Indonesia, Nigeria, and the Russian Federation which are in the bottom-right quadrant of Fig. 7. However, this interplay is de-stabilizing for many developing and transition economies that combine trade deficits with negative NFA-returns and are in the bottom-left quadrant of Fig. 7, as well as for a significant number of developed economies (Belgium, Canada, Germany, Japan, Norway, Sweden, and the three outliers mentioned above) and the Republic of Korea that combine trade surpluses with positive NFA-returns and are in the upper-right quadrant of Fig. 7.

4 Yield differentials and crisis insurance strategies

This section uses econometric analysis to examine the link between yield differentials and policy options regarding crisis insurance strategies. The set-up of the analysis is guided by the concept of "currency hierarchy". This concept is operationalized through Keynes' approach to the total return of specific assets. According to Keynes, four attributes jointly determine an asset's own rate of interest, or its total (expected) return. These are the asset's valuation change (a), its yield (q), carrying cost (c) and liquidity premium (l); the latter is the non-observable non-pecuniary return on holding an asset that addresses uncertainty.

Applying this concept to the IMFS, Andrade and Prates (2013) and Fritz et al. (2017) argue that the currency hierarchy is determined by differences in a currency's liquidity premium and that the liquidity premium of currencies from developing countries is lower than that of the currencies of developed countries. To compensate for this lower liquidity premium and make a financial investor hold their assets, developing countries have to offer higher total monetary returns or reduce the carrying cost by withdrawing capital-account regulation, i.e.:

$$l_n - l_s = \left(a_n + q_n - c_n\right) - \left(a_s + q_s - c_s\right) \text{ or } l_n - l_s = \left(a_n - a_s\right) + \left(q_n - q_s\right) - c_s + c_n \tag{10}$$

where s denotes Southern or developing countries, and n denotes Northern or developed countries.

4.1 Regression analysis

The remainder of this section uses econometric analysis for 71 countries and the period 2010–2019 to examine the link between yield differentials on the one hand

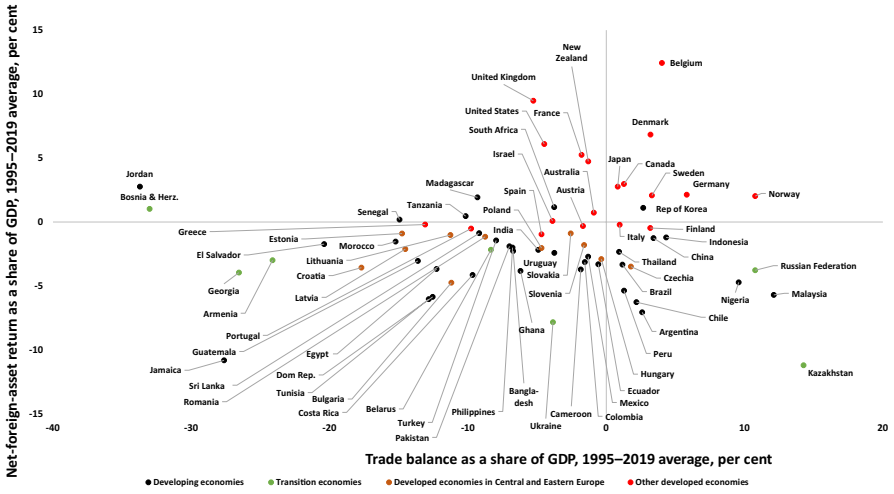

Fig. 7 Trade balance and total NFA-return as a share of GDP, 1995–2019, selected economies (per cent). *Source*: Author's calculations; for data sources, see "Appendix". *Note*: The extreme outliers Mauritius (upper-left quadrant) and Ireland, Netherlands and Switzerland (upper-right quadrant) are not shown

and the United States' exorbitant privilege and crisis insurance strategies available in the GFSN on the other hand.[17] The panel-data estimations have the following form:

$$i_{c,t}^{diff} = \alpha + \beta * UnitedStates + \gamma * GFSN_{c,t} + \delta * controls_{c,t} + \varepsilon_{c,t} \qquad (11)$$

where c and t denote countries and years, and i denotes yield differentials on four categories of gross external assets and liabilities—total, safe, FDI or non-FDI—and GFSN refers to policy options in the GFSN. Apart from accumulating reserves, these options include engaging in swap arrangements and adhering to RFAs. Given that swap arrangements have become a critical element of the GFSN since the GFC (IMF, 2017b), the analysis focusses on the period 2010–2019.

Central bank currency swaps are arrangements between two or more central banks to enable a central bank in one country to provide foreign-currency liquidity to banks in its jurisdiction in the event of a sudden shortage of such liquidity. Given the dominant role of the dollar in global interbank markets, and the fact that most local foreign-currency loans are denominated in dollars, the United States Federal Reserve (Fed) has been one of the parties involved in many of these arrangements.

Swap arrangements have come to play a critical role in crisis insurance. When the implosion of the United States financial markets eventually led to the GFC, interbank funding began drying up beyond United States financial markets and created an acute global shortage of dollar liquidity. The Fed could use its ordinary facilities to provide liquidity to United States banks, but could not do so for multinational

[17] The regressions exclude the outliers Dominican Republic, Kazakhstan, Nigeria, and Peru (Fig. 5), as well as Uruguay due to data breaks in the incomes account.

banks, many of which are based in other developed countries, and which, prior to the crisis, had relied on cheap dollar funding through their operation in the United States. Addressing these liquidity problems by using foreign currency swap arrangements relied on three main premises. First, central banks can act swiftly; second, they face virtually no limit on their money-creating capacities; and third, the provision of international liquidity through swap arrangements with the central bank that issues the currency in which the liquidity shortage occurs does not cause any exchange-rate effects.

