CREDIT Research Paper

No. 14/02

Global Imbalances and the External Solvency of Nations

Michael Bleaney and Mo Tian

School of Economics, University of Nottingham

Abstract

Global current account imbalances were a major subject of concern in the years before the recent financial crisis. It is shown that the expected (negative) equilibrium relationship between net foreign assets and the trade balance that had held in the previous twenty years appeared to break down in this period. The explosion of the magnitude and equity component of cross-border assets and liabilities has made net foreign assets much harder to track, and may have introduced significant measurement errors and/or bubble effects into the series. The structural break is not evident if net property income flows are used in place of net foreign assets. This suggests that net exports do indeed adjust so as to maintain external solvency in the long run.

Keywords: current account, exchange rates, net foreign assets, trade balance

JEL No.: F31

Corresponding author: Professor M F Bleaney, School of Economics, University of Nottingham, Nottingham NG7 2RD. e-mail: michael.bleaney@nottingham.ac.uk. Tel. +44 115 951 5464. Fax +44 116 951 4159.

1 Introduction

Recent years have seen much discussion of "global current account imbalances" (e.g. Blanchard *et al*., 2005; Bracke *et al*., 2008; Gourinchas and Rey, 2013; Gruber and Kamin, 2007; Obstfeld and Rogoff, 2005). As a proportion of world GDP, the sum of countries' absolute current account imbalances grew from 2-3% of GDP before 1998 to 6% by 2007 (Bracke *et al*., 2008, Chart 2), although the imbalances have diminished since then. The appearance of large current account imbalances is likely to mean sizeable shifts in countries' net foreign assets, implying that the world is a long way from the full stock equilibrium of constant country ratios of net foreign assets to GDP. Here we investigate whether the equilibrium relationships that one would expect to see in cross-border stocks and flows broke down during the period of large current account imbalances. The imbalances stimulated a great deal of discussion – ranging over causes, the role of government policy in various countries, the extent to which they were an equilibrium phenomenon, and the size of expected real exchange rate adjustments – but the issue that we address here has been largely ignored.

We use data from a wide range of countries back to 1971. We show that the expected long-run relationships between net exports and net foreign assets held up to the early 1990s, but subsequently broke down. We also show that, if the income flows from these assets is used instead of the estimated asset values, there is not the same evidence of a structural break. The negative relationship between the two elements of the current account holds in both the 1971-91 and the 1992-2007 periods. Possible reasons for these apparently contradictory results are discussed.

2 Theory

The following identity determines the dynamics of net foreign assets:

$$NFA_t = (1 + r_{1t} + r_2)NFA_{t-1} + NX_t + VE_t + APM_t \quad (1)$$

where NFA_t denotes net foreign assets at the end of period t; r_{1t} is the income return on these net assets during period t; r_2 is the *average* capital return on net assets; NX is net exports; VE is the valuation effect of exchange rate movements; and APM is the effect of asset price changes in whatever currencies assets are denominated, relative to their average return.[1] The reasons for separating the income and capital returns on net assets will become clear shortly. Converting this identity to a ratio of gross domestic product (Y), which grows at a rate g_t, equation (1) becomes:

$$\left(\frac{NFA}{Y}\right)_t = \left(\frac{1+r_1+r_2}{1+g}\right)_t \left(\frac{NFA}{Y}\right)_{t-1} + \left(\frac{NX}{Y}\right)_t + \left(\frac{VE}{Y}\right)_t + \left(\frac{APM}{Y}\right)_t \quad (2)$$

In the long-run steady state the ratio of NFA to GDP is constant, and VE and APM are zero, so in long-run equilibrium:

$$\left(\frac{r_1+r_2-g}{1+g}\right)\left(\frac{NFA}{Y}\right)_{t-1} = -\left(\frac{NX}{Y}\right)_t \quad (3)$$

Defining the flow of income from net financial assets as net property income (NPI), equation (3) also implies that

$$\left(\frac{NPI}{Y}\right)_t = \left(\frac{r_1}{1+g}\right)\left(\frac{NFA}{Y}\right)_{t-1} = -\left(\frac{r_1}{r_1+r_2-g}\right)\left(\frac{NX}{Y}\right)_t \quad (4)$$

Equation (4) shows that the two elements of the current account will have opposite signs in long-run equilibrium, provided that the no-Ponzi condition of $r_1 + r_2 > g$ holds. The sign of

[1] Throughout this article net exports will mean all elements of the current account balance other than net property income, so it includes remittances and transfers as well as net trade in goods and services.

the relationship between the current account balance and net foreign assets depends on the relative sizes of r_1 and r_2:

$$\left(\frac{CA}{Y}\right) = \left(\frac{NX}{Y}\right) + \left(\frac{NPI}{Y}\right) = \left(\frac{g-r_2}{1+g}\right)\left(\frac{NFA}{Y}\right) \quad (5)$$

This will be positive or negative depending on whether g is greater or less than r_2, i.e. whether the return on assets consists largely of an income flow (as with nominal bonds), in which case r_2 is small, or of capital gains (as with indexed bonds), so that r_2 is large.

Assuming that $r_1 + r_2 > g$, equation (3) predicts a negative relationship between net foreign assets and net exports. If net exports are largely determined by the real exchange rate, then this implies a positive relationship between net foreign assets and real exchange rates. This positive relationship has largely been confirmed in empirical tests by Lane and Milesi-Ferretti (2004), Christopoulos *et al*. (2012) and Bleaney and Tian (2014), although the evidence is stronger for emerging markets and developing countries than for the industrial countries. Note however that, because the real effective exchange rate is an index, these tests can only exploit the time-series dimension of the data: that is, they ask whether a country's real exchange rate increases with its net foreign assets, and not whether at a given date a country that has more net foreign assets than another has a higher real exchange rate.

