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Net foreign assets and macroeconomic volatility☆

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ABSTRACT

This study analyses the co-movements of net foreign asset accumulation, consumption, real exchange rate, and real interest rate in a cross section of countries. Our sample covers both industrial and developing economies, spanning 1981–2010 period. We find that the accumulation of net foreign assets is associated with increasing consumption and real exchange rate appreciation. In a cross section of countries, when a country increases its net foreign assets to GDP ratio by a one-standard deviation, consumption to GDP increases by 0.02% per year and real exchange rate appreciates by 2% per year. Consumption to GDP responds more positively to net foreign asset accumulation in G7 countries, +0.1 to +0.2% per year, while the response is smaller and negative in developing countries reporting a −0.02% per year. The real exchange rate appreciation, however, is about +3% per year in developing countries and only about +0.2% per year in OECD countries.

1. Introduction

Manifested by the concern over current account deficits in the U.S. as well as the issue of global imbalances in recent years, the accumulation of net foreign assets[1] (NFA) in developing countries, particularly in emerging Asia, has received much renewed attention from policymakers and academics. The debate over current account sustainability and global imbalances has further intensified when the world witnessed the so-called great moderation in macroeconomic adjustments with strong economic growth, low financial market volatility and more integrated global economy. Then, triggered by the subprime mortgage crisis in the U.S. during 2008–09, the global economy fell into the period of a sharp decline in growth and markedly higher financial volatility. While the global economy has recovered since 2010 and the financial volatility has

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[1] As a measure of a country's national wealth, net foreign asset is identified as the difference in the value of assets that a country owns abroad and the value of domestic assets owned by foreigners. The net foreign asset position at any given point in time can be measured by its initial position plus cumulative current account balances and cumulative net capital gains on cross-border positions in subsequent periods. See Lane and Milesi-Ferretti (2007) for a detailed discussion on the measures of net foreign assets.

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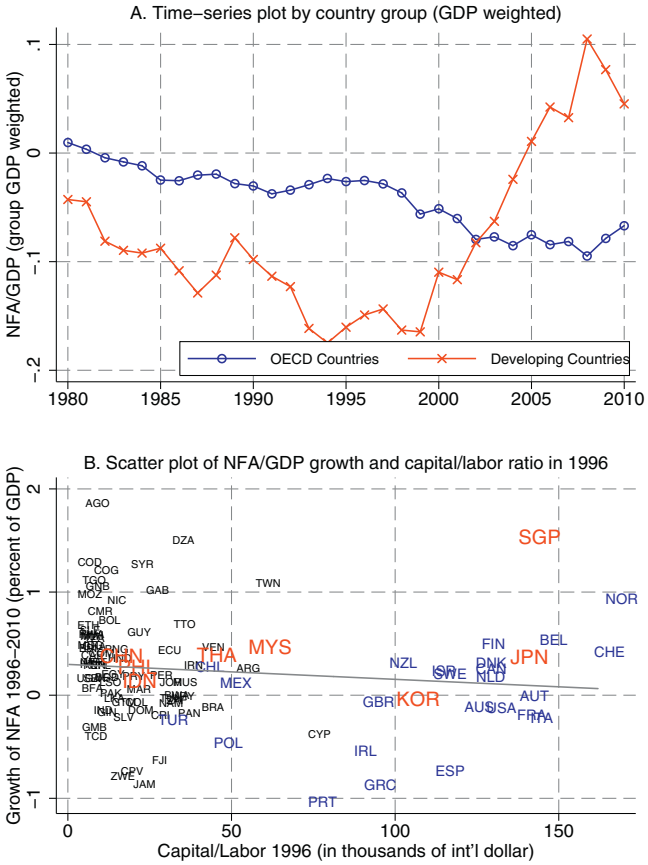

Fig. 1. Trend of net foreign assets/GDP over time, and its association with capital/labor ratios (in thousands of international dollar).
Source: WDI, IIP, WEO, EWN, and Authors' calculation.

fallen significant since the immediate post-crisis years, a significant amount of resources has been committed in solving the liquidity problem in the public and private sectors in some troubled countries, as well as to create appropriate policy tools as a preemptive measure. At present, there is still no consensus in the literature on how current account and asset accumulation actually contributed to the problem in the first place (see, for instance, Chinn, Eichengreen, & Ito, 2011). The question on how countries should manage their current accounts, stock of foreign exchange reserves and net foreign assets has therefore become an ever more challenging task to tackle in both the developed and emerging countries.

By and large, the recent discussions on net foreign assets are framed into the context of 'global imbalances,' 'sovereign wealth funds,' and 'global saving glut.'[2] Yet, against these important discussions is a state of current understanding on any macroeconomic implications of net foreign asset accumulation, which remains a challenge in both the theoretical and empirical literature. Past studies examined the role of net foreign asset accumulation, taking it either as given with respect to other macroeconomic variables [for cross-country empirical evidence, see Lane and Milesi-Ferretti (2002) and Lane and Milesi-Ferretti (2004)], or as an endogenous variable among several others [see for theoretical models and evidence of industrial countries in Masson, Kremers, and Horne (1994), Cavallo and Ghironi (2002), Ghironi, Iscan, and Rebucci (2008)]. Related strands of the literature focus on the accumulation of foreign exchange reserves [see Aizenman and Riera-Crichton (2008) and Rodrik (2006) on the determinants and consequences of holding reserves] and current account adjustment [see Faruqee and Lee (2008) and Debelle and Galati (2007) on the global distribution and relationship with trade and financial integration].

Fig. 1A compares the size of net foreign asset relative to GDP between OECD group and developing countries.[3] While there is a large cross-country variation in the size of net foreign assets to GDP ratio, one distinct pattern is the significant growth of net foreign assets to GDP ratio of the developing countries in recent years. For instance, China's net foreign assets to GDP ratio increased from −6.9% in 1999 to +24.3% in 2010, with most of the net foreign assets accumulated in the form of foreign exchange reserves and new portfolio investment abroad.[4] The rise of net foreign assets/GDP is clearly evident in the case of

[2] See for example Bernanke (2005) and Jen (2007).
[3] To take into account the country size, the net foreign assets/GDP series are weighted by each country's GDP in the group.
[4] As of 2006, the position is about 20 percent of GDP. See also Dollar and Kraay (2006) where it is argued that a long-run forecast of China's NFA position is around 3–9 percent of its total wealth.

developing countries from the late 1990s onwards, whereas the OECD countries have registered a gradual decline over the same period. From a theoretical point of view, the observed empirical pattern is quite surprising since the developing countries have relatively lower capital/labor ratio than the OECD countries, and thus the developing countries were supposed instead to be a net debtor as a group. Fig. 1B plots the capital/labor ratio (in thousands of 1996 international dollars) as of 1996[5] against the change in net foreign assets/GDP during 1996–2010. We can see that the relationship is rather weak or insignificantly negative, so unlike what the neoclassical growth theory would have predicted, low capital/labor ratio countries tend to accumulate net foreign assets at the same rate or even faster than the rest of the world.

