Net Foreign Assets and Real Exchange Rates Revisited

Michael Bleaney and Mo Tian

School of Economics, University of Nottingham

(Revised version – December 2013)

Abstract

Theory suggests a significant positive relationship in long-run equilibrium between the net foreign assets (NFA) of a country and its real exchange rate. Empirical tests have ignored two issues: the large variation in cross-country trade/GDP ratios, which is likely to induce substantial cross-country differences in coefficients when net foreign assets are scaled by GDP, and the reverse causality associated with valuation effects. A real exchange rate appreciation reduces the absolute value of NFA denominated in foreign currency relative to domestic GDP, because of the sizeable component of non-tradable goods in domestic GDP. This endogeneity biases the test results. New tests are implemented that address these issues. The valuation effect bias is found to be significant. The new tests nevertheless still support the existence of a long-run positive relationship between NFA and real exchange rates.

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

The publication of a data set of foreign assets and liabilities for a substantial number of countries by Lane and Milesi-Ferretti (2001) has stimulated empirical research on the implications of large net foreign asset (*NFA*) positions. If, as discussed below, the rate of return on foreign assets exceeds the growth rate of *GDP*, in the long run a larger *NFA* position should be associated with a more appreciated real exchange rate in order to induce lower net exports to offset the increased net income flow (Blanchard *et al.*, 2005; Devereux and Sutherland, 2010; Tille and van Wincoop, 2010). This effect has been investigated empirically for real exchange rates by Lane and Milesi-Ferretti (2004) and Christopoulos *et al*. (2012). Both find that the effect varies across countries, being most evident in poorer economies and more or less absent in rich countries. The same pattern of less (or in-) significant coefficients in richer countries appears in Durdu *et al*.'s (2013) analysis of the long-run relationship between *NFA* and net exports. Christopoulos *et al*. (2012) suggest that this difference reflects whether countries are or are not credit-constrained in international markets.

Here we demonstrate that the smaller coefficients estimated for richer countries can be to a significant degree explained by the feedback effect of real exchange rate movements on the relative valuations of assets and liabilities denominated in foreign and domestic currencies, as highlighted by Gourinchas and Rey (2007) and Lane and Shambaugh (2010a). These valuation effects (VE) mean that countries whose foreign currency exposure (*FXE*) is positive (i.e. whose assets denominated in foreign currencies exceed their liabilities denominated in foreign currencies) experience a fall in their *NFA/GDP* ratio as the real exchange rate appreciates. This is the effect of the large weight in *GDP* of non-tradable goods and services, whose price rises in terms of foreign currency. This group generally comprises richer countries. In the opposite case (negative *FXE*), the valuation effects tend to imply a rise in the *NFA/GDP* ratio as the real exchange rate appreciates, as *FXE* gets less negative (i.e. debts denominated in foreign currency fall relative to GDP). This is typically the case in poorer countries. In the long-run steady state the valuation effects are zero, but in time series estimation any exogenous changes in real exchange rates that are not associated with the accumulation or decumulation of net foreign assets have feedback effects on the *NFA/GDP* ratio that bias the estimated coefficient in a way that varies systematically across countries.

The purpose of the present paper is to re-estimate the relationship between the real exchange rate and net foreign assets in a way that addresses the endogeneity issue. The results confirm that valuation effects are substantial, but also provide robust support for the underlying hypothesis of a positive correlation between net financial assets and the real exchange rate. It is also argued that the use of GDP as a denominator for net financial assets is a mis-specification that is liable to induce cross-country variation in coefficients. The tests presented here address this issue also.