Durdu *et al*. (2013) offer a direct test of the relationship between net exports and net foreign assets. Using data for 50 countries back to 1970 (where available), they estimate separate time-series regressions between net exports and net foreign assets as ratios of GDP for each country; they also re-estimate these regressions restricting the long-run coefficients (but not the dynamics) to be identical across countries, which greatly reduces the standard errors of the coefficients. They find considerable support for their hypothesis in the data, particularly using the second method. Nevertheless, by allowing the intercept term to vary

across countries, they are also only using the time-series dimension of the data. In effect they are estimating a generalization of (3) that includes a country-specific constant. As Bohn (2007) shows, such a specification is an adequate test of long-run sustainability, but it is in reality equivalent to amending equation (1) by a country-specific shift factor. Inclusion of this shift factor implies that net foreign assets are increasing or decreasing each year by a constant amount in a particular country, for no apparent reason. In other words, Durdu *et al*. (2013) test a specification that is rather less restrictive than the underlying theory suggests.

Also relevant is the work of Chinn and Prasad (2003), who estimate a cross-country regression for the average current account balance (as a ratio of GDP) over the period 1971 to 1995 for 89 countries. Since the ratio of net foreign assets to GDP is one of the regressors, this is like estimating an extended version of equation (5). They find a significant positive coefficient for net foreign assets, both in the cross-country regression and when they split the time period up into five-year intervals and estimate a panel regression. Chinn *et al*. (2014) estimate a similar panel regression with more recent data and confirm this result, as do Gruber and Kamin (2007). Since in all these cases the estimated NFA coefficient tends to be larger than the value of r_1 that we estimate below, the implication of these studies is that when the cross-country dimension is taken into account, net exports are *positively* rather than negatively correlated with NFA, in violation of equation (3). An important *caveat* is that this may be only because the NFA coefficient is affected by the inclusion of other variables that are collinear with it, and might not hold in a bivariate regression.

In short, the evidence so far on equation (3) is rather contradictory: supportive when we consider the time dimension only (Durdu *et al*., 2013), but not so when we bring in the cross-country dimension (Chinn and Prasad, 2003; Gruber and Kamin, 2007; Chinn *et al*., 2014). None of these papers have investigated whether the underlying relationship has

shifted in the period of global current account imbalances. Although large trade surpluses or deficits are not in themselves inconsistent with long-run equilibrium, consistency with equilibrium requires that creditor countries run deficits and debtor countries run surpluses. In this period the major surplus countries (China, Germany, Japan and Russia) on average had positive net foreign assets, whilst the main deficit country (the USA) became a net debtor. This implies that the world was indeed shifting away from its old equilibrium in these years, and that substantial adjustments would be required for a new equilibrium to be reached.

To estimate the long-run relationship between net exports and net foreign assets, we use an error-correction model on a panel of annual data that takes the form:

$$\Delta\left(\frac{NX}{GDP}\right)_{it} = a(i,t) + b\Delta\left(\frac{NFA}{GDP}\right)_{it} - c\left(\frac{NX}{GDP}\right)_{it-1} + e\left(\frac{NFA}{GDP}\right)_{it-1} + u_{it} \qquad (6)$$

where Δ is the first difference operator, i represents countries and t time, a, b, c and e are parameters to be estimated, and u is a random error term. The existence of a long-run relationship requires $c > 0$; and the estimated long-run effect of *NFA* on *NX* is $\hat{e}/\hat{c}$. We consider three different variants of the intercept term $a(i,t)$:

(1) Pooled Ordinary Least Squares (OLS): $a(i,t) = a$;

(2) Pooled OLS with time dummies: $a(i,t) = a_t$; and

(3) Fixed country effects with time dummies: $a(i,t) = a_t + v_i$.

We also estimate a second variant of fixed effects in which only the estimated long-run coefficient $\hat{e}/\hat{c}$ is constrained to be uniform across countries. This is the pooled mean group (PMG) estimation method of Pesaran *et al*. (1999) and used by Durdu *et al*. (2013), which (apart from this constraint) allows a, b, c and e to differ across countries.

Equation (3) suggests that option (1) is the most appropriate. In general, however, net exports and net foreign assets will not add up to zero in our sample in any particular year, and including time dummies (option (2)) allows for that. Option (3) explores whether it makes a difference when we take out the cross-section dimension and use the time-series dimension of the data only. In PMG estimation, the short-run dynamics are allowed to differ across countries.

As a check on these results we also estimate the long-run relationship between net exports and net property income, which we show to be closely correlated with net foreign assets.

3 Preliminary Data Analysis

Except where otherwise indicated, data are taken from the World Bank World Development Indicators (WDI) database. Net foreign assets are from the Lane and Shambaugh (2010) data set, so data from 1971 to 2007 can be used. The countries in the sample are listed in the Appendix.

Figure 1 shows the emergence of global imbalances from the late 1990s onwards. The continuous line is the average absolute value of net exports divided by GDP for the countries in the sample, while the broken line shows the sum of the absolute value of countries' net exports divided by the sum of their GDPs. The difference is that the broken line attaches much more weight to imbalances in large countries that have a significant weight in world GDP, since each country's imbalance is not scaled by its own GDP. The two lines follow a similar path, with the continuous line showing greater volatility. It can be seen that imbalances reached a peak in the mid-1980s, and then declined more or less to 1970s levels,

before rising almost continuously, and to a much higher level than in the 1980s, from 1997 onwards.

From our point of view, the fact that the continuous line follows a similar path to the broken line is highly significant, since it means that the global imbalance problem has affected more than just a few large countries on which the discussion of the issue has focused. If only a few large countries were affected, the continuous line would not rise in parallel with the broken line, and we would not expect "global imbalances" (which would then be "globally important" rather than global in scope) to have much impact on our regression results, because of the numerically small numbers of countries involved.