According to some observers (e.g. Prasad, 2013), the counterparts involved in these swap arrangements were those countries that had banking systems with a sizeable stock of liabilities owed to the United States' banking system, as well as a good sovereign credit history. This means that extending the swap arrangements was in the interest of the United States and served simply to control a situation that may have posed a systemic risk to that country's banking system. This may also explain why all of the swap lines established by the Fed in the GFC expired, as scheduled, in February 2010, except for the arrangements with five central banks (i.e. the Bank of Canada, the Bank of England, the Bank of Japan, the European Central Bank, and the Swiss National Bank) that were made permanent in October 2013. It may also explain why Japan, Switzerland, and some members of the euro area (Belgium, France, and Italy), did not incur losses but recorded valuation gains during the GFC (Fig. 5).

The People's Bank of China (PBOC) did not request a swap arrangement with the Fed, partly because it had access to a very substantial amount of dollar reserves. Moreover, Chinese banks are funded mainly from domestic sources, with few international operations that would require dollar-denominated liquidity. Instead, the PBOC itself established swap arrangements with a wide range of other central banks, mostly from developing countries. It is generally believed that the objective of these arrangements was not to address the problem of liquidity shortages, but rather to foster the internationalization of the renminbi, achieved by both increasing the share of China's trade invoiced and settled in renminbi and compensating for the yet incomplete capital account convertibility of the Chinese currency. The main long-term objectives of the swap arrangements extended by the PBOC are also reflected in their denomination in renminbi. This differs, for example, from the PBOC's swap arrangements under the CMIM that are denominated in dollars and serve to strengthen the defences of member States during financial stress. Nevertheless, renminbi-denominated swap arrangements with the PBOC also provide rapid access to liquidity and can free up dollar reserves for immediate needs.

The CMIM is the quantitatively most important RFA among developing countries.[18] It is a multilateral reserve-pooling and swap arrangement that has replaced the Chiang Mai Initiative, which was a system of bilateral swap arrangements. The CMIM was not used during the GFC, possibly because of the relatively small

[18] For detailed discussion of RFAs, see Mühlich et al. (2019) who indicate that other RFAs among developing countries are either small or designed for long-term credits, with little role for crisis insurance.

amount that a member can draw without having a loan agreement with the IMF. Nevertheless, it has an important signalling function, not only because of its overall large size but also because its members include both China and Japan, which have already participated in bilateral swap arrangements in the region, and because Japan has a permanent swap arrangement with Fed.

The regressions include dummy variables for the countries and years with a permanent swap arrangement with the Fed (*swap_per*); the members of the CMIM with its dollar-based swap arrangements (*CMIM*); the countries and years with renminbi-based swap arrangement with the PBOC (*swap_rmb*); and the countries and years with often temporary and small dollar-based swap arrangements between the Fed or the Bank of Japan and Mexico (1995–2019), Australia, Brazil, Republic of Korea (2008–2010), Indonesia (2010–2019), and India, the Philippines and Thailand (2012–2019), as well as the euro-based swap arrangement between the ECB and China (2012–2019), which may be considered equivalent to a dollar-based arrangement (*swap_dollar*). Reserves, i.e. the other element of the GFSN, is reflected by actual foreign-exchange holdings as a share of GDP (*forex_gdp*) and the two metrics of reserve adequacy used in Sect. 3.2 (*resad_ca_gdp* and *resad_m2_gdp*). Each of these three variables is also used in combination with a dummy variable for developing economies (*developing*).

Regarding controls, all regressions include three variables that reflect macroeconomic stability: inflation (*infl*), measured by the log of consumer-price inflation, where inflation rates below one per cent are set to equal 1 per cent; exchange-rate volatility (*exrate_vol*), measured as the standard deviation of the logged exchange rate between the domestic currency and the dollar; and the current-account balance as a ratio of GDP (*ca_bal_gdp*). The latter variable is also used in combination with *developing* to control for differences between developing and other economies regarding the relationship between yield differentials and external accounts, as reflected, for example, in Fig. 7. The normalized Chinn-Ito index (*chinn-ito*) is used to control for financial openness (Chinn & Ito, 2020).[19] All regressions also control for differences in the level of development (*pcinc*), measured as the log of per-capita income. The exorbitant privilege of the United States is reflected by *United States* which, alone or in combination with *swap_per* and *developing*, may also be interpreted as reflecting the currency hierarchy.

In all regressions with yield differentials on total assets and liabilities as the dependent variable (Table 3) *United States* is highly statistically significant with a large positive sign, indicating the country's exorbitant privilege. The high significance and positive coefficient on *pcinc* further suggest that richer countries tend to benefit from larger yield differentials. Of the variables controlling for macroeconomic stability, the coefficient on inflation has the expected negative sign but, as the coefficient on exchange-rate stability, is not statistically significant. The coefficient on the current-account balance reflects a general positive and highly significant

[19] Given that this index is available only until 2018, data for 2019 are assumed to be unchanged from 2018.

correlation with yield differentials while, for developing economies, this correlation has a highly significant negative and large coefficient.

Regarding reserves, the coefficient on actual holdings is positive and significant when combined with *developing*. The evidence for the reserve adequacy metrics is mixed, but especially the metric related to M2 indicates no crisis insurance for developing economies. The coefficients on permanent swap arrangements and on *CMIM* have positive signs and are highly significant. This indicates that these two crisis insurance strategies are positively related to yield differentials between total external assets and liabilities.