Motivated by the significant accumulation of net foreign assets in the developing countries and the lack of evidence on the macroeconomic implications of net foreign asset accumulation in the literature, we aim to empirically examine the relationship between net foreign assets and some key macroeconomic variables using a large sample of OECD and developing countries. We then provide a battery of statistics and estimations, taking into account the theoretical predictions. Using data over three decades, the empirical analysis summarizes several macroeconomic relationships and studies how the size of net foreign asset affects consumption, real exchange rate, and real interest rate in a cross section of countries.

Because of the structural differences across countries, we conduct the analysis for the whole sample of countries and for country groups such as OECD, G7, developing countries, and East Asia covering ASEAN and ASEAN plus China, Japan, and South Korea or the commonly known ASEAN+3. The disaggregation of countries into OECD and developing countries accounts for potential influences of income level and development threshold in the data. In the literature, net foreign assets of G7 have been studied extensively, for example Ghironi et al. (2008), among others. Our paper adds Asia and less developed countries, highlighting not only its global importance, but also a presently growing economic cooperation worldwide. In relation to the net foreign asset accumulation, after the financial crisis in the late 1990s, several countries in Asia have established bilateral swap agreements.[6] Kohlscheen and Taylor (2008) note that this type of swap agreements tends to be associated with correlation of foreign exchange reserve accumulation, a significant part of net foreign assets in East Asia and developing countries. While our study is empirical in nature, we also take into account as much as possible all these relevant theories, policy and political economy considerations into the analysis.

To preview our estimation results, we find that in the long run there is a convergence in the distribution of net foreign assets to GDP ratio across countries. However, macroeconomic adjustments found in our study tend to vary across OECD, G7, developing countries, and East Asia. Based on the benchmark estimation, in the presence of positive global real economic shocks, if a country raises its accumulation of net foreign assets to GDP by one standard deviation, this may lead to a higher level of consumption to GDP ratio by 0.02% per year and an appreciation of real exchange rate by 2% per year in the whole sample of countries. The consumption to GDP response is most responsive in G7 (+0.1 to +0.2% per year), while the response is negative and rather small in the developing countries (−0.02% per year), consistent with higher private saving rates of developing countries, especially in Asia. We also find that the resultant real exchange rate appreciation tends to be larger in the developing countries (+3% per year) compared to the OECD countries (0.2% per year), suggesting that real exchange rates in the developing countries may not be overvalued in the long term given the trend in the net foreign asset accumulation observed during the sample period.

The remaining of the paper is organized as follows. Section 2 discusses the relationships between the net foreign assets and macroeconomic adjustments based on theoretical and empirical considerations to be used in the econometric analysis. Section 3 presents the estimation sample and reports macroeconomic responses to net foreign asset accumulation in the data. Section 4 discusses the implications of our findings and concludes.

2. Related studies on net foreign assets and possible macroeconomic implications

This section first summarizes the theoretical associations between the size of net foreign assets and some key macroeconomic variables followed by a description on our empirical approach. Note that our focus is not on questioning whether a large level of net foreign asset is a source of instability per se [see Henderson and Rogoff (1982)], but instead mainly on measuring the feedbacks between net foreign asset position and some macroeconomic adjustments across countries. To measure the size of net foreign assets, we use the most recent data based on Lane and Milesi-Ferretti (2007): net foreign asset position at time t is calculated from its initial position plus cumulative current account balance and cumulative net capital gain on country's cross-border positions.[7] Essentially, net foreign assets accumulated in each period differ from the current account balance by the size of capital gains or valuation change; a country's net foreign asset position is critically sensitive to asset price valuation and exchange rate movements. While it is beyond the scope of this paper to account for

[5] See Caselli and Feyrer (2007) for a detailed estimation of capital to labor ratio across countries.

[6] The agreement is the on-going effort to establish a self-managed reserve pool by multilateralizing the bilateral swaps under the Chiang Mai Initiative in 1999. The objective is to manage short-term liquidity among the country members in the event of financial crisis, particularly when resources of international organizations (i.e. IMF) are committed to other countries. For studies on the crises and management of international reserves, see for example Aizenman, Lee, and Rhee (2007) and Edwards (2009).

[7] Note that the initial positions are based on the estimates in Sinn (1990).

such sensitivity, the measurement issue has important implications. As suggested by Lane and Milesi-Ferretti (2009) and Curcuru, Dvorak, and Warnock (2008), the current account deficits of the U.S. may be overestimated by as much as 0.6% per year when different measurement of net financial inflows is used.[8]

Theoretically, the size of net foreign assets in macroeconomic adjustment process can either be exogenous or endogenous. For instance, Lane and Milesi-Ferretti (2002) take the size of net foreign assets as an exogenous variable and provide some evidence on how the size of net foreign assets influences trade balance and real exchange rate. According to Lane and Milesi-Ferretti (2002), positive steady state net external asset position in a country allows the country to run persistent trade deficits and hence exchange rate appreciation. Conversely, a country with negative net foreign assets has to run trade surpluses to service its external liabilities, thereby requiring its exchange rate to depreciate. If a country with negative net foreign assets has large economic growth and/or realized returns on its foreign assets that are higher than the payouts on its foreign liabilities, these favorable conditions could then translate into a smaller trade surplus required to stabilize its negative net foreign asset position.

Alternatively, Masson et al. (1994), Cavallo and Ghironi (2002), Ghironi et al. (2008), and Ghironi (2008) consider net foreign asset as an endogenous variable in the macroeconomic adjusting process. For example, Ghironi et al. (2008) examine how the consumption dynamics in the G7 countries is related to a country's size of net foreign assets, when net foreign assets are endogenously determined. In this account, global economic system comprises countries with different discount factors, giving rise to non-zero steady-state net foreign assets. As a result, there are gains from asset trade due to different discounting of future utility across countries. In response to positive global productivity shocks, the relatively patient country accumulates assets and its per capita consumption rises.