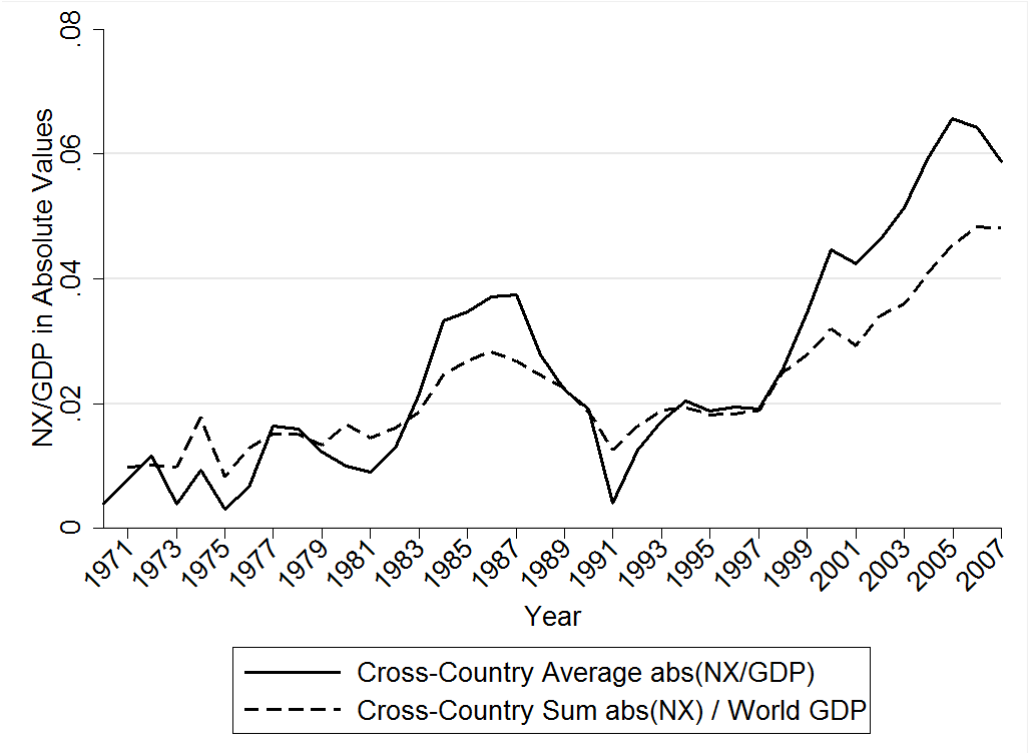

Figure 1. Average Trade Imbalances 1971-2007

Figure 2 shows some trends relating to cross-border financial assets. The continuous line is the cross-country average absolute NFA as a percentage of GDP by year. This was very low in the 1970s, rising steadily to nearly 60% from 1975 to 1985, and steady again (but with

significant volatility) from then onwards. The broken line in Figure 2 shows the average country's gross foreign asset position – the sum of its assets and liabilities as a percentage of GDP. This ratio rose gently from under 100% in the 1970s to 130% by 1995, and has since increased sharply and continuously to 400% in 2007. This implies that net foreign assets have been estimated as the difference between two increasingly large numbers as time has passed, which has markedly increased the potential for measurement error. The difficulties in estimating net foreign assets accurately are discussed at some length by Lane and Milesi-Ferretti (2007).

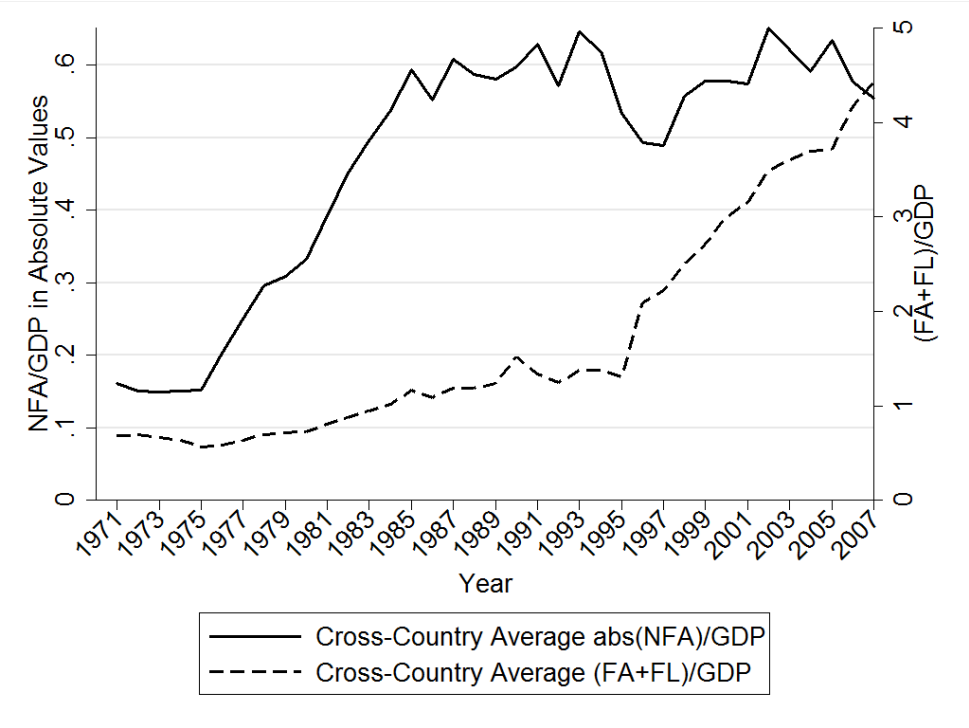

Figure 2. Average Net and Gross Foreign Assets and Liabilities

4 Empirical Results

4.1 Net Exports and Net Foreign Assets

Table 1 shows the results of estimating equation (6) over the period 1971-2007 for three different groups of countries: industrial countries, emerging markets and developing countries. The countries are separated into these groups to reduce heteroscedasticity problems: the root mean square error (RMSE) of the equation is always highest for developing countries and lowest for the industrial countries, by a factor of about three. For brevity Table 1 only reports the estimated long-run coefficient for net foreign assets ($\hat{e}/\hat{c}$), and whether $\hat{c}$ is significantly different from zero (if it is not, the null hypothesis of no long-run relationship in levels can be rejected).

The first column of Table 1 shows that the pooled OLS results without time dummies are not particularly supportive of long-run external solvency. For the industrial countries the estimated long-run NFA coefficient is positive; for developing countries it is very close to zero; and for emerging markets it is negative but significant at only the 10% level. When time dummies are added (column (2)), the picture is similar except that now no coefficient is significant at even the 10% level. Adding country fixed effects (column (3)) improves matters slightly: the emerging markets coefficient is now significantly negative at the 1% level, but for the other two groups the results are similar to those in the first two columns. Only in the final column (PMG estimation) do all three coefficients come out as significantly negative at the 1% level.