The results of the regressions with yield differentials on safe assets and liabilities diverge in four important ways (Table 4).[20] First, the United States dummy is no longer significant. This is not surprising given the country's negative net safe holdings of external assets. The coefficient on per-capita income remains highly significant with a positive sign, indicating that richer countries enjoy higher yield differentials also on their safe assets. Second, the coefficient on the current-account balance is positive (and significant in some of the regressions) for developing economies. This change in sign reflects global current-account imbalances combined with a negative total NFA-position (Fig. 1) and a positive safe NFA-position (Fig. 3) of developing economies. Third, the size of the coefficient on actual reserve holdings for developing economies is similar to the regressions on total yield differentials. Moreover, it increases and remains strongly significant in the regressions with the variables on swap arrangements and the CMIM, which seem to be less effective in reducing yield differentials on safe than on total assets and liabilities. Finally, *chinn-ito* is not significant, or even has a significant negative sign in some of the regressions, suggesting that financial openness plays little role for yield differentials on safe investment categories.

Taken together, the regression results suggest that richer countries enjoy larger positive yield differentials and that the United States has an exorbitant privilege on its total assets and liabilities. The permanent bilateral swap arrangements between the Fed and the other major developed economies have a further positive effect on yield differentials. These results support the hypothesis of a currency hierarchy. Regarding insurance strategies, the results indicate that reserve holdings most effectively limits negative yield differentials of developing countries, but that regional monetary arrangements also are effective insurance strategies.

4.2 Robustness tests

This section discusses how the results in Tables 3 and 4 may be affected by the estimation method, or by selection or measurement issues.

[20] These regressions also exclude Armenia, Belarus, China, Ecuador, Ghana, Jordan, Madagascar, Tunisia, and United Republic of Tanzania, for which the required data on safe investment categories are not available, as well as Bosnia and Herzegovina, Guatemala, and Jamaica, which are outliers. Running the regressions reported in Table 3 on the smaller sample of countries for which yield differentials on safe assets and liabilities are available affects the results only marginally.

Table 3 Regression results: yield differentials on total external assets and liabilities, 2010–2019 *Source*: Author's calculations; see the "Appendix" for data sources

Dependent variable: yield differentials on total assets and liabilities							
infl	−0.14	−0.12	−0.14	−0.13	−0.09	−0.08	−0.09
	(0.09)	(0.09)	(0.09)	(0.12)	(0.09)	(0.09)	(0.12)
exrate_vol	7.07	8.49	5.92	7.31	9.78**	6.96	8.61
	(5.31)	(5.27)	(5.42)	(6.42)	(5.10)	(5.15)	(6.27)
ca_bal_GDP	2.98***	5.98*	6.18*	11.75*	4.85*	5.06**	9.64*
	(1.76)	(1.82)	(2.04)	(2.81)	(1.79)	(1.97)	(2.78)
ca_bal_GDP *developing	-17.90*	−22.36*	−23.76*	−23.09*	−22.99*	−24.67*	−22.58*
	(2.66)	(2.75)	(3.89)	(3.66)	(2.87)	(3.71)	(3.85)
chinn-ito	1.65*	1.62*	1.72*	1.50*	1.65*	1.80*	1.70*
	(0.27)	(0.27)	(0.28)	(0.33)	(0.26)	(0.27)	(0.34)
pcinc	0.74*	0.62*	0.69*	0.41*	0.49*	0.53*	0.26**
	(0.09)	(0.09)	(0.09)	(0.12)	(0.09)	(0.09)	(0.12)
United States	2.00*	1.97*	1.85*	2.20*	2.64*	2.44*	2.66*
	(0.49)	(0.49)	(0.52)	(0.62)	(0.49)	(0.51)	(0.61)
Developing	0.55*	−0.51***	0.17	0.06	−0.10	0.39	0.08
	(0.18)	(0.27)	(0.26)	(0.24)	(0.28)	(0.25)	(0.27)
forex_GDP		−1.93*			−0.90***		
		(0.48)			(0.51)		
forex_GDP * developing		4.99*			3.65*		
		(1.03)			(1.09)		
resad_ca_gdp			−1.89*			−1.09**	
			(0.54)			(0.55)	
resad_ca_gdp * developing			3.10**			0.89	
			(1.43)			(1.50)	
resad_m2_gdp				−3.33*			−2.30*
				(0.72)			(0.72)
resad_m2_gdp * developing				0.20			−0.93
				(1.61)			(1.61)
swap_per					0.92*	0.83*	1.37*
					(0.18)	(0.17)	(0.38)
swap_dollar					−0.52**	−0.57**	−0.39
					(0.26)	(0.25)	(0.30)
swap_rmb					−0.31**	−0.34**	−0.29
					(0.14)	(0.14)	(0.19)
CMIM					0.59**	1.12*	0.59***
					(0.25)	(0.27)	(0.30)
Observations	682	682	625	472	682	625	472
R-squared	0.36	0.38	0.37	0.32	0.41	0.40	0.36

All results based on panel regressions with robust least squares. Coefficient on constant not reported. Standard errors in parenthesis

*, ** and ***Denote significance at 1 per cent, 5 per cent and 10 per cent. Reduced sample size for regressions including *resad_ca_gdp* because of incomplete data on short-term debt, as well as for regressions including *resad_m2_gdp* as broad-money data are not available for euro-zone members and Canada

Table 4 Regression results: yield differentials on safe external assets and liabilities, 2010–2019 *Source*: See Table 3