Our empirical approach nests together the macroeconomic variables based on the abovementioned studies. We provide a battery of statistics and regressions to study the adjustment of consumption, real exchange rate, and real interest rate, considering net foreign asset position as endogenously determined, and examine how these macroeconomic variables adjust in the presence of global economic shocks. In proceeding to the analysis, one issue is whether we should normalize net foreign asset position by aggregate output or GDP (as in Lane & Milesi-Ferretti, 2002), or by population (as in Ghironi et al., 2008). Because the current account sustainability is related in part to the economy size,[9] we normalize net foreign asset and consumption series by GDP. Our hypothesis is whether, in the presence of positive global economic shocks, a net foreign asset accumulation of relatively more patient country is associated with its consumption to GDP ratio, increasing more slowly with its real exchange rate appreciating more quickly.[10] Empirical tests are performed on 66 countries in which we have the data, as well as separately on several country groups, including OECD, G7, developing countries, ASEAN, among others.

3. Estimating macroeconomic adjustment to net foreign asset accumulation

3.1. Sample

Subject to data availability, we collect the information on relevant macroeconomic covariates. The collection of data covers 177 countries, spanning 1981–2010.[11] The data are at annual frequency based on various statistical sources: net foreign assets from the External Wealth of Nations database (Lane & Milesi-Ferretti, 2007) and International Investment Positions (IMF); consumption, real exchange rates, real interest rates, trade balance, fiscal balance, GDP, age dependency from World Development Indicators (World Bank); GDP growth and population growth from World Economic Outlook (IMF); global real economic activity shocks from Kilian (2009); and S&P500 implied volatility from Chicago Board Options Exchange.

[8] See also Gourinchas and Rey (2007) on the relationship between current accounts (flow) and the net foreign assets (stock), as well as Helbling, Batini, and Cardarelli (2008).

[9] Aizenman and Sun (2010) find that, with the exception of the US, the length of current account deficit spells is negatively related to the relative size of the countries' GDP.

[10] These considerations are also drawn from the literature on the current account sustainability, including for example Boileau and Normandin (2008) on real interest rate differentials, and Lee and Chinn (2006) on real exchange rates.

[11] Aruba, Afghanistan, Angola, Albania, United Arab Emirates, Argentina, Armenia, Antigua and Barbuda, Australia#, Austria#, Azerbaijan, Burundi, Belgium#, Benin, Burkina Faso, Bangladesh, Bulgaria, Bahrain, Bosnia and Herzegovina, Belarus, Belize, Bolivia, Brazil, Brunei Darussalam+, Bhutan, Botswana, Central African Republic, Canada#*, Switzerland#, Chile#, China+, Cote d'Ivoire, Cameroon, Congo, Dem. Rep., Congo, Rep., Colombia, Comoros, Cape Verde, Costa Rica, Cyprus, Czech Republic#, Germany#*, Djibouti, Dominica, Denmark#, Dominican Republic, Algeria, Ecuador, Egypt, Arab Rep., Eritrea, Spain#, Estonia#, Ethiopia, Finland#, Fiji, France#*, Gabon, United Kingdom#*, Georgia, Ghana, Guinea, Gambia, The, Guinea-Bissau, Greece#, Grenada, Guatemala, Guyana, Honduras, Croatia, Haiti, Hungary#, Indonesia+, India, Ireland#, Iran, Islamic Rep., Iraq, Israel#, Italy#*, Jamaica, Jordan, Japan#*+, Kazakhstan, Kenya, Kyrgyz Republic, Cambodia+, Kiribati, St. Kitts and Nevis, Korea, Rep.#+, Kosovo, Kuwait, Lao PDR+, Lebanon, Liberia, Libya, St. Lucia, Sri Lanka, Lesotho, Lithuania, Luxembourg#, Latvia, Macao SAR, China, Morocco, Moldova, Madagascar, Maldives, Mexico#, Macedonia, FYR, Mali, Malta, Myanmar+, Montenegro, Mongolia, Mozambique, Mauritania, Mauritius, Malawi, Malaysia+, Namibia, Niger, Nigeria, Nicaragua, Netherlands#, Norway#, Nepal, New Zealand#, Oman, Pakistan, Panama, Peru, Philippines+, Papua New Guinea, Poland#, Portugal#, Paraguay, Qatar, Romania, Russian Federation, Rwanda, Saudi Arabia, Sudan, Senegal, Singapore+, Solomon Islands, Sierra Leone, El Salvador, Serbia, Sao Tome and Principe, Suriname, Slovak Republic#, Slovenia#, Sweden#, Swaziland, Syrian Arab Republic, Chad, Togo, Thailand+, Tajikistan, Turkmenistan, Timor-Leste, Tonga, Trinidad and Tobago, Tunisia, Turkey#, Tanzania, Uganda, Ukraine, Uruguay, United States#*, Uzbekistan, St. Vincent and the Grenadines, Venezuela, RB, Vietnam+, Vanuatu, Samoa, Yemen, Rep., South Africa, Zimbabwe [# OECD countries; * G7 countries; + ASEAN plus 3 countries].

Table 1
Net foreign assets/GDP and macroeconomic variables.

Period	NFA/GDP	Consumption/GDP	Real exchange rate	Real interest rate
Whole sample				
1982–1989	−.028	.771	2.491	.053
1990–1999	−.051	.768	.985	.062
2000–2010	−.058	.763	.993	.036
OECD countries				
1982–1989	−.015	.800	1.048	.059
1990–1999	−.033	.788	1.014	.057
2000–2010	−.076	.799	1.002	.028
G7				
1982–1989	.015	.817	1.067	.061
1990–1999	−.007	.798	1.028	.057
2000–2010	−.031	.816	1.006	.030
G7 excluding USA				
1982–1989	.023	.780	.987	.055
1990–1999	.040	.767	1.068	.057
2000–2010	.103	.780	.998	.026
Developing countries				
1982–1989	−.091	.629	10.509	.023
1990–1999	−.145	.666	.830	.081
2000–2010	−.008	.642	.939	.068
ASEAN+3 countries				
1982–1989	.006	.728	.996	.045
1990–1999	.082	.698	1.118	.040
2000–2010	.239	.669	1.044	.028
ASEAN				
1982–1989	−.318	.645	.529	.050
1990–1999	−.280	.636	1.036	.072
2000–2010	.017	.664	1.021	.036
China, Japan, S. Korea				
1982–1989	.042	.736	1.046	.045
1990–1999	.118	.704	1.125	.037
2000–2010	.265	.669	1.045	.027

Source: WDI, IIP, WEO, EWN, and Authors' calculation.
This table reports net foreign assets (NFA) and consumption (relative to GDP), and the level of real exchange rate and real interest rate. All variables for each country group are GDP-weighted.