Table 1. Net exports and net foreign assets 1971-2007

	Pooled OLS	Pooled OLS with time dummies	Country fixed effects with time dummies	Pooled mean group
		Industrial countries		
Sample size	719	719	719	719
No. countries	23	23	23	23
RMSE	0.019	0.019	0.018	0.017
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NFA	0.038	0.046	0.011	-0.063***
coefficient	(0.79)	(0.83)	(0.29)	(-4.73)
		Emerging markets		
Sample size	729	729	729	729
No. countries	26	26	26	26
RMSE	0.031	0.030	0.029	0.028
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NFA	-0.067*	-0.046	-0.096***	-0.218***
coefficient	(-1.71)	(-1.48)	(-2.78)	(-8.74)
		Developing countries		
Sample size	1821	1821	1821	1821
No. countries	79	79	79	79
RMSE	0.056	0.055	0.052	0.048
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NFA	-0.002	-0.001	-0.002	-0.011***
coefficient	(-0.33)	(-0.09)	(-0.20)	(-2.75)

Notes. The estimated regression is: $\Delta\left(\frac{NX}{GDP}\right)_{it} = a(i,t) + b\Delta\left(\frac{NFA}{GDP}\right)_{it} - c\left(\frac{NX}{GDP}\right)_{it-1} + e\left(\frac{NFA}{GDP}\right)_{it-1} + u_{it}$. The long-run NFA coefficient is $\hat{e}/\hat{c}$. The numbers in parentheses are robust *t*-statistics, with standard errors clustered at the country level. ***,**, *: significant at the 1%, 5% and 10% levels respectively.

The long-run coefficients are significant in PMG estimation and generally not in the other cases for two reasons: the standard error is only about half as large, and the estimated coefficients are considerably more negative. The difference between PMG estimation and the other methods is that in PMG estimation the short-run dynamics are no longer constrained to be identical across countries, and this seems to make a major difference to the results. The other notable feature of Table 1 is that, whatever estimation method is used, the long-run NFA coefficient is considerably more negative for emerging markets than for the other two country groups.

The results in Table 1 are not particularly supportive of equation (6). To investigate the role of recent global current account imbalances in this outcome, we now divide the sample period into two parts. The period of global imbalances is generally reckoned to start after the Asian crisis of 1997, but to split the sample at that date would make the two parts too uneven in size. Accordingly we have chosen to divide the sample more equally, at the end of 1991; the later sub-sample is still shorter but has a larger country representation to compensate.

Table 2 shows the results for the 1971-91 period. What stands out is that every coefficient is negative, and ten out of twelve of them are significant at the 5% level (and seven of them at the 1% level). Only the pooled OLS estimates for developing countries, with and without time dummies, are not significant. For this period it is not just the PMG estimates but also the fixed effects and pooled OLS results that tend to support the hypothesis of long-run solvency. There is still a tendency for the emerging markets to have more negative and more highly significant coefficients, but the coefficients for the industrial countries are now consistently significant as well.

Table 2. Net exports and net foreign assets 1971-1991

	Pooled OLS	Pooled OLS with time dummies	Country fixed effects with time dummies	Pooled mean group
		Industrial countries		
Sample size	368	368	368	368
No. countries	21	21	21	21
RMSE	0.018	0.017	0.016	0.015
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NFA	-0.039**	-0.038**	-0.129***	-0.067***
coefficient	(-2.64)	(-2.64)	(-4.83)	(-5.41)
		Emerging markets		
Sample size	323	323	323	323
No. countries	22	22	22	22
RMSE	0.031	0.030	0.028	0.025
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NFA	-0.093***	-0.056***	-0.136***	-0.244***
coefficient	(-4.75)	(-3.27)	(-4.53)	(-13.5)
		Developing countries		
Sample size	764	764	764	753
No. countries	58	58	58	54
RMSE	0.062	0.061	0.057	0.047
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NFA	-0.012	-0.009	-0.008**	-0.053***
coefficient	(-1.64)	(-1.19)	(-2.10)	(-6.14)

Notes. The estimated regression is: $\Delta\left(\frac{NX}{GDP}\right)_{it} = a(i,t) + b\Delta\left(\frac{NFA}{GDP}\right)_{it} - c\left(\frac{NX}{GDP}\right)_{it-1} + e\left(\frac{NFA}{GDP}\right)_{it-1} + u_{it}$. The long-run NFA coefficient is $\hat{e}/\hat{c}$. The numbers in parentheses are robust *t*-statistics, with standard errors clustered at the country level. ***,**, *: significant at the 1%, 5% and 10% levels respectively.

Table 3 shows the results for 1992-2007, which are very different from those for the earlier period. For the industrial countries, the long-run NFA coefficient is always *positive*, and significantly so in the case of PMG estimation, whereas it was always negative and significant in 1971-91. For emerging markets the coefficient is negative, but never significant with pooled OLS with or without time dummies, or with fixed effects estimation. In the case of PMG estimation emerging markets have a negative coefficient that is significant at the 1% level, in line with the theory, and similar in magnitude to that shown in Table 2 for 1971-91. For developing countries the coefficient is negative and significant only at the 10% level using PMG estimation (and much smaller than in Table 2), but it is positive in the other three cases.

To summarise Table 3, the estimated coefficient is positive in seven out of the twelve cases, and significantly negative at the 5% level in only one, compared with ten out of twelve cases in Table 2. Even with PMG estimation the long-run NFA coefficient for industrial countries is significantly positive rather than negative. As before, the strongest results come from the emerging markets group, but the coefficient only reaches the 10% level of significance in PMG estimation. Thus the strong negative long-run relationship between net exports and net foreign assets that existed up to 1991 appears to have broken down in the 1992-2007 period.