Dependent variable: yield differentials on safe assets and liabilities							
infl	−0.15*	−0.09*	−0.14*	−0.19*	−0.07***	−0.09**	−0.15**
	(0.04)	(0.03)	(0.04)	(0.07)	(0.03)	(0.04)	(0.07)
exrate_vol	−7.40*	−8.62*	−7.28*	−1.84	−8.24*	−5.42**	−1.95
	(2.49)	(2.17)	(2.70)	(4.08)	(2.22)	(2.59)	(3.94)
ca_bal_GDP	−0.53	−0.77	−0.25	−2.04	0.98	0.10	−2.34
	(0.69)	(0.64)	(0.84)	(1.51)	(0.65)	(0.82)	(1.48)
ca_bal_GDP * developing	7.49*	0.89	6.51*	12.80*	0.16	5.92*	9.36*
	(1.19)	(1.20)	(1.89)	(2.20)	(1.28)	(1.81)	(2.27)
chin-ito	−0.24***	0.16	−0.35**	−0.19	0.18	−0.28**	−0.24
	(0.13)	(0.12)	(0.15)	(0.22)	(0.12)	(0.14)	(0.22)
pcinc	0.53*	0.46*	0.55*	0.59*	0.47*	0.56*	0.65*
	(0.04)	(0.04)	(0.04)	(0.07)	(0.04)	(0.04)	(0.07)
United States	0.02	0.02	0.01	0.15	0.07	0.12	0.10
	(0.18)	(0.16)	(0.20)	(0.31)	(0.17)	(0.20)	(0.30)
Developing	0.66*	−0.17	0.61*	1.01*	−0.18	0.67*	0.66*
	(0.08)	(0.12)	(0.12)	(0.13)	(0.12)	(0.12)	(0.15)
forex_GDP		−0.51*			−0.56*		
		(0.16)			(0.18)		
forex_GDP * developing		4.85*			4.80*		
		(0.46)			(0.51)		
resad_ca_gdp			−0.04			−0.02	
			(0.22)			(0.22)	
resad_ca_gdp * developing			0.56			−0.76	
			(0.65)			(0.67)	
resad_m2_gdp				0.63***			0.76**
				(0.37)			(0.36)
resad_m2_gdp * developing				−2.00**			−3.11*
				(0.99)			(1.00)
swap_per					0.04	0.12***	−0.51*
					(0.06)	(0.07)	(0.18)
swap_dollar					0.08	0.41*	0.13
					(0.10)	(0.11)	(0.16)
swap_rmb					0.08	−0.05	0.18***
					(0.05)	(0.06)	(0.10)
CMIM					0.18***	0.21***	0.73*
					(0.09)	(0.11)	(0.17)
Observations	568	568	517	364	568	517	364
R-squared	0.23	0.27	0.22	0.34	0.28	0.24	0.38

See Table 3

4.2.1 Estimation method

Testing for estimation bias by running the main regressions with ordinary least squares and period fixed effects changes the results only marginally (online appendix table OA7).

An estimation bias could also result from multi-collinearity among independent variables. Online appendix table OA8 indicates that this could be caused by *pcinc*. However, running the main regressions without *pcinc* affects the results only marginally, except that the size of the coefficients on *chinn_ito*, *United States* and *swap_per* increase in the regressions on yield differentials on total assets and liabilities, and that *United States* has a positive and significant coefficient also in the regressions for safe assets and liabilities (online appendix table OA9).

4.2.2 Selection bias

The selection of yield differentials on total external assets and liabilities as the main dependent variable may affect the results, as it has been argued that the exorbitant privilege of the United States is driven by FDI (Curcuru et al., 2013; Darvas & Hüttle, 2017). Running the main regressions on FDI indeed doubles the size of the coefficients on per-capita income and the United States dummy, providing some support for this argument (Table 5).[21]

Adding to these regressions a variable reflecting corporate tax rates incorporates the argument of Vicard (2019) that the exorbitant privilege of advanced economies in FDI reflects tax avoidance by multinational enterprises. For a given level of external FDI-assets, this would inflate inflows and decrease outflows of FDI-income in high-tax countries and generate an apparent exorbitant privilege for high-tax countries. Dropping the variable controlling for per-capita income and running the regression for countries above an income level of $8000 supports this argument; it results in large positive and strongly significant coefficients on the variables on corporate tax, the United States and the other main advanced economies (covered by *swap_per*). Finding a positive correlation between corporate tax and yield differentials on FDI for rich economies does not imply that developing economies are not affected. Indeed, the coefficient on *developing* is positive and highly significant in the regression that includes *corp_tax*. Nevertheless, the size of the coefficient is only one third that for the United States and only slightly larger than that for *swap_per*. The reason for the finding of a relatively small effect of tax issues on yield differentials for developing economies—which diverges from Vicard (2019) who finds a strong effect also for developing economies—probably is that the country sample in this paper does not include various small and often poor economies and territories,

[21] The regressions on FDI and non-FDI categories also exclude Armenia, Belarus, China, Ecuador, Ghana, Jordan, Madagascar, Tunisia, and United Republic of Tanzania, for which the required data on disaggregated investment categories are not available, as well as the outliers Bangladesh, Cameroon, Croatia, Georgia, Greece, Guatemala, Jamaica, and Ukraine for the regressions on FDI, and Argentina, Croatia, Georgia, Guatemala, Thailand, and Ukraine for the regressions on non-FDI categories (see also Fig. 4).

Table 5 Regression results: yield differentials on FDI and non-FDI categories, 2010–2019 *Source*: See Table 3