2 Theory

The starting point is the identity:

$$NFA_t = (1 + r_t)NFA_{t-1} + NX_t + VE_t + APM_t \tag{1}$$

where NFA_t denotes net foreign assets at the end of period t; r_t is the total return (income plus capital) on these net assets during period t; NX is net exports; VE is the valuation effects of exchange rate movements; and APM is the effect of asset price changes in whatever currencies assets are denominated.[1] Converting this identity to a ratio of *GDP*, which grows at a rate g_t, equation (1) becomes:

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

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:

$$\left(\frac{r-g}{1+g}\right)\left(\frac{NFA}{GDP}\right) = -\left(\frac{NX}{GDP}\right) \quad (3)$$

What is called net exports here is in fact the sum of the trade balance and all other items of the current account apart from net property income flows (which are already included in the *rNFA* term), such as workers' remittances. Assuming that these other components of the current account are relatively insensitive to the real exchange rate, the main mechanism for changing net exports is the negative relationship between the real exchange rate and the trade balance. Thus if $(r - g)$ is positive, then a higher value of *NFA/GDP* should be associated with a higher real exchange rate, in order to induce lower net exports. Another possible mechanism is increased absorption relative to output as the additional income is consumed, at an unchanged real exchange rate; Rowthorn and Solomou (1991) argue that this is what happened in the United Kingdom in the 1870-1913 period.

Lane and Milesi-Ferretti (2004) and Christopoulos *et al*. (2012) investigate the long-run time-series relationship between *NFA/GDP* and the real exchange rate (*R*) for a panel of

[1] Equation (1) assumes equal rates of return on assets and liabilities. The analysis of US data by Curcuru *et al*. (2008) suggests that this is a reasonable approximation.

countries, assuming constant coefficients across countries.[2] Thus they estimate panel regressions of the form:

$$lnR_{it} = a_i + b\left(\frac{NFA}{GDP}\right)_{it} + u_{it} \quad (4)$$

where i denotes countries and t time.[3] There are at least two reasons why the assumption of constant coefficients is problematic in this context.

One is the point made above: the accumulation of *NFA* tends to raise the real exchange rate, but for countries with positive *FXE* this has the accounting effect of devaluing existing foreign assets denominated in foreign currency relative to *GDP*, thus diluting the impact. The "signal" of accumulation of *NFA* will thus be more difficult to detect, as the noise associated with other factors causing changes in *NX* will dominate the data. The opposite is the case for countries with negative *FXE*, for which the accounting effect will reinforce the upward shock to *NFA*, so the signal is reinforced. More importantly, any exogenous changes in R (captured by u) will have feedback effects on *NFA/GDP* through *FXE*, so that the estimated coefficient in this regression is biased, with the direction of bias depending on the sign of *FXE*. The estimated coefficient of *NFA/GDP* for any particular country will therefore vary with *FXE/GDP*.

The second reason is that the elasticity of the response of trade flows to real exchange rate movements tends to be similar across countries. This implies marked differences in the effect on net exports as a ratio of *GDP*, because of the enormous cross-country variation in the ratio of trade to *GDP* (Isard, 2007). Suppose that a 10% real depreciation raises exports by x% and reduces imports by the same x%. This implies that net exports increase by x% of

---

[2] Obviously a cross-country analysis is meaningless because the real effective exchange rate is an index with an arbitrarily selected base year.
[3] Some cross-country variation in b arises when the authors estimate the model on sub-samples of countries.

total trade, which is about 0.25*x*% of GDP in the United States but more than *x*% of GDP in Belgium. Therefore it makes little sense to assume the same coefficients in a regression of *R* on *NFA/GDP* in these two countries; in general we would expect the effect to be larger in countries where the ratio of trade to GDP is smaller, because a given increase in *NFA/GDP* is a larger increase relative to total trade in these countries.

The second point can be dealt with by dividing equation (1) by total trade (*XM*) instead of by *GDP*. Then equation (3) becomes:

$$\left(\frac{r-h}{1+h}\right)\left(\frac{NFA}{XM}\right) = -\left(\frac{NX}{XM}\right) \tag{5}$$

where *h* is the growth rate of *XM*. Moreover, because of the exclusion of non-tradables, total trade flows measured in *foreign* currency are likely to be relatively immune to real exchange rate movements. The accounting problem in this case is the opposite one: net assets denominated in domestic currency, or domestic currency exposure (*DXE*), will vary with the real exchange rate as a ratio of *XM*, because the real exchange rate affects *XM* measured in domestic currency. Specifically, the absolute value of net assets or liabilities denominated in domestic currency will rise as a ratio of *XM* as the currency appreciates. As we shall see later, *DXE* varies less than *FXE* across countries, and is in most cases negative (i.e. liabilities exceed assets). The feedback effect of real exchange rate appreciations on *NFA/XM* will be positive for $DXE > 0$ and negative for $DXE < 0$.