Table 1 reports for each time period the group averages (GDP weighted) of the macroeconomic variables. After constructing lags for the variables of interests (net foreign asset to GDP ratio, consumption to GDP ratio, real exchange rate, and real interest rate), we keep countries with at least 10 annual observations. 66 countries pass this filtering for the empirical analysis. The marked trend is the decline of net foreign assets to GDP of the OECD and G7 countries, while the trend is increasing for the developing countries as discussed earlier in Fig. 1, driven mainly by China, Japan, and South Korea. When the US is excluded from the G7 group, the trend of the net foreign assets to GDP ratio is increasing over this period. For the ASEAN countries, while the net foreign assets to GDP ratio stays negative for a large span of the sample period, this ratio has turned positive in the 2000s. Real exchange rate appreciation is also observed in Asia driven by high GDP weights of the plus-three countries in this grouping. Real interest rates have in general declined in the 2000s, reflecting the great moderation in the first half of the decade.[12] The patterns of these macroeconomic variables suggest that each country group experiences a unique adjustment of its own, influenced by structural differences, economy size, level of income and development threshold. As a result, we attempt to account for these structural differences using various estimation techniques and alternative specifications, and present the estimation results by different country groupings.

Table 2A reports the correlations of the variables in our sample. These correlations are based on de-trended macroeconomic series. Note that given the data are at annual frequency in an unbalanced panel, we proceed with a simple linear de-trending. The correlations are first calculated for each country pair in the corresponding regional group, and then

[12] We have also examined the mean of these variables for fixed and flexible exchange rate countries. Consumption/GDP ratio tends to be more volatile under the fixed exchange rate regimes, whereas the opposite applies to net foreign assets to GDP ratio and real interest rates. However, the preliminary statistics suggest no distinct pattern on the macro dynamics between the two groups. Nonetheless, while beyond the scope of this study, the effects of exchange rate regimes, and possibly inflation targeting on the accumulation of net foreign assets warrant further analysis. See also Chinn and Wei (2008) for a case of current account adjustments. The challenge, however, is to categorize countries according to their exchange rate flexibility across time periods.

Table 2A
Sample correlations.

Variables	NFA/GDP	Consumption/GDP	Real exchange rate
Consumption/GDP	0.1783*		
Real exchange rate	0.2218*	0.0689*	
Real interest rate	−0.0593	0.0464	−0.2251*

Source: WDI, IIP, WEO, EWN, and Authors' calculation.
This table reports sample correlations.
* Statistical significance at 5 percent level.

Table 2B
Cross correlations.

Region	Variable			
	NFA/GDP	Consumption/GDP	Real exchange rate	Real interest rate
OECD	.002	.137	.066	.143
G7	−.075	.162	−.113	.094
Developing	.054	.021	.107	.092
ASEAN + 3	.260	.105	.222	.121
ASEAN	.221	.079	.607	.254
China, Japan, S. Korea	.358	.174	−.354	−.131

Source: WDI, IIP, WEO, EWN, and Authors' calculation.
This table provides a cross-correlation of macroeconomic variables for each country group.

averaged. As discussed in Section 2, consumption to GDP ratio, real exchange rate, and real interest rate are all potentially associated with net foreign assets to GDP ratio. To empirically examine whether these correlations are the product of regional economic interdependence such as a 'de-coupling' debate in Kose, Otrok, and Prasad (2008), Table 2B provides the cross-correlation of these variables for each country group. As shown, the cross-correlation of net foreign assets to GDP ratio is higher and positive in ASEAN+3, particularly among China, Japan, and South Korea, than we can observe in other country groups. After the 1997 Asian financial crisis, Asian countries have established various bilateral swap agreements, which may help explain this pattern. Kohlscheen and Taylor (2008) provide some evidence that these swap agreements take into account the correlation of foreign reserve level among the participating members. We also note that the cross-correlations of consumption are small for all the country groups, seemingly consistent with the notion of international consumption correlation puzzle [see Backus, Kehoe, & Kydland, 1992]. Higher correlations of real interest rates among the OECD countries and among the ASEAN countries may reflect a tighter financial integration between countries in these regional groupings.

3.2. Empirical specification

Our empirical analysis proceeds first with a baseline adjustment of net foreign assets to GDP ratio, consumption to GDP ratio, real exchange rate, and real interest rate, all considered as endogenously determined in a system over the sample period. We then introduce real and financial shocks at a global level, in order to measure the influence that net foreign assets to GDP has on other macroeconomic variables in the presence of these global shocks. Essentially, we want to understand whether macroeconomic responses in the presence of global economic shocks are dependent on the level of net foreign assets to GDP ratio in the data. We consider two global economic shocks: a real shock and a financial shock. For the real shock, we use the global real economic activity shock of Kilian (2009); this index is a measure of worldwide real economic activity in global industrial commodity markets. For the financial shock, we use S&P500 implied volatility index, compiled by the Chicago Board of Exchange (CBOE)[13]; this index measures the expectation of volatility in the financial markets over the next 30-day period.

As shown in Fig. 2A, negative global real shocks can be observed throughout the 1980s and the 1990s, whereas the 2000s witnessed positive shocks that began from 2002 onwards. For the financial shocks, we can see in Fig. 2B that the late 1980s, late 1990s, and late 2000s were dominated by high global volatility. In the data, we find that these global shocks are contemporaneously and negatively correlated for most of the periods.[14]

To purge out cyclical variation in macroeconomic variables, we de-trend the macro series in our sample. In order to verify that all variables in our estimation have the same order of integration, we apply panel unit root test of Maddala and Wu (1999) to net foreign assets to GDP ratio, consumption to GDP ratio, real exchange rate, and real interest rate series, and apply

[13] Instead of VIX, which is frequently followed in the media, we use a related VXO index, which has a longer time span for our empirical analysis.
[14] Similar finding is found at the monthly frequency.

