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Preface

An emphasis on exchange rate surveillance—a topic that has always been at the core of the IMF's mandate—received renewed impetus in the IMF's Medium-Term Strategy (MTS),[1] that called inter alia for stronger emphasis on multilateral surveillance, macro-financial linkages, and the implications of globalization, reflecting the stronger economic ties among member countries brought about by the rapid increase in international trade and financial integration. The exchange rate analysis conducted by the IMF's Consultative Group on Exchange Rate Issues (CGER)—which was formed in the mid-1990s with a mandate to provide exchange rate assessments for a number of advanced economies from a multilateral perspective—has accordingly been expanded to cover both key advanced economies and major emerging market economies. This paper summarizes the methodologies that underpin this expanded analysis.

This paper was prepared under the direction of Jonathan D. Ostry (Deputy Director, Research Department). Its main authors are Jaewoo Lee, Gian Maria Milesi-Ferretti, and Luca Antonio Ricci, with substantial contributions from Jonathan Ostry and Alessandro Prati.

Background research on expanding the CGER methodology to include emerging market countries was led by Gian Maria Milesi-Ferretti (Chief of the Exchange Rate Issues Division in the Research Department). Tamim Bayoumi played an instrumental role in the early phase of the research, and Sarma Jayanthi has been the critical lynchpin in data management and quantitative analysis.

The authors would also like to acknowledge the significant contributions made by José Antonio Rodriguez-Lopez to the implementation of the external sustainability methodology, and by Marco Arena, Giang Do, and Jungjin Lee who provided excellent research assistance. Carlo Cottarelli and Ketil Hviding of the Policy Development and Review Department, as well as numerous other colleagues on the IMF staff, provided comments and suggestions. The authors are grateful to Katia Berruetta and Laura Leon for administrative support, and to Marina Primorac of the External Relations Department for editing and coordinating production of the publication.

The paper has also benefited from the discussion at an IMF Executive Board seminar in September 2006. The opinions expressed in the paper are those of the authors and do not necessarily reflect the views of the IMF or its Executive Directors.

[1]www.imf.org/external/np/omd/2005/eng/091505.pdf.

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List of Abbreviations

CA	current account balance
CGER	Consultative Group on Exchange Rate Issues
ERER	reduced-form equilibrium real exchange rate
ES	external sustainability
DOLS	dynamic ordinary least squares
IFS	International Financial Statistics
MB	macroeconomic balance
MTS	Medium-Term Strategy
MUV	manufacturing unit value index
NFA	net foreign assets (net international investment position)
UN	United Nations
WDI	World Development Indicators
WEO	World Economic Outlook

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I Overview

Exchange rate surveillance has always been at the core of the IMF's responsibilities. Throughout its existence, the Fund has striven to strengthen its framework for assessing exchange rates, adapting it to underlying macroeconomic and financial developments in member countries. As part of this mandate, since the mid-1990s the IMF Consultative Group on Exchange Rate Issues (CGER) has provided exchange rate assessments for a number of advanced economies from a multilateral perspective, with the aim of informing the country-specific analysis of the IMF's Article IV staff reports and fostering multilateral consistency. These assessments are additional tools at the disposal of the IMF staff country desks, which are responsible for formulating exchange rate assessments as part of the Fund's bilateral surveillance, another of the IMF's core responsibilities.

The role of exchange rates in the external adjustment process is increasing as the world economy rapidly becomes more integrated. During the past 15 years, world trade and international financial integration have grown very rapidly, with the ratio of world trade to world GDP increasing by over 40 percent and the ratio of international financial cross-holdings to world GDP more than doubling. Emerging market countries have contributed significantly to these developments, as witnessed by the increase in their share of world trade—from 27 percent in 1990 to 40 percent in 2006—as well as by their importance in international capital flows.

Accordingly, this paper presents revised and extended methodologies for exchange rate assessments covering not only advanced countries—as in the past—but also emerging market countries. The three complementary methodologies are a "macroeconomic balance" approach, a reduced-form "equilibrium real exchange rate" approach, and an "external sustainability" approach. They are discussed briefly in the remainder of this section, and presented in more detail in Sections II, III, and IV below. The focus of this paper is on methodological issues that could underpin exchange rate assessments rather than on the assessments themselves. Exchange rate assessments are ideally based on the notion of equilibrium, that is, consistency with external and internal balance over the medium to long run. In practice, most empirical studies relate the real exchange rate or trade flows to their observed determinants on the basis of reduced-form relationships.

The macroeconomic balance (MB) approach—a pillar of current account and exchange rate assessments for a number of years[1]—calculates the difference between the current account balance projected over the medium term at prevailing exchange rates and an estimated *equilibrium* current account balance, or "CA norm." The exchange rate adjustment that would eliminate this difference over the medium term—a horizon over which domestic and partner-country output gaps are closed and the lagged effects of past exchange rate changes are fully realized—is then obtained using country-specific estimated responses of the trade balance to the real exchange rate.

The reduced-form equilibrium real exchange rate (ERER) approach directly estimates an *equilibrium* real exchange rate for each country as a function of medium-term fundamentals such as the net foreign asset (NFA) position of the country, the relative productivity differential between the tradable and nontradable sectors, and the terms of trade.[2] The exchange rate adjustment needed to restore equilibrium over the medium term is, then, simply calculated as the difference between the estimated equilibrium real exchange rate and its current value.

The external sustainability (ES) approach calculates the difference between the actual current account balance and the balance that would stabilize the NFA position of the country at some benchmark level. On the basis of the aforementioned trade elasticities, this difference is translated into the real exchange rate adjustment that—over the medium term—would bring the current account balance in line with its NFA-stabilizing level, under a particular assumption about the economy's medium-term growth rate.

[1]See Isard and Faruqee (1998) and Isard, Kincaid, and Fetherston (2001). The broader country coverage being implemented here requires a greater variety of fundamentals to "explain" the current account than when the exercise covered only advanced countries.

[2]The fundamentals are expected to play a role over the medium term even though exchange rates are essentially unpredictable in the near term (Meese and Rogoff, 1983). Hence, short-term effects of capital flows would eventually disappear, while their medium-term effect should be captured by the underlying fundamentals.

These three methodologies provide complementary perspectives on exchange rate assessments. Taken together, and combined with additional country-specific information, they can help researchers reach informed judgments about medium-term real exchange rates and current account balances, weighing the relative importance of a number of economic factors affecting these key variables. Although assessments indicate that the misalignment estimates arising from the various methodologies are quite similar for most countries, some differences can arise. These differences can be traced either to aspects of the particular methodological approach being used or to the inherent difficulty of incorporating critical country-specific information into cross-country approaches. In these cases, the assessment weighs the various methodologies differently, reflecting their relative strength. For example, the ERER methodology may be less accurate for countries with a short sample. Also, the external sustainability approach can be used to assess the implications for the external position of different exchange rate misalignment estimates arising from the ERER and MB approaches. This serves to underscore the complementary nature of the CGER-based assessments to those arrived at in the context of bilateral surveillance.

While adopting different empirical methodologies goes some way toward strengthening the robustness of exchange rate assessments, such assessments are unavoidably subject to large margins of uncertainty. These relate to a number of factors, such as the potential instability of the underlying macroeconomic links, differences in these links across countries, and significant measurement problems for some variables, as well as the imperfect "fit" of the models. Some of these problems may be more severe for emerging market economies, where structural change is more likely to play an important role and where limitations in terms of data availability and length of sample are more acute.

II Macroeconomic Balance Approach

The macroeconomic balance approach to exchange rate assessments consists of three steps. First, an equilibrium relationship between current account balances and a set of fundamentals is estimated with panel econometric techniques. Second, for each country, equilibrium current accounts ("current account norms") are computed from this relationship as a function of the levels of fundamentals projected to prevail in the medium term. Third, the real exchange rate adjustment that would close the gap between the estimated current account norm and the underlying current account balance (i.e., the current account balance that would emerge at a zero output gap both domestically and in partner countries) is computed for each country.

The current account norms are estimated using a panel data set of 54 advanced and emerging market economies over 1973–2004.[3] This large sample of countries is likely to be helpful in achieving greater precision in the estimation of the equilibrium relationship between current account balances and the set of fundamentals; the sample period extends two previous studies by IMF staff (Debelle and Faruqee, 1996, and Chinn and Prasad, 2003), which used data through the mid-1990s.

The first subsection discusses the theoretical basis for the empirical investigation and defines the variables. We then address estimation issues, presenting some representative results; describe the current account norms obtained from the econometric estimates; and explain how the real exchange rate adjustment that closes the gap between current account norms and the underlying current account is derived.