Since this endogeneity is expected to affect only the *DXE* component of *NFA*, our strategy is to separate the (*NFA/XM*) variable into its two components (*DXE/XM* and *FXE/XM*), and to treat the *FXE/XM* as an unbiased estimator. We then estimate simultaneously the long-run and short-run effects of these two components of *NFA* on the real exchange rate using the following error correction model:

$$\Delta lnR_{it} = a_i + z_t + b_i\Delta\left(\frac{FXE}{XM}\right)_{it} + c_i\Delta\left(\frac{DXE}{XM}\right)_{it} - e_i lnR_{it-1} + f_i\left(\frac{FXE}{XM}\right)_{it-1} + v_i\left(\frac{DXE}{XM}\right)_{it-1} + u_{it} \quad (6)$$

Country subscripts are added to the coefficients because in some forms of estimation they will be allowed to vary across countries. In equation (6), the terms in (*DXE/XM*) control for valuation effects, and the long-run effect of *NFA* on the real exchange rate is estimated from the coefficients of the *FXE* terms as $m = (f/e)$. The implicit long-run relationship is:

$$lnR_i = country\ dummy + time\ dummy + \left(\frac{f_i}{e_i}\right)\left(\frac{FXE}{XM}\right) + \left(\frac{v_i}{e_i}\right)\left(\frac{DXE}{XM}\right) \quad (7)$$

This approach avoids the usual problems of loss of efficiency and instrument inadequacy associated with instrumental variable estimation; instead the endogeneity is assumed to be concentrated in one part of the explanatory variable (*DXE*), and only the other part (*FXE*) is used for estimation.

3 Data

Except where otherwise indicated, data are taken from the World Bank World Development Indicators (WDI) database. Net financial assets and domestic and foreign currency exposure are from the Lane and Shambaugh (2010a) data set. Data from 1992 to 2006 are used (lack of information on the composition of NFA precludes the use of more recent data). The countries in the sample are listed in the Appendix. Real effective exchange rates are trade-weighted averages of the bilateral nominal end-of-month exchange rates against the US dollar from IMF International Financial Statistics, adjusted by the consumer price index.[4] The trade weights used are those for the year 2002. The WDI real effective exchange rate series was

[4] The real exchange rate is often referred to as the price of non-tradables relative to that of tradables. Bleaney and Tian (2012, Table 8) show that real effective exchange rate movements are strongly negatively correlated with changes in the ratio of exports plus imports to GDP. This ratio is likely to be a good indicator of the price of tradables relative to non-tradables, since only the denominator contains non-tradables.

preferred where bilateral trade data were missing or where the correlation between the two series was not high. Per capita GDP data are in constant 2005 international dollars.

Table 1 gives some summary statistics for the components of *NFA*. All components have more between-country than within-country variation. For industrial countries foreign-currency assets tend to exceed foreign-currency liabilities, whereas for other countries it is the other way around. Domestic-currency liabilities tend to exceed domestic-currency assets, consisting mainly of foreign direct investments in poorer countries and financial securities in richer ones.