Dependent variable	Yield differentials on FDI				Yield differentials on non-FDI			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
infl	0.03	0.08	−0.17	−0.05	−0.10	−0.07	−0.11***	−0.09
	(0.22)	(0.22)	(0.21)	(0.26)	(0.06)	(0.07)	(0.06)	(0.06)
exrate_vol	15.98	20.63	16.17	15.79	−1.69	4.24	−2.37	1.11
	(13.46)	(13.30)	(12.39)	(17.34)	(4.43)	(4.51)	(4.07)	(4.15)
ca_bal_GDP	2.31	3.34	2.04	14.92*	1.43	4.17*	1.85	4.45*
	(3.70)	(3.64)	(3.60)	(3.43)	(1.19)	(1.20)	(1.16)	(1.16)
ca_bal_GDP * developing	−25.60*	−25.53*	−17.76**	−41.99*	7.62*	9.58*	−3.27	−2.29
	(6.46)	(6.35)	(7.02)	(7.77)	(2.08)	(2.18)	(2.23)	(2.32)
chin-ito	2.56*	2.50*	2.61*	6.86*	−0.20	0.69*	−0.36	0.33***
	(0.72)	(0.71)	(0.66)	(0.87)	(0.24)	(0.20)	(0.22)	(0.18)
pcinc	1.89*	1.72*	1.53*		0.51*		0.44*	
	(0.21)	(0.21)	(0.21)		(0.07)		(0.07)	
United States	4.47*	5.38*	5.33*	4.96*	0.58*	1.10*	0.54***	0.94*
	(0.92)	(0.93)	(0.88)	(0.93)	(0.31)	(0.32)	(0.29)	(0.30)
Developing	1.30	1.70*	1.18***	1.68*	0.21	−0.06	−1.34*	−1.75*
	(0.42)	(0.43)	(0.69)	(0.48)	(0.15)	(0.15)	(0.24)	(0.24)
forex_GDP			0.61				−0.30	−0.44
			(0.92)				(0.31)	(0.32)
forex_GDP * developing			9.48*				5.66*	6.61*
			(2.63)				(0.95)	(0.96)
swap_per		1.18*	1.52*	1.16*	0.32*	0.46*	0.25**	0.33*
		(0.31)	(0.32)	(0.31)	(0.10)	(0.11)	(0.11)	(0.11)
swap_dollar			−0.95***				−0.35***	−−0.54*
			(0.57)				(0.18)	(0.18)
swap_rmb			−1.64*				−0.09	−0.09
			(0.29)				(0.09)	(0.10)
CMIM			−2.55*				0.70*	0.69*
			(0.48)				(0.17)	(0.16)
corp_tax				13.05*				
				(2.11)				
Observations	519	519	519	395	553	553	553	553
R-squared	0.38	0.40	0.45	0.36	0.32	0.27	0.36	0.33
				pcinc> 8000				

See Table 3

some of which play an outsized role in the global FDI-network. Indeed, Damgaard et al. (2019: 4–5) "find that exposure to Phantom FDI, notably among low-income economies, correlates positively with the corporate tax rate, which is consistent with the notion that some Phantom FDI serves tax avoidance purposes."

Running the main regressions on the non-FDI category points to the existence of a currency hierarchy also for this investment category (Table 5): the coefficient on *United States* remains positive and highly significant, that on *swap_per*, i.e. the variable for the other main advanced economies with whom the Fed has standing swap arrangements is also highly significant and positive, albeit smaller than that on *United States*, and the coefficient on *developing* is negative and highly significant in the regressions that also include insurance strategies. These findings combined may reflect an extension of the exorbitant privilege to include the main advanced economies, perhaps because their international banks have a major role for the provision of dollar liquidity in the current IMFS (Prasad, 2013).

It is also notable that the coefficient on *chinn_ito* is only a fraction of that in the regressions on the total and FDI-categories (Table 3, and Table 5 columns 6 and 8)—and even negative when *pcinc* is included (Table 5 columns 5 and 7). Combined with the evidence on safe investment categories (Table 4), this indicates that a positive correlation between financial openness and yield differentials mainly holds only for the FDI-category.

Regarding the various crisis insurance strategies, reserves appear to play a very important role for developing countries concerning yield differentials on FDI. They also seem to play an important role for yield differentials on non-FDI categories where there also is a positive and significant correlation with the CMIM, similarly to the results on total and safe investment categories (Tables 3 and 4). Taken together, the findings of a currency hierarchy and of reserves and regional monetary arrangements being crucial insurance strategies holds across different investment categories.

4.2.3 Measurement issues

Measurement issues may arise from the inclusion of extreme observations. While all regressions exclude the outliers Dominican Republic, Kazakhstan, Nigeria, Peru, and Uruguay, trimming the observations by excluding yield differentials below minus 4 percentage points (Table 6, columns 2 to 6) and by running the main regressions on yield differentials on total and safe investment categories only for countries above a per-capita income of $2500 (Table 6, column 5 and 6) indicates that the sign and significance of the main coefficients are robust.

Further measurement issues may arise from the Chinn-Ito index, which is a crude measure of aggregate financial openness. Fernandez et al. (2016) provide data on capital-control measures that distinguish between measures on capital inflows and those on capital outflows, though for a smaller number of countries. Assuming no change in these data in 2019 from the numbers in 2018, excluding the outliers Argentina, Ghana, Guatemala, Jamaica, Russian Federation, Thailand, and Ukraine, and running the main regressions on the general capital-control measures on inflows (*kai*), outflows (*kao*) and inflows and outflows combined (*ka*), provides interesting results.

Keeping in mind that the data from Fernandez et al. (2016) reflect the use of controls, so that their sign is the opposite to that on *chinn-ito*, the results for *ka* mirror those for *chinn_ito* independently of whether the regressions are run with or without *pcinc*.[22] By contrast, the disaggregated measures *kai* and *kao* are not significant, while the coefficients on the other variables are robust across the various specifications (Table 7).[23] For the regressions on non-FDI categories, it is appropriate to replace the aggregate measures *ka*, *kai* and *kao* by *eq*, *eqi* and *eqo*, which reflect equity restrictions and exclude guarantees, real-estate restrictions and the like. Doing so indicates a significant negative correlation of *chinn_ito* and a positive correlation of *eq* with yield differentials, while the coefficient on the *eqi* and *eqo* are not significant (online appendix table OA10).