Table 3. Net exports and net foreign assets 1992-2007

	Pooled OLS	Pooled OLS with time dummies	Country fixed effects with time dummies	Pooled mean group
		Industrial countries		
Sample size	351	351	351	351
No. countries	23	23	23	23
RMSE	0.018	0.017	0.016	0.015
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NFA	0.285	0.384	0.068	0.095***
coefficient	(1.09)	(0.90)	(1.02)	(7.16)
		Emerging markets		
Sample size	406	406	406	406
No. countries	26	26	26	26
RMSE	0.030	0.030	0.028	0.025
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NFA	-0.030	-0.030	-0.066	-0.221***
coefficient	(-0.40)	(-0.49)	(-1.14)	(-6.42)
		Developing countries		
Sample size	1057	1057	1057	1038
No. countries	79	79	79	73
RMSE	0.050	0.049	0.045	0.040
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NFA	0.022*	0.026*	0.004	-0.008*
coefficient	(1.78)	(1.96)	(0.17)	(-1.82)

Notes. The estimated regression is: $\Delta\left(\frac{NX}{GDP}\right)_{it} = a(i,t) + b\Delta\left(\frac{NFA}{GDP}\right)_{it} - c\left(\frac{NX}{GDP}\right)_{it-1} + e\left(\frac{NFA}{GDP}\right)_{it-1} + u_{it}$. The long-run NFA coefficient is $\hat{e}/\hat{c}$. The numbers in parentheses are robust *t*-statistics, with standard errors clustered at the country level. ***,**, *: significant at the 1%, 5% and 10% levels respectively.

Global imbalances are not the only possible reason for this result. Another possibility is that returns on assets were particularly low relative to growth rates in this period, implying that $r_1 + r_2 \leq g$, so the long-run relationship in equation (3) is no longer negative. A different possibility is that $r_1 + r_2$ has recently differed systematically across countries, in such a way as to invalidate the assumption in equation (1) that net returns from assets are of the same sign as net foreign assets themselves. This could happen if creditor (debtor) countries had sufficiently low (high) rates of return on their assets relative to their liabilities. A frequently cited example is the large Chinese holdings of relatively low-return US Treasury bills. Finally, there could be major measurement error problems with net foreign assets in recent years because of the explosion of cross-border investments discussed earlier, which biases the coefficients towards zero.

If increased measurement error is the true explanation for the apparent structural break, then we should get different results with an alternative variable to NFA, if one can be found. If we get similar results with an alternative variable, it would be plausible to conclude that the structural break is genuine. In the next section we explore this possibility, using the income flows from foreign assets rather than the estimated asset stocks themselves.

4.2 Net Exports and Net Property Income

Equation (4) shows that in long-run equilibrium we should observe the same negative relationship between the two components of the current account as between net exports and net foreign assets. Net property income flows should of course be closely correlated with net foreign assets, but the data come from different sources: net property income from balance of payments statistics, and net foreign assets from asset surveys. Measurement error in either source will reduce the observed correlation. Moreover, those who argue that equities are

excessively volatile (e.g. Shiller, 1981) have suggested that the flow of income from financial assets is a more reliable indicator of their equilibrium valuation than their price, which may at any one moment contain a substantial disequilibrium component. In other words, even if asset values are accurately measured in the data, they may be some way away from their equilibrium valuation, which will distort empirical tests, and income flow data are less susceptible to this problem.

Table 4 shows some pooled OLS regressions of net property income on lagged foreign assets and liabilities, all as a share of GDP, for 1971-2007. As expected, lagged foreign assets have a positive coefficient and lagged foreign liabilities a negative coefficient in every case. All the coefficients are significant at the 1% level. The coefficients are larger for the industrial countries, for reasons that are not clear – perhaps in part because they have more observations from earlier years when interest rates were higher. Nevertheless the relatively good fit for these regressions implies that estimation of the relationship between net exports and net property income should serve as a useful check on our previous results.

Table 4. Net property income flows and net foreign assets, 1971-2007

	All	Industrial	Emerging	Developing
Constant	-0.013*** (4.01)	-0.003 (-0.89)	-0.013* (-1.91)	-0.023*** (-4.47)
Foreign assets (t-1)	0.025*** (4.79)	0.065*** (9.92)	0.035*** (4.54)	0.046*** (3.25)
Foreign liabilities (t-1)	-0.025*** (-4.76)	-0.066*** (-9.85)	-0.042*** (-3.42)	-0.021*** (-6.39)
Sample size	3270	719	729	1822
No. countries	129	23	26	80
R-squared	0.33	0.44	0.25	0.40
RMSE	0.030	0.026	0.018	0.032

Notes. The dependent variable is net property income flows. All variables scaled by GDP. The numbers in parentheses are robust *t*-statistics. ***,**, *: significant at the 1%, 5% and 10% levels respectively.

One way to get a feel for the measurement problems is to note that both net property income and net foreign assets necessarily sum to zero over the whole world. Consequently the degree to which this is not true in the data (i.e. the world discrepancy) may be regarded as an index of measurement error. Figure 3 shows the cross-country sum of each of these variables, scaled by the cross-country sum of the absolute value, for as large a sample of countries as possible (i.e. oil producers and offshore financial centres are included, although they are excluded from the rest of the analysis). The broken line in Figure 3 suggests that liabilities are more completely recorded than assets, with the negative discrepancy steadily increasing up to 1999 but then falling relatively sharply. The continuous line in Figure 3 shows the same measure for net property income, which shows a rather similar pattern, but with a discrepancy that has fallen to near zero in recent years.