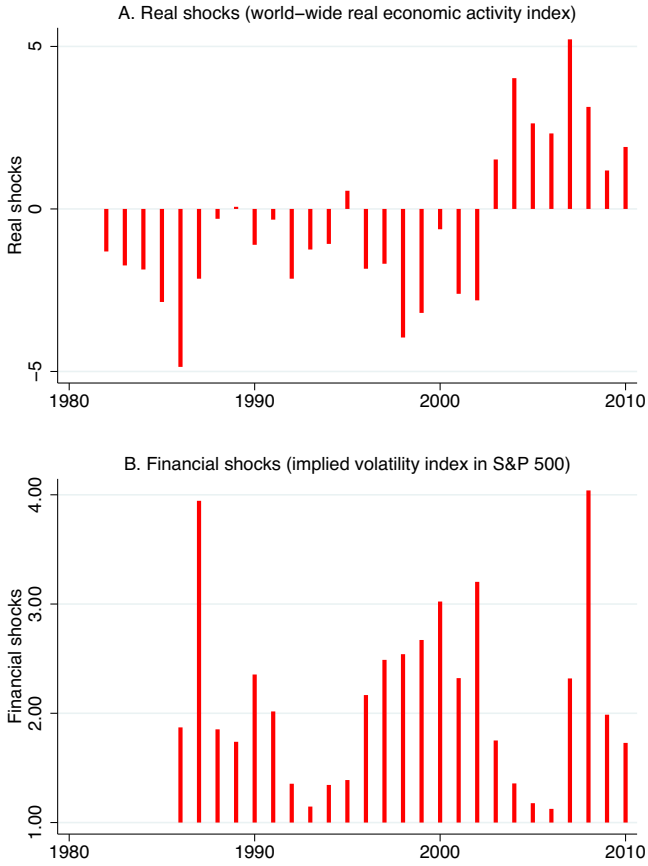

Fig. 2. Global real and financial shocks. The real shocks are measured by the world-wide real economic activity index (Kilian, 2009). The financial shocks are measured by the implied volatility index in S&P 500.
Source: WDI, IIP, WEO, EWN, and Authors' calculation.

Phillips-Perron test to the global real and financial shocks series.[15] Table 3 reports the p-values of the tests under the null of unit root. As shown, the global real and financial shock series appear to be non-stationary at 5% level, so we use the first-difference of these two variables (which are stationary, as reported in the second column of Table 3) in our formal estimation.

Let B_t denote net foreign asset to GDP ratio at time t, C_t consumption to GDP ratio, Q_t real exchange rate, R_t real interest rate, and Z_t global shock. We consider the following multivariate regression:

$$Y_t^i = Y_{t-1}^{i'}\beta_B^i + \Phi_j^i + \varepsilon_{j,t}^i \tag{1}$$

where $Y_t^i = \{B_t, C_t, Q_t, R_t\}$ and Φ_j^i is a set of country fixed effects. This estimation is closely related to a vector autoregression (VAR), being applied in a panel. The multivariate system regresses each of the dependent variables on the same set of lagged regressors and imposes a constraint that their coefficient estimates do not differ across panels. This way, our specification considers all the variables as endogenously determined and allows not only persistence in the macro time-series, but also cross-country difference in the data.

3.3. Estimation results

Panel A of Table 4 reports our baseline estimation for the whole sample of countries. We find that net foreign assets to GDP has a positive association with its own lag, suggesting the persistence of the series; similar persistency can also be found in all the other three variables. As shown in the table, lagged net foreign assets to GDP is positively associated with real exchange rate appreciation. As a macroeconomic adjustment in countries with positive net foreign assets (net creditor) may differ from countries with negative net foreign assets (net debtor), panels A and B of Fig. 3 probes into this difference by

[15] We use Maddala–Wu test since it does not require a balanced panel data as the Im, Pesaran, and Shin (2003) and Levin, Lin, and James Chu (2002) tests. Based on the p-values of individual unit root tests, this test assumes that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary.

Table 3
Non-stationarity of macroeconomic variables.

Variables	Level	Difference
Maddala–Wu panel unit-root test (*p*-values)		
Net foreign assets/GDP	.0028	.0000
Consumption/GDP	.0001	.0000
Real exchange rate	.0004	.0000
Real interest rate	.0000	.0000
Phillips-Perron unit-root test (*p*-values)		
Global real shocks	.2093	.0000
Global financial shocks	.0390	.0000

Source: WDI, IIP, WEO, EWN, and Authors' calculation.
This table reports *p*-values from unit-root tests based on the Maddala–Wu (1999)'s procedure (under the null that all panels are nonstationary) and the Phillips-Perron (1988)'s procedure (under the null that the series is nonstationary).

Table 4
Baseline macroeconomic adjustment in a sample of 66 countries.

(A) Whole sample

Endogenous variables in a multivariable system	NFA/GDP_t			$Consumption/GDP_t$			Real exchange $rate_t$			Real interest $rate_t$		
	est.	s.e.	sig.	est.	s.e.	sig.	est.	s.e.	sig.	est.	s.e.	sig.
NFA/GDP_{t-1}	.796	.019	***	.001	.005		.116	.025	***	.014	.014	
$Consumption/GDP_{t-1}$	.288	.068	***	.769	.018	***	−.023	.089		.082	.051	
Real exchange $rate_{t-1}$	−.071	.018	***	.003	.005		.537	.024	***	−.069	.014	***
Real interest $rate_{t-1}$	−.091	.035	***	−.020	.009	**	−.168	.045	***	.359	.026	***
R-squared	.603			.601			.359			.185		

(B) Comparing net creditors ($NFA > 0$) and net debtors ($NFA < 0$)

Endogenous variables		NFA/GDP_t			$Consumption/GDP_t$			Real exchange $rate_t$			Real interest $rate_t$		
		est.	s.e.	sig.	est.	s.e.	sig.	est.	s.e.	sig.	est.	s.e.	sig.
$NFA_{t-1} > 0$	NFA/GDP_{t-1}	.846	.035	***	.009	.009		.144	.042	***	.012	.024	
	$Consumption/GDP_{t-1}$	.140	.105		.823	.028	***	−.066	.127		.051	.070	
	Real exchange $rate_{t-1}$	−.032	.025		.009	.007		.412	.030	***	−.020	.017	
	Real interest $rate_{t-1}$	−.065	.056		−.007	.015		−.383	.068	***	.682	.038	***
$NFA_{t-1} < 0$	NFA/GDP_{t-1}	.799	.031	***	.027	.008	***	.070	.038	*	.006	.021	
	$Consumption/GDP_{t-1}$	.310	.117	***	.710	.031	***	−.026	.142		.105	.078	
	Real exchange $rate_{t-1}$	−.144	.038	***	−.001	.010		.779	.046	***	−.050	.026	*
	Real interest $rate_{t-1}$	−.062	.053		−.026	.014	*	−.079	.064		.067	.035	*
	R-squared	.560			.552			.378			.264		