Above all, these findings point to the difficulty in measuring the impact of financial openness and capital controls based on annual cross-country data. Country-specific studies on the effectiveness of capital controls point to the importance of institutional settings and, crucially, timing. Having in place legislation providing for comprehensive and lasting capital controls allows policymakers to act quickly and avoid lengthy debates and procedures, especially during surges of capital inflows when the build-up of macroeconomic and financial vulnerabilities is greatest and when the political forces against regulation tend to be strongest.[24] This suggests that capital controls may well represent an additional insurance strategy and reduce revenue transfers from developing countries. Regarding the effectiveness of capital controls, an often quoted meta study, drawing on close to 40 empirical studies on capital controls, indicates that controls on capital inflows "seem to make monetary policy more independent by introducing a wedge between domestic and international interest rates] and alter the composition of capital flows [towards less volatile categories]" (Magud et al., 2018: 3–4).

Sensitivity analysis. The regression results are most likely sensitive to the chosen period, as the various swap arrangements have become available as crisis insurance strategies only after the GFC. Running the regressions for the pre-crisis period 1995–2007 affects the main control variables only marginally (Table 8).[25] The coefficient on *United States* also changes little, while that on *pcinc* turns negative and insignificant. This may indicate that the exorbitant privilege of the United States was larger during the pre-crisis period. The results also indicate a large positive correlation between yield differentials and reserve holdings of developing countries. This

[22] The results in Table 7 columns 5 and 6 differ from those in Table 3 because Table 7 is based on the smaller sample of countries for which Fernandez et al. (2016) provide data.

[23] The significant and positive coefficient on *exrate_vol* indicates that allowing for some exchange-rate adjustment may reduce adjustment pressure for which insurance is required.

[24] This may be crucial as "the effectiveness of the measures depends on the level of short-term capital flows at the moment that the controls are put in place" (Magud et al., 2018: 4). Opposition to controls on capital inflows may be strongest during surges because a "surge is initially associated with exchange rate appreciation, asset price increases, and an increase in GDP; thus firms, workers, and households can purchase more goods and services during a surge, feel wealthier due to asset price increases, and see that the economy is growing" (Gallagher, 2015: 102–103).

[25] The regressions covering the period 1995–2007 also exclude the outliers Chile and Costa Rica.

Table 6 Regression results: yield differentials with trimmed variables, 2010–2019 *Source*: See Table 3

	Yield differentials > −4					
	Total assets and liabilities					Safe
	(1)	(2)	(3)	(4)	(5)	(6)
infl	−0.02	0.04	0.04	0.11	−0.08	−0.11*
	(0.08)	(0.08)	(0.08)	(0.09)	(0.08)	(0.04)
exrate_vol	1.98	5.13	3.24	1.81	8.21**	−0.81
	(4.21)	(4.06)	(4.04)	(4.45)	(4.00)	(2.02)
ca_bal_GDP	3.62*	4.66*	5.02*	9.20*	0.96	1.48**
	(1.36)	(1.39)	(1.50)	(1.95)	(1.39)	(0.70)
ca_bal_GDP * developing	−14.91*	−19.06*	−17.52*	−19.93*	−19.21*	−1.85
	(2.10)	(2.33)	(3.02)	(2.77)	(2.41)	(1.17)
chinn-ito	1.56*	1.64*	1.73*	1.70*	1.81*	0.67*
	(0.23)	(0.23)	(0.23)	(0.26)	(0.23)	(0.10)
pcinc	0.58*	0.44*	0.45*	0.27*	0.85*	0.45*
	(0.07)	(0.07)	(0.07)	(0.09)	(0.08)	(0.04)
United States	1.85*	2.29*	2.18*	2.20*	1.87*	0.22
	(0.36)	(0.36)	(0.37)	(0.40)	(0.34)	(0.18)
developing	0.50*	0.14	0.54**	0.13	0.20	0.05*
	(0.50	(0.24)	(0.22)	(0.21)	(0.24)	(0.11)
forex_GDP		−0.47			−0.22	−0.57*
		(0.39)			(0.37)	(0.19)
forex_GDP * developing		1.85**			2.81*	4.85*
		(0.89)			(0.86)	(0.43)
resad_ca_gdp			−0.58			
			(0.42)			
resad_ca_gdp * developing			−1.02			
			(1.18)			
resad_m2_gdp				−1.56*		
				(0.50)		
resad_m2_gdp * developing				−0.19		
				(−1.12)		
swap_per		0.64*	0.60*	0.96*	0.47*	0.07
		(0.13)	(0.13)	(0.25)	(0.13)	(0.07)
swap_dollar		0.10	0.08	0.02	0.25	0.07
		(0.23)	(0.23)	(0.24)	(0.26)	(0.11)
swap_rmb		−0.30*	−0.31*	−0.31**	−0.44*	0.11***
		(0.11)	(0.11)	(0.14)	(0.12)	(0.06)
CMIM		0.59*	0.99*	0.57**	0.78*	0.20**
		(0.21)	(0.22)	(0.23)	(0.20)	(0.10)
Observations	572	572	522	372	509	578
R-squared	0.44	0.48	0.49	0.48	0.52	0.23
					pcinc > $2500	

Table 6 (continued)

See Table 3

Table 7 Regression results: yield differentials with variables on capital controls, 2010–2019 *Source*: See Table 3