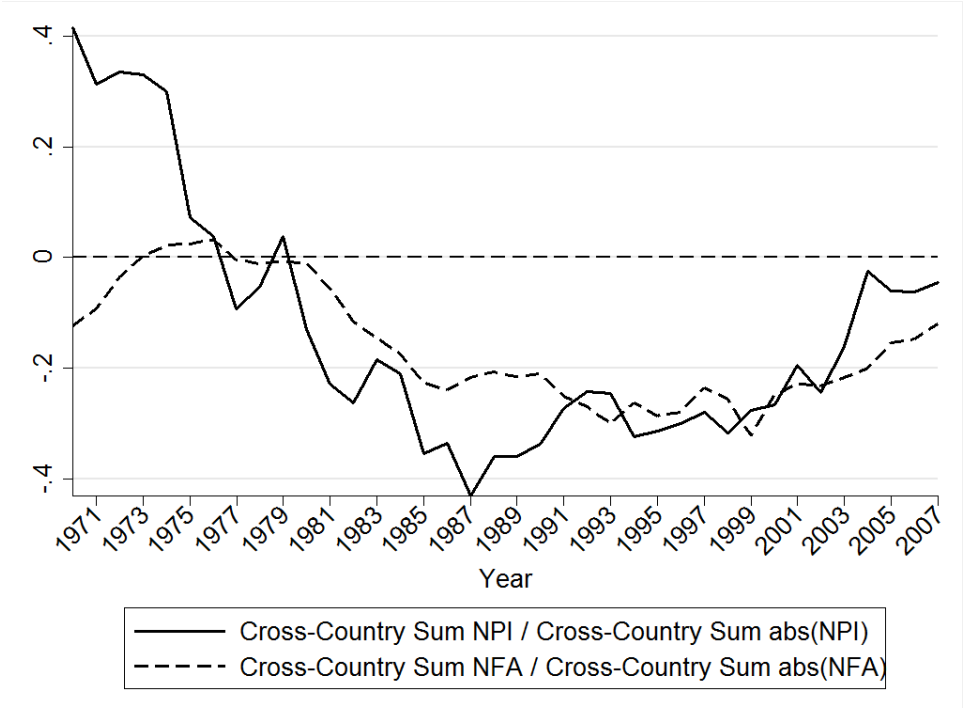

Figure 3. The World Discrepancy in Net Foreign Assets and Net Property Income

Tables 5 and 6 show the results of estimating equation (6) using net property income instead of net foreign assets, for 1971-91 and 1992-2007 respectively. In Table 5 (1971-91), the results for the industrial countries are very similar to those in Table 2, with negative coefficients that are significant at the 5% level with pooled OLS, with or without time dummies, and at the 1% level with fixed effects or PMG estimation. For emerging markets the coefficient is negative and significant at the 1% level in all four cases, as in Table 2. For developing countries the results in Table 5 are much stronger than those shown in Table 2, with all four coefficients negative and significant at the 1% level, whereas in Table 2 the coefficients, although negative, were not significant for pooled OLS with or without time dummies. Thus in all twelve cases in Table 5, the estimated coefficients are significantly negative at the 5% level, which constitutes strong empirical support for equation (4). It is still the case, as it was in earlier tables, that the coefficients tend to be higher for emerging markets.

Table 6 repeats the exercise for 1992-2007. The results here are very different to those for net foreign assets (Table 3). Nine of the twelve coefficients are significantly negative at the 5% level, compared with one in Table 3. For industrial countries no long-run coefficient can be identified in pooled OLS estimation, with or without time dummies, because the lagged NPI coefficient is positive; but for both fixed effects and PMG estimation the estimated coefficient is negative and significant at the 1% level. For emerging markets the coefficients are all negative and significant at 10% (pooled OLS without time dummies), 5% (pooled OLS with time dummies) or 1% (fixed effects and PMG). For developing countries the coefficient is significantly negative at either the 1% level (PMG) or the 5% level (the rest). This is in marked contrast to Table 3, where more than half of the estimated coefficients were positive.

Table 5. Net exports and net property income 1971-1991

	Pooled OLS	Pooled OLS with time dummies	Country fixed effects with time dummies	Pooled mean group
		Industrial countries		
Sample size	368	368	368	368
No. countries	21	21	21	21
RMSE	0.020	0.019	0.018	0.017
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NPI	-0.577**	-0.556**	-1.44***	-0.918***
coefficient	(-2.73)	(-2.56)	(-5.54)	(-4.72)
		Emerging markets		
Sample size	334	334	334	334
No. countries	23	23	23	23
RMSE	0.030	0.029	0.027	0.026
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NPI	-1.36***	-1.09***	-2.05***	-3.24***
coefficient	(-5.15)	(-4.83)	(-4.44)	(-18.1)
		Developing countries		
Sample size	832	832	832	826
No. countries	63	63	63	60
RMSE	0.070	0.069	0.064	0.058
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NPI	-0.961***	-0.930***	-1.21***	-1.38***
coefficient	(-9.41)	(-7.99)	(-3.43)	(-9.26)

Notes. The estimated regression is: $\Delta\left(\frac{NX}{GDP}\right)_{it} = a(i,t) + b\Delta\left(\frac{NPI}{GDP}\right)_{it} - c\left(\frac{NX}{GDP}\right)_{it-1} + e\left(\frac{NPI}{GDP}\right)_{it-1} + u_{it}$. The long-run NPI coefficient is $\hat{e}/\hat{c}$. The numbers in parentheses are robust *t*-statistics, with standard errors clustered at the country level. ***,**, *: significant at the 1%, 5% and 10% levels respectively.

Table 6. Net exports and net property income 1992-2007

	Pooled OLS	Pooled OLS with time dummies	Country fixed effects with time dummies	Pooled mean group
		Industrial countries		
Sample size	351	351	351	351
No. countries	23	23	23	23
RMSE	0.017	0.017	0.016	0.014
$\hat{c} > 0$?	No	No	Yes	Yes
Long-run NPI coefficient	undefined	undefined	-1.17*** (-3.22)	-1.03*** (-22.2)
		Emerging markets		
Sample size	406	406	406	406
No. countries	26	26	26	26
RMSE	0.029	0.028	0.026	0.024
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NPI coefficient	-1.31* (-1.83)	-1.45** (-2.08)	-1.48*** (-3.28)	-1.85*** (-12.9)
		Developing countries		
Sample size	1093	1093	1093	1074
No. countries	81	81	81	75
RMSE	0.050	0.050	0.045	0.042
$\hat{c} > 0$?	Yes	Yes	Yes	Yes
Long-run NPI coefficient	-0.781** (-2.22)	-0.804** (-2.19)	-0.905** (-2.40)	-1.14*** (-12.1)

Notes. The estimated regression is: $\Delta\left(\frac{NX}{GDP}\right)_{it} = a(i,t) + b\Delta\left(\frac{NPI}{GDP}\right)_{it} - c\left(\frac{NX}{GDP}\right)_{it-1} + e\left(\frac{NPI}{GDP}\right)_{it-1} + u_{it}$. The long-run NPI coefficient is $\hat{e}/\hat{c}$. The numbers in parentheses are robust *t*-statistics, with standard errors clustered at the country level. ***,**, *: significant at the 1%, 5% and 10% levels respectively.