Table 1. Summary Statistics on Net Foreign Assets

	N	N_C	T-bar	Mean	SD	SD within	SD between
FAFC/(X+M)							
Overall	1060	88	12.05	0.833	0.836	0.293	0.765
Industrial	264	21	12.57	1.512	1.239	0.478	1.163
Emerging	251	19	13.21	0.572	0.259	0.137	0.227
Other Dev	421	37	11.38	0.523	0.414	0.205	0.338
FLFC/(X+M)							
Overall	1060	88	12.05	1.087	0.800	0.460	0.660
Industrial	264	21	12.57	0.978	0.637	0.289	0.571
Emerging	251	19	13.21	0.838	0.483	0.237	0.443
Other Dev	421	37	11.38	1.374	0.984	0.604	0.801
FXE/(X+M)							
Overall	1060	88	12.05	-0.254	1.001	0.450	0.874
Industrial	264	21	12.57	0.533	0.877	0.333	0.827
Emerging	251	19	13.21	-0.266	0.489	0.274	0.418
OthrDev	421	37	11.38	-0.850	0.933	0.565	0.754
FADC/(X+M)							
Overall	1060	88	12.05	0.137	0.414	0.261	0.326
Industrial	264	21	12.57	0.483	0.595	0.423	0.439
Emerging	251	19	13.21	0	0	0	0
Other Dev	421	37	11.38	0	0	0	0
FLDC/(X+M)							
Overall	1060	88	12.05	0.636	0.663	0.361	0.542
Industrial	264	21	12.57	1.260	0.854	0.573	0.630
Emerging	251	19	13.21	0.437	0.281	0.162	0.241
Other Dev	421	37	11.38	0.349	0.264	0.156	0.204
DXE/(X+M)							
Overall	1060	88	12.05	-0.499	0.442	0.224	0.376
Industrial	264	21	12.57	-0.776	0.652	0.349	0.570
Emerging	251	19	13.21	-0.437	0.281	0.162	0.241
Other Dev	421	37	11.38	-0.349	0.264	0.156	0.204

Notes. FAFC: foreign assets denominated in foreign currencies; FLFC: foreign liabilities denominated in foreign currencies; FXE: foreign currency exposure (= FAFC – FLFC); FADC: foreign assets denominated in domestic currency; FLDC: foreign liabilities denominated in domestic currency; DXE: domestic currency exposure (= FADC – FLDC); (X+M): exports plus imports. Data period: 1992-2006. N: number of observations; N_C: number of countries; T-bar: mean number of years; SD: standard deviation (overall; within countries; between countries).

4 Empirical Results

4.1 Main results

Table 2 shows what happens if we estimate an error-correction version of equation (4), using *NFA* as a proportion of GDP as previous authors have done, but splitting the sample into countries with positive and negative foreign currency exposure. Because we do not necessarily expect the coefficients to be identical across countries, because of differing endogeneity bias, we have used the Pooled Mean Group (PMG) method of Pesaran *et al.* (1999), which constrains only the estimated long-run effect to be identical across countries. The insignificant *p*-values of the Hausman test indicate that this restriction of identical long-run effects is not rejected by the data.[5]

In column (1), the sample consists of the 28 countries whose average *FXE* is positive (i.e. with assets denominated in foreign currency exceeding liabilities on average). The majority, but not all, of these countries are industrial countries. The estimated long-run coefficient for this sample is negative and significantly less than zero, contrary to expectation. According to our argument, this is at least partly the effect of the endogeneity bias.

For the 48 countries with negative *FXE*, which are mostly emerging markets and developing countries, the regression is shown in column (2). The coefficient is positive and highly significant, as we expect because it should be biased upwards in this case by endogeneity.

[5] Results are similar if we use the Mean Group method of Pesaran and Smith (1995), allowing the long-run coefficients to differ across countries as well, or if we use fixed effects, allowing only the intercept to differ across countries.

Table 2. Real Exchange Rates and NFA/GDP by Foreign Exchange Exposure

	FXE_Avg>0	FXE_Avg<0
	(1)	(2)
Dependent Variable: ΔlnREER		
ΔNFA	-0.048	0.393
	(-0.93)	(5.84)***
Trend	0.003	-0.002
	(1.85)*	(-0.80)
lnREER(-1)	-0.386	-0.382
	(-8.68)***	(-7.80)***
Constant	0.505	0.616
	(2.40)**	(3.82)***
Long-Run		
NFA	-0.263	0.652
	(-7.42)***	(15.36)***
No_Economies	28	48
No_Observations	407	675
RMSE	0.0462	0.0638
Log-Likelihood	780.4	1071.7
Pesaran CADF	0.000	0.000
Hausman p-value	0.347	0.291

Notes. REER – real effective exchange rate; NFA – net foreign assets; FXE – foreign currency exposure. Both FXE and NFA are ratios of GDP. Estimation is by the pooled mean group method (Pesaran *et al*., 1999), in which only the long-run coefficients are constrained to be equal across countries. The homogeneity restriction is tested by using the Hausman test, for which the p-values are presented. The other coefficients are unweighted averages of estimated coefficients for each individual country. Figures in parentheses are *t*-statistics. RMSE is the root mean square error of the residuals. FXE_Avg represents the mean value of FXE for each individual country.