Theoretical Background and Variable Definitions

Economic theory underscores how in open economies national saving may exceed or fall short of domestic investment, thus allowing consumption to be smoothed and investment to reflect rate of return opportunities, rather than just the availability of domestic saving (Obstfeld and Rogoff, 1996, and Obstfeld, 2004). The substantial body of literature on the subject has guided the empirical investigation below and led to the identification of the following robust determinants of the current account balance over the medium term:[4]

- *Fiscal balance.* A higher government budget balance raises national saving and thereby increases the current account balance (Ahmed, 1986, and Chinn, 2005). Only in the particular case of full Ricardian equivalence, where private saving fully offsets changes in public saving, would there be no link between government budget balances and current account balances.[5] The measure of fiscal balance used below is the ratio of the general government budget balance to GDP in deviation from the average budget balance of trading partners: if the government budget balance improved in all countries, there would be a world-wide macroeconomic effect but little expected effect on the current account balance of each country.
- *Demographics.* A higher share of the economically inactive dependent population reduces national saving and decreases the current account balance (Higgins, 1998, and Federal Reserve Bank of Kansas City, 2004). To proxy for this, the model includes an old-age dependency ratio as well as the population growth rate (which captures the share of economically dependent young people). Both variables, measured in deviation from trading-partner averages, are expected to decrease the current account balance.[6]
- *Net foreign assets (NFA).* The level of NFA can affect the current account in opposite directions. On the one hand, economies with relatively high NFA can

[3]The euro area countries are treated as separate entities in the estimation. Previously, information for 21 industrial countries was used to estimate norms for the exchange rate assessments of the 11 advanced economies covered in the exchange rate assessments produced by the CGER.

[4]Appendix 2.1 describes the database construction and each variable definition in detail.

[5]Bernheim (1987) finds little support for the hypothesis of full Ricardian equivalence.

[6]Although the quantitative effect of the age profile on the current account may differ across countries depending on financial development and the characteristics of the retirement system, it is not possible to accurately estimate country-specific coefficients for all countries.

afford to run trade deficits on an extended basis and still remain solvent, potentially leading to a negative association between NFA and the current account. On the other hand, economies with high NFA benefit from higher net foreign income flows, which tend to create a positive association between NFA and current account balances. Standard open economy macroeconomic models predict that this second effect is stronger.[7] The "initial" NFA position used in the empirical model is measured before the period of reference for the current account balance, to avoid capturing a reverse link from the current account balance to NFA.[8]

- *Oil balance.* Higher oil prices increase the current account balance of oil-exporting countries and decrease the balance of oil-importing countries (International Monetary Fund, 2006). The variable used here (the oil balance as a ratio to GDP) allows the effect of oil prices to differ in sign and magnitude across countries.
- *Economic growth.* Economies that are in the early stages of economic development have a greater need for investment and are likely to finance investment through external borrowing (Obstfeld and Rogoff, 1996). As they develop and approach the income levels of advanced economies, their current account balances should improve. Among countries at a similar initial stage of development, the stronger economic growth is relative to trading partners, the lower the current account is likely to be. The ratio of GDP per capita in purchasing power parity terms to the U.S. level—hereafter referred to as relative income—is taken to measure the relative stage of economic development, while the deviation of the real per capita GDP growth rate from its trading-partner average is the variable used to capture relative economic growth.[9] The current account balance is expected to increase with relative income but to decline with relative growth.
- *Economic crises.* During economic crises, sharp current account adjustments occur as a by-product of macroeconomic contraction, the reduced availability of international financing, or the attempt to reduce net external liabilities. The empirical evidence suggests that crises have an effect even after controlling for other macroeconomic factors. This is particularly true in the case of the Asian crisis, where a dummy variable remains highly significant even after other plausible determinants of the current account are controlled for. An indicator of banking crisis episodes (Demirgüç-Kunt and Detragiache, 2005, and Gruber and Kamin, 2005) also helps to explain current account behavior.
- *Financial center.* Economies that serve as hubs for international financial flows have tended to run substantial current account surpluses and net creditor positions. This effect is captured by a dummy variable that represents the following financial centers: Belgium, Hong Kong SAR, Luxembourg, the Netherlands, Singapore, and Switzerland.

Estimation Results

The estimation database consists of nonoverlapping four-year averages for 54 economies over 1973–2004. There are thus eight observations for most countries and three observations for transition economies (where the data begin in the early 1990s). The 54 countries in the sample were selected because of their significance in global trade, on the grounds that an economy with a larger global presence will have greater multilateral effects on the exchange rates of other countries. This country coverage enables one to exploit the substantial cross-country variation among the advanced and emerging market economies in the sample.[10]

High-frequency fluctuations are filtered out by taking four-year averages of the data; this enables the specification to uncover the medium-term relationship between the current account and macroeconomic determinants. Recent studies, including Chinn and Prasad (2003), Chinn and Ito (2005), and Gruber and Kamin (2005), have used similar methods. Cointegration methods are not appropriate here because the current account balance (in percent of GDP) is a stationary series in most countries during most sample periods. Moreover, the current account needs to be stationary for the intertemporal budget constraint to hold (Ghosh and Ostry, 1997; Taylor, 2001; and Lee and Chinn, 2007). To reflect the significant persistence of the current account series, a

[7]If this were not the case, there would be a tendency for NFA to systematically decline in creditor countries and increase in debtor countries, which is at odds with what the data show.

[8]All three approaches discussed in this paper use the NFA variable in the revised database on external assets and liabilities of Lane and Milesi-Ferretti (2007b), which has a broader coverage of NFA data across countries and time than the data used in previous studies.

[9]The inclusion of relative economic growth was statistically important only for nonindustrial countries, reflecting greater heterogeneity in their growth performance.

[10]The estimation treats the 12 euro area countries as separate economies for two reasons: (1) although these countries now share a common currency, their real exchange rates can still behave differently depending on relative inflation; and (2) the sample spans also the pre-euro period, when the countries had their own currencies. While the estimation treats the euro area countries separately, the planned exchange rate assessments going forward would continue to be made only for the euro area as a whole. Finally, it is worth noting that the country coverage used here is broader and more heterogeneous than that of Debelle and Faruqee (1996), who examined 21 industrial countries. Compared with Chinn and Prasad (2003), who examined 99 countries including 71 nonindustrial countries, the country coverage here is more homogeneous and provides sharper statistical results.

specification including a lagged current account term has also been estimated. Under this specification, the initial NFA term is excluded because its effect becomes statistically indistinguishable from that of the lagged current account term.

Three representative estimates are reported below: two pooled estimates, the first with no country-specific constant terms and the second with a very limited number thereof, and one fixed-effects estimate that allows country-specific constant terms for all countries. These results are supported by several robustness checks across different variable definitions, samples, and specifications, as briefly discussed in Appendix 2.1.

The pooled estimation results include no or few country-specific constants and therefore use the variables in the regression to explain both the cross-sectional and time-series (within-country) variation in the data. Estimation biases can arise if there are important factors explaining the cross-country variation in the data that are not captured in the specification but are correlated with the other variables. While fixed-effects estimation controls for this possibility by including country-specific constants, the resulting estimates of country effects may be unduly influenced by historical realizations of the dependent variable—especially for countries with a short sample—or may end up accounting for the bulk of the cross-country variation when data change little over time. For this reason, estimation results are presented below for both the pooled and fixed-effects models.[11]

The two left-hand-side columns of Table 1 report the results of the pooled estimation. The first column (pooled estimation) uses initial NFA and contains no country-specific constant terms, while the second column (hybrid pooled estimation) uses lagged current account and allows for a few country-specific constant terms that were found to have very high statistical significance (see Appendix 2.1 for details). Estimated coefficients are statistically significant and have expected signs and plausible magnitudes:

- The coefficients on the fiscal balance imply that a 1 percentage point increase in the government budget balance (relative to trading partners) leads to a 0.2 percentage point increase in the current account balance in percent of GDP. This result is broadly consistent with previous estimates, which mostly ranged between 0.2 and 0.5.
- A higher dependency ratio reduces the current account balance. The coefficients on population growth imply that a 1 percentage point increase in the population growth rate relative to trading partners—a very large change given the cross-country variation in the data—deteriorates the current account balance by 1 to 1.25 percent of GDP.
- The 0.02 coefficient on initial NFA implies that an increase in NFA of 10 percent of GDP raises the medium-term current account balance by about 0.2 percent of GDP. Although the sign of the coefficient is theoretically ambiguous as discussed above, the positive sign estimated here is consistent with previous empirical findings, including those of Lane and Milesi-Ferretti (2002) and Chinn and Prasad (2003). The estimated size of the coefficient—which is below the average interest rate on external assets and liabilities—indicates that countries with larger initial NFA positions tend to run a smaller trade balance, offsetting part of the positive effect on the current account from higher investment income.
- When the lagged current account term is used, the NFA term (which is strongly correlated with past current account balances) loses statistical significance, and the coefficient on the lagged current account is 0.37. The estimated coefficient indicates the gradual nature of current account adjustment: for example, nearly 30 percent of the effect of a shock to the current account would remain five years after the event.