These results show remarkably little evidence of any structural break. The long-run equilibrium relationship predicted by equation (4) seems to hold as well for 1992-2007 as for 1971-91. Some insight can be gained into the differences between the results for NFA and net property income by looking at the cross-country correlations between our three variables in each year. Figure 4 shows the correlation between NFA and net property income, which is above 0.6 in most years up to 1995, but almost always below that (and below 0.4 in several years) after 1995. Thus it is not surprising that there is some divergence in results for the two variables for recent years. Figures 5 and 6 look at the correlation between each of these variables and net exports. For NFA (Figure 5), the correlation is almost always (and surprisingly) positive; for net property income (Figure 6), it is consistently negative, except in the early 1970s.

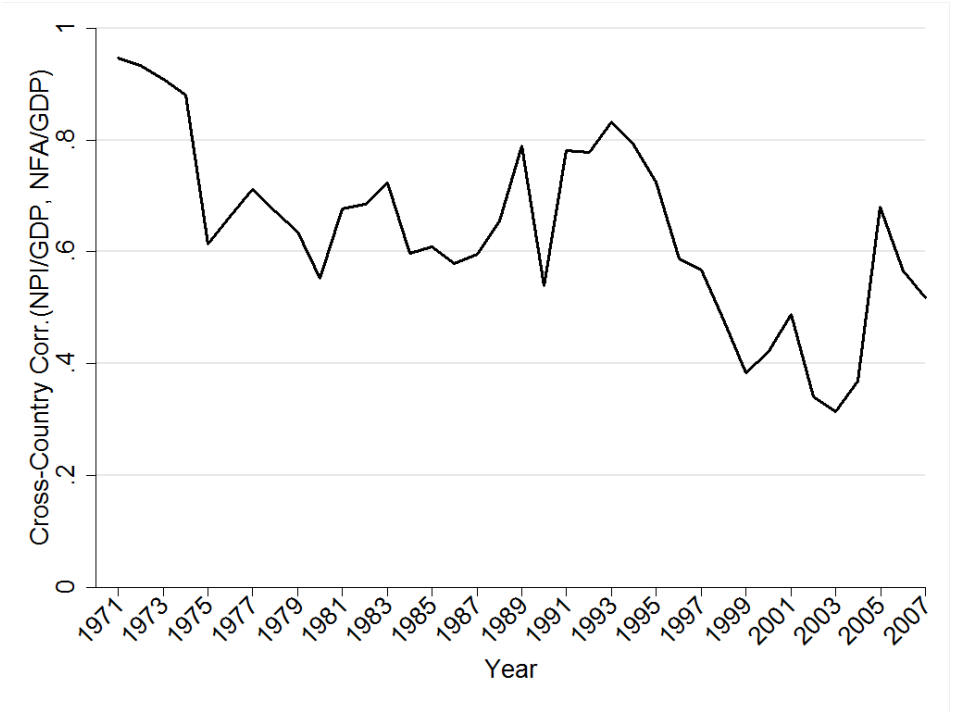

Figure 4. Cross-Country Correlation Between Net Property Income and Net Foreign Assets

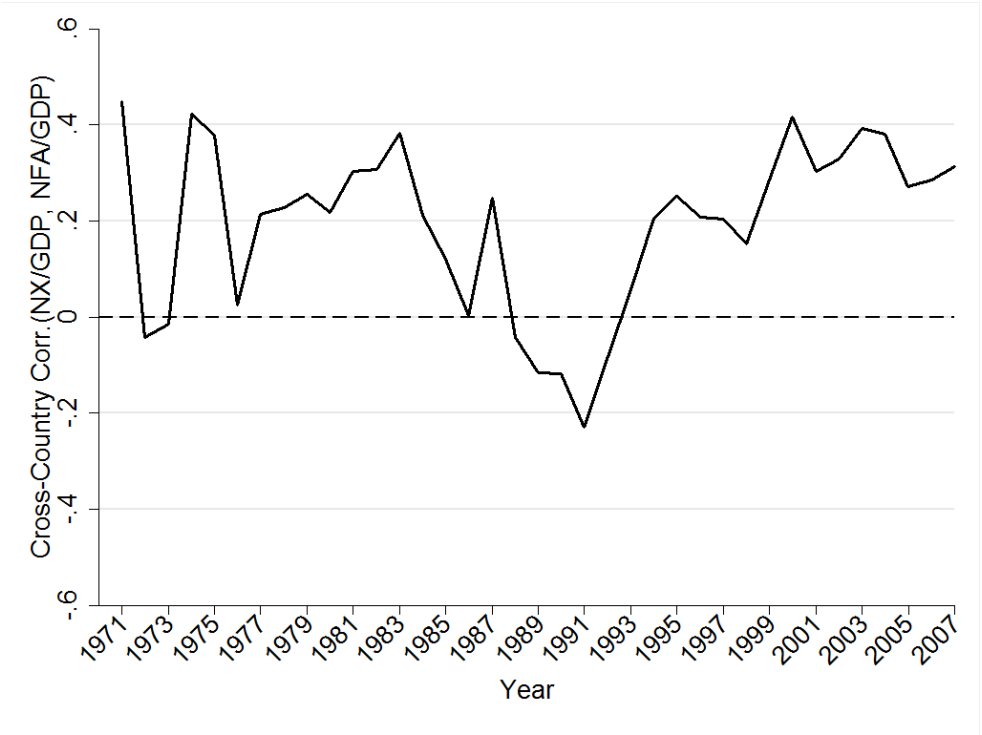

Figure 5. Cross-Country Correlation Between Net Exports and Net Foreign Assets

Figure 6. Cross-Country Correlation Between Net Exports and Net Property Income

To summarise: over time the correlation between net property income flows and net foreign assets has fallen; this may be because of greater divergence across assets in the flow rate of return, but it may also be an indicator of significant measurement errors in NFA as cross-border asset holdings have expanded. Another feature of the data is that the cross-county correlation between net exports and net property income flows as a share of GDP has been consistently negative, unlike that between net exports and net foreign assets. Even in the 1970s and 1980s, only the time-series dimension of the data shows the expected negative correlation between net exports and net foreign assets, and not the cross-country dimension.