	Dependent variable: yield differentials on total assets and liabilities					
infl	0.01	−0.10	0.01	−0.10	0.01	−0.08
	(0.11)	(0.11)	(0.10)	(0.11)	(0.11)	(0.11)
exrate_vol	13.27**	20.68*	13.33**	20.20*	12.40**	19.80*
	(6.00)	(6.10)	(6.03)	(6.13)	(6.07)	(6.07)
ca_bal_GDP	3.77**	7.82*	3.82**	7.69*	3.61**	7.63*
	(1.74)	(1.66)	(1.74)	(1.67)	(1.74)	(1.65)
ca_bal_GDP * developing	−20.13*	−22.82*	−20.00*	−23.31*	−20.32*	−22.47*
	(3.05)	(3.13)	(3.16)	(3.29)	(3.03)	(3.10)
chinn_ito					−0.14	0.72**
					(0.33)	(0.30)
ka	−0.13	−0.60**				
	(0.26)	(0.25)				
kai			0.03	−0.45		
			(0.41)	(0.42)		
kao			−0.14	−0.16		
			(0.32)	(0.33)		
pcinc	0.59*		0.59*		0.61*	
	(0.09)		(0.09)		(0.10)	
United States	2.35*	2.98*	2.37*	2.94*	2.31*	2.90*
	(0.43)	(0.43)	(0.44)	(0.44)	(0.43)	(0.43)
developing	−1.43*	−2.39*	−1.38*	−2.49*	−1.54*	−2.30*
	(0.32)	(0.31)	(0.34)	(0.32)	(0.32)	(0.32)
forex_GDP	−0.60	−0.85***	−0.58	−0.87***	−0.60	−0.88***
	(0.32)	(0.47)	(0.47)	(0.48)	(0.46)	(0.47)
forex_GDP * developing	5.12*	7.38*	5.00*	7.56*	5.08*	7.31*
	(1.24)	(1.24)	(1.30)	(1.30)	(1.24)	(1.23)
swap_per	0.84*	0.99*	0.85*	0.96*	0.82*	0.95*
	(0.16)	(0.17)	(0.17)	(0.17)	(0.16)	(0.16)
swap_dollar	−0.41	−0.82*	−0.41	−0.84*	−0.40	−0.81*
	(0.27)	(0.27)	(0.27)	(0.27)	(0.27)	(0.27)
swap_rmb	−0.54*	−0.40*	−0.54*	−0.39	−0.53*	−0.44*
	(0.14)	(0.15)	(0.14)	(0.15)	(0.14)	(0.15)
CMIM	0.62*	0.55**	0.61*	0.57**	0.60*	0.51**
	(0.23)	(0.24)	(0.23)	(0.24)	(0.23)	(0.24)
Observations	525	525	525	525	525	525
R-squared	0.46	0.42	0.46	0.42	0.46	0.42

See Table 3

Table 8 Regression results: yield differentials, selected periods *Source*: See Table 3

Dependent variable: yield differentials on total assets and liabilities								
	1995–2007			2008–09	1995–2019			
infl	−0.09	−0.13	−0.09	0.06	−0.01	0.03	0.01	−0.02
	(0.08)	(0.08)	(0.09)	(0.21)	(0.06)	(0.06)	(0.06)	(0.07)
exrate_vol	−0.02	−0.21	−2.21	1.90	5.96**	5.77**	3.74	2.58
	(3.61)	(3.71)	(4.05)	(12.56)	(2.81)	(2.67)	(2.74)	(3.13)
ca_bal_GDP	9.89*	11.48*	8.31*	11.55*	9.95*	8.37*	8.44*	8.47*
	(1.49)	(1.57)	(1.99)	(3.47)	(1.07)	(1.03)	(1.15)	(1.47)
ca_bal_GDP	−18.14*	−15.74*	−12.43*	−21.75*	−18.34*	−17.10*	−15.23*	−13.26*
* developing	(2.72)	(3.24)	(3.08)	(4.80)	(1.80)	(1.74)	(2.21)	(2.16)
chin-Ito	1.00*	1.43*	1.11*	2.17*	1.81*	1.84*	1.89*	1.81*
	(0.27)	(0.27)	(0.31)	(0.70)	(0.18)	(0.18)	(0.18)	(0.21)
pcinc	−0.08	−0.04	−0.13	−0.32	−0.02	−0.04	−0.02	−0.08
	(0.08)	(0.08)	(0.09)	(0.31)	(0.06)	(0.06)	(0.06)	(0.07)
United States	1.53*	1.83*	1.99*	1.58	1.99*	2.65*	2.64*	2.51*
	(0.55)	(0.55)	(0.61)	(1.34)	(0.36)	(0.36)	(0.37)	(0.42)
Developing	−1.61*	−0.34	−0.02	−2.71*	−1.34*	−0.51	0.23	0.13
	(0.30)	(0.22)	(0.22)	(0.88)	(0.19)	(0.19)	(0.16)	(0.16)
forex_GDP	−7.50*			−4.95**	−3.81*	−1.54*		
	(1.18)			(2.41)	(0.47)	(0.50)		
forex_GDP * developing	10.77*			9.44*	6.72*	5.13*		
	(1.66)			(3.51)	(0.85)	(0.83)		
resad_ca_gdp		−3.37*					−0.95***	
		(1.23)					(0.53)	
resad_ca_gdp * developing		2.81***					1.04	
		(1.63)					(0.94)	
resad_m2_gdp			−6.16*					−2.17*
			(1.18)					(0.63)
resad_m2_gdp			4.61**					−0.52
* developing			(1.81)					(1.15)
swap_per						1.00*	1.03*	1.22*
						(0.14)	(0.13)	(0.27)
swap_dollar						−0.66*	−0.57**	−0.30
						(0.24)	(0.24)	(0.27)
swap_rmb						−0.63*	−0.67*	−0.75*
						(0.15)	(0.15)	(0.19)
CMIM						−0.21	0.06	−0.09
						(0.23)	(0.25)	(0.27)
Observations	825	825	654	140	1673	1623	1568	1211
R-squared	0.17	0.14	0.14	0.26	0.21	0.26	0.24	0.22

See Table 3

may reflect that reserve holdings were the only means that developing economies could use to avoid negative yield differentials and possibly capital-flow reversals when these differentials were judged insufficient to compensate for differences in the liquidity premium, with an ensuing series of crises and IMF-loans as the only crisis insurance strategy accessible to developing countries. The coefficient on *United States* in the regression for 2008–2009 is not significant. This is as expected because the GFC was the period when the exorbitant privilege was to turn into an exorbitant duty. The regressions on the entire period 1995–2019 further indicate that the main results hold across various sub-periods.