Table 1. Macroeconomic Balance Approach: Current Account Regressions

	Pooled Estimation	Hybrid Pooled Estimation	Fixed Effects Estimation
Fiscal balance	0.20***	0.19***	0.32***
Old-age dependency	–0.14**	–0.12**	–0.23**
Population growth	–1.21***	–1.03**	–0.47
Initial net foreign assets (NFA)	0.02***	…	…
Lagged current account	…	0.37***	…
Oil balance	0.23***	0.17***	0.31***
Output growth	–0.21**	–0.16*	–0.27
Relative income	0.02*	0.02*	…
Banking crisis	0.01*	0.01	…
Asian crisis	0.06***	0.04***	0.07***
Financial center	0.03***	0.03***	…
Adjusted R^2	0.52	0.62	0.56

Note: The regression specification in the second column (hybrid pooled estimation) also includes a few country-specific constant terms (see Appendix 2.1 for details). * ,**, and *** indicate significance at the 10, 5, and 1 percent level, respectively, based on standard errors robust to serial correlation.

[11]The regressions presented in Table 1 also include a limited number of country-specific variables capturing (1) the effect of the euro adoption on several member countries; (2) country-specific effects of aging in selected advanced economies where long-run changes in the demographic structure are more dramatic; and (3) the effect of the oil balance for Norway, whose oil reserves are to be depleted in the foreseeable future.

- The coefficients on the oil balance are about 0.2, reflecting the cross-country variation in the effect of oil price changes. Oil exporters have large oil surpluses, amounting to tens of percent of GDP, but spend a large part of them on imports of goods and services, leading to a much smaller current account surplus.[12] Oil importers compress other imports as oil prices increase. The oil balance coefficient is larger in the fixed-effects model than in the pooled models, reflecting a negative correlation between oil balances and country-specific factors.
- An increase in relative income raises the current account balance while higher relative output growth lowers it. The coefficient of 0.02 on relative income implies that, other things being equal, a country whose income is half the U.S. level will have on average a current account balance that is 1 percentage point of GDP smaller than that of the United States. The coefficient estimate of about 0.2 on relative output growth implies that a 1 percentage point increase in real GDP growth of an emerging market economy (compared with the trading-partner average) reduces the current account balance by 0.2 percent of GDP.
- The banking crisis and Asian crisis dummy variables lead to a higher current account balance, by 1 and 4–6 percent of GDP respectively, confirming that the macroeconomic contraction and reduced availability of international financing associated with crises tend to increase current account balances temporarily (while the crisis prevails), other things being equal.
- The current account balances of financial centers are found to be about 3 percent of GDP larger than those of other countries.

Compared with the results of the pooled estimation, the fixed-effect estimates (right-hand-side column of Table 1) have the same signs but somewhat different magnitudes. On the one hand, the fiscal balance, old-age dependency ratio, and oil balance have weaker effects in the cross-sectional dimension, reflecting the fact that the impact of these variables on the current account may be weakened by country-specific factors (such as a different retirement age across countries). For this reason the fixed-effect estimates, which capture mainly the time-series correlations with the current account, are larger (in absolute value). On the other hand, population growth has a stronger economic and statistical effect across countries than over time, reflecting the very gradual change in population growth within countries; this shows up as a smaller (in absolute value) coefficient in the fixed-effects specification. Other variables whose economic and statistical significance is mostly captured by country-specific constants—initial NFA, relative income, the financial center dummy variable, and the banking crisis dummy variable—are excluded from the regression.

While the estimates of Table 1 capture medium-term tendencies in the co-movement of the current account balance with the underlying fundamentals, they are unavoidably subject to significant uncertainty, reflecting the large variation in current account balances across countries and over time and the limits of the common specification imposed across a diverse set of countries. The standard errors of the in-sample current account forecast are in the range of 2–3.5 percent of GDP, with the standard errors for the emerging markets at the higher end of the range.

Current Account Norms

Illustrative current account norms[13] can be calculated by applying the coefficient estimates in Table 1 to the medium-term values of the regressors. In computing the norms, medium-term values of the fiscal balance, oil balance, output growth, and relative income are drawn from the World Economic Outlook (WEO) database (projections for 2012), while demographic variables are obtained from the United Nations (UN) database under the assumption of a constant fertility rate. Lagged current accounts are calculated by the average current account–to-GDP ratio over the most recent five-year period, from 2002 to 2006, whereas the average over a longer period is used for a few countries for which current account developments over 2002–06 were substantially different from historical trends. The effect of crises is excluded from the norm calculations because they can be expected to wane over the medium term.

Table 2 presents current account balances and the illustrative current account norms for six country groups (defined in Appendix 2.1): European advanced economies, other advanced economies, and four groups of emerging markets (emerging Asian countries, Central and Eastern European countries, Latin American countries, and other countries). The first two columns of Table 2 report the actual and projected current account balances, in GDP-weighted averages for each country group. The 2012 projection is taken to be the underlying current account—the level reached after lagged exchange rate effects have worked themselves out and

[12]For resource exporters, the effect of an increase in the price of nonrenewable resources on domestic saving, and hence on the current account, should be larger in countries where the stock of remaining reserves is smaller, as spending should rise in proportion to the increase in the annuity value of existing reserves. Indeed, the country-specific coefficient on the oil balance for Norway, whose remaining oil reserves are relatively limited, is higher than for the rest of the sample.

[13]Since the current account equals the saving-investment (S–I) balance, the current account norms referred to here used to be called S–I norms in previous CGER notes.

Table 2. Macroeconomic Balance Approach: Illustrative Current Account Norms
(In percent of GDP)

Country	Current Account[1] Observed 2006	Current Account[1] Medium term 2012	Current Account Norm[2]
Advanced countries			
Europe	0.3	–0.2	0.3
Other	–3.4	–3.3	–1.9
Emerging markets			
Asia	6.3	7.3	1.3
Latin America	1.8	–0.8	–0.3
Central and Eastern European countries	–3.8	–3.9	–2.8
Other	3.7	–0.2	1.1

[1]Based on the September 2007 World Economic Outlook database.
[2]Calculated from hybrid pooled estimates.

output gaps have closed.[14] The last column of Table 2 reports the group-wide current account norms, defined as the GDP-weighted averages of the individual-country norms that were calculated by using the hybrid pooled estimates of Table 1. Of course, going forward, exchange rate assessments under the MB approach will make use of estimates of the individual country norms, and will reflect a judgment about the relative informational value of statistical estimates in particular country cases.

The gap between group-wide current account norms and underlying current account balances in Table 2 varies significantly across country groups. For the group of European advanced economies, the current account norm is a surplus of 0.3 percent of their combined GDP, close to the broadly balanced position of their underlying current account. In contrast, there are larger gaps between the current account norm and the underlying current account for other areas, including the non-European advanced economies and emerging Asia. For the non-European advanced economies, the current account norm is a deficit of 1.9 percent, somewhat lower than their underlying current account deficit of 3.3 percent of GDP—which reflects primarily the large projected U.S. deficit. For the group of 10 Asian emerging market economies, the current account norm is a surplus of 1.3 percent of their combined GDP, substantially below the underlying current account surplus of 7.3 percent.

[14]In countries where the 2012 current account projection is predicated on substantial real exchange rate adjustment, this adjustment is taken into account in the calculation of the implied exchange rate misalignment.

Exchange Rate Assessments

The last step of the MB approach consists of computing the real exchange rate adjustment that would close the gap between the estimated current account norm and the underlying current account of each economy.[15] The magnitude of the exchange rate adjustment is derived by applying the elasticity of the current account balance to the real exchange rate. The current account elasticity is calculated as *(export elasticity)* × *(export-to-GDP ratio)* – *(import elasticity* – 1*)* × *(import-to-GDP ratio)*: for a given response of export and import volumes to the real exchange rate, the impact on the trade balance and the current account will be roughly proportional to trade openness. Therefore, a country more open to trade will be able to close the current account gap with less exchange rate adjustment.

Once exchange rate adjustments are calculated for all countries, a final correction is made to ensure that they are mutually consistent. This multilateral consistency is required by the fact that there can only be *n*–1 independent exchange rates among *n* currencies. The correction consists of adjusting all exchange rate misalignments equally or proportionately, to preserve their relative ranking.[16]

Appendix 2.1. MB Approach: Data and Methodology

Data Description

The estimation sample includes 54 economies and the euro area, for the period from 1973 to 2004, and four-year averages are used in the estimation. The main data sources are International Financial Statistics (IFS) and World Development Indicator (WDI), with World Economic Outlook (WEO) data used to fill in some missing values. Data for the euro area were obtained from the Euro Area Business Cycle Network Real Time Database and the European Centre for Advanced Research in Economics and Statistics. Data for Taiwan Province of China come primarily

[15]This final step is unchanged from previous versions of the MB approach described in Isard and Faruqee (1998) and Isard, Kincaid, and Fetherston (2001), which assume that the trade balance is the sole source of current account adjustment.

[16]See Isard and Faruqee (1998) for a detailed discussion of the "*n*th" currency problem. In principle, if current account gaps and elasticities reflect all aspects of the complex web of bilateral trade relations, this correction should be very small. In past CGER assessments, this correction has amounted to some 1–4 percentage points.

from national sources. Demographic data come from the United Nations Population Database (Population Prospects: The 2004 Revision), except for data for Taiwan Province of China, which were obtained from the U.S. Census Bureau International Database.