Source: WDI, IIP, WEO, EWN, and Authors' calculation.
This table reports estimation results from a multivariate system where all four macroeconomic variables are endogenously determined. The sample period is 1980–2010, covering 1366 country-year observations.
* Statistical significance at 10 percent level.
** Statistical significance at 5 percent level.
*** Statistical significance at 1 percent level.

plotting empirical distribution of net foreign assets to GDP for the 5-year average from 2006 to 2010. While negative net foreign asset positions may not constitute an independent source of macroeconomic instability [Henderson & Rogoff, 1982], a few countries with very large negative or positive positions should be considered outliers. To verify these potential extreme observations, panel C of Fig. 3 also plots the kernel density estimates of the cross-sectional distribution for each time period. We can see a medium-run decline in the dispersion net foreign assets to GDP from the 1980s to early 2000s. The kernel density is similar to that of a normal distribution, and majority of the sample observations are within the [−50%, +50%] boundary.[16] These figures provide supportive evidence that our sample of net foreign assets to GDP is representative in terms of the net foreign asset position across countries over the study period.

Next, our estimation takes into account a difference between positive versus negative net foreign assets to GDP across countries. Panel B of Table 4 reports coefficient estimates using net foreign assets to GDP of 0 as a cutoff. Focusing on the effects of the lagged net foreign assets to GDP on the other three variables, the difference of coefficient estimates between net creditors and net debtors shows up significantly in the case of consumption to GDP ratio and real exchange rate appreciation.

[16] Five percent of the sample observations have NFA/GDP (de-trended) below −50%. The kernel is that of Epanechnikov.

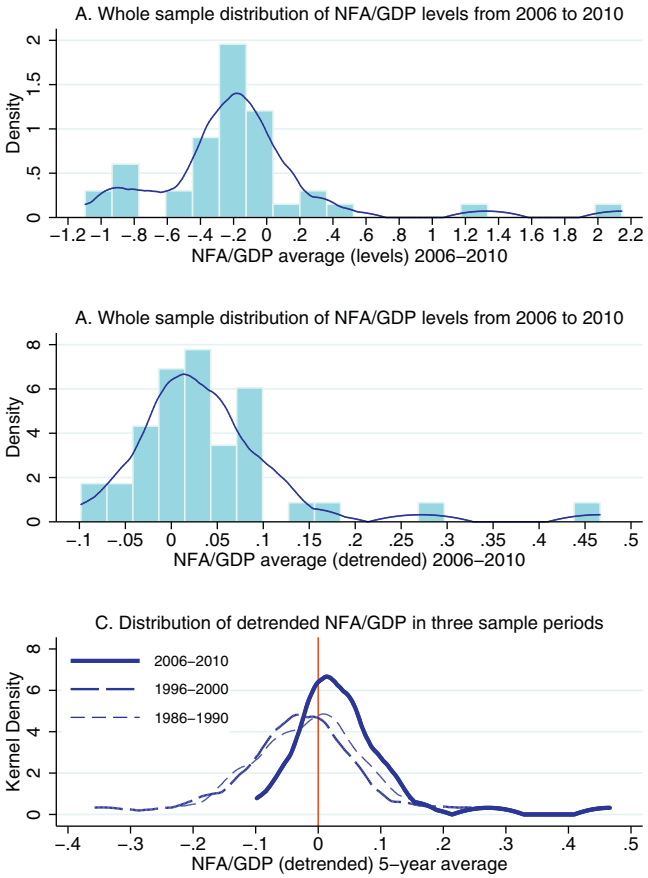

Fig. 3. Cross-country distribution of net foreign assets/GDP.
Source: WDI, IIP, WEO, EWN, and Authors' calculation.

For both net creditors and net debtors, an increase in net foreign assets to GDP ratio is positively associated with real exchange rate appreciation. Interestingly, the increase of net foreign assets to GDP raises consumption to GDP only for net debtors, the finding which is consistent with a notion that creditor country tends to be more patient in terms of consumption than the debtor country.

We now introduce the global economic shocks into our system of estimation. This allows us to examine how the macroeconomic adjustments in the presence of the global shocks are dependent on the position of net foreign assets to GDP. Table 5 reports our main results, tabulating coefficient estimates of lagged net foreign assets to GDP for the entire sample and across country groups. Using the global real shocks in our estimation, we find that the accumulation of net foreign assets to GDP is positively associated with consumption to GDP for OECD, G7 excluding the U.S., China, Japan, South Korea group, and net debtor countries. For the real exchange rate appreciation, its positive association with net foreign assets to GDP accumulation is found for the whole sample, developing countries, and non-extreme observations.

Although we find that macroeconomic variables in OECD, G7, developing countries and ASEAN display different dynamics in the presence of global shocks, some patterns have also emerged from the data. By and large, the accumulation of net foreign assets is associated with lower consumption and appreciation of real exchange rate in the countries studied. For the real interest rate, we do not detect any significant association with the net foreign assets to GDP.[17] In terms of inter-temporal adjustment, a country with a large level of negative net foreign asset position relative to its GDP (debtor country) must eventually service its liabilities by running trade surpluses, which requires real exchange rate depreciation; this adjustment process may take place through a depreciation of nominal exchange rate and/or a lower domestic price level relative to foreign prices. On the other hand, a creditor country may run trade deficits, which results in real exchange rate appreciation. Qualitatively, the empirical evidence seems to be consistent with the theoretical explanation.

To gauge the economic significance of our coefficient estimates, we calculate the extent to which consumption and real exchange rate are influenced by net foreign assets to GDP. We look at the effect of a one-standard deviation increase in net

[17] This finding on real interest rate is also in line with Ghironi et al. (2008) where in the model of US and other G7 countries the response of real interest rate is not statistically different from zero.

Table 5
Effects of net foreign assets/GDP in the presence of global economic shocks.