So far we have shown that a regression of *R* on *NFA/GDP* is likely to display significant bias from valuation effects. We next estimate our preferred specification shown in equation (6), with *NFA* scaled by total trade, and separated into its *DXE* and *FXE* components, of which only the coefficient of the *FXE* component is expected to be unbiased. The coefficient of the *DXE* component should be biased downwards by endogeneity since, as the real exchange rate appreciates, assets and liabilities denominated in domestic currency will increase in absolute value relative to total trade, making *DXE* more negative.

The results for two-way fixed effects estimation are shown in Table 3. In column (1) of Table 3 the long-run equilibrium real exchange rate is assumed to be a constant apart from any *NFA* effects. The long-run *FXE* coefficient is positive, as expected, but with a *t*-statistic of only 1.21. The long-run *DXE* coefficient is negative, but also not statistically significant. The short-run coefficients are of the same sign as their long-run counterparts, but also not statistically significant.

In the second and third columns of Table 3 we enrich the specification somewhat. In the second column we introduce per capita GDP relative to that of trading partners, to capture the Balassa-Samuelson effect that higher per capita GDP tends to be associated with a higher real exchange rate. The coefficient is significant with the expected positive sign, but a disadvantage is that the sample is rather smaller (56 rather than 75 countries). Nevertheless the long-run coefficients are plausible. The Balassa-Samuelson effect is estimated to be significant at the 1% level in both the long and the short run. The long-run coefficient of *FXE* is now estimated to be 0.130, and significant at the 5% level. The long-run *DXE* coefficient is now slightly positive, at 0.044, but with a *t*-statistic of only 0.87.[6]

[6] We also tried adding the terms of trade. For exporters of primary products, this would capture relative price movements that are probably exogenous, but for exporters of manufactures, the terms of trade are likely to be endogenous to the real exchange rate. Since the terms of trade variable turned out to be most significant for the industrial countries, for which the endogeneity problem is likely to be more severe, we decided to omit it.

Table 3. Error Correction Model of Real Effective Exchange Rates and Net Foreign Assets, Allowing for Valuation Effects

	(1)	(2)	(3)
Dependent Variable: ΔlnREER			
ΔDXE	-0.063	-0.054	-0.062
	(-1.55)	(-1.20)	(-1.64)
ΔFXE	0.021	0.035	0.029
	(0.92)	(1.23)	(1.28)
Δln(GDPpc/WGDPpc)		0.903	
		(3.27)***	
lnREER (-1)	-0.279	-0.267	-0.458
	(-9.63)***	(-7.14)***	(-11.85)***
DXE (-1)	-0.014	0.012	-0.050
	(-1.06)	(0.87)	(-1.96)*
FXE (-1)	0.014	0.035	0.058
	(1.21)	(2.40)*	(2.45)**
ln(GDPpc/WGDPpc)(-1)		0.229	
		(2.91)***	
Country Dummy	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes
Country-Specific Time Trend	No	No	Yes
No_Economies	75	56	75
No_Observations	1060	818	1060
R-squared	0.185	0.256	0.341
RMSE	0.0788	0.0779	0.0735
Calculated Long-Run			
DXE	-0.049	0.044	-0.109
	(-1.15)	(0.87)	(-2.14)**
FXE	0.052	0.130	0.127
	(1.21)	(2.22)**	(2.56)**
ln(GDPpc/WGDPpc)		0.856	
		(2.84)***	

Notes. Estimation method is two-way fixed effects. Standard errors are clustered by individual country. Robust t-statistics are in parentheses. DXE and FXE are ratios of exports plus imports. REER – real effective exchange rate; DXE – domestic currency exposure; FXE – foreign currency exposure; GDPpc/WGDPpc – ratio of per capita GDP to the trade-weighted average of per capita GDP of other countries (weights identical to those used in REER calculation); RMSE – root mean square residual.