Definitions of each variable are as follows. The following four variables are calculated as deviations from the averages for trading partners.

- *Fiscal balance* is measured as the ratio of the general government balance to GDP. Exceptions include Algeria and Korea, for which the central government balance was used instead of the general government balance.
- *Old-age dependency ratio relative to the prime age population* is measured as the ratio of the population above 65 to the population between 30 and 64.
- *Population growth rate* is the annual population growth rate of each country.
- *Growth rate of real per capita GDP* is included only for emerging market economies.

The remaining variables are not calculated as deviations from the averages of trading partners, either because this is already implicit in their measure (NFA and oil balance) or because it turned out to be statistically redundant (crisis variables).

- *Initial NFA* is measured as the ratio of NFA to GDP prevailing at the beginning of each four-year period, using the NFA data from Lane and Milesi-Ferretti (2007b).
- *Oil balance* is measured as a ratio to GDP.
- *Dummy variable for Asian crisis* is included for Asian emerging markets for 1997–2004: China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan Province of China, and Thailand.
- *Dummy variable for banking crisis* is obtained from Demirgüç-Kunt and Detragiache (2005), and Gruber and Kamin (2005).
- *Relative income* is measured as the ratio of per capita PPP income to the U.S. level, both in constant 2000 international dollars.

The 54 sample countries are as follows.

Current CGER countries: Australia, Canada, Denmark, Japan, New Zealand, Norway, Sweden, Switzerland, United Kingdom, United States; and 12 euro area countries (comprising Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain).

Newly industrialized or emerging markets: Algeria, Argentina, Brazil, Chile, China, Colombia, Croatia, Czech Republic, Egypt, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, the Philippines, Poland, Russia, Singapore, Slovak Republic, Slovenia, South Africa, Taiwan Province of China, Thailand, Tunisia, Turkey, and Venezuela.

Country groupings for Tables 2 and 4 are defined as follows.

Advanced countries, Europe: the euro area, Denmark, Norway, Sweden, Switzerland, and the United Kingdom.

Advanced countries, other: Australia, Canada, Japan, New Zealand, and the United States.

Emerging markets, Asia: China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan Province of China, and Thailand.

Emerging markets, Latin America: Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela.

Emerging markets, Central and Eastern Europe: Croatia, Czech Republic, Hungary, Poland, Slovak Republic, and Slovenia.

Emerging markets, Other: Algeria, Egypt, Israel, Morocco, Pakistan, Russia, South Africa, Tunisia, and Turkey.

Econometric Methodology

In the hybrid pooled estimation of Table 1, country-specific constant terms are included for six medium-sized economies—Australia, Chile, Israel, New Zealand, Sweden, and Thailand—for which the hypothesis that the constant term is zero is strongly rejected (at the 0.5 percent critical value) in this as well as alternative specifications that were estimated to check robustness; and the Asian crisis dummy is included for four countries with statistically significant coefficients—Korea, Malaysia, Singapore, and Thailand. The three estimates reported in Table 1 are confirmed by several robustness checks. For example, similar patterns are found in estimates over 1980–2004. When estimated over samples consisting of advanced economies and emerging markets separately, coefficients are comparable but less statistically significant, reflecting the more limited variation in samples half as large. The conventional old-age dependency ratio based on the working age population (between ages 15 and 64) had a statistically weaker effect than the dependency ratio based on the prime age population. Finally, several measures of financial development—such as capital account liberalization and financial depth—were found to have economically and statistically less robust effects than the variables included in Table 1.

III Equilibrium Real Exchange Rate Approach

The reduced-form equilibrium real exchange rate (ERER) approach to exchange rate assessment consists of three steps. First, panel regression techniques are used to estimate an equilibrium relationship between real exchange rates and a set of fundamentals. Second, equilibrium real exchange rates are computed as a function of the medium-term level of the fundamentals. Third, the magnitude of the exchange rate adjustment that would restore equilibrium is calculated directly as the difference between each country's actual real exchange rate and the equilibrium value identified in the second step.

Since 2003, the IMF's CGER assessments have used the ERER approach for 11 advanced economies. This section presents an updated methodology for estimating equilibrium real exchange rates for 48 countries over 1980–2004, which, as discussed below, also includes factors specific to emerging markets. For a more extensive presentation of the methodologies, see Ricci, Milesi-Ferretti, and Lee (2008).[18]

Theoretical Background and Variable Definitions

The literature on the determinants of real exchange rates is very extensive (see, for example, the surveys by Froot and Rogoff, 1995; Rogoff, 1996; and, for developing countries, Edwards, 1989; Hinkle and Montiel, 1999; and Edwards and Savastano, 2000).[19] Empirical analyses differ in the choice of underlying real exchange rate fundamentals, in part because of data availability considerations. In the econometric analysis of this section, the CPI-based real effective exchange rate, defined as the ratio of domestic consumer prices to a weighted index (exchange-rate-adjusted) of consumer prices in trading partners, is expected to depend on the following six fundamentals:[20]

- *Net foreign assets.* Standard intertemporal macroeconomic models predict that debtor countries will need a more depreciated real exchange rate to generate the trade surpluses necessary to service their external liabilities. Conversely, economies with relatively high NFA can "afford" more appreciated real exchange rates—and the associated trade deficits—while remaining solvent.[21] The stock of net foreign assets is scaled by each country's trade (the sum of exports and imports).
- *Productivity differential.* According to the so-called Balassa-Samuelson effect, if productivity in the tradables sector grows faster than in the nontradables sector, the resulting higher wages in the tradables sector will put upward pressure on wages in the nontradables sector, resulting in a higher relative price of nontradables (i.e., a real appreciation). The productivity differential used in the specification below is the difference in output per worker in tradables and nontradables production (relative to trading partners), and is expected to have a positive effect on the ERER.[22]
- *Commodity terms of trade.* Higher commodity terms of trade should appreciate the real exchange rate through real income or wealth effects.[23] The vari-

[18]The sample of countries is smaller than in Section II, owing to the difficulty in obtaining data for some determinants of real exchange rates, such as sector-level productivity measures. See Appendix 3.1 for the list of countries.

[19]For a recent application to the exchange rate assessment of Central and Eastern European countries, see Maeso-Fernandez, Osbat, and Schnatz (2004).

[20]Appendix 3.1 describes the construction of each variable and discusses some remaining limitations of the data.

[21]The net effect of investment income ensures that creditor countries would still run current account surpluses and debtor countries, current account deficits. The economic literature also refers to this long-standing issue as the "transfer problem." Previous analyses of the impact of the NFA position on the ERER include Faruqee (1995), who focused on the United States and Japan; Gagnon (1996), who used the cumulative current account as an approximation of net foreign assets; Bayoumi, Faruqee, and Lee (2005), who use trend net investment income; and Lane and Milesi-Ferretti (2002, 2004).

[22]This section uses new measures of productivity in tradables and nontradables, constructed on the basis of a six-sector classification of output and employment. For earlier studies using advanced-economy data, see Canzoneri, Cumby, and Diba (1999), Choudhri and Khan (2005), MacDonald and Ricci (2005, 2007), and Lee and Tang (2007).

[23]See, for example, Ostry (1988), Edwards and Ostry (1992), Ostry and Reinhart (1992), Chen and Rogoff (2003), and Cashin, Céspedes, and Sahay (2004).

able used below is a weighted average of the main commodity export prices (where country-specific weights reflect the share of particular commodities in a country's overall exports) divided by a weighted average of the main commodity import prices. All commodity prices are calculated relative to the price of manufacturing exports of advanced economies.

- *Government consumption*. Higher government consumption (as a ratio to GDP) is likely to appreciate the real exchange rate to the extent that such consumption falls more on nontradables than tradables, thereby raising the relative price of the former (Ostry, 1994; and De Gregorio, Giovannini, and Wolf, 1994).
- *Trade restriction index*. Trade restrictions may lead to higher domestic prices and more appreciated real exchange rates (Edwards and Ostry, 1990; Ostry, 1991; and Goldfajn and Valdes, 1999). The trade restriction index used below is a dummy variable that takes a value of 1 before liberalization and a value of 0 after liberalization, according to the liberalization years coded by Sachs and Warner (1995) and Wacziarg and Welch (2003).[24]
- *Price controls*. The share of administered prices in the consumer price index (CPI) basket is a proxy for the deviation of prices from their market value in transition economies. As price controls are removed, the rise in administered prices toward market levels—and hence the rise in the consumer price index—would tend to be accompanied by a real appreciation. A lower share of administered prices in the consumer price index is thus expected to be associated with a more appreciated real exchange rate in transition economies.