Variable	Consumption/GDP			Real exchange rate			Real interest rate		
Region	est.	s.e.	sig.	est.	s.e.	sig.	est.	s.e.	sig.
(A) Real shocks									
Whole sample	.001	.005		.116	.025	***	.012	.014	
OECD	.010	.005	**	.016	.020		.023	.010	**
G7	.019	.012		.065	.080		−.015	.017	
G7 excluding US	.025	.013	*	.045	.082		−.021	.018	
Developing countries	−.001	.007		.152	.036	***	.012	.021	
ASEAN + 3	−.002	.007		.014	.051		−.027	.021	
ASEAN	.001	.008		.025	.048		−.020	.028	
China, Japan, Korea	.043	.021	**	.310	.248		−.057	.048	
NFA = [−.5, .5]	.019	.005	***	.117	.026	***	.014	.015	
NFA > 0	.009	.009		.077	.061		.009	.024	
NFA < 0	.020	.008	***	.015	.023		.010	.025	
(B) Financial shocks									
Whole sample	−.003	.005		.055	.016	***	.008	.015	
OECD	.010	.005	**	.000	.020		.017	.011	
G7	.023	.014	*	.041	.083		−.012	.019	
G7 excluding US	.028	.015	*	.045	.089		−.019	.019	
Developing countries	−.005	.007		.069	.022	***	.012	.022	
ASEAN+3	−.003	.007		−.006	.049		−.020	.021	
ASEAN	−.002	.008		.001	.048		−.004	.026	
China, Japan, Korea	.038	.023	*	.089	.239		−.035	.051	
NFA = [−.5, .5]	.018	.005	***	.059	.017	***	.010	.015	
NFA > 0	.013	.009		.067	.034	**	−.012	.023	
NFA < 0	.019	.007	**	.019	.022		.011	.027	

Source: WDI, IIP, WEO, EWN, and Authors' calculation.
The estimation is multivariate regression, including country fixed effects and time trend (coefficient estimates not reported).
* Statistical significance at 10 percent level.
** Statistical significance at 5 percent level.
*** Statistical significance at 1 percent level.

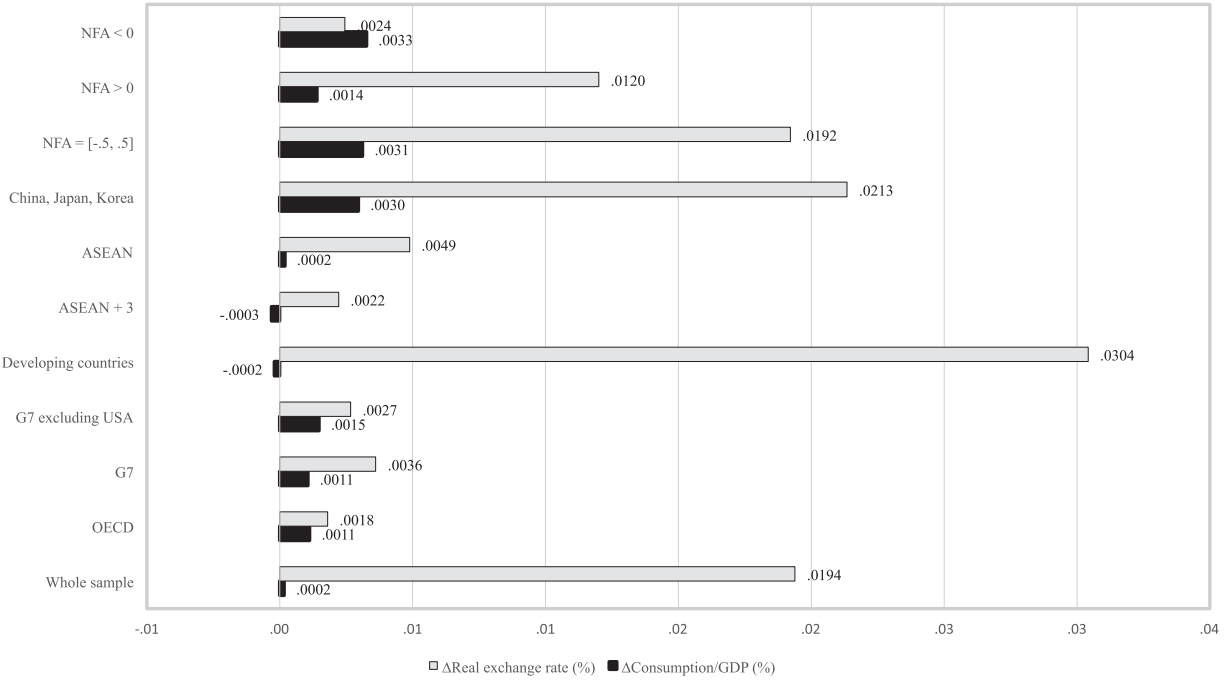

Fig. 4. Economic significance of net foreign assets on macroeconomic variables. This figure plots empirical response of consumption/GDP and real exchange rate to one standard deviation increase of net foreign assets/GDP.
Source: WDI, IIP, WEO, EWN, and Authors' calculation.

foreign assets to GDP on these two variables and report our calculation in Fig. 4. Based on the coefficient estimates in Table 5, the economic significance of net foreign assets to GDP accumulation is calculated by multiplying its coefficient estimate on real exchange rate and consumption by its one standard deviation. We repeat this calculation for each country groups accordingly. For instance, the whole sample's coefficient estimate of net foreign assets to GDP on real exchange rate is 0.116; one standard deviation of net foreign assets to GDP is 0.167, or 16.7 percent of GDP; therefore the economic significance of one-standard deviation increase of net foreign assets to GDP on real exchange rate is $0.116 \times 0.167 = 0.019$, or about 2 percent annually. We can see that the economic significance of net foreign asset accumulation on real exchange rate is strongest on the developing countries, and a group of large countries in Asia (China, Japan, South Korea). The economic significance of net foreign assets to GDP on consumption to GDP is largest in G7 and the OECD countries, but much smaller in other country groups.

A distinct pattern in our findings is that the net foreign assets to GDP effect on the real exchange rate appreciation is the most economically significant in countries with positive net foreign asset position. We find that the accumulation of net foreign assets to GDP by a further one-standard deviation is associated with 1.2 percent annual real appreciation for the creditor country, whereas it is only 0.2 percent for the debtor country. The economic significance of net foreign assets to GDP on consumption to GDP portrays a rather different picture: increasing net foreign assets to GDP by one standard deviation raises consumption to GDP by 0.3 percent annually for the debtor country, but only 0.14 percent for the creditor country. Since our estimation is done on an annual basis, adding up these effects of net foreign assets to GDP over a decade implies a non-negligible macroeconomic adjustment that is both quantitatively and economically significant across countries.

4. Concluding remarks

This study analyses the relationship between net foreign asset accumulation and the adjustment of consumption, real exchange rate, and real interest rate. Our sample focuses on OECD, G7, developing countries, and East Asia, over the 1980–2010 periods. On average, we find that the accumulation of net foreign assets to GDP is associated with lower consumption to GDP and larger real appreciation. Based on our baseline estimation, in the presence of positive global real economic shocks, if a country raises its accumulation of net foreign assets to GDP by a one-standard deviation, this is associated with a higher level of consumption to GDP by 0.02% per year and an appreciation of real exchange rate by 2% per year in the whole sample of countries. Consumption to GDP responds more positively in G7 (+0.1 to +0.2% per year), while the response is negative and rather small in developing countries (−0.02% per year). The adjustment of real exchange rate appreciation tends to be large in developing countries (+3% per year) but relatively smaller in OECD (0.2% per year).