To consider whether the regression results are sensitive to the choice of exchange-rate arrangement, fixed (no separate legal tender, currency board, conventional peg), managed floating (stabilized arrangement, crawling peg, crawl-like arrangement, other managed arrangement), and floating (floating, free floating) arrangements may be distinguished following IMF (2020), but considering members of currency unions (such as the euro area) as having fixed exchange rates. The results suggest that reserve holdings are an important insurance mechanism for developing economies across these arrangements, although reserves appear less important in floating regime where the coefficient on *cmim* is also significant and positively correlated with yield differentials (online appendix table OA11).

5 Conclusions

The increased size and altered composition of gross external assets and liabilities imply that developing economies are exposed to valuation losses on their external balance sheets and that they pay higher total returns on their external liabilities than they earn on their external assets. This means that the opening to capital flows does not only raise developing economies' macroeconomic and financial vulnerability to boom-bust cycles in international capital *flows*. It also implies that yield differentials and changes in interest rates, asset prices and exchange rates in major advanced economies alter the value of developing economies' *stocks* of gross international assets and liabilities. Valuation changes during crisis periods do not compensate the insurance premium made by developing economies during normal periods. The transfer of resources from the 36 developing economies examined in this paper amounted to about $800 bn on average per year over the period 2010–2019, i.e. 3.3 per cent of their combined GDP.

Related evidence suggests that the global insurance view on the setup of the IMFS (Gourinchas & Rey, 2014) primarily applies to main developed economies, with considerable differences between developed and developing economies as well as within these groups of countries. The United States is the only country that combines the exorbitant privilege with the exorbitant duty. Several other developed economies also enjoy positive yield differentials but did not suffer valuation losses during the GFC. By contrast, developing economies generally record negative yield differentials and about two-third of them also experienced valuation losses during the GFC.

One approach towards reducing the resource transfer from developing economies would involve a more even coverage of the global financial safety network, allowing these countries to hold fewer low-yielding safe assets for precautionary reasons. This could be achieved by broadening the coverage of bilateral swap arrangements that facilitate access to dollar liquidity and bolstering swap arrangements in regional monetary arrangements. However, both these changes pose conceptual and institutional challenges that will take time to resolve. An alternative method to reduce the yield differential in developing countries' external balance sheets may be the adoption of capital controls designed to reduce speculative capital inflows and limit the stock of high-yielding external liabilities. One effective way to achieve this could be recognizing capital controls as an essential part of the macroeconomic policy toolkit. Perhaps most urgently at the current juncture, developed economies could return past wealth transfers from developing economies through direct transfers to the most vulnerable countries or through the creation of a fund from which developing economies could mobilize resources to finance recovery from the COVID-19 crisis and achieving the 2030 Agenda for Sustainable Development.

Appendix

Country sample (76 countries)

Developing countries (36 countries)

Argentina, Bangladesh, Brazil, Cameroon, Chile, *China*, Colombia, Costa Rica, Dominican Republic, *Ecuador*, Egypt, El Salvador, *Ghana*, Guatemala, India, Indonesia, Jamaica, *Jordan*, *Madagascar,* Malaysia, Mauritius, Mexico, Morocco, Nigeria, Pakistan, Peru, the Philippines, Republic of Korea, Senegal*, South Africa*, Sri Lanka, Thailand, *Tunisia*, Turkey, *United Republic of Tanzania*, Uruguay.

Transition economies (7 economies)

Armenia, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Russian Federation*,* Ukraine.

Developed countries in Central and Eastern Europe (11 countries)

Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia.

Other developed countries (22 countries)

Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

For the countries in italics, comprehensive disaggregated data on foreign assets and liabilities or related income flows are not available. Therefore, the country-specific figures in the online appendix include no information on the respective positions for these countries.

Data sources

Stock of external assets and liabilities	Lane and Milesi-Ferretti (2018) and IMF International Investment Position database
Capital flows	IMF Balance of Payments Statistics
Inflation	IMF World Economic Outlook database
Exchange-rate volatility	IMF International Financial Statistics
Current-account balance	Lane and Milesi-Ferretti (2018) and IMF Balance of Payments Statistics
GDP	IMF World Economic Outlook database
Chinn-Ito openness index	Chinn and Ito (2020)
Per-capita income	IMF World Economic Outlook database
Foreign-exchange reserves	Lane and Milesi-Ferretti (2018) and IMF International Investment Position database
Short-term external debt	World Development Indicators
M2	World Development Indicators
Swap arrangements	Denbee et al. (2016), Essers and Vincent (2017) Mühlich et al. (2019), Song and Xia (2019), Steil (2019)
Exchange-rate arrangements	IMF Annual Reports on Exchange Arrangements and Exchange Restrictions
Corporate tax rates	OECD Statistics, https://stats.oecd.org/Index.aspx?QueryId=78166, and KPMG, *Corporate Tax Rate table,* https://home.kpmg/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html
Capital controls data	Fernandez et al. (2016)
Trade balance as a share of GDP	UNCTADstat
3 months of imports as a share of GDP	UNCTADstat

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10290-021-00422-5.

Acknowledgements Parts of this paper draw on the author's contribution to UNCTAD's Trade and Development Reports 2015 and 2019. The author is grateful to an anonymous referee, Yilmaz Akyüz, Barbara Fritz, Ricardo Gottschalk, Nicolas Maystre, Laurissa Mühlich, Ugo Panizza, Daniela Prates, and Vincent Vicard for helpful comments on earlier drafts and to Lyubov Chumakova for help with the data. The opinions expressed are solely those of the author and do not necessarily reflect the views of UNCTAD or its member States.

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