Estimation Results

The first column in Table 3 reports the estimated equilibrium long-run (cointegrating) relationship between the real exchange rate and the aforementioned set of explanatory variables, including a set of country-specific constant terms (the estimation methodology and robustness tests are described in Appendix 3.1).[25] The specification in column 2 also includes a parsimonious set of coefficients and dummy variables, which help control for country/region-specific factors or structural breaks (see Appendix 3.1 for details).

Table 3. Equilibrium Real Exchange Rate Approach: Regressions

	(1)	(2)
Net foreign assets	0.04***	0.04***
Productivity differential		
All countries	0.19***	0.12*
Central and Eastern European countries	…	1.30***
Commodity terms of trade	0.55***	0.39***
Government consumption	2.91***	2.65***
Trade restriction index	0.12***	0.14***
Price controls	–0.04**	–0.02
Observations	861	861
Adjusted R^2	0.6	0.62

Note: Column (2) includes a parsimonious set of coefficients and dummy variables, which help control for country/region-specific factors or structural breaks (see Appendix 3.1 for details). *, **, and *** indicate significance at the 10, 5, and 1 percent level, respectively, based on standard errors robust to serial correlation.

- The estimated coefficient on the net foreign asset variable scaled by trade is about 0.04. A deterioration of the ratio of net foreign assets to trade of about 50 percentage points (as experienced by the United States between 2001 and 2005) would imply a depreciation of the equilibrium exchange rate by about 2 percent.
- A 10 percent increase in the domestic productivity of tradables relative to nontradables (relative to the corresponding variable for trading partner countries) tends to appreciate a country's equilibrium exchange rate by about 1 to 2 percent in most countries, and up to 13 percent in Central and Eastern European countries.[26]
- A 10 percent increase in the commodity terms of trade implies an equilibrium appreciation of about 4 to 6 percent. As an example, between 2001 and 2005 Venezuela's terms of trade improved by about 50 percent, implying an appreciation in its equilibrium real effective exchange rate of about 20 to 30 percent.
- An increase in the government consumption to GDP ratio of 1 percentage point is associated with an appreciation of the equilibrium real exchange rate of 2½ to 3 percent.

[24]The limitation of the trade restriction index is its inability to capture gradual liberalization. Other studies have used trade openness (average export and import share of GDP). Such a measure, however, is only an indirect indicator of the extent of liberalization and is subject to endogeneity when used in exchange rate regressions (as a change in the exchange rate would affect openness for a given trade regime).

[25]Country-specific constant terms are needed because (1) there could be residual country-specific effects that are not captured by the other regressors; and (2) the real exchange rates are index numbers with no natural common anchor across different countries.

[26]The estimated effect for the whole sample is smaller than the amount predicted by theory (which is equal to the share of nontradables in the CPI), but is in line with recent estimates for a large sample of advanced and developing countries (Choudhri and Khan, 2005, estimate a coefficient of about 0.2).

- A move to a liberalized trade regime, as in the example of Brazil around 1990, would depreciate the equilibrium real exchange rate by 12.14 percent.
- The elimination of administered prices in 7 percent of the price basket (one unit of the index on the share of administrative prices) is associated with an appreciation of the real exchange rate by about 2 to 4 percent. As an example, the Slovak Republic experienced a liberalization of prices accounting for about 20 percent of the price basket between 1997 and 2004, which would be associated with an equilibrium appreciation of the real exchange rate of about 6 to 12 percent.

Equilibrium Real Exchange Rates

Equilibrium real exchange rates are computed by evaluating the relationship between the real exchange rate and the fundamentals at an appropriate level of those fundamentals. The ERER approach computes twosets of equilibrium real exchange rates based, respectively, on the current value of fundamentals and their projected medium-term value (WEO projections).[27]

Equilibrium real exchange rates also reflect the estimated value of the country-specific constants, which are equal to the average of each country's real exchange rate over the sample period. Whenever the sample period is short, as in the case of the Central and Eastern European countries, or there is a "peso problem" (i.e., systematic overvaluation or undervaluation for a prolonged period of time), caution is warranted in interpreting the estimates of the country-specific constants as the average value anchoring each country's equilibrium real exchange rate.

Exchange Rate Assessments

The magnitude of the exchange rate adjustment that would restore equilibrium is calculated directly as the difference between each country's current real exchange rate and two possible equilibrium values, corresponding to current or medium-term fundamentals. A final step in the ERER approach—like in the MB approach—is to impose multilateral consistency of the estimated exchange rate adjustments by applying a common correction factor, as explained in Section II.

The ERER approach does not yield in and of itself any indication of how quickly the exchange rate would adjust to restore equilibrium. To gain some insight into this issue, the long-run model was estimated with an error-correction specification. The results suggest that, on average, two and a half years are enough to halve the gap between actual and equilibrium exchange rates for both advanced and emerging economies (or, equivalently, the gap closes by about one-fourth within a year).

While the econometric model captures the broad trends in real exchange rate behavior, estimates of equilibrium real exchange rates are unavoidably subject to significant uncertainty. In particular, the forecast standard error of the real exchange rate is about 12 percent, which is reduced to 7–8 percent if one accounts for factors driving the real exchange rate in the short run through an error-correction specification.

Appendix 3.1. ERER Approach: Data and Methodology

Data Description

The sample includes 48 countries for the period 1980 to 2004. From the 54 countries used in the MB approach, the following six countries were excluded from the ERER approach owing to data availability: Algeria, Croatia, Egypt, Israel, Luxembourg, and Tunisia. This subsection describes in detail the construction of the variables used in the ERER approach.

- *Real effective exchange rate* is based on consumer price index (CPI) and new competitiveness weights constructed from 1999–2001 data (Bayoumi, Lee, and Jayanthi, 2006). The nominal exchange rate and CPI were obtained from IFS, and the euro area aggregate exchange rate (prior to 1999) was obtained from the European Central Bank.
- *Productivity of tradables and nontradables relative to trading partners.* Productivity, measured as output per worker, is calculated on the basis of a newly constructed data set for output and employment for a six-sector classification (or three-sector when the six-sector data were not available). In the six-sector classification, the tradable sector includes agriculture, hunting, forestry, and fishing; mining, manufacturing, and utilities; and transport, storage, and communication, whereas the nontradable sector includes construction; wholesale and retail trade; and other services. In the three-sector classification, the tradable sector includes agriculture and industry. The sources are the United Nations Statistics Division, International Labor Office Bureau of Statistics, Eurostat, World Bank, Groningen Growth and Devel-

[27]Net foreign assets are extended by cumulating the projected WEO current accounts. Productivity variables, the trade liberalization index, and the share of administered prices are left unchanged at the latest available observation. An alternative way to calculate the equilibrium exchange rate would be to apply the econometric methodology suggested by Gonzalo and Granger (1995), decomposing fundamentals into a permanent and transitory component and using the permanent component to calculate the ERER.

opment Centre, CEIC database, IMF country desks, and national authorities.[28]

A few missing observations were filled using the sectoral shares for adjacent years and aggregate data. Series for trading partners were constructed by applying the competitiveness weights to productivity series that were extended when data were missing for a few early or late years (using the trends over the adjacent three-year period). Robustness checks were undertaken using relative productivity measures that either exclude the volatile agricultural sector for some countries (Chile, Colombia, Morocco, Peru, South Africa, Turkey, Poland, Thailand, Malaysia, Mexico, and New Zealand) or are constructed from employment series smoothed with a Hodrick-Prescott filter.

- *Commodity-based terms of trade* is the ratio of a weighted average price of the main commodity exports to a weighted average price of the main commodity imports. The index is constructed from the prices of six commodity categories (food, fuels, agricultural raw materials, metals, gold, and beverages), measured against the manufacturing unit value index (MUV) of the IMF's *World Economic Outlook*. These relative commodity prices of six categories are weighted by the time average (over 1980–2001) of export and import shares of each commodity category in total trade (exports and imports of goods and services). The terms of trade index is the ratio of aggregate indexes of commodity exports and imports, as follows:

$$TOT_j = \prod_i (P_i/MUV)^{X_j^i} / \prod_i (P_i/MUV)^{M_j^i},$$

where i represents the six commodity categories; X_j^i is the share of exports of commodity i in country j's total trade, averaged over 1980–2001; and M_j^i is the share of imports of commodity i in country j's total trade, averaged over 1980–2001.

The prices (P_i) of the six commodity categories are obtained from the database of the RES Commodities Unit. Exports and imports by commodity category are obtained from the United Nations Common Format for Transient Data Exchange (COMTRADE) data at SITC two-digit level; South Africa's gold export series is obtained from national sources.

Trade data are obtained from the IFS and extended using WEO data. Pre-1998 merchandise trade for the euro area are constructed on the basis of COMTRADE data.[29] Singapore's exports are adjusted for re-exports.

- *Net foreign assets to trade* is the ratio of net foreign assets at the end of the previous period to the average exports and imports (in goods and nonfactor services) of the previous period. The net foreign asset data are from Lane and Milesi-Ferretti (2007b).
- *Government consumption–to-GDP ratio* is defined as the ratio of government consumption (purchases of goods and services plus government wages) to GDP. The main source is OECD, Annual National Income Accounts, and missing observations are spliced using the IFS or WEO data.
- *Trade restriction index* takes the value of 0 during years of liberalization and 1 during years of restriction. It is constructed on the basis of the liberalization years suggested by Sachs and Warner (1995), and extended for recent years by Wacziarg and Welch (2003).
- *Share of administered prices* (for transition economies only) is constructed by the EBRD as the number of categories with administered prices out of a basket of 15 categories (EBRD, 2005). Hence a unit increase in this variable corresponds to an increase in the share of administered prices corresponding to about 7 percent of the CPI basket. This variable is available for the Czech Republic, Hungary, Poland, Russia, Slovak Republic, and Slovenia, and takes a value of 0 for the other countries.
- *Additional terms in Table 3 regressions*. The regression in column 2 includes coefficients and dummy variables that help control for several country/region-specific factors or structural breaks. In particular, it includes four additional dummies to account for significant breaks in the real exchange rate series that are not captured in the Sachs and Warner index as episodes of major liberalization: three dummies (equal to 1 before 1986 and 0 otherwise) for Indonesia, Malaysia, and Thailand; and one dummy (equal to 1 in 1991–2001 and 0 otherwise) for Argentina. It also allows for an heterogeneous slope for China for the Balassa-Samuelson effect (with an estimated coefficient of about 0.5). Finally, the government spending variable is dropped for Central and Eastern European countries. The regression in column 1 accounts only for the 1982 devaluation in Indonesia (associated with import liberalization) and for the Argentina dummy.

[28]Our classification follows De Gregorio, Giovannini, and Wolf (1994) and is bound to be imperfect. As the authors acknowledge, every sector has some degree of tradability, which can vary from country to country.

[29]For the euro area prior to 1998, member-country data (which includes intra–euro area trade) is aggregated first; and then area-wide services exports and imports are calculated by assuming that the trade in services outside the euro area is 10 percentage points higher than the trade in goods outside the euro area. The 10 percentage point difference between trade in goods and services is based on observations from 1998 onward, the only period where data is available for services trade both within and outside the euro area.

The set of real exchange rate fundamentals of this analysis is broader than that used in previous studies, and includes novel measures of productivity differentials and net foreign assets. Nevertheless, most variables capture the underlying economic effect only imperfectly. For example, the split between tradable and nontradable sectors is bound to be arbitrary to some extent. Similarly, the net external position is the appropriate measure of the "transfer problem" only to the extent that rates of return on external assets and liabilities are broadly the same (Lane and Milesi-Ferretti, 2002). Finally, commodity terms of trade are calculated for a given (fixed) composition of a country's exports and imports, which is likely to have changed during the sample period. However, data availability issues prevent us from addressing some of these concerns. For example, while interest payments on net foreign assets are available, the appropriate measure of the "transfer effect" requires the calculation of rates of return (which include capital gains and losses). These calculations are fraught with measurement problems, especially for the early years of the sample.

Econometric Methodology

This appendix describes the estimation of the long-run relationship between the real effective exchange rate and macroeconomic fundamentals. Given the limited length of the sample (25 years), estimating separate real exchange rate equations for each country gives very imprecise results. This shortcoming can be reduced by pooling the data. Over the sample period the variables exhibit unit root behavior, when tested via the Levin, Lin, and Chu (2002) and Im, Pesaran, and Shin (2003) panel unit root tests. We find evidence of panel cointegration among our variables using the Kao (1999) test—there appears to be a long-run relationship between the real effective exchange rate and the set of fundamentals.[30]

The estimation is thus undertaken using the dynamic ordinary least squares (DOLS) methodology developed by Stock and Watson (1993), applied to a panel of countries with fixed country effects. Fixed effects are necessary because the real effective exchange rate measures are index numbers, making their levels not comparable across countries. They also account for time-invariant country-specific factors, thus reducing the omitted variable bias. The DOLS methodology has been widely used in panel analysis with nonstationary data. The results were also checked with an alternative panel cointegration estimation procedure (FMOLS; see Kao and Chiang, 2000; Pedroni, 2000; and Phillips and Hansen, 1990) and results were similar.[31]

The estimated cointegrating relationship is imposed in an error-correction formulation, to assess the speed of adjustment of the real exchange rate toward its long-run equilibrium relation. The long-run relationship should be interpreted as an equilibrium relationship rather than a causal one. One might expect the presence of reverse causality, particularly between the real exchange rate and the productivity or the net foreign asset indicators.

The forecast standard error of the real exchange rate is estimated at about 12 percent (mostly due to the standard error of the regression at about 11 percent, hence with little variation across countries and years). This is mainly because the real exchange rate estimation is tailored to capturing the long-run relationship between the real exchange rate and the fundamentals and neglects short term exchange rate dynamics, which are notoriously volatile. If one accounts for short-term effects, for example when imposing the cointegrating vector in an error-correction mechanism, the forecast standard error of the real exchange rate is estimated at about 7–8 percent.

Several robustness tests were performed and yielded similar estimation results. First, alternative series were employed for the net foreign assets ratio (to GDP, to imports, and to exports), the relative productivity measures (see the data description subsection in this appendix), and the government consumption ratio (from IFS rather than OECD). Second, OLS regressions were performed on three-year averages of the data. Third, different slopes of the relative productivity variable were allowed during crisis times (as defined by a 20 percent depreciation): the coefficient during crisis times were larger, but the coefficients during noncrisis times were overall unaffected.

[30]The programs adopted for testing for panel unit root (STATA routines) and for panel cointegration (NPT1.3 in www.maxwell.syr.edu/maxpages/faculty/cdkao/working/npt.html) require a balanced panel; hence some countries and years are dropped from the sample for these tests. A panel unit root was not rejected for the commodity price index. However, a Phillips-Perron unit root test run on commodity prices for each country separately could not be rejected for the vast majority of countries. Considering the limitation of the panel unit root test in dealing with cross-sectional dependence, which is likely to be very strong for commodity prices, we ignore the panel unit root test results and treat commodity prices as nonstationary.

[31]Plain fixed-effects estimation provides consistent estimates if the residuals are stationary. However, it would generate incorrectly lower standard errors—and misleading inference—if the residuals are correlated with the stationary component of the unit root processes of the explanatory variables, which is generally the case. The dynamic OLS methodology adds leads and lags of first differences of right-hand-side variables to the set of regressors in order to wipe out such correlation (we employ one lead and lag, but we also explore robustness to more leads and lags). As this automatically introduces serial correlation of the residuals, which distorts standard errors, an additional correction is necessary (we use the Newey-West method). The DOLS residuals were found to be stationary using the aforementioned panel unit root tests, a result which is consistent with panel cointegration. The FMOLS panel cointegration estimation based on the routine provided by Kao and Chiang (2000) was used mainly as a robustness exercise as it requires a balance panel like the panel unit root and panel cointegration tests.

IV External Sustainability

The external sustainability (ES) approach, not previously used in Consultative Group on Exchange Rate Issues (CGER) assessments, complements the two other methodologies by focusing on the relationship between the sustainability of a country's external stock position and its flow current account position, trade balance, and real exchange rate. It consists of three steps. The first involves determining the ratios of trade or current account balance to GDP that would stabilize the net foreign asset position at given "benchmark" values. The second step compares these NFA-stabilizing trade or current account balances with the level of a country's trade or current account balance expected to prevail over the medium term. And, finally, the third step consists of assessing the adjustment in the real effective exchange rate that is needed to close the gap between the medium-term trade and current account balances and the NFA-stabilizing trade and current account balances.

Unlike the macroeconomic balance (MB) and equilibrium real exchange rate (ERER) approaches, which rely on econometric estimation, the ES approach requires only a few assumptions about the economy's potential growth rate, inflation rate, and rates of return on external assets and liabilities. This simple and transparent structure makes it a natural reference point against which to compare more sophisticated econometric approaches. The implications of the ES approach are straightforward. Debtor economies that grow faster can afford to run larger current account deficits and smaller trade balances without increasing their ratio of external liabilities to GDP. Also, high rates of return on external assets and liabilities imply that debtor countries need larger trade balances (and creditor countries can afford larger deficits) to stabilize the external position. Finally, economies that earn lower rates of return on their assets than they pay out on their liabilities (for example, because of risk premiums on their external debt) must—other things being equal—run larger trade surpluses to stabilize their net foreign assets.

We first discuss the theoretical basis for the external sustainability approach and define how results relate to the underlying variables. Then we discuss the choice of the benchmark value for net foreign assets. The next subsection provides a simple example that determines the current account balance consistent with stabilization of net foreign assets at their most recent level. Finally, we briefly discuss the implications of the NFA-stabilizing trade and current account balances for the medium-term real exchange rate.

Theoretical Background

Like approaches to public debt sustainability that develop the concept of the debt-stabilizing primary fiscal balance, the ES approach relies on an intertemporal budget constraint—in this case for the economy as a whole rather than just the fiscal sector—which requires that the present value of future trade surpluses is sufficient to pay for the country's outstanding external liabilities. One simple (albeit not unique) way to satisfy a country's intertemporal budget constraint is to ensure that the size of net foreign assets is stabilized relative to the size of the economy, thus preventing assets or liabilities from growing without bound. We invoke this assumption in the following discussion.

To determine the level of the current account balance that stabilizes NFA at a given level, we use the accumulation equation for net foreign assets (denoted by B_t), which states that changes in net foreign assets are due either to net financial flows (net purchases of foreign assets minus net foreign purchases of domestic assets) or to changes in the valuation of outstanding foreign assets and liabilities:

$$B_t - B_{t-1} = CA_t + KG_t + E_t, \tag{1}$$

where CA_t is the current account balance, KG_t is capital gains arising from valuation changes, and E_t includes factors such as capital account transfers and errors and omissions that can drive a wedge between the current account balance and net financial flows. Assuming that $E = 0$, so that the current account and net financial flows coincide, and denoting ratios to GDP by lowercase letters, Equation (1) can be rewritten as follows:

$$b_t - b_{t-1} = ca_t + kg_t - \frac{g_t + \pi_t(1+g_t)}{(1+g_t)(1+\pi_t)} b_{t-1}, \tag{2}$$

where g_t is the growth rate of real GDP and π_t is the inflation rate. If it is further assumed that capital gains are zero and the benchmark level of NFA is denoted by b^s, the current account that stabilizes NFA at b^S is

$$ca^S = \frac{g + \pi(1+g)}{(1+g)(1+\pi)} b^S. \quad (3)$$

Using the same approach, and assuming for simplicity that the real rates of return on external assets and liabilities are the same (r), the level of the trade balance inclusive of services and transfers ($bgst$) consistent with stabilizing NFA at the level b^s is

$$bgst^S = -\frac{r-g}{1+g} b^S. \quad (4)$$

Condition (4) is analogous to the determination of the debt-stabilizing primary balance in public debt sustainability analysis. Conditions (3) and (4) imply the following links between the current account, economic growth, inflation, and the net external position:

- *Net foreign asset position*. The current account balance consistent with stabilizing the ratio of net foreign assets to GDP at a level b^s is proportional to b^s. For example, for a country with a nominal growth rate of 5 percent, the current account balance necessary to stabilize net foreign assets at –50 percent of GDP is about –2.5 percent. If the interest rate exceeds the growth rate, the trade balance consistent with a stable net foreign asset position is instead inversely proportional to b^s. For example, if the nominal rate of interest is 7 percent, stabilizing net foreign assets at –50 percent of GDP requires a trade surplus of 1 percent of GDP. Finally, Equation (4) shows that if the rate of return and the rate of growth are close in value, the trade balance necessary to stabilize net foreign assets is not very sensitive to the benchmark level b^s.
- *Economic growth*. The absolute size of the current account balance and trade balance consistent with stabilizing net foreign assets at any given level b^s is proportional to the rate of growth. To continue with the previous example, the current account balance consistent with stabilizing net foreign assets at –50 percent of GDP becomes –4 percent of GDP if nominal growth is 8 percent, compared with the value of –2.5 percent when growth was assumed to be 5 percent.
- *Rates of return*. For a given growth rate, an increase in the rate of return on external assets and liabilities requires a larger trade balance for a debtor country and a smaller trade balance for a creditor country to stabilize the ratio of net foreign assets to GDP at any given level. For both debtors and creditors, the absolute size of the trade balance that stabilizes NFA at a given level grows with the absolute size of the differential between the rates of return and the growth rate.
- *Rate of return differentials.* As shown in Appendix 4.1, a positive rate of return differential between external assets and liabilities implies that a smaller trade balance is necessary to stabilize the ratio of NFA to GDP. Conversely, a negative differential requires a larger trade balance to stabilize NFA. The effect is proportional to the size of the return differential and to the size of gross external positions, and is therefore increasing in the level of international financial integration. A 2 percent return differential between external assets and liabilities when these are about 100 percent of GDP—a value lower than the current one in many advanced economies—implies that the NFA-stabilizing trade balance is 2 percentage points of GDP lower than what Equation (4) would suggest. For example, the U.S. net foreign asset position has been broadly stable as a ratio of GDP since 2001, despite very large trade and current account deficits, because of a substantial positive return differential between U.S. external assets and liabilities.[32]

Choosing a Benchmark Level for Net Foreign Assets

Clearly, the benchmark level of net foreign assets is a key element in the assessment of the current account balance (or of the exchange rate). However, the choice of b^s is to some extent arbitrary, and may reflect a variety of considerations. For example, low external exposure is likely to be associated with reduced risks of external crises or disruption, but may also leave faster convergence possibilities unexploited by forgoing higher access to foreign capital. For creditor countries, similar considerations apply—a large stock of foreign assets is a useful buffer against external risks and declining domestic returns on capital, but may also imply inefficiently low domestic consumption and investment. Benchmark levels could also be estimated on the basis of cross-country and time-series evidence, relating the external asset positions to underlying fundamentals such as the level of development, demographics, and fiscal policy (as in Lane and Milesi-Ferretti, 2001), analogously to the empirical analysis of current account balances underpinning the MB approach.

In the example below, the workings of this approach are illustrated using the NFA position in 2006—the latest year for which complete data are available—as the benchmark level. While stabilization of the NFA position at its 2006 level has little normative content, it does

[32]See, for example, Lane and Milesi-Ferretti (2007a). The return differential in recent years has been partly due to U.S. dollar depreciation (which has raised the dollar value of U.S. foreign currency returns) and partly due to equity prices, which have risen more slowly in the United States than in the rest of the world.

provide a useful perspective on whether projected current account developments at current exchange rates are expected to lead to larger debtor or creditor positions over time. Assessing whether such trends in external positions are desirable provides an additional perspective on the appropriateness of current real exchange rates from a medium-term perspective. One important factor to be taken into account in addressing these trends is the impact of large shifts in commodity prices, particularly for exporters of nonrenewable resources. In such cases, an increase in commodity prices should be reflected in a temporary accumulation of net foreign assets through current account surpluses, particularly for countries where such resources are likely to be rapidly depleted.

An Example: Using 2006 NFA as the Benchmark Level

In this example, the current account balance that would stabilize the ratio of NFA to GDP at its estimated level in 2006 is derived. The current account that stabilizes NFA at the 2006 level (in percent of GDP) is computed by using Equation (3). For the calculation, an inflation rate of 2.5 percent is assumed, consistent with the WEO projections for the United States over the medium term.[33] The real GDP growth for each country, g_t, is assumed to be the potential output growth rate embodied in WEO projections.

Results for the country groupings used in Section II are presented in Table 4, where the NFA-stabilizing current account balance is compared with the projected medium-term current account at prevailing real exchange rates. Among non-European advanced economies, projected current account deficits at current real exchange rates would lead to a substantial increase in external liabilities, reflecting the large projected current account imbalances for the United States.

Among most emerging market economies, projected current account balances exceed the levels that would stabilize NFA at its 2006 level, indicating a trend toward reduced external liabilities and/or increased net foreign assets, which is particularly pronounced in emerging Asia, already a net creditor region. In contrast, projected current accounts are associated with a worsening external position in Central and Eastern European countries, where in several cases sizable current account deficits are expected to persist over the medium term.

As discussed above, stabilization of the NFA position at its 2006 level has little normative content. Nevertheless, the exercise provides a perspective on how current account balances expected to prevail at current exchange rates would affect the net external asset position of countries over the medium term. On this basis, the results suggest that emerging market countries as a bloc seem likely to further increase their net asset positions, mirroring a further deterioration in the position of non-European advanced economies, which mainly reflects the position of the United States.

Table 4. External Sustainability: Current Account Stabilizing NFA at 2006 Level
(In percent of GDP)

	NFA 2006	Current Account: Medium term 2012	Current Account: Stabilizing NFA at 2006 level
Advanced countries			
Europe	–9.6	–0.2	–0.5
Other	–7.6	–3.3	–0.5
Emerging markets			
Asia	21.2	7.3	1.7
Latin America	–28.6	–0.8	–1.6
Central and Eastern European countries	–49.1	–3.9	–3.1
Other countries	–13.9	–0.2	–0.9

Sources: Lane and Milesi-Ferretti (2007b); net foreign assets database; IMF, *World Economic Outlook* (October 2007); and IMF staff estimates.

Current Account, Net Foreign Assets, and Exchange Rate Adjustment

The last step of the approach consists of deriving the medium-term real effective exchange rate that would be consistent with stabilization of net foreign assets at the benchmark level. As in the MB approach, this calculation relies on estimating the change in the real effective exchange rate needed to induce the necessary shift in the trade balance and current account.[34] Appendix 4.1 discusses in greater detail some conceptual issues arising from this calculation, particularly in light of the fact that the ratio of net foreign assets to GDP depends in general on the real effective exchange rate.

[33]The appropriate measure of inflation is the domestic one if external assets and liabilities are primarily denominated in domestic currency, or foreign inflation if they are primarily foreign-currency-denominated.

[34]The same trade elasticities are used as in the MB approach, scaled by the openness of each country. As a final step, multilateral consistency is imposed by applying a common correction factor to the estimated exchange rate adjustments (as described in Section II).

Appendix 4.1. ES Approach: An Extension

In this appendix, we derive a more complete link between the trade balance, net foreign assets, and rates of return on external assets and liabilities. To determine the trade balance that stabilizes net foreign assets, we need to consider the income balance—which depends on the NFA itself and on yields on external assets and liabilities. Disregarding capital gains and losses on external holdings, the NFA-stabilizing level of the trade balance can simply be obtained by subtracting the income balance from the NFA-stabilizing level of current account, as in Equation (4) in the text.

Alternatively, we can derive directly the level of trade balance that stabilizes NFA at the anchor level, incorporating information on capital gains (see Lane and Milesi-Ferretti, 2007a and 2007b). Decomposing NFA into assets and liabilities *(a* and *l)*, Equation (2) can be rewritten as

$$b_t - b_{t-1} = bgst_t + \frac{i_i^A - \pi_t - g_t(1+\pi_t)}{(1+g_t)(1+\pi_t)} a_{t-1} - \frac{i_i^L - \pi_t - g_t(1+\pi_t)}{(1+g_t)(1+\pi_t)} l_{t-1}, \quad (5)$$

where i_i^A and i_i^L denote the nominal rates of return—inclusive of capital gains—for external assets and liabilities. For purposes of comparison with Equation (4) in the text, we can rewrite Equation (5) as

$$b_t - b_{t-1} = bgst_t + \frac{r_t^L - g_t}{1+g_t} b_{t-1} \frac{r_t^A - r_t^L}{1+g_t} a_{t-1}, \quad (6)$$

where $r_t^j = [(1+i_t^j)/(1+\pi_t)]-1$ is the real rate of return on external assets (r_t^A) and liabilities (r_t^L). Consider, for example, a country with external assets a equal to 100 percent of GDP (well below the average for advanced economies). In that case, a positive return differential $r_t^A - r_t^L$ of 1 percent between external assets and liabilities would imply that the country can run a trade balance that is 1 percent of GDP worse than in the absence of the return differential, with no impact on the evolution of the net external position.

Decomposing external assets and liabilities further into their "equity" and "debt" components, we can rewrite Equation (5) as

$$b_t - b_{t-1} = bgst_t + \frac{i_t^{EQA} - n_t}{1+n_t} a_{t-1}^{EQA} + \frac{i_t^{DA} - n_t}{1+n_t} a_{t-1}^{DA} - \frac{i_t^{EQL} - n_t}{1+n_t} l_{t-1}^{EQL} + \frac{i_t^{DL} - n_t}{1+n_t} l_{t-1}^{DL}, \quad (7)$$

where the superscripts *EQ* and *D* stand for the "equity" and "debt" components, respectively, and $1 + n_t = (1+g_t)(1+\pi_t)$, that is, n_t is the growth rate of nominal GDP.

To apply this formula, we need to determine the levels of assets and liabilities that are consistent with an anchor level of NFA b^S. We assume that the ratios among different assets and liabilities remain constant at the levels prevailing in the "benchmark," and thereby derive one balance sheet composition that is consistent with b^S:

$$bgst_s = \frac{i_t^{EQA} - n_t}{1+n_t} a^{EQA,S} - \frac{i_t^{DA} - n_t}{1+n_t} a^{DA,S} + \frac{i_t^{EQL} - n_t}{1+n_t} l^{EQL,S} + \frac{i_t^{DL} - n_t}{1+n_t} l^{DL,S}. \quad (8)$$

What is the "value added" of Equations (6) and (8) with respect to (3)? First, Equations (6) and (8) better reflect the increasing role of portfolio equity investment. The current account only records dividends earned and paid on cross-border portfolio equity holdings; however, most of the returns on equity occur through changes in the capital value of stocks, which are not captured in the current account. This can be easily understood by considering one example. The average dividend on portfolio equity holdings overseas over 1996–2005 (as recorded in the U.S. current account) was about 2 percent, but the average return (including capital gains, not incorporated in the current account) was over 10 percent.[35] Because portfolio equity and foreign direct investment (FDI) holdings represent a significant share of GDP, ignoring net capital gains and focusing exclusively on the current account gives an incomplete picture of the likely evolution of net foreign assets.

A second reason why Equations (6) and (8) are more appropriate than (3) relates to the role of inflation differentials. Consider a country that has liabilities in foreign currency (for example, euros), an inflation rate higher than trading partners, and a broadly stable real exchange rate. In this case, the investment income balance of the current account will understate the true cost of debt servicing, because the country will incur a systematic capital loss on its external liabilities as its exchange rate depreciates vis-à-vis the euro.

Exchange Rate Adjustment

As briefly discussed in Section IV, the level of net foreign assets is in general not invariant to changes in the real effective exchange rate, reflecting different currencies of denomination for external assets and liabilities. For example, in a country with external liabilities (mostly) in domestic currency and external assets

[35]The difference between yields and returns is lower for FDI (where reinvested earnings are counted as investment income) but still significant (over 4 percent over the past decade for both assets and liabilities).

(mostly) in foreign currency, a real exchange rate depreciation would tend to improve the net external position by increasing the domestic-currency value of foreign assets. Conversely, in a country where foreign assets and liabilities are both denominated in foreign currency, a real depreciation would worsen the net external position if the country is a debtor or improve it if the country is a creditor, as it would raise the domestic-currency value of net foreign assets. To the extent that the rate of appreciation or depreciation is not fully incorporated in return differentials, its implications for net foreign assets must be taken into account when calculating a path for the real exchange rate that ensures convergence to the desired or benchmark level of net foreign assets.

Consider, for example, the case of a debtor country whose net foreign position b is negatively related to the real effective exchange rate. In this case, as shown by Blanchard, Giavazzi, and Sa (2005), external adjustment would require a gradual depreciation, if the initial depreciation were large enough to ensure that $bgst^s = bgst^s$ it would also increase b above b^s and subsequently drive it further and further away from b^s. With a gradual depreciation, the net external position would initially improve, but the trade balance would not improve by enough to ensure a stable external position. Hence b would deteriorate, the real exchange rate would depreciate further, and the trade balance would improve until a new steady state was reached where $b = b^S$ and $bgst = bgst^S$.

V Conclusions

This paper has presented three alternative methodologies to help gauge the consistency of current account balances and real effective exchange rates with their underlying fundamentals. While assessments of exchange rate misalignment will always need to be informed by country-specific factors that are difficult to incorporate into studies based on large cross-country data sets, the consistent multilateral approach developed in the foregoing sections should nevertheless prove useful and complementary to the approaches pursued at the IMF country desk level.[36]

The three approaches are also intended to be complementary to one another in the process of arriving at "exchange rate assessments." In many cases the different approaches will yield qualitatively and even quantitatively similar results, but this will not necessarily be the case: the ERER approach focuses directly on prices (exchange rates), while the other two approaches focus on quantities (current accounts and net foreign assets) and then derive the implications for the exchange rate. This difference in focus also implies some differences in the fundamentals being captured under each of the approaches.[37] Indeed, the process of arriving at exchange rate assessments is not a mechanical one, in which the results of applying one particular methodology are imposed, or a simple average among all the available approaches is used. For example, a methodology's estimate for a specific country may be disregarded in light of factors such as data limitations, a short sample, and large sensitivity of that country's results to minor modifications in the methodology.

The importance of avoiding a mechanical assessment is underscored by the uncertainty surrounding econometric estimates, the inability to fully incorporate all relevant country-specific factors, issues related to data availability and reliability, and potential shifts in the underlying macroeconomic and structural relationships. These problems may be particularly severe for countries undergoing rapid structural change and for those for which sample length is relatively short.

This paper's other main contribution is to explicitly recognize the much greater weight of key emerging market countries in the problem of global imbalances and currency misalignments. While past exchange rate assessments had an entirely advanced-economy focus, the work developed in this paper is based on a much larger sample of both emerging and advanced economies, and hence is able to capture a much greater share of global trade. This should allow more balanced judgments to be reached on how currencies—of both advanced and emerging economies—ultimately may need to adjust as the currently sizable global current account imbalances are narrowed.

[36]Of course the exchange rate is not necessarily the only variable delivering the adjustment. The idea behind assessing an exchange rate misalignment is to evaluate what would be the necessary exchange rate adjustment should all fundamentals be at their projected value.

[37]In a few instances, there can be significant differences between misalignment estimates according to the different methodologies. For example, in the case of China and the United States, the ERER methodology points to a much lower misalignment than the MB or the ES approach as of 2007. One reason is that the two methodologies are based on different measures of external imbalances. ERER is based on the stock of net foreign assets projected for 2012, while the medium-term current account projections that underpin the MB and the ES would result in much higher stock imbalances over the longer run.

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