Possible extension may delve further into the accumulation of net foreign assets by types of the financial assets, e.g. portfolio investment and others, considering also a contemporaneous correlation between domestic financial markets and the global capital markets.[18] It would also be useful to also look into the role of economic size, the informal sector, population composition (total and working age), private and public net foreign assets (i.e. sovereign wealth funds), as well as the role of flexible and fixed exchange rate regimes (i.e. the Euro area, dollarization) on the correlation between macroeconomic adjustment and the accumulation of net foreign assets across countries.

References

Aizenman, J., Lee, Y., & Rhee, Y. (2007). International reserves management and capital mobility in a volatile world: Policy considerations and a case study of Korea. *Journal of the Japanese and International Economies, 21*(1), 1–15.

Aizenman, J., & Sun, Y. (2010). Globalization and the sustainability of large current account imbalances: Size matters. *Journal of Macroeconomics, 32*(1), 35–44.

Aizenman, J., & Riera-Crichton, D. (2008). Real exchange rate and international reserves in an era of growing financial and trade integration. *Review of Economics and Statistics, 90*(4), 812–815.

Backus, D. K., Kehoe, P. J., & Kydland, F. E. (1992). International real business cycles. *The Journal of Political Economy, 100*(4), 745–775.

Bernanke, B. (March 10, 2005). *"The global saving glut and the U.S. current account". Remarks at the Sandridge Lecture*. Richmond, VA: Virginia Association of Economics.

Boileau, M., & Normandin, M. (2008). Dynamics of the current account and interest differentials. *Journal of International Economics, 74*(1), 35–52.

Caselli, F., & Feyrer, J. (2007). The marginal product of capital. *Quarterly Journal of Economics, 122*(2), 535–568.

Cavallo, M., & Ghironi, F. (2002). Net foreign assets and the exchange rate: Redux revived. *Journal of Monetary Economics, 49*(5), 1057–1097.

Chinn, M. D., Eichengreen, B., & Ito, H. (October, 2011). *A forensic analysis of global imbalances*. NBER Working Paper No. 17513..

Chinn, M. D., & Wei, S.-J. (2008). *A faith-based initiative: Does a flexible exchange rate regime really facilitate current account adjustment*? NBER Working Paper No. 14420..

Curcuru, S. E., Dvorak, T., & Warnock, F. E. (2008). Cross-border returns differentials. *Quarterly Journal of Economics, 123*(4), 1495–1530.

Debelle, G., & Galati, G. (2007). Current account adjustment and capital flows. *Review of International Economics, 15*(5), 989–1013.

Dollar, D., & Kraay, A. (2006). Neither a borrower nor a lender: Does China's zero net foreign asset position make economic sense? *Journal of Monetary Economics, 53*(5), 943–971.

Edwards, S. (2009). Sequencing of reforms, financial globalization, and macroeconomic vulnerability. *Journal of the Japanese and International Economies, 23*(2), 131–148.

Faruqee, H., & Lee, J. (2008). *Global dispersion of current accounts: Is the universe expanding*? IMF..

Ghironi, F. (2008). The role of net foreign assets in a New Keynesian small open economy model. *Journal of Economic Dynamics and Control, 32*(6), 1780–1811.

Ghironi, F., Iscan, T. B., & Rebucci, A. (2008). Net foreign asset positions and consumption dynamics in the international economy. *Journal of International Money and Finance, 27*(8), 1337–1359.

[18] The challenge has to do with different types of net foreign assets are subject to measurement errors to a varying degree. See Lane and Milesi-Ferretti (2009).

Gourinchas, P.-O., & Rey, H. (2007). International financial adjustment. *Journal of Political Economy, 115*(4), 665–703.
Helbling, T., Batini, N., & Cardarelli, R. (2008). Globalization and external imbalances. In *World Economic Outlook*. Washington, D.C. International Monetary Fund.
Henderson, D. W., & Rogoff, K. (1982). Negative net foreign asset positions and stability in a world portfolio balance model. *Journal of International Economics, 13*(1–2), 85–104.
Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics, 115*(1), 53–74.
Jen, S. (May, 2007). *How big could sovereign wealth funds be by 2015*? Morgan Stanley Global Research..
Kilian, L. (2009). Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. *American Economic Review, 99*(3), 1053–1069.
Kohlscheen, E., & Taylor, M. P. (2008). International liquidity swaps: Is the Chiang Mai Initiative pooling reserves efficiently? *International Journal of Finance & Economics, 13*(4), 323–332.
Kose, M. A., Otrok, C., & Prasad, E. S. (2008). *Global business cycles: Convergence or decoupling*? NBER Working Paper No. 14292..
Lane, P. R., & Milesi-Ferretti, G. M. (2002). External wealth, the trade balance, and the real exchange rate. *European Economic Review, 46*(6), 1049–1071.
Lane, P. R., & Milesi-Ferretti, G. M. (2004). The transfer problem revisited: Net foreign assets and real exchange rates. *Review of Economics and Statistics, 86*(4), 841–857.
Lane, P. R., & Milesi-Ferretti, G. M. (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., & Milesi-Ferretti, G. M. (2009). Where did all the borrowing go? A forensic analysis of the U.S. external position. *Journal of the Japanese and International Economies, 23*(2), 177–199.
Lee, J., & Chinn, M. D. (2006). Current account and real exchange rate dynamics in the G7 countries. *Journal of International Money and Finance, 25*(2), 257–274.
Levin, A., Lin, C.-F., & James Chu, C.-S. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics, 108*(1), 1–24.
Maddala, G. S., & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics, 61*(S1), 631–652.
Masson, P. R., Kremers, J., & Horne, J. (1994). Net foreign assets and international adjustment: The United States, Japan and Germany. *Journal of International Money and Finance, 13*(1), 27–40.
Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika, 75*, 335–346.
Rodrik, D. (2006). The social cost of foreign exchange reserves. *International Economic Journal, 20*(3), 253–266.
Sinn, S. (1990). *Net external asset positions of 145 countries*. Tubingen: Kieler Studien Institut fur Weltwirtschaft an der Universitat Kiel/JCB Mohr.