In column (3) of Table 3, we include a country-specific time trend to capture unidentified factors that might shift the equilibrium real exchange rate; this adds flexibility to the specification without reducing the sample size as in column (2). The long-run *FXE* coefficient is significant and very similar to in column (2), at 0.127, but more statistically significant, with a *t*-statistic of 2.56. The long-run *DXE* coefficient is significantly negative (-0.109, with a *t*-statistic of -2.14).

The results shown in Table 3 suggest that there is a significant positive long-run effect of net foreign asset accumulation on real exchange rates. The lower (and often negative) coefficient of the *DXE* component implies that the true coefficient of *NFA* is likely to be underestimated if endogeneity bias is not taken into account.

In Table 4 we repeat the same exercise as in Table 3 but with fewer constraints on the coefficients. Instead of fixed effects estimation we use the Pesaran *et al*. (1999) Pooled Mean Group (PMG) estimation procedure, in which only the long-run coefficients are constrained to be equal across countries (i.e. the coefficients listed down to ln*REER(-1)* are country-specific, and the figure shown is the mean of the country-specific coefficients, but the ratio of the coefficient of *NFA(-1)* to that of ln*REER(-1)* is the same across countries, yielding the same long-run estimate). The Hausman test statistic is always insignificant, which implies that the null of identical long-run effects across countries is not rejected by the data. The main effect of using this alternative estimation procedure is that the coefficients of *FXE(-1)* and *DXE(-1)* have much smaller standard errors than in Table 3, and therefore much higher levels of significance.

Table 4. Real Exchange Rates and Net Foreign Assets Allowing for Valuation Effects: Pooled Mean-Group Estimation

	(1)	(2)	(3)
Dependent Variable: dlnREER			
dDXE	-0.049	0.042	0.019
	(-0.60)	(0.55)	(0.32)
dFXE	0.011	0.008	0.023
	(0.32)	(0.26)	(0.72)
dln(GDPpc/WGDPpc)		0.568	
		(1.95)*	
Time Trend			-0.008
			(-4.72)***
Constant	0.375	0.536	0.586
	(2.97)***	(3.94)***	(3.84)***
ln REER(-1)	-0.251	-0.323	-0.383
	(-6.91)***	(-8.03)***	(-9.37)***
Long-Run			
DXE	-0.172	-0.017	-0.218
	(-19.57)***	(-0.83)	(-5.63)***
FXE	0.279	0.059	0.459
	(12.93)***	(4.06)***	(15.04)***
ln(GDPpc/WGDPpc)		1.474	
		(22.48)***	
No_Economies	75	55	74
No_Observations	1060	811	1053
Log-Likelihood	1700.059	1405.442	1821.515
RMSE	0.0668	0.0585	0.0592
Pesaran CADF	0.000	0.000	0.000
Hausman p-value	0.241	0.707	0.855

Notes. Estimation method is Pesaran *et al.* (1999) pooled mean-group estimation, in which only the long-run coefficients are constrained to be equal across countries. The homogeneity restriction is tested by using the Hausman test, for which the p-values are presented. The figures in parentheses are *t*-statistics. DXE and FXE are ratios of exports plus imports. REER – real effective exchange rate; DXE – domestic currency exposure; FXE – foreign currency exposure; GDPpc/WGDPpc – ratio of per capita GDP to the trade-weighted average of per capita GDP of other countries (weights identical to those used in REER calculation); RMSE – root mean square residual; Pesaran CADF – Pesaran (2006) unit root test of residuals.

The estimated long-run *FXE* coefficient is considerably more variable than in Table 3, with point estimates of 0.279, 0.059 and 0.459 in columns (1) to (3) respectively, compared with 0.052, 0.130 and 0.127 in Table 3. The estimated *DXE* long-run coefficient, which we expect to be biased downwards, is always negative, and statistically significant in columns (1) and (3). As in Table 3, the short-run coefficients are not significant.

