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# New Estimates of Fundamental Equilibrium Exchange Rates

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From early in its existence, the Peterson Institute for International Economics has occasionally produced estimates of the fundamental equilibrium exchange rates (FEERs) of major currencies. We have long felt that there would be value in regularly producing such numbers, so that observers had a metric with which to judge ongoing changes in exchange rates but were deterred from producing such estimates by the difficulties and expense involved in making estimates of FEERs in the absence of a working model. There are, of course, floating fundamentalists who regard such an exercise as superfluous, because the market is by definition always right.

But there are also those who believe that markets can and do at times err. Some of those who believe this also believe that markets would be less liable to err if there were informed public debates, such as we seek to stimulate with this policy brief, about the appropriateness of current rates. Since we now have a tool that permits regular calculation of estimates of equilibrium exchange rates, we have decided to exploit it.

The first part of this policy brief reminds readers of the nature of the FEER. Since it is defined as the (real, effective) exchange rate that will achieve specified medium-term objectives for the economy, the next task is to describe and justify the assumptions that are made. These are of two types: assumptions of what would happen if there were no exchange rate changes and assumptions about the policy objectives that are being pursued. The object is to calculate exchange rate changes consistent with achievement of those objectives. We then describe briefly the nature of the model we employ to translate objectives into exchange rate outcomes. (The model is presented more fully in Cline 2008.) The final and most substantive section of the paper presents and discusses the new results.

These results, of course, depend on both normative judgments and specific measures of likely changes in current account balances in response to exchange rate changes. However, the transparency with which the calculations are presented should allow for others to make their own evaluations. They are our estimates of what would be needed in order to achieve specified macroeconomic outcomes.

We are well aware that neither the outcomes specified nor the assumptions about what would happen at constant exchange rates nor the model used to estimate the exchange rate implications of the outcomes specified are beyond challenge. But we are also convinced that debate about where exchange rates ought to be needs to start by someone laying out their ideas on paper.

We hope that those who disagree with our conclusions will explain their disagreements by pinpointing the specific part of the analysis that they find lacking, so that we may benefit from the criticisms and be able to make better estimates in the future.

## THE CONCEPT OF THE FEER

One of the authors of this policy brief introduced the concept of the fundamental equilibrium exchange rate in one of the early publications of the Institute for International Economics (Williamson 1983). The term was chosen to emphasize that one was seeking the obverse of an exchange rate in "fundamental disequilibrium" in the Bretton Woods sense. Hence a FEER involved an exchange rate that is indefinitely sustainable on the basis of existing policies. It should be one expected to generate a current account surplus or deficit that matched the country's underlying capital flow over the cycle, assuming that the country is pursuing internal balance as best as it can and that it is not restricting trade for balance-of-payments reasons. In a growing world where demand for reserves is increasing over time, one needs to include the secular growth of reserve holdings as part of the capital flow that is to be financed by the current account surplus (or deduct the desired reserve increase from the capital inflow that permits a current account deficit).

Few countries now restrict trade for balance-of-payments reasons. Similarly, the dominant view that demand pressure drives the *acceleration* rather than the *level* of inflation pretty much removes choice about what is meant by internal balance. In contrast, the widespread advent of high capital mobility has made it far more difficult to definitively pin down what is meant by a country's "underlying capital flow." An extreme view would be that *any* level of current account imbalance can be financed by an endogenous capital flow, making it impossible to define a FEER. We believe that this goes altogether too far and that one can still identify dangerously large capital inflows (i.e., borrowing) and economically unproductive capital outflows (lending, including reserve buildups). There is nevertheless a range of indeterminacy: Within some limits, capital flows and therefore current accounts may vary without inducing forces that tend to curtail the flows. Limits lie at the edges of this range of indeterminacy, and it is desirable to work toward a situation in which the limits are respected. We adopt this position in our study, as will be evident when we discuss the appropriate set of current account targets.

Naturally a FEER is defined in *real* (inflation-adjusted) terms. If a country suffers 10 percent higher inflation than its peers, then its currency will have to depreciate by 10 percent in order to restore the same real position as before. Only then will its producers have their competitive position restored and will its consumers face the same choices as before. Similarly the relevant exchange rate concept is an *effective* rate—i.e., one where the myriad foreign currencies are all taken into account and weighted (by their importance in the foreign trade of the country concerned) to form a single estimate of the exchange rate. The practice of measuring a currency's value in terms of the currency of a single trading partner and calling this "the" exchange rate is quite wrong for a country with reasonably diversified trade. This is a bilateral rate, in contrast to the effective rate, which gives a measure of a country's overall competitive position. (None of this is to deny that many other factors such as productivity also influence competitiveness, which are implicitly being held constant in the analysis of exchange rates.)

## ASSUMPTIONS

As stated above, it is natural to break down the assumptions into two types. One is a projection about what would occur if no exchange rate changes were made. The other assumptions relate to the policy objectives that are being, or ought to be, sought by macroeconomic policy.

The projections come directly from the International Monetary Fund's latest *World Economic Outlook* (IMF 2008a). In principle, it might be better to use the longest projections published by the Fund, for the year 2013, on the ground that these would build in a return of output levels to their cyclically normal positions and would allow time for the effects of past exchange rate changes to work their way through the system. However, for almost all countries except Russia, the IMF is projecting that there would be no further significant changes in current account positions on the basis of existing policies. This vitiates the value of using a distant projection, which is intended to recognize further changes that seem likely to occur on the basis of present policies and with existing real exchange rates. For example, the IMF is projecting mild cycling of the Brazilian current account deficit in the out years, rather than the progressive deterioration that we believe to be likely with the present real value of the real. It, therefore, seems to us preferable to use their projections for 2009, which are more solidly based than those for 2013 can hope to be. In the future it is conceivable that we will be in a position to add assumptions regarding the elimination of cyclical slack, or adopt our own projections for the progressive change in current account positions that seem likely on the basis of existing exchange rates, but we have made no such assumptions of our own in this instance. Hence if the United States suffers a more severe slowdown than most other countries in 2008–09, and if the US current account deficit is being projected as abnormally small on account of this fact, then our procedures imply that we will underestimate the dollar depreciation needed to achieve the objectives specified.

The April 2008 *World Economic Outlook* was prepared on the basis of data up to and including February 2008. That

is why we have estimated the bilateral dollar exchange rates consistent with achievement of all FEERs as changes in dollar exchange rates compared with the rates of February 2008.

We assume that all countries target employment at its natural rate. But this is not the same as assuming that they always hit it. The forecasts used in projecting balance-of-payments outcomes on present policies may assume that some countries are in for a long spell of high unemployment. If unemployment is being deliberately sought in order to reduce inflation to an acceptable target, then one might still want to classify a country as being in internal balance. But if the high unemployment results from a failure to stimulate demand sufficiently, then in principle one would wish to allow for this in calculating the equilibrium exchange rate. In practice we have not changed the IMF projections to attempt to do this at the present time.

**The most important determinant of a non-oil-exporting area's equilibrium exchange rate is its current account target.**

It is widely believed that there are two major causes of the current external imbalances in the world economy. One is the recent increases in oil prices, which have caused large surpluses in most of the oil-exporting countries and correspondingly large deficits in the oil-importing countries. The other is the large imbalance between a number of East Asian countries on the one hand and a number of other countries, primarily the United States, on the other. The central case of our analysis is focused on the second of these problems and not the first.

We do not believe that it is fruitful to attempt to estimate the equilibrium exchange rates of the currencies of the oil exporters, represented in our group of countries by Saudi Arabia, Norway, Russia, and Venezuela. These depend negatively upon their saving strategies and positively on the oil price. Saving strategies vary enormously from one country to another, from a country like Norway that saves virtually all of an increment in the oil price to one like Ecuador that spends virtually everything and will face difficulties if and when the oil price falls. The world has to find a way of accommodating countries like Norway, since such savings reflect the transformation of exhaustible natural resource wealth into wealth in the form of foreign assets. If exchange rate targeting came to be viewed as a way of trying to cajole oil exporters into acting contrary to their enlightened long-run interest and forcing them into excessive adjustment, their reluctance to participate would be well-merited. A likely reaction would be a decision to keep more oil in the ground and sell less on the world market. Nevertheless, there is a view that the oil exporters should be subjected to similar disciplines as other countries irrespective of the consequences, so we report a simulation in which they are assigned targets similar to other countries.

The other critical variable is the oil price, which has already (as of late May) risen by over 40 percent from the $95 per barrel assumed by the IMF in the exercise that forms the basic projection of this study. Since many of the oil exporters will ultimately spend much of their additional receipts, the equilibrium real exchange rates of most of the oil exporters have risen in consequence. We have two reasons for not attempting to estimate by how much. First, this would depend on a reasonable extrapolation of the oil price, which neither we nor anyone else is currently in a position to make. (Attempts to keep up with the latest numbers would threaten us with apoplexy.) Second, estimating equilibrium exchange rates would demand estimates of the saving strategies of each oil exporter identified in this study. That would at the least require detailed knowledge of each country, which we do not claim to possess. We believe that it is better to restrict our task to that of estimating the equilibrium exchange rates of other countries, in the belief that these estimates are reasonably independent of the oil price.

None of this is to doubt that the policy of many oil exporters of pegging their currencies to the dollar is questionable, or that the IMF's endorsement of this policy is misguided. As Brad Setser argued in his policy brief 07-8 for the Peterson Institute (Setser 2007), most of these countries would benefit both themselves and the world economy if they either floated their exchange rates or pegged them to a basket that contained both the currencies from which they buy their imports and the oil price.[1] This would not necessarily increase the total amount of adjustment that occurs (which should not be our aim), but it would make adjustment both more rapid and more focused on changes in the income and spending of the private sector. Perhaps most important, it would enable adjustment to an increased oil price to occur without the inevitable side product of inflation, which is implied by a dollar peg.

The most important determinant of a non-oil-exporting area's equilibrium exchange rate is its current account target. We started from a presumption that in general, imbalances should not exceed 3 percent of GDP in the intermediate run. This has become a standard figure, so the first justification for using it is to prevent our conclusions from being based on assumptions that are at variance with conventional wisdom. But one should also ask whether its adoption as conventional wisdom was solidly based. The answer is that there is at least a

1. However, simulations suggest that the 50 percent weight on the oil price mentioned by Setser would have been far too high. A reasonable value might in our view fall in the range of 10 to 15 percent.

rule of thumb with a modicum of statistical support to justify the contention that most countries should not accept deficits exceeding 3 percent of GDP except on a transitory basis.[2] If one does not wish the burden of adjustment to fall overwhelmingly on deficit countries, then one needs to make sure that a roughly symmetrical rule applies to surplus countries.

Given the 3 percent rule, we can classify in the following ways the 30 nonoil countries whose FEERs we are seeking to establish:

1. Eight countries that have projected 2009 deficits in excess of 3 percent of GDP, which we assume should be reduced to 3 percent. These countries are Colombia, Hungary, India, Poland, South Africa, Turkey, the United Kingdom, and the United States. Counting Hungary, Poland, and Turkey as developing countries, six of these eight countries are developing countries, in which we regard it as appropriate to run moderate current account deficits. The remaining two are the large Anglo-Saxon chronic-deficit countries, in which a more ambitious target than a 3 percent of GDP deficit at present appears unrealistic.
2. Four economies that have projected 2009 deficits less than 3 percent of GDP, which we have reduced to a target of zero. Three of these, Korea (arguably) and the euro area and Canada (indisputably), are industrial economies. We subscribe to the traditional view that it is fundamentally a distortion in the international economy for capital to flow "uphill" from developing to industrial countries, so we suggest they should target zero for that reason and because they are clearly capable of achieving that objective. The remaining country is Argentina, which seems unlikely to be able to finance much of a deficit in the future in the light of its record of unilaterally renouncing debt contracts when these become inconvenient.
3. Four developing countries, mostly Latin American (Mexico, Brazil, Chile, and the Czech Republic), that have a 2009 projected deficit of less than 3 percent of GDP, whose target we assume should be to remain the same. This is a reflection of our belief that it is wrong to oblige countries to adjust when they have no need to and that it is appropriate and conducive to good resource allocation for developing countries (within reason) to run deficits and borrow.
4. Two resource-intensive countries in deficit that appear to prefer larger deficits than 3 percent and have demonstrated that they are capable of managing large debts. We have doubled the allowable deficit for Australia and New Zealand to 6 percent on these grounds. But we still believe that prudence demands that they not allow their debts to explode as would certainly result from even larger deficits.[3]
5. Four developing countries (Indonesia, Thailand, Philippines, and Israel) with projected 2009 surpluses of less than 3 percent of GDP, which we have given a target of zero. The reasons are symmetrical with those cited for group 2.
6. Two countries (Singapore and Switzerland) that have for many years run large surpluses, as part of a rational strategy of optimal accumulation, to which we have assigned a target surplus of 6 percent of GDP in symmetry with group 4. We accept that these countries would face major difficulties in adjusting if they were expected to follow the same rules as other countries, and that saving is a social virtue, but it is also true that saving can be so large as to inflict deflation on trading partners. The suggested targets represent a compromise between alternative views of what is socially responsible.[4]

This set of categories and country conditions provides targets for 24 economies. For reasons mentioned earlier, we

2. For emerging-market economies, Reinhart, Rogoff, and Savastano (2003) statistically identify 40 percent as a critical threshold for external debt relative to GDP, beyond which countries have tended to be vulnerable to default. External debt stabilizes at a debt to GDP ratio that equals the ratio of the current account deficit as a percent of GDP to the nominal growth rate of GDP in foreign currency. With emerging-market growth rates typically in the range of 4 to 5 percent and world inflation at 2½ percent in dollars or euros, nominal GDP growth in foreign currency is typically on the order of 7 percent. Forty percent of this growth rate is about 3 percent, so the critical debt to GDP ratio translates into a current account deficit of about 3 percent of GDP. For industrial countries, Freund (2000) found that reversals of deficits tend to begin at a threshold of 5 percent of GDP and involve a slowdown in growth in the adjustment period. Mann (1999, 156) identifies 17 episodes in which widening current account deficits of industrial countries were reversed in the 1980s and 1990s; the average ratio of the current account deficit to GDP was 4.5 percent when the reversal began (although she indicates that the turning points were not necessarily thresholds of unsustainability). For the important case of the United States, Cline (2005, 172–74) argues that 3 percent of GDP is a prudent long-term ceiling for the current account deficit despite past advantages of higher return on foreign assets than liabilities and favorable valuation effects from exchange rate changes. Williamson (2004, 30) and Mussa (2005, 189) set the ceiling at 2 to 2.5 percent of GDP.

3. Moreover, one of us has argued that New Zealand's net international liabilities, at 92 percent of GDP, are already precariously high, especially given its higher rate of return paid on external liabilities than earned on external assets (Cline 2006, IMF 2008b).

4. Switzerland has an unusual structure of assets and liabilities, which partially explains its flow balance of payments figures. Large multinational firms based in Switzerland are principally owned by foreigners. The reinvested earnings of these corporations are included in the current account, but the result is an appreciation in the stock market value of the corporations and the foreign component of that does not get registered in the current account as a debit item. No similar simple explanation is available for Singapore, which shows a deficit in its investment income on the balance of payments despite its massive NFAs.

have resolved not to formulate targets for the four oil exporters in the central case (although we do so in one of the three variant scenarios considered). The remaining task is to formulate targets for the other six economies: China, Hong Kong, Japan, Malaysia, Taiwan, and Sweden, all of which are economies with a major surplus exceeding 3 percent of GDP. The preceding suggestions call for an aggregate net reduction in deficits of $351 billion (deficit reductions of $429 billion, led by the United States with $170 billion and the euro area with $120 billion; and surplus reductions of $78 billion, led by Singapore and Switzerland with about $30 billion each). If one imposes the condition that the rest of world (RoW) imbalance not be affected by the adjustment program (because one surely does not want to require countries to adjust simply because they were not individually identified), the six preceding adjusters have to reduce their surpluses by a collective $351 billion. The collective excess of their surpluses over 3 percent of GDP is $430 billion. Hence the target of each is a reduction in their surplus of 351/430 x (the excess of their projection over 3 percent of GDP).

**The US dollar remains somewhat overvalued on a multilateral basis. A further decline in its value will be needed to restore equilibrium, even defining equilibrium to be a 3 percent of GDP deficit in the current account.**

This method is most comparable to the first methodology expounded by Lee et al. (2008) in their description of the three methodologies employed by the IMF's Consultative Group on Exchange Rate Issues (CGER) to assess equilibrium exchange rates. This first methodology, which they call the Macroeconomic Balance Approach, differs in two important ways from that we use. First, we use a judgmental rather than an econometric approach to determine current account targets. Second, we use standard rather than estimated country-specific responses of the trade balance to the real exchange rate.

So far as the first difference is concerned, they use an estimated equation with arguments of fiscal balance, demographics, net foreign assets (NFAs), oil balance, economic growth, economic crises, and whether a country is a financial center to determine the current account targets for 54 advanced and emerging-market countries. It is inevitable that the staff of an international organization will seek to use a formula rather than judgment in such a sensitive exercise. The judgment that we use is, of course, constrained by what seems reasonable in the light of factors such as those used in the IMF's estimating equation. We nevertheless chose a judgmental approach for three reasons. First, we were in no position to estimate a full econometric equation of the type employed by the IMF. Second, we believe it to be important to treat comparable countries equivalently, and unless the IMF has chosen exactly the right variables to include in its estimating equation (and has estimated the true coefficients), this treatment will not be guaranteed by the IMF approach. In this context, inclusion of an economy's oil balance as a determinant of its current account target appears particularly dubious, although it surely improves the goodness of fit of an estimated equation explaining current account balances. Third, we do not agree that the results of the IMF equation make normative sense. These results average to a balance of +0.3 percent of GDP for advanced economies in Europe, –1.9 percent of GDP for all other advanced economies (dominated by the United States), +1.3 percent of GDP for emerging-market economies in Asia, –0.3 percent for Latin America, and –2.8 percent for Central and Eastern Europe (Lee et al. 2008, 7). But surely it is hardly normative for the Asian emerging-market economies to be running sizable current account surpluses rather than receiving net capital inflows for development any more than it should be seen as normative for advanced economies outside Europe to be running deficits and absorbing capital from the developing world.

So far as the second difference is concerned, we have neither access to a compendium of country-specific elasticities nor the capacity to estimate such elasticities ourselves. We suspect the uncertainties involved in estimating elasticities are such as to give the IMF approach a minimal advantage.

The second method employed by the IMF is an equilibrium real exchange rate approach (also known among practitioners as a "behavioral effective exchange rate" or BEER), while the third aims for a current account balance that would stabilize NFAs as a proportion of GDP at an appropriate level. We do not pursue a BEER approach and have critiqued it as a guide to FEERs on grounds, among others, that such estimates must assume that on average all countries were in fundamental equilibrium during the estimation period (Cline and Williamson 2008). As for the NFA approach, in practice the appropriate level is interpreted by the IMF as the 2006 level (2006 was the latest year for which complete data were available). In one of our alternative simulations we adopt the aim of stabilizing NFA/GDP at its projected 2009 level.[5] As

5. We calculate these based on the 2006 NFA estimates available in IMF (2008b), by adding cumulative current account balances in 2007–09 as projected in IMF (2008a). For the United States, specific estimates are developed based on the model discussed in Cline (2005). These involve significant gains from exchange rate valuation effects in 2007 and 2008. The same study is the

the IMF study concedes (Lee et al. 2008, 15–16), there is little normative content to this objective since it may be optimal to raise or lower the level of NFA/GDP, but the method does have the virtue of ruling out Ponzi strategies.[6]

In addition to the central case described above, we run three other simulations of the model described below. The first uses the same set of current account objectives as described above but assumes that the trade elasticities are higher (the "high-elasticities variant") in order to shrink the global current account discrepancy that otherwise emerges in the realignment solution. The second attempts to apply the same set of rules to the four of our countries described by the IMF as fuel exporters, namely Saudi Arabia, Norway, Russia, and Venezuela. The latter two are unaffected because they have projected imbalances of less than 3 percent of GDP, but it is assumed that both Saudi Arabia and Norway should aim to reduce their surpluses to 6 percent of GDP, the same as Singapore and Switzerland. The third variant simulation represents an attempt to apply the IMF's last approach. It adjusts current accounts from their 2009 baselines to levels needed to stabilize NFA/GDP ratios at their 2009 levels. In our NFA variant, however, the oil-exporting economies are once again exempted from the general rule. The sets of current account targets and figures relevant to their derivation are shown in table 1.

## NATURE OF THE MODEL EMPLOYED

This section summarizes the features of the symmetric matrix inversion method (SMIM) model developed in Cline (2008) to calculate FEERs for 34 economies. This method is symmetric in that it gives equal weight to each country in arriving at the realignment to FEERs, rather than requiring exact achievement of the adjustment target for the United States and then solving for partner exchange rate changes consistent with this requirement and also as consistent as possible with the other current account targets.[7] The model is based on two sets of relationships. The first is economic: The current account depends on the real effective exchange rate.[8] The second is essentially algebraic: The change in the effective exchange rate is a weighted average of changes in bilateral exchange rates. Realignment of bilateral exchange rates to arrive at FEERs must obey this consistency relationship in coming as close as possible to the desired set of changes in effective exchange rates.

**The dollar has been overstrong for many years (as a result of which the United States has changed from the world's largest net creditor to its largest debtor), a disequilibrium that our method assumes needs to be reduced to a prudent level.**

The economic relationship states that the change in the current account as a percent of GDP will be equal to the percentage change in the effective exchange rate, multiplied by a country-specific impact parameter. The impact parameter equals the export price elasticity multiplied by the share of exports in GDP. Ideally, export elasticities would be specially tailored for each economy, for example, to reflect idiosyncrasies of greater or lesser exchange rate responsiveness (including, for example, influences of product composition as well as exchange rate pass through) of the economy's principal trading partners. In practical implementation, the export price elasticity is assumed to follow a standard formula set at unity for a relatively closed economy with exports amounting to 10 percent of GDP and falling to 0.5 (because of increasing supply constraints) for a highly open economy with exports equal to 100 percent of GDP or more.[9] A variant using high elasticities was also explored, in an effort to narrow the global current account discrepancy from an increase of $122 billion in the central case. Increasing the elasticities to 1.5 for the relatively closed economy and 0.75 for the highly open economy, thus increasing the impact parameters for all countries except the United States (for which a model-specific value is used), realignment generates an increase of only $45 billion in the global current account discrepancy.

source for the NFA estimate for Taiwan (p. 23). The estimate for Saudi Arabia is for the country's sovereign wealth fund (Truman 2008).

6. In which deficits or surpluses could continue to widen without limit.

7. In two earlier approaches that may be designated US-centric instead of symmetric, Cline (2005) used an optimization algorithm and Cline (2007) used a matrix inversion method for this purpose.

8. This relationship focuses on the relative price or "elasticity" effect in determination of trade. A parallel shadow "absorption" effect must also be consistent, involving the national accounts identity whereby net imports equal investment minus saving (including public). Implicitly the focus on the effective exchange rate in external-sector adjustment assumes that parallel influences on domestic demand, such as a fiscal adjustment, take place to facilitate external adjustment and maintain the economy at full capacity.

9. Absence of change on the imports side is premised on a price elasticity of unity for imports, which means that the local currency value of imports does not change, and both the volume and dollar value of imports change in proportion to the strength of the local currency against the dollar. In the case of oil, exports are not sensitive to price so the adjustment of economies that export only oil takes place exclusively on the import side. (For them, the parameters used here imply an import price elasticity of about 2.) For the United States, the estimates use an impact parameter derived from a much more complete model and include capital income effects from cumulative changes in net foreign liabilities.

**Table 1 Macroeconomic benchmarks[a] and adjustment targets**

| Country | GDP (billions of dollars) | Current account | | NFA as percent of GDP[b] | Target change in current account (percent of GDP) | | |
|---|---|---|---|---|---|---|---|
| | | Billions of dollars | Percent of GDP | | Central case | Oil-adjustment variant | NFA variant |
| **Pacific** | | | | | | | |
| Australia | 1,103 | –58.2 | –5.3 | –60 | 0.0 | 0.0 | 1.3 |
| New Zealand | 152 | –10.8 | –7.1 | –88 | 1.1 | 1.1 | 1.5 |
| **Asia** | | | | | | | |
| China | 4,430 | 442.7 | 10.0 | 42 | –5.7 | –3.9 | –5.9 |
| Hong Kong | 240 | 20.0 | 8.3 | 244 | –4.4 | –2.3 | 8.8 |
| India | 1,357 | –46.1 | –3.4 | –11 | 0.4 | 0.4 | 1.8 |
| Indonesia | 536 | 6.5 | 1.2 | –21 | –1.2 | –1.2 | –3.8 |
| Japan | 5,027 | 198.5 | 3.9 | 48 | –0.8 | 0.0 | –2.3 |
| Korea | 1,073 | –9.2 | –0.9 | –20 | 0.9 | 0.9 | –0.9 |
| Malaysia | 222 | 24.6 | 11.1 | 31 | –6.6 | –5.0 | –11.1 |
| Philippines | 187 | 1.8 | 1.0 | –9 | –1.0 | –0.9 | –2.2 |
| Singapore | 202 | 38.2 | 18.9 | 121 | –12.9 | –12.7 | –11.8 |
| Taiwan | 443 | 35.8 | 8.1 | 100 | –4.1 | –2.0 | –1.6 |
| Thailand | 294 | 3.9 | 1.3 | –6 | –1.3 | –1.3 | –2.4 |
| **Middle East/Africa** | | | | | | | |
| Israel | 184 | 3.1 | 1.7 | –1 | –1.7 | –1.7 | –2.3 |
| Saudi Arabia | 506 | 121.3 | 24.0 | 77 | 0.0 | –17.7 | 0.0 |
| South Africa | 314 | –24.9 | –7.9 | –35 | 4.9 | 5.0 | 4.4 |
| **Europe** | | | | | | | |
| Czech Republic | 227 | –6.3 | –2.8 | –29 | 0.0 | 0.0 | 0.5 |
| Euro area | 13,978 | –120.8 | –0.9 | –8 | 0.9 | 0.9 | 0.4 |
| Hungary | 163 | –8.3 | –5.1 | –91 | 2.1 | 2.1 | –1.1 |
| Norway | 471 | 96.3 | 20.4 | 99 | 0.0 | –14.2 | 0.0 |
| Poland | 481 | –27.3 | –5.7 | –47 | 2.7 | 2.7 | 1.9 |
| Russia | 2,017 | 57.7 | 2.9 | 8 | 0.0 | 0.0 | 0.0 |
| Sweden | 513 | 34.5 | 6.7 | 10 | –3.0 | –0.7 | –8.0 |
| Switzerland | 475 | 65.4 | 13.8 | 142 | –7.8 | –7.6 | –9.2 |
| Turkey | 758 | –47.9 | –6.3 | –44 | 3.3 | 3.4 | 2.3 |
| United Kingdom | 2,990 | –131.0 | –4.4 | –34 | 1.4 | 1.4 | 2.1 |
| **Western Hemisphere** | | | | | | | |
| Argentina | 364 | –2.0 | –0.5 | 6 | 0.5 | 0.6 | 0.8 |
| Brazil | 1,730 | –16.0 | –0.9 | –23 | 0.0 | 0.0 | –0.8 |
| Canada | 1,632 | –19.8 | –1.2 | –7 | 1.2 | 1.2 | 0.7 |
| Chile | 173 | –2.3 | –1.3 | –6 | 0.0 | 0.0 | 0.7 |
| Colombia | 209 | –9.1 | –4.3 | –31 | 1.4 | 1.4 | 1.7 |
| Mexico | 988 | –16.3 | –1.6 | –44 | 0.0 | 0.0 | –1.0 |
| United States | 14,533 | –605.5 | –4.2 | –25 | 1.2 | 1.2 | 2.4 |
| Venezuela | 339 | 17.1 | 5.0 | 37 | 0.0 | 0.0 | 0.0 |
| **Rest of world** | 5,042 | 196.2 | 3.9 | n.a. | 0.0 | 0.0 | 0.0 |
| **World** | 63,354 | 202.1 | 0.3 | n.a. | 0.0 | 0.0 | 0.0 |

n.a. = not available; NFA = net foreign assets

a. International Monetary Fund forecast for 2009 (IMF 2008a).

b. Estimates for 2009 (authors' calculations; see footnote 5).

The overall effect in the central case is that the impact parameter rises from about 0.15 percent of GDP change in current account for each percentage point change in the effective exchange rate for a relatively closed economy to a maximum of 0.5 percent of GDP per percentage point for a highly open economy. In the case of China, for example, the central case estimates the impact parameter at 0.3 percent of GDP reduction in current account surplus for a 1 percentage point appreciation in the effective exchange rate.[10] If the target external adjustment is a reduction in the current account surplus by 6 percentage points, the target effective exchange rate appreciation will need to be 6/(0.3) = 20 percent.

The first step in the analysis, identification of the target change in each country's real effective exchange rate (REER), is thus simple. For each country, the change equals the desired change in the current account as a percent of GDP, divided by the elasticity-based impact parameter. The problem then becomes more complicated, however, when consistency is imposed on all of the resulting changes in REERs. Changing the REER for any given country necessarily changes those of its trading partners. The second part of the analysis, then, involves a set of algebraic relationships among individual economies' effective exchange rates, and between bilateral and multilateral effective exchange rate changes. If a currency appreciates by, say, 10 percent against the dollar in isolation, its effective appreciation against all trading partners also equals the bilateral appreciation, or 10 percent. But if other trading partners also appreciate, the home country's appreciation in effective terms will be diminished by an amount that depends on the importance of the other appreciating countries as trading partners. This influence turns out to be particularly important when considering possible corrective change in exchange rates in East Asia. Bilaterally against the dollar, some of the indicated changes can be quite large; but because several regional trading partners also show sizable bilateral appreciations against the dollar needed to reach adjustment targets, the corresponding effective exchange rate changes are typically considerably smaller and thus likely not as daunting in policy terms.

The SMIM model solves for a set of bilateral exchange rate changes against the dollar that is consistent with a target set of changes in effective exchange rates. It turns out that this is the solution to a matrix algebra problem, in which the bilateral exchange rate changes (in percent), the effective exchange rate changes (in percent), and a matrix of trade weights enter the equation.[11] It also turns out that there is not just one solution to this problem. With 35 economies, the number considered in this study, there are 35 possible alternative solutions. The reason is that there are 35 equations for target effective exchange rate changes (one for each country, in light of its target current account change and impact parameter) but only 34 unknown exchange rate changes against the dollar—because the dollar cannot change against itself (in the jargon of the exchange rate literature, it is the numeraire). Our approach to dealing with this problem of "overdetermination" is simply to average the alternative possible sets of exchange rate changes.[12]

## RESULTS

The results of the analysis are shown in table 2 for the central case. The first column shows the target change in the current account balance as a percentage of GDP, reproduced from the final column in table 1. We are, of course, well aware that adjustment usually takes longer than a year; consequently, even if all countries succeeded immediately in achieving and subsequently in maintaining the exchange rates calculated to be equilibria, they would not be expected to achieve the desired current account outcomes in 2009. We have nevertheless focused on values of 2009 for purposes of analysis.

The next column in table 2 shows how close a simulation of the model described in the preceding section came to achieving the targets laid out. The simulation gives an equal weight to all countries in meeting the targets of column (1). It will be observed that in these simulations the United States somewhat overachieves its needed adjustment.

Column (3) shows our estimate of the needed changes in the multilateral exchange rates in February 2008, derived from the target change in the current account and the impact parameter. A positive number indicates that the currency of the area in question needed to appreciate and thus that the

10. To calculate the effective exchange rate, the importance of each of the 34 trading partners in the trade turnover (exports plus imports) of a country is calculated from a matrix of bilateral trade flows (Cline 2008, appendix D).

11. Namely: $Z = B^{-1}R$, where $Z$ is a vector of bilateral exchange rate changes against the dollar (percentages), $R$ is a vector of effective exchange rate changes (percentages), and $B = I - A$, where $B$ is the matrix obtained by subtracting the trade-weights matrix $A$ from the identity matrix $I$.

12. With a single exception, for each currency. Of the 35 solutions, the average for the currency in question is for the 34 equations in which the country has been included. The remaining equation omits the direct effective rate equation for the country and only obtains the country's bilateral exchange rate change indirectly as needed to generate the set of effective exchange rate changes sought for the other countries. The average of the 34 results with own country included, or 34OCI, is used as the estimate of the bilateral exchange rate change for the country in question, because the one own country excluded (OCE) result systematically turns out to be unrepresentative. The OCE estimate is always lower than the 34OCI average, in some cases absurdly so. With the 34OCI estimate in hand for each of the 35 economies' exchange rate change against the dollar (zero, for the dollar), the corresponding set of effective exchange rate changes is then calculated. Because of the overdetermination problem, this estimated consistent set will show divergences from the target set of effective exchange rate changes. These divergences are generally small, however.

**Table 2 Results of the central simulation**

| Country | Changes in current account as percent of GDP | | Change in REER (percent) | | Change in dollar exchange rate | Dollar rate in February 2008 | FEER-equivalent dollar rate |
|---|---|---|---|---|---|---|---|
| | Target change | Change in simulation | Target change | Change in simulation | | | |
| **Pacific** | | | | | | | |
| Australia | 0.0 | 0.2 | 0.0 | –1.3 | 12.8 | 0.91 | 1.02 |
| New Zealand | 1.1 | 1.4 | –4.4 | –5.4 | 6.7 | 0.80 | 0.85 |
| **Asia** | | | | | | | |
| China | –5.7 | –5.5 | 19.2 | 18.4 | 31.5 | 7.17 | 5.45 |
| Hong Kong | –4.4 | –4.1 | 8.7 | 8.2 | 29.0 | 7.80 | 6.05 |
| India | 0.4 | 0.5 | –2.8 | –3.6 | 7.1 | 39.7 | 37.1 |
| Indonesia | –1.2 | –1.0 | 4.4 | 3.5 | 22.6 | 9,181 | 7,490 |
| Japan | –0.8 | –0.7 | 6.6 | 5.7 | 19.0 | 107.2 | 90.1 |
| Korea | 0.9 | 1.1 | –2.7 | –3.5 | 11.2 | 945 | 850 |
| Malaysia | –6.6 | –6.1 | 13.2 | 12.3 | 30.7 | 3.22 | 2.47 |
| Philippines | –1.0 | –0.7 | 2.5 | 1.7 | 18.2 | 40.7 | 34.4 |
| Singapore | –12.9 | –12.3 | 25.8 | 24.7 | 41.2 | 1.41 | 1.00 |
| Taiwan | –4.1 | –3.8 | 9.7 | 9.0 | 26.0 | 31.6 | 25.1 |
| Thailand | –1.3 | –0.9 | 2.9 | 2.0 | 17.9 | 32.7 | 27.7 |
| **Middle East/Africa** | | | | | | | |
| Israel | –1.7 | –1.5 | 5.2 | 4.5 | 9.4 | 3.61 | 3.30 |
| Saudi Arabia | 0.0 | 0.3 | 0.0 | –0.7 | 10.1 | 3.75 | 3.41 |
| South Africa | 4.9 | 5.2 | –13.9 | –14.6 | –6.7 | 7.66 | 8.21 |
| **Europe** | | | | | | | |
| Czech Republic | 0.0 | 0.2 | 0.0 | –0.5 | 1.4 | 17.2 | 17.0 |
| Euro area | 0.9 | 1.0 | –6.0 | –7.2 | –0.2 | 1.47 | 1.47 |
| Hungary | 2.1 | 2.3 | –4.3 | –4.8 | –1.9 | 178 | 181 |
| Norway | 0.0 | 0.2 | 0.0 | –0.5 | 2.2 | 5.39 | 5.28 |
| Poland | 2.7 | 2.9 | –8.0 | –8.6 | –6.1 | 2.43 | 2.59 |
| Russia | 0.0 | 0.2 | 0.0 | –0.6 | 4.2 | 24.5 | 23.5 |
| Sweden | –3.0 | –2.8 | 8.6 | 7.9 | 10.7 | 6.35 | 5.74 |
| Switzerland | –7.8 | –7.6 | 21.9 | 21.4 | 23.9 | 1.09 | 0.88 |
| Turkey | 3.3 | 3.5 | –12.4 | –13.0 | –8.5 | 1.21 | 1.32 |
| United Kingdom | 1.4 | 1.5 | –6.0 | –6.6 | –2.5 | 1.96 | 1.91 |
| **Western Hemisphere** | | | | | | | |
| Argentina | 0.5 | 0.9 | –2.4 | –3.8 | 2.6 | 3.14 | 3.06 |
| Brazil | 0.0 | 0.2 | 0.0 | –1.4 | 4.8 | 1.73 | 1.65 |
| Canada | 1.2 | 1.3 | –3.8 | –4.1 | –1.5 | 1.00 | 1.02 |
| Chile | 0.0 | 0.3 | 0.0 | –1.1 | 5.9 | 467 | 441 |
| Colombia | 1.4 | 1.6 | –6.8 | –7.8 | –3.5 | 1,907 | 1,977 |
| Mexico | 0.0 | 0.1 | 0.0 | –0.4 | 2.0 | 10.8 | 10.6 |
| United States | 1.2 | 1.4 | –7.4 | –8.6 | 0.0 | 1.00 | 1.00 |
| Venezuela | 0.0 | 0.3 | 0.0 | –0.8 | 2.8 | 2.14 | 2.08 |

REER = real effective exchange rate

currency was then undervalued. A negative number indicates that the currency needed to depreciate, which implies that it was overvalued. Column (4) shows how close the simulation came to achieving the target laid out in the previous column. According to the central simulation, the largest undervaluations are estimated to be those of Singapore (25 percent real effective appreciation needed), China (18 percent), Switzerland (21 percent), and Malaysia (12 percent), while the largest overvaluations are estimated to be those of South Africa (15 percent real effective depreciation needed) and Turkey (13 percent). The United States is estimated to have been still overvalued on a multilateral basis in February 2008, with 9 percent real effective depreciation called for (in the consistent solution, overshooting the US target by about 1 percentage point).[13] All other misalignments are estimated to be in single digits, 18 of them of less than 5 percent.

**A number of Asian currencies, particularly the Chinese renminbi, are seriously undervalued and need to appreciate strongly, and this correction needs to be accompanied by appreciations against the dollar by a number of other currencies—such as the New Zealand dollar and the Korean won—that are already somewhat too strong on a multilateral basis.**

Three alternative simulations of the exchange rates needed to reach FEERs are shown in tables 3 through 5. In the first of these, elasticities were assumed to be higher than was assumed in the central case. While we doubt that the bulk of the econometric evidence points to such high figures, we have a markedly smaller change in the estimated global current account discrepancy in this case. Needed adjustments are (naturally) estimated to be rather smaller under this high-elasticities variant: Singapore's needed revaluation is estimated at 17 percent, that of China is put at 13 percent, Switzerland at 14 percent, and Malaysia's falls to single digits, while the maximum overvaluations are put at 9 percent effective depreciation needed for South Africa and 8 percent each for both Turkey and the United States. The second simulation assumes that oil producers in imbalance should be subjected to the same rules as oil importers, so that both Saudi Arabia and Norway are estimated to need large revaluations, even with the high import elasticities implicitly assumed. The corollary is, of course, that other surplus countries are required to adjust much less. The third simulation shows the effect of adopting the IMF's third objective, in which each country aims to stabilize the ratio of its net international investment position to GDP (NIIP/GDP) at a target level, here assumed to be the level that will be reached in 2009, based on 2006 levels and IMF forecasts of current account outcomes through 2009.

It turns out that in the oil-adjustment scenario, the reductions in surpluses by Saudi Arabia and Norway would be so large (summing to about $160 billion) that five of the six high-surplus residual economies would continue to have surpluses in excess of 6 percent of GDP if the same residual allocation approach were applied as in the central and high-elasticities cases. As a result, the 6 percent of GDP surplus ceiling is imposed in this variant not only on Singapore and Switzerland (as before) and on Saudi Arabia and Norway but also on China, Hong Kong, Malaysia, Sweden, and Taiwan. Because no further surplus reductions would be needed among the residual set, Japan's surplus would remain unchanged at about 4 percent of GDP.

The principal difference in the variant imposing the same rules of adjustment on the oil producers (table 4) is the large effective appreciations of Norway and Saudi Arabia (in the range of 40 to 50 percent), despite the generous assumption of an import elasticity of about 2, which helps limit their estimated need to revalue. This considerably narrows the size of adjustment required for other high-surplus economies, so that whereas the real effective appreciation for China is 18 percent in the central solution, it is only 13 percent in the oil-adjustment variant.

The most general differences in the patterns of adjustment arise in the variant for stabilizing the NFA/GDP ratios (table 5). The largest swing from the central case is for Hong Kong, where an effective depreciation of 18 percent is needed to hold the net foreign assets at their extraordinary level of 244 percent of GDP, in contrast to an effective appreciation of 8 percent in the central case. For the important case of the United States, the simulation shows a needed effective depreciation of 16 percent instead of 9 percent in the central case because a more ambitious narrowing of the current account deficit is needed to keep net foreign liabilities from rising above the 2009 benchmark of 25 percent of GDP. Other cases of considerably larger effective depreciation than in the central case include

13. Note that although the dollar depreciated by 1.2 percent from February to March/April, using the broad real index of the Federal Reserve, by June it had rebounded to the same level as in February.

**Table 3 Results of high-elasticities simulation**

| Country | Changes in current account as percent of GDP | | Change in REER (percent) | | Change in dollar exchange rate | Dollar rate in February 2008 | FEER-equivalent dollar rate |
|---|---|---|---|---|---|---|---|
| | Target change | Change in simulation | Target change | Change in simulation | | | |
| **Pacific** | | | | | | | |
| Australia | 0.0 | 0.1 | 0.0 | –0.3 | 11.3 | 0.91 | 1.01 |
| New Zealand | 1.1 | 1.2 | –3.0 | –3.2 | 7.1 | 0.80 | 0.86 |
| **Asia** | | | | | | | |
| China | –5.7 | –5.6 | 12.8 | 12.6 | 23.4 | 7.17 | 5.81 |
| Hong Kong | –4.4 | –4.2 | 5.8 | 5.7 | 21.8 | 7.80 | 6.40 |
| India | 0.4 | 0.4 | –1.9 | –2.1 | 7.3 | 39.7 | 37.0 |
| Indonesia | –1.2 | –1.1 | 2.9 | 2.7 | 17.8 | 9,181 | 7,795 |
| Japan | –0.8 | –0.7 | 4.4 | 4.2 | 15.1 | 107.2 | 93.1 |
| Korea | 0.9 | 1.0 | –1.8 | –2.0 | 10.0 | 945 | 859 |
| Malaysia | –6.6 | –6.4 | 8.8 | 8.5 | 23.1 | 3.22 | 2.62 |
| Philippines | –1.0 | –0.8 | 1.7 | 1.5 | 14.6 | 40.7 | 35.5 |
| Singapore | –12.9 | –12.7 | 17.2 | 16.9 | 30.2 | 1.41 | 1.08 |
| Taiwan | –4.1 | –4.0 | 6.5 | 6.3 | 19.8 | 31.6 | 26.4 |
| Thailand | –1.3 | –1.2 | 1.9 | 1.7 | 14.6 | 32.7 | 28.5 |
| **Middle East /Africa** | | | | | | | |
| Israel | –1.7 | –1.6 | 3.5 | 3.3 | 8.3 | 3.61 | 3.33 |
| Saudi Arabia | 0.0 | 0.1 | 0.0 | –0.2 | 9.2 | 3.75 | 3.43 |
| South Africa | 4.9 | 5.0 | –9.2 | –9.4 | –1.8 | 7.66 | 7.80 |
| **Europe** | | | | | | | |
| Czech Republic | 0.0 | 0.1 | 0.0 | –0.1 | 3.8 | 17.2 | 16.6 |
| Euro area | 0.9 | 0.9 | –4.0 | –4.3 | 2.7 | 1.47 | 1.51 |
| Hungary | 2.1 | 2.2 | –2.9 | –3.0 | 1.7 | 178 | 175 |
| Norway | 0.0 | 0.1 | 0.0 | –0.1 | 4.2 | 5.39 | 5.17 |
| Poland | 2.7 | 2.8 | –5.3 | –5.5 | –1.1 | 2.43 | 2.46 |
| Russia | 0.0 | 0.1 | 0.0 | –0.2 | 5.7 | 24.5 | 23.2 |
| Sweden | –3.0 | –2.9 | 5.7 | 5.5 | 9.9 | 6.35 | 5.78 |
| Switzerland | –7.8 | –7.7 | 14.6 | 14.4 | 18.6 | 1.09 | 0.92 |
| Turkey | 3.3 | 3.4 | –8.3 | –8.4 | –2.9 | 1.21 | 1.25 |
| United Kingdom | 1.4 | 1.4 | –4.0 | –4.2 | 1.0 | 1.96 | 1.98 |
| **Western Hemisphere** | | | | | | | |
| Argentina | 0.5 | 0.7 | –1.6 | –2.0 | 4.5 | 3.14 | 3.01 |
| Brazil | 0.0 | 0.1 | 0.0 | –0.4 | 5.8 | 1.73 | 1.64 |
| Canada | 1.2 | 1.3 | –2.5 | –2.6 | –0.3 | 1.00 | 1.01 |
| Chile | 0.0 | 0.1 | 0.0 | –0.3 | 6.4 | 467 | 439 |
| Colombia | 1.4 | 1.4 | –4.5 | –4.8 | –0.4 | 1,907 | 1,913 |
| Mexico | 0.0 | 0.0 | 0.0 | –0.1 | 2.1 | 10.8 | 10.6 |
| United States | 1.2 | 1.2 | –7.4 | –7.8 | 0.0 | 1.00 | 1.00 |
| Venezuela | 0.0 | 0.1 | 0.0 | –0.2 | 3.7 | 2.14 | 2.06 |

REER = real effective exchange rate

**Table 4 Results of simulation with oil producers' adjustment**

| Country | Changes in current account as percent of GDP | | Change in REER (percent) | | Change in dollar exchange rate | Dollar rate in Feburary 2008 | FEER-equivalent dollar rate |
|---|---|---|---|---|---|---|---|
| | Target change | Change in simulation | Target change | Change in simulation | | | |
| **Pacific** | | | | | | | |
| Australia | 0.0 | 0.1 | 0.0 | –0.7 | 11.7 | 0.91 | 1.01 |
| New Zealand | 1.1 | 1.3 | –4.5 | –5.0 | 6.2 | 0.80 | 0.85 |
| **Asia** | | | | | | | |
| China | –3.9 | –3.8 | 13.2 | 12.8 | 24.0 | 7.17 | 5.78 |
| Hong Kong | –2.3 | –2.1 | 4.6 | 4.3 | 21.1 | 7.80 | 6.44 |
| India | 0.4 | 0.5 | –2.8 | –3.3 | 7.3 | 39.7 | 37.0 |
| Indonesia | –1.2 | –1.1 | 4.3 | 3.8 | 21.4 | 9,181 | 7,562 |
| Japan | 0.0 | 0.1 | 0.0 | –0.5 | 12.6 | 107 | 95.2 |
| Korea | 0.9 | 1.0 | –2.7 | –3.2 | 10.6 | 945 | 854 |
| Malaysia | –5.0 | –4.7 | 10.0 | 9.5 | 26.3 | 3.22 | 2.55 |
| Philippines | –0.9 | -0.8 | 2.5 | 2.0 | 17.0 | 40.7 | 34.8 |
| Singapore | –12.7 | –12.4 | 25.4 | 24.8 | 39.6 | 1.41 | 1.01 |
| Taiwan | –2.0 | –1.9 | 4.8 | 4.4 | 19.2 | 31.6 | 26.5 |
| Thailand | –1.3 | –1.1 | 2.9 | 2.4 | 16.9 | 32.7 | 27.9 |
| **Middle East /Africa** | | | | | | | |
| Israel | –1.7 | –1.5 | 5.1 | 4.8 | 9.4 | 3.61 | 3.30 |
| Saudi Arabia | –17.7 | –17.5 | 47.4 | 47.0 | 56.4 | 3.75 | 2.40 |
| South Africa | 5.0 | 5.2 | –14.1 | –14.5 | –5.6 | 7.66 | 8.11 |
| **Europe** | | | | | | | |
| Czech Republic | 0.0 | 0.1 | 0.0 | -0.3 | 3.0 | 17.2 | 16.7 |
| Euro area | 0.9 | 1.0 | –6.1 | –6.8 | 1.5 | 1.47 | 1.49 |
| Hungary | 2.1 | 2.2 | –4.4 | –4.7 | –0.7 | 178 | 179 |
| Norway | –14.2 | –14.1 | 38.7 | 38.4 | 41.9 | 5.39 | 3.80 |
| Poland | 2.7 | 2.8 | –8.1 | –8.4 | –4.4 | 2.43 | 2.54 |
| Russia | 0.0 | 0.1 | 0.0 | –0.3 | 5.0 | 24.5 | 23.4 |
| Sweden | –0.7 | –0.6 | 2.0 | 1.6 | 8.6 | 6.35 | 5.85 |
| Switzerland | –7.6 | –7.5 | 21.5 | 21.3 | 24.9 | 1.09 | 0.87 |
| Turkey | 3.4 | 3.5 | –12.6 | –12.9 | –7.0 | 1.21 | 1.30 |
| United Kingdom | 1.4 | 1.5 | –6.1 | –6.5 | –0.2 | 1.96 | 1.96 |
| **Western Hemisphere** | | | | | | | |
| Argentina | 0.6 | 0.7 | –2.4 | –3.2 | 3.3 | 3.14 | 2.96 |
| Brazil | 0.0 | 0.1 | 0.0 | –0.8 | 5.9 | 1.73 | 1.64 |
| Canada | 1.2 | 1.3 | –3.9 | –4.0 | –1.4 | 1.00 | 0.99 |
| Chile | 0.0 | 0.2 | 0.0 | –0.6 | 5.8 | 467 | 482 |
| Colombia | 1.4 | 1.5 | –6.9 | –7.5 | –3.2 | 1,907 | 1,846 |
| Mexico | 0.0 | 0.1 | 0.0 | –0.2 | 1.9 | 10.8 | 10.5 |
| United States | 1.2 | 1.3 | –7.6 | –8.2 | 0.0 | 1.00 | 1.00 |
| Venezuela | 0.0 | 0.1 | 0.0 | –0.5 | 3.3 | 2.14 | 2.00 |

REER = real effective exchange rate

**Table 5 Results of simulation aiming to stabilize NFA/GDP ratios**

| Country | Changes in current account as percent of GDP | | Change in REER (percent) | | Change in dollar exchange rate | Dollar rate in February 2008 | FEER-equivalent dollar rate |
|---|---|---|---|---|---|---|---|
| | Target change | Change in simulation | Target change | Change in simulation | | | |
| **Pacific** | | | | | | | |
| Australia | 1.3 | 1.4 | –7.4 | –8.4 | 13.8 | 0.91 | 1.03 |
| New Zealand | 1.5 | 1.7 | –5.9 | –6.6 | 11.7 | 0.80 | 0.89 |
| **Asia** | | | | | | | |
| China | –5.9 | –5.8 | 20.0 | 19.4 | 35.7 | 7.17 | 5.28 |
| Hong Kong | 8.8 | 9.0 | –17.5 | –17.9 | 9.3 | 7.80 | 7.13 |
| India | 1.8 | 1.9 | –12.9 | –13.6 | 4.5 | 39.7 | 38.0 |
| Indonesia | –3.8 | –3.6 | 13.9 | 13.2 | 40.2 | 9,181 | 6,549 |
| Japan | –2.3 | –2.2 | 19.5 | 18.8 | 37.5 | 107 | 78.0 |
| Korea | –0.9 | –0.6 | 2.7 | 2.0 | 23.5 | 945 | 765 |
| Malaysia | –11.1 | –10.7 | 22.2 | 21.5 | 46.2 | 3.22 | 2.21 |
| Philippines | –2.2 | –2.0 | 5.8 | 5.2 | 28.6 | 40.7 | 31.6 |
| Singapore | –11.8 | –11.3 | 23.5 | 22.6 | 46.3 | 1.41 | 0.96 |
| Taiwan | –1.6 | –1.4 | 3.8 | 3.2 | 26.6 | 31.6 | 25.0 |
| Thailand | –2.4 | –2.1 | 5.3 | 4.6 | 28.3 | 32.7 | 25.4 |
| **Middle East /Africa** | | | | | | | |
| Israel | –2.3 | –2.1 | 7.0 | 6.5 | 16.7 | 3.61 | 3.09 |
| Saudi Arabia | 0.0 | 0.2 | 0.0 | –0.6 | 19.2 | 3.75 | 3.14 |
| South Africa | 4.4 | 4.6 | –12.4 | –13.0 | 3.7 | 7.66 | 7.38 |
| **Europe** | | | | | | | |
| Czech Republic | 0.5 | 0.7 | –1.0 | –1.4 | 11.7 | 17.2 | 15.4 |
| Euro area | 0.4 | 0.5 | –2.8 | –3.7 | 11.6 | 1.47 | 1.64 |
| Hungary | –1.1 | –0.9 | 2.2 | 1.8 | 15.4 | 178 | 154 |
| Norway | 0.0 | 0.2 | 0.0 | –0.4 | 13.1 | 5.39 | 4.77 |
| Poland | 1.9 | 2.0 | –5.5 | –6.0 | 7.5 | 2.43 | 2.26 |
| Russia | 0.0 | 0.1 | 0.0 | –0.5 | 14.7 | 24.5 | 21.4 |
| Sweden | –8.0 | –7.8 | 22.4 | 21.9 | 34.4 | 6.35 | 4.73 |
| Switzerland | –9.2 | –9.1 | 26.0 | 25.6 | 37.9 | 1.09 | 0.79 |
| Turkey | 2.3 | 2.4 | –8.7 | –9.1 | 5.0 | 1.21 | 1.15 |
| United Kingdom | 2.1 | 2.2 | –9.1 | –9.6 | 3.9 | 1.96 | 2.04 |
| **Western Hemisphere** | | | | | | | |
| Argentina | 0.8 | 1.1 | –3.5 | –4.6 | 10.2 | 3.14 | 2.85 |
| Brazil | –0.8 | –0.6 | 4.7 | 3.7 | 16.9 | 1.73 | 1.48 |
| Canada | 0.7 | 0.8 | –2.2 | –2.4 | 2.4 | 1.00 | 0.98 |
| Chile | 0.7 | 1.0 | –2.3 | –3.1 | 12.0 | 467 | 417 |
| Colombia | 1.7 | 1.8 | –8.3 | –9.1 | 1.2 | 1,907 | 1,885 |
| Mexico | –1.0 | –0.9 | 3.8 | 3.5 | 8.0 | 10.8 | 10.0 |
| United States | 2.4 | 2.5 | –15.2 | –16.1 | 0.0 | 1.00 | 1.00 |
| Venezuela | 0.0 | 0.2 | 0.0 | –0.7 | 8.2 | 2.14 | 1.98 |

those of Australia (8 percent instead of 1 percent) and India (14 percent instead of 4 percent). Taiwan has a smaller effective appreciation (3 percent instead of 9 percent).

In contrast, several cases of much larger effective appreciations are called for than in the central case. These include the currencies of Japan (19 percent instead of 6 percent), Malaysia (22 percent instead of 12 percent), Indonesia (13 percent instead of 3 percent), Sweden (22 percent instead of 8 percent), and Brazil (4 percent instead of –1 percent). The results for Japan and Malaysia indicate that their baseline net foreign asset positions, though large, are not large enough to warrant the size of projected current account surpluses.

Supercreditors Singapore and Switzerland turn out to have effective appreciations that are relatively close to the central case solutions, indicating that not even the need to nourish the maintenance of net foreign assets in the range of 120 to 140 percent of GDP would warrant current account surpluses as large as they are projected to run. Taiwan does receive more margin to continue large surpluses under the NFA variant, as it requires limiting the effective appreciation to 3 percent instead of 9 percent to keep net foreign assets as high as 100 percent of GDP.

Because we do not consider the 2009 levels of net foreign assets to have any particular merit as permanent targets, we would suggest that these more extreme results should be taken with a grain of salt. However, we would underscore that using the alternative NFA criterion leaves intact the qualitative pattern of a needed real appreciation in East Asia and depreciation for the United States. In fact, the effective appreciation called for would be even greater for Japan, Malaysia, and to a lesser extent China, than in the central case, and the effective depreciation would be greater for the United States.[14]

Table 6 shows how strong currencies were in February 2008 in comparison both with the past and with the values implied by the FEER calculation. All of the comparisons are ratios in index form, with 100 indicating a ratio of one to one. Column (1) shows, for the 24 countries for which the IMF publishes data on REERs, how its estimates of the REER published in *International Financial Statistics* for February 2008 compared with the 10-year average of the same measure of the REER. Columns (2) and (3) show how the estimate of each currency's REER made by Citigroup for February 2008 compares with 10- and 20-year averages. Column (4) is a transformation of column (4) in table 2 and shows the ratio between the February 2008 REER and the FEER estimated there using the central simulation. This ratio is derived as 100/[(1 + (the entry in column (4) of table 2)/100]. For example, column (4) shows an index of 109.4 for the US dollar, indicating that in February 2008 the dollar was overvalued by 9.4 percent.

If it were true that the past average REER gives a good estimate of equilibrium, these figures would be approximately equal, differing essentially only because of rounding error. A quick glance at the table suffices to establish that this is not the case. In some cases it seems that the average REER differed markedly from one decade to the next or that the IMF estimate differs markedly from that of Citigroup even though both are based on the consumer price index (CPI), but in more cases there is a big discrepancy between our estimate of the FEER and the past average value of the REER. The appendix argues that many of those discrepancies seem quite reasonable, especially in the light of the Balassa-Samuelson effect. However, it identifies at least one instance (Brazil) in which the estimated FEER looks implausible and considers why an erroneous estimate appears to have been made.

**We do not see a further appreciation of the euro against the dollar as appropriate, although we estimate that the desirable depreciation of the euro on a multilateral basis should be effected by a depreciation against the Asian currencies rather than against the dollar.**

Reverting to table 2, column (5) shows the needed changes in the bilateral exchange rate against the dollar in the case of the central simulation for each of our 34 currencies. Naturally these are generally larger, in many cases much larger, than the necessary change in the *effective* exchange rate. Indeed, there are instances (e.g., New Zealand or Korea) where countries need a *multilateral* depreciation but a *bilateral* appreciation. The reason is easy to understand. Because countries trade with each other as well as with the United States, many of their trading partners will be appreciating as well, so that each of them needs a large bilateral appreciation in order to engineer a modest multilateral appreciation. This is emphasized by the fact that where countries trade principally with the United States—like its neighbors, Canada and Mexico—the difference between bilateral and multilateral exchange rate changes is rather modest. Notice also that whereas China needs a much larger effective appreciation than what are often called the other parts of Greater China, namely Hong Kong and Taiwan, the changes in their bilateral exchange rates against the dollar

14. Again the sharp exception is the case of Hong Kong, which would switch from sizeable appreciation to large depreciation.

**Table 6 Effective exchange rates: Recent rates compared with averages and FEERs, February 2008**

| Country | IMF REER (10-year average) | Citigroup REER | | REER/FEER ratio estimated by central simulation |
|---|---|---|---|---|
| | | 10-year average | 20-year average | |
| **Pacific** | | | | |
| Australia | 124.1 | 124.3 | 125.8 | 101.3 |
| New Zealand | 118.5 | 120.1 | 121.5 | 105.7 |
| **Asia** | | | | |
| China | 104.8 | 107. 9 | 107.0 | 84.5 |
| Hong Kong | n.a. | 79.8 | 82.7 | 92.5 |
| India | n.a. | 107.9 | 108.0 | 103.8 |
| Indonesia | n.a. | 118.5 | 107.6 | 96.6 |
| Japan | 83.6 | 81.3 | 78.2 | 94.6 |
| Korea | n.a. | 107.2 | 103.4 | 103.6 |
| Malaysia | 104.1 | 101.6 | 92.1 | 89.1 |
| Philippines | 123.9 | 122.1 | 117.5 | 98.3 |
| Singapore | 102.4 | 100.2 | 98.6 | 80.2 |
| Taiwan | n.a. | 85.5 | 78.4 | 91.7 |
| Thailand | n.a. | 115.7 | 107.1 | 98.0 |
| **Middle East /Africa** | | | | |
| Israel | 98.4 | 98.0 | 95.4 | 95.6 |
| Saudi Arabia | 85.3 | 85.6 | 82.1 | 100.7 |
| South Africa | 88.1 | 92.7 | 84.7 | 117.1 |
| **Europe** | | | | |
| Czech Republic | 134.0 | 128.3 | 136.2 | 100.5 |
| Euro area | 112.1 | 108.1 | 103.7 | 107.8 |
| Hungary | 119.6 | 115.8 | 130.4 | 105.1 |
| Norway | 108.4 | 104.3 | 103.4 | 100.5 |
| Poland | 118.3 | 111.5 | 127.3 | 109.4 |
| Russia | 133.8 | 136.2 | 135.5 | 100.6 |
| Sweden | 100.6 | 99.4 | 91.8 | 92.7 |
| Switzerland | 98.4 | 95.9 | 95.3 | 82.4 |
| Turkey | n.a. | 126.3 | 144.1 | 114.9 |
| United Kingdom | 100.1 | 92.0 | 97.4 | 107.1 |
| **Western Hemisphere** | | | | |
| Argentina | n.a. | 64.5 | 59.9 | 103.9 |
| Brazil | n.a. | 133.8 | 119.5 | 101.4 |
| Canada | 125.7 | 124.1 | 119.4 | 104.3 |
| Chile | 11.2 | 112.8 | 115.9 | 101.1 |
| Colombia | 118.9 | 121.8 | 122.7 | 108.5 |
| Mexico | n.a. | 98.5 | 106.1 | 100.4 |
| United States | 86.8 | 85.1 | 90.0 | 109.4 |
| Venezuela | 107.2 | 101.5 | 120.3 | 100.8 |

n.a. = not available

Note: All comparisons are ratios in index form, with 100 indicating a ratio of one to one.

*Sources:* IMF, *International Financial Statistics*; Citigroup trade-weighted exchange rate index (CTERI) database.

would be similar. This is because China is a much more important trading partner to Hong Kong and Taiwan than they are to China, so that similar changes in bilateral rates translate into very different changes in effective rates.

Column (6) shows purely historical data: the average dollar exchange rate of each currency in February 2008, the month that formed the base for the projections in the April 2008 *World Economic Outlook*. All data are shown to three significant figures. Except in the cases of the Australian and New Zealand dollars, the euro, and the pound sterling, exchange rates are shown as local currency units per dollar.

Column (7) of table 2 shows the estimates of equilibrium dollar exchange rates (again to three significant figures, although a case can be made for limiting the estimates to two significant figures to emphasize that any third figure is essentially meaningless, given the margin of error inherent in such an exercise) using the central simulation. For example, the equilibrium bilateral appreciation of 12.8 percent shown for the Australian dollar in column (5) and a February 2008 rate of A$1 = US$0.91 imply that the equilibrium rate for the Australian dollar is A$1 = US$1.02. Most readers will be familiar with a handful of currencies and will naturally examine the figures for those currencies to judge whether the results appear plausible. However, in doing such an exercise it is important to remember that we are undertaking a general equilibrium exercise, in which many other currency values are changing simultaneously and this ought to exercise a major influence on one's appraisal of a dollar rate. For example, many Europeans who believe the euro is already overvalued will be taken aback to see the equilibrium dollar-euro rate at about $1.50 = €1; but this should be judged in a context where the Asian currencies appreciate against the dollar and the euro, so as to effect the multilateral *depreciation* of the euro indicated to be appropriate in column (3) and realized as shown in column (4).

## CONCLUSION

This policy brief has presented estimates of the current equilibrium exchange rates of a large number of currencies. The general picture is very much like that previously presented in policy brief 07-4 (Ahearne et al. 2007): A number of Asian currencies, particularly the Chinese renminbi, are seriously undervalued and need to appreciate strongly, and this correction needs to be accompanied by appreciations *against the dollar* by a number of other currencies—such as the New Zealand dollar and the Korean won—that are, if anything, already somewhat too strong on a multilateral basis. However, these currency moves against the dollar are markedly less than was earlier portrayed, because of the dollar's strong depreciation in the intervening year. In particular, we do not see a further appreciation of the euro against the dollar as appropriate, although we estimate that the desirable depreciation of the euro on a multilateral basis should be effected by a depreciation against the Asian currencies rather than against the dollar. For currencies that need to move a lot, effective appreciations would be substantially smaller than bilateral appreciations.

The equilibrium dollar exchange rates of both the Australian and Canadian dollars have been estimated at about parity with the US dollar. Under the scenario presented here, they would achieve their multilateral depreciations primarily by the Asian appreciations rather than by further movement against the US dollar. Any analysis that assumes that Japan has a duty to seek a reasonably balanced payments outcome has for years yielded the conclusion that the yen needs to appreciate strongly. This is somewhat less true of the present study, but even so we estimate an equilibrium bilateral dollar rate of about 90 yen to the dollar. The equilibrium rate of the renminbi is estimated as about 5.4 in the central simulation, in comparison to the present rate of a little under 7. This ought ideally to be accompanied by parallel moves by the economies of Greater China—Hong Kong and Taiwan—as well as by Malaysia and Singapore, while other Asian countries that have little or no need for a multilateral appreciation would still need a bilateral appreciation against the dollar in order to keep their effective rates stable. In most countries except South Africa and Turkey that need a multilateral depreciation, this is accomplished largely by the Asian appreciations, although in these two cases and to a lesser extent in Poland some depreciation against the dollar is also called for. The pound sterling is an example of a currency that needs an effective depreciation (in addition to its recent pronounced fall against its major trading partner, the euro area) that should be accomplished largely by Asian strengthening rather than a depreciation against the dollar. The equilibrium value of the Swiss franc is estimated at well over a dollar.

In the central scenario we made no attempt to estimate the equilibrium exchange rates of the currencies of the oil exporters. These were already projected to run a massive $292 billion surplus in 2009 on the basis of an assumed oil price of $95 per barrel (the assumption in the April 2008 *World Economic Outlook*), and the figure is presumably substantially larger by now in the light of the further increase in oil prices since February. Our decision not to target a current account change by these countries is based on several considerations. The IMF has concluded that in the past most of the oil-exporting countries always ultimately adjusted to an oil price increase, though the pace may have been somewhat lethargic, and it believes that this time around current accounts may adjust even more slowly than they have in the past (IMF 2006, 91). As explained

before, we are strongly in favor of their shifting from a bilateral peg to the dollar (in most cases) to either a managed float or a peg to a basket that includes oil, on the grounds that this would accelerate adjustment and make it less traumatic. But it is quite different to argue that they should manage their exchange rates so as to contribute to adjustment. A FEER is intended to be a sustainable equilibrium rate that maximizes the utility of a country's residents, not a rate that disrupts optimal saving plans in pursuit of an arbitrary rule. Some of the oil exporters—especially those with large oil sales relative to domestic investment opportunities, like Norway, Kuwait, and the United Arab Emirates—are deliberately accumulating some of their oil revenues in the form of sovereign wealth funds as part of a program of optimal saving. Short-run current account targeting would disrupt this program, while long-run targeting is, according to the IMF analysis, unnecessary. It is simpler to leave the oil-exporting countries alone and to recognize that the oil surplus will wax or wane depending on how much time has elapsed since the last oil price increase or decline. The analysis on which we have focused is the problem of securing adjustment within the group of oil-importing countries.

Nevertheless, because some people believe that the oil producers should not be allowed to "get away" with something, we have also calculated a simulation in which the oil exporters in our model were subjected to similar rules as other countries. Even making a very generous elasticity assumption, this simulation suggests that Saudi Arabia should revalue by 47 percent and Norway by 38 percent. Although these appreciations are probably greatly underestimated as a result of the generous elasticity assumption, they would be similar in magnitude to those that would have resulted if these oil producers had pegged in 2000 to a basket with a 10 percent oil weight.

We have also calculated simulations for two other variants of the basic model. One assumed the elasticities to be higher than in the central case, on the ground that the resulting simulation implies a smaller increase in the world current account discrepancy. The other, inspired by the IMF, asked what exchange rate would stabilize the ratio of NFA/GDP at its 2009 level. This does not in general seem to us to be a sensible policy objective, but it does have the merit of exposing when countries are indulging in Ponzi-like behavior.

The basic features illuminated by this analysis remain unchanged in the variants. It is still true that the dollar remains somewhat overvalued on a multilateral basis; that the Chinese renminbi is strongly undervalued multilaterally and bilaterally; that the euro is now overvalued multilaterally but is not significantly, if at all, overvalued against the dollar; and that the undervaluation of the yen remains but is much less than at one time.

## APPENDIX

## EVALUATION OF THE FEER ESTIMATES

This appendix examines the plausibility of the FEERs estimated in this policy brief. The figures given in table 6 permit a direct comparison of our estimates of how strong each currency was in February 2008 in relation to its FEER, given in the last column, with estimates of how strong each currency then was in comparison to its historical average (given in the first three columns). All of the ratios in the table are shown in index form, with 100 indicating a ratio of unity. It turns out that in several instances, developing or rapidly growing industrial countries have FEERs that exceed the average REER of the past decade, and often it will be the case that a plausible explanation is the Balassa-Samuelson effect. This effect reflects more rapid productivity growth in the export sector than in the nontradables sector, causing the exchange rate that is in equilibrium from the standpoint of trade to rise over time relative to the exchange rate predicted by purchasing power parity across both traded and nontraded goods. Nonetheless, a plausible range for this effect for a period as short as five years, the distance away from the midpoint of two of the historical levels shown in the table, would likely be modest, perhaps on the order of 5 to 10 percent.

### Pacific

In the case of *Australia*, any overvaluation of the Australian dollar is modest compared with the extent to which the currency is strong relative to its past values. This seems entirely plausible in view of Australia's prominent role as an exporter of primary products and the recent strength of primary product prices. Assuming that one expects primary product prices to remain relatively strong in the future, as we do, the FEER of the Australian dollar can be expected to remain strong.

The same is true of *New Zealand*, though in smaller measure. Significantly less than one half of the New Zealand dollar's strength relative to its past average can be explained by overvaluation. The remainder should be attributed to the current and likely future strength in primary product prices.

### Asia

We estimate the *Chinese renminbi* to be substantially undervalued (by at least 15 percent on a multilateral basis), whereas the other figures already show it to be stronger than its medium-run average. In view of the vast Chinese current account surplus, which cannot conceivably be justified as an optimal

use of resources by China, we regard this as demonstrating the superiority of an analytical over a purely historical approach to the analysis of equilibrium exchange rates. Clearly, the figures imply that the equilibrium Chinese exchange rate has appreciated strongly in recent years. In view of China's emergence as a market economy, it is not altogether surprising that there is limited value in past figures on average exchange rates. One also expects to find strong Balassa-Samuelson appreciation in the equilibrium rate. The undervaluation is even more pronounced using the criterion of stabilizing NFA/GDP.

The real effective exchange rate of the *Hong Kong dollar* is much weaker than before, since the nominal rate has been dragged down by the weakness of the US dollar and the persistence of Hong Kong authorities in maintaining an inappropriate fixed bilateral exchange rate. Our estimate is that Hong Kong is indeed in need of a revaluation, though one more modest than the historical experience would suggest. Even if no Balassa-Samuelson effect has been operative in the case of Hong Kong, the fact that our analysis shows historical *depreciation* in the equilibrium exchange rate stands in wait of a ready explanation.

The *Indian rupee* appears close to equilibrium, with possibly a mild overvaluation. We would surmise that the Balassa-Samuelson effect is weak because India is only now reaching the stage at which one expects the effect to operate.

The *Indonesian rupiah* is currently very strong relative to its past average, but we nevertheless estimate it to be, if anything, slightly undervalued. This might be partly explained by a strong Balassa-Samuelson effect.

The *Japanese yen* is exceptionally weak relative to past values. Our analysis confirms that it is undervalued, but we also regard it as appropriate that it should be weaker than a simple extrapolation of historical experience. As is well known, the Japanese economy has not functioned well in recent years, and one consequence has presumably been a reduction in Japanese competitiveness at constant prices and exchange rates. Our figures suggest that a relatively modest multilateral revaluation of the yen would suffice to take it to its FEER. The size of the corresponding revaluation in the bilateral exchange rate against the dollar is considerably larger than that of the effective rate, however, because of the large trade weight of China and other East Asian economies whose REERs rise substantially in a general realignment to FEERs.

The *Korean won* appears close to equilibrium. If anything, it is mildly overvalued.

The *Malaysian ringgit* is on our measure substantially undervalued. It is nevertheless not particularly weak relative to its past average over the last decade on either the IMF or the Citigroup measures; one has to go back to before the Asian crisis to find a period in which the ringgit was reasonably valued.

The *Philippine peso* is much stronger than it used to be, but our analysis does not suggest that it is overvalued. Presumably the Balassa-Samuelson effect is at work.

The *Singapore dollar's* present value is broadly in line with its past value, which is not surprising since the Monetary Authority of Singapore aims to stabilize its value in terms of a basket. However, we estimate a very large undervaluation. That is because Singapore has a large published current account surplus, which has cumulated into a large stock of NFAs. Despite this, it continues to show a deficit on investment income. We would not be entirely surprised if the figures were revised in a way that reduced the measured need for appreciation.

Our analysis suggests that the *New Taiwan dollar* is undervalued to a similar extent as the Hong Kong dollar. (The analysis of bilateral exchange rates suggests that mainland China and both these constituents of Greater China need to revalue against the dollar to a roughly similar extent.)

The *Thai baht* is estimated to be near equilibrium, having apparently returned to the vicinity of its level before the Asian crisis. One may suspect it was then somewhat overvalued; the views are consistent if a Balassa-Samuelson effect has been at work.

### Middle East/Africa

In the case of *Israel* we do not find a big disequilibrium, though there is some evidence of a mild undervaluation of the shekel.

In the central simulation we have not attempted to estimate equilibrium exchange rates for oil producers like *Saudi Arabia*. The first three columns of table 6 show that the Saudi riyal is currently very weak, a result of pegging to the US dollar in a period when the latter has been weak.

*South Africa* presents a conundrum. Both the IMF and Citigroup view the rand as weak relative to the past, but our calculations suggest that it is not nearly weak enough to be consistent with a reasonable current account. It is difficult to imagine that South Africa will in the future achieve a satisfactory current account except with a rand weaker than in the past.

### Europe

The *Czech crown* is estimated as near equilibrium, despite being much stronger than in the past. One assumes that the successful transition to a market economy and the strong Balassa-Samuelson effect that has operated in Central and Eastern Europe are collectively responsible.

The *euro* is shown as strong relative to its past average on all three measures and also as somewhat overvalued by our estimate of the FEER. This is consistent with European concerns

about the recent strength of the euro. However, as noted in the main text, a euro depreciation needs to be accomplished vis-à-vis the Asian currencies rather than the dollar, if it is to promote the adjustment process.

The *Hungarian forint* is somewhat overvalued but by much less than history would suggest, presumably for the same reasons described regarding the Czech crown.

The *Norwegian krone* is currently somewhat strong relative to its past values. We have not attempted to estimate a FEER for the krone in the central case.

The *Polish zloty* is more overvalued than the Hungarian forint according to our estimates, though—like other regional currencies—it is less overvalued than historical comparisons might suggest.

The figures for *Russia* show that the ruble is now very strong relative to its past average. We have not aimed to produce a FEER for the ruble in the central case.

The *Swedish krona* is close to its average of the past 10 years. Sweden nonetheless has a big current account surplus, and our estimate is that the krona is correspondingly undervalued. This is consistent with the weakness of the krona in a longer historical perspective.

All estimates agree that the *Swiss franc* is currently undervalued, though our estimate is substantially larger than the extent to which the Swiss franc currently falls short of its historical average. This is presumably because (like in Singapore) the country has been in substantial surplus for many years. While allowing a larger than normal surplus (6 percent of GDP instead of the regular 3 percent, close to what can be justified by abnormalities in the Swiss overseas investment position), our method limits this excess surplus.

The *Turkish lira* is shown as distinctly overvalued, though by less than the extent to which it is stronger than its past average. This suggests a strong Balassa-Samuelson effect.

There is a curious conflict, which we are in no position to resolve, regarding the strength of the *United Kingdom's pound sterling* relative to the past. The IMF reckons that the pound is almost exactly equal to its past average, whereas Citigroup puts it distinctly weaker. Our FEER suggests that in any event it needs to depreciate somewhat more. (In terms of the euro, the currency of the United Kingdom's main trading partner, the FEER-equivalent exchange rate is €1.30.)

### Western Hemisphere

The *Argentine peso* is currently very weak by historical standards, but we nonetheless calculate it to be marginally overvalued. Presumably the major explanation is to be found in the very heavy export taxes on most agricultural products, which are assumed as part of the data that produce an estimate of overvaluation but are not reflected in calculations of the current value of the exchange rate relative to past values.

The *Brazilian real* is currently very strong by historical standards. In contrast, we estimate only a marginal overvaluation. A part of the explanation is again to be found in Brazil's role as a major exporter of primary products (about half its export value comes from the primary sector). But Brazil ran a current account deficit of $14 billion in the first four months of 2008, against the IMF projection of an $11 billion deficit for the entire year, despite the strength of primary product prices. Its deficit is already running at a higher rate than during the overvaluation of the 1990s. Hence this is one case in which we are skeptical of the IMF projection used in estimating the FEERs, which shows the current account deficit remaining at less than 1 percent of GDP, and believe that a more realistic forecast of what is likely at current exchange rates would have led to a significant less highly valued FEER and bigger overvaluation.

The *Canadian dollar* is currently strong by historical standards. We nonetheless calculate it to be at most only marginally overvalued. The explanation again is the current and probable future strength of primary product prices (including energy), of which Canada is a significant net exporter. Doubtless