4.3 Robustness checks

We have checked the robustness of our results for 1992-2007 in two ways: (a) by including only those countries that were used in the 1971-91 sample; and (b) by omitting the five countries which made the largest contributions to world current account imbalances in 2005 (USA, Germany, Japan, China and Russia). The results, which are not shown for brevity but are available from the authors upon request, are similar to those reported above.

5 Conclusions

The expected negative long-run equilibrium relationship between net exports and net foreign assets is evident in the data in the period 1971-91, but broke down in 1992-2007, the period of global current account imbalances. Large imbalances may be an equilibrium adjustment to large net foreign asset positions, ensuring their sustainability (e.g. if creditor countries start to run trade deficits); alternatively they can represent a move away from a previous near-equilibrium position, implying the need for substantial future real exchange rate movements to re-establish equilibrium. The recent imbalances of large countries have been more of the

latter type, so our finding that the equilibrium relationship tested here broke down in this period is not surprising.

An alternative view is that in this period net foreign assets became significantly harder to measure, because of rapidly increasing cross-border flows, so that gross assets increased much more quickly than net assets. The errors in the measurement of gross assets and liabilities are unlikely to be self-cancelling. Moreover the growth of the equity component has increased the volatility of asset prices and may have introduced bubble effects into asset valuations at times. Thus it could be argued that the apparent structural break is at least in part a reflection of an increased problem of measurement error and disequilibrium valuations of assets, rather than being genuine.

We have addressed this issue by noting that the same negative long-run relationship should theoretically exist between net exports and net property income, which is the income flow from net assets. The data for net property income are derived from balance of payments statistics rather than asset surveys. Moreover, as has been argued in relation to the "excess volatility" of equity prices, the flow of income may be a better indicator of long-run equilibrium valuations than the prices themselves. Using income data is therefore a useful way of testing the robustness of our previous findings, although summing over all countries indicates that there is a world discrepancy in both the NFA and net property income series.

Our results show that there is not the same structural break in the relationship between net exports and net property income as was found for net exports and net foreign assets. For net property income the negative relationship is almost as strong in the 1992-2007 period as in 1971-91. Thus the empirical evidence that net exports adjust to ensure long-run external solvency is compelling when we use the net income flows from foreign assets and liabilities rather than the estimates of the stock of net foreign assets.

References

Blanchard, O., F. Giavazzi and F. Sa (2005). International Investors, the U.S. Current Account, and the Dollar, *Brookings Papers on Economic Activity*, 1-49.

Bleaney, M.F. and M. Tian (2014). Net Foreign Assets and Real Exchange Rates Revisited. *Oxford Economic Papers*, Forthcoming

Bohn, H. (2007). Are Stationarity and Cointegration Restrictions Really Necessary for the Intertemporal Budget Constraint? *Journal of Monetary Economics*, 54(7), 1837–1847.

Bracke, T., M. Bussière, M. Fidora and R. Straub (2008). A Framework for Assessing Global Imbalances. *ECB Occasional Paper,* No. 78.

Chinn, M. D., B. Eichengreen and H. Ito (2014). A Forensic Analysis of Global Imbalances. *Oxford Economic Papers*, 66(2), 465-490.

Chinn, M. D. and E. S. Prasad (2003). Medium-Term Determinants of Current Accounts in Industrial and Ceveloping Countries: An Empirical Exploration. *Journal of International Economics*, 59(1), 47-76.

Christopoulos, D. K., K. Gente and M. A. León-Ledesma (2012). Net Foreign Assets, Productivity and Real Exchange Rates in Constrained Economies. *European Economic Review*, 56(3), 295–316.

Durdu, C. B., E. G. Mendoza and M. E. Terrones (2013). On the Solvency of Nations: Cross-Country Evidence on the Dynamics of External Adjustment. *Journal of International Money and Finance*, 32, 762-780.

Gruber, J.W. and S.B. Kamin (2007). Explaining the Global Pattern of Current Account Imbalances. *Journal of International Money and Finance*, 26, 500-522.

Lane, P. R. and G. M. Milesi-Ferretti (2004). The Transfer Problem Revisited: Net Foreign Assets and Real Exchange Rates. *Review of Economics and Statistics*, 86(4), 841-857.

Lane, P. R. and G. M. Milesi-Ferretti (2007). The External Wealth of Nations Mark Ii: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004. *Journal of International Economics*, 73(2), 223-250.

Lane, P. R. and J. C. Shambaugh (2010). Financial Exchange Rates and International Currency Exposures. *American Economic Review*, 100(1), 518-540.

Obstfeld, M. and K. S. Rogoff (2005). Global Current Account Imbalances and Exchange Rate Adjustments. *Brookings Papers on Economic Activity*, 2005(1), 67-123.

Pesaran, M. H., Y. Shin and R. P. Smith (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*, 94(446), 621-634.

Shiller, R. J. (1981). Do Stock Prices Move Too Much to Be Justified by Subsequent Changes in Dividends? *American Economic Review*, 71(3), 421-436.

Appendix

Table A. Country List

Industrial
Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States
Emerging Markets
Argentina, Brazil, Bulgaria, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Israel, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, South Africa, South Korea, Thailand, Turkey, Ukraine, Uruguay
Other Developing
Afghanistan, Albania, Armenia, Bangladesh, Belarus, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Costa Rica, Cote d'Ivoire, Croatia, Djibouti, Dominica, Dominican Republic, El Salvador, Eritrea, Estonia, Ethiopia, Faeroe Islands, Fiji, Gambia, Georgia, Ghana, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Jamaica, Jordan, Kenya, Kiribati, Kyrgyz Republic, Laos, Latvia, Lesotho, Liberia, Lithuania, Macedonia, Madagascar, Malawi, Maldives, Mali, Mauritania, Moldova, Mongolia, Mozambique, Namibia, Nepal, Nicaragua, Niger, Papua New Guinea, Paraguay, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Slovak Republic, Slovenia, Solomon Islands, Somalia, Sri Lanka, Suriname, Swaziland, Tajikistan, Tanzania, Togo, Tonga, Tunisia, Uganda, Zambia, Zimbabwe