4.2 Are Industrial Countries Different?

An interesting question is whether, in these new tests, there is evidence of differences in the long-run effects of the accumulation of *NFA* on the real exchange rate across country groups of the kind suggested by previous research. Christopoulos *et al*. (2012) present some theoretical arguments why the relationship should be stronger in credit-constrained economies. Does the empirical evidence support this claim after allowing for valuation effects? To test this, we interact the *FXE* and *DXE* coefficients with a dummy for the industrial countries (the group that is not likely to be credit-constrained). Table 5 repeats Table 3 with the addition of these interaction terms, which should have a negative coefficient if the credit-constraint effect operates.

Table 5. Testing for different long-run NFA effects in the industrial countries

	(1)	(2)	(3)
Dependent Variable: ΔlnREER			
ΔDXE	-0.062	-0.055	-0.056
	(-1.60)	(-1.25)	(-1.52)
ΔFXE	0.021	0.033	0.031
	(0.97)	(1.21)	(1.36)
Δln(GDPpc/WGDPpc)		0.895	
		(3.41)***	
lnREER (-1)	-0.279	-0.272	-0.464
	(-9.83)***	(-7.31)***	(-11.94)***
DXE (-1)	0.004	0.028	-0.074
	(0.17)	(1.02)	(-2.28)**
FXE (-1)	0.017	0.047	0.069
	(1.34)	(3.13)***	(2.31)**
DXE(-1)*IND	-0.039	-0.044	0.019
	(-1.54)	(-1.77)*	(0.44)
FXE(-1)* IND	-0.027	-0.046	-0.060
	(-1.55)	(-2.47)**	(-1.77)*
ln(GDPpc/WGDPpc)(-1)		0.225	
		(3.05)***	
Country Dummy	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes
Individual Trend	No	No	Yes
N_Economies	75	56	75
N_Obs.	1060	818	1060
R^2	0.187	0.260	0.344
RMSE	0.0788	0.0778	0.0734
Pesaran CADF	0.0000	0.0000	0.0000
Calculated Long-Run			
DXE	0.016	0.102	-0.160
	(0.17)	(0.98)	(-2.45)**
FXE	0.063	0.171	0.148
	(1.30)	(2.75)***	(2.36)**
DXE*IND	-0.138	-0.164	0.040
	(-1.46)	(-1.65)	(0.44)
FXE*IND	-0.095	-0.170	-0.128
	(-1.53)	(-2.37)**	(-1.76)*
ln(GDPpc/WGDPpc)		0.827	
		(2.85)***	

See notes to Table 3. IND is an indicator variable for Industrial economies. In column (3) a country-specific time trend is included in the regression.

The results in Table 5 show that the long-run *FXE*IND* coefficient is always negative, as predicted by the Christopoulos *et al*. (2012) hypothesis. Indeed the long-run *FXE*IND* coefficient is about minus one times the long-run *FXE* coefficient, implying a near-zero long-run effect in the industrial countries (but a slightly larger long-run *FXE* effect than in Table 3 for emerging markets and developing countries). On the other hand, the difference in coefficients between industrial countries and the rest tends not to be statistically significant: it is significant at the 5% level only in the reduced sample of 56 countries in column (2). It is worth noting that the within-country variation in *FXE*, as shown in Table 1, is particularly high for developing countries, which should aid precise estimation of the coefficient for this group. The long-run *DXE*IND* coefficient is negative in columns (1) and (2), but never significantly so, and positive in column (3).

Thus our new tests do not offer compelling evidence that the relationship between net foreign assets and the real exchange rate is enhanced in credit-constrained economies.

5 Conclusions

So long as the real interest rate exceeds the growth rate, accumulation of net foreign assets, scaled by some appropriate measure of the size of the economy, should be associated with real exchange rate appreciation in equilibrium. When net foreign assets are scaled by GDP, as in previous tests, the effect is expected to be stronger in economies with lower trade/GDP ratios, because in these economies a 1% increase in *NFA/GDP* represents a larger increase relative to total trade, implying that a larger appreciation should be required to offset it. In addition, because foreign assets and liabilities are to a considerable extent denominated in foreign currencies, valuation effects can distort the relationship, and can potentially explain previous findings that it appears to apply only to poorer countries, which mostly have negative foreign currency exposure. Negative foreign currency exposure means that a real exchange rate appreciation reduces debts denominated in foreign currency relative to *GDP*, thus improving the *NFA/GDP* ratio through a valuation effect. In this paper new tests have been developed to address these issues. Net foreign assets were deflated by total trade instead of *GDP*, and *NFA* was split into foreign-currency and domestic-currency components to isolate the valuation effects, which should now be concentrated in the domestic-currency component, assuming that the foreign-currency value of total trade is relatively immune to real exchange rate movements.

The results for the foreign-currency component of net foreign assets confirm that, as the hypothesis predicts, in the long run the real exchange rate is significantly positively correlated with *NFA* in appropriate specifications (allowing for relative productivity and/or country-specific time trends). The results also confirm the importance of valuation effects. The long-run coefficient of *DXE* was frequently negative and consistently smaller than that of *FXE*, which should be unbiased in our new tests. The negative bias to the *DXE* coefficient reflects the inflation of domestic-currency liabilities (which tend to exceed domestic-currency assets) relative to total trade as the real exchange rate appreciates.

Christopoulos *et al*. (2012) argue that the relationship should be stronger in credit-constrained economies. Our results suggest that any such effect is not statistically significant in our maximum sample of 75 countries, although the estimated coefficient is somewhat higher in emerging markets and developing countries.

Acknowledgements

The authors would like to thank three anonymous referees and one of the editors, Francis Teal, for helpful comments on an earlier version. Any errors that remain are of course the authors' responsibility.

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 (2012). "Exchange Rates and Trade Balance Adjustment: A Multi-Country Empirical Analysis", University of Nottingham Centre for Research in Economic Development and International Trade Discussion Paper no. 12/10.

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.

Curcuru, S.E., T. Dvorak and F.E. Warnock (2008). "Cross-Border Returns Differentials". Quarterly Journal of Economics, 123(4): 1495-1530.

Devereux, M. B. and A. Sutherland (2010). "Valuation Effects and the Dynamics of Net External Assets". Journal of International Economics, 80(1): 129-143.

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, 33: 762-780.

Gourinchas, P.-O. and H. Rey (2007). "International Financial Adjustment." Journal of Political Economy, 115(4): 665-703.

Isard, P. (2007). "Equilibrium Exchange Rates: Assessment Methodologies". Working Paper no. 07/296, Washington, DC: International Monetary Fund.

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 (2010a). "Financial Exchange Rates and International Currency Exposures". American Economic Review, 100(1): 518-540.

Lane, P. R. and J. C. Shambaugh (2010b). "The long or short of it: Determinants of foreign currency exposure in external balance sheets". Journal of International Economics, 80(1): 33-44.

Pesaran, M. H. (2006). "Estimation and Inference in Large Heterogeneous Panels with a Multifactor Error Structure". Econometrica, 74(4): 967-1012.

Pesaran, M.H. and R. Smith (1995). "Estimating Long-Run Relationships from Dynamic Heterogeneous Panels". Journal of Econometrics, 68(1): 79-113.

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.

Rowthorn, R.E. and S.N. Solomou (1991). "The Macroeconomic Effects of Overseas Investment on the UK Balance of Trade, 1870-1913". Economic History Review, 44(4): 654-664.

Tille, C. and E. van Wincoop (2010). "International Capital Flows". Journal of International Economics, 80(2): 157-175.

Appendix

Appendix Table A. Country List

Industrial

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

Emerging Markets

Argentina, Brazil, 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

Albania, Armenia, Bangladesh, Belarus, Benin, Bolivia, Bosnia and Herzegovina, Botswana, Burkina Faso, Cambodia, Cameroon, Chad, Cote d'Ivoire, Croatia, Dominican Republic, El Salvador, Estonia, Ethiopia, Fiji, Georgia, Ghana, Guatemala, Guinea, Haiti, Honduras, Jamaica, Jordan, Kenya, Kyrgyz Republic, Latvia, Lithuania, Macedonia, Madagascar, Malawi, Mali, Moldova, Mozambique, Nepal, Nicaragua, Niger, Papua New Guinea, Paraguay, Rwanda, Senegal, Slovak Republic, Slovenia, Sri Lanka, Tanzania, Togo, Tunisia, Uganda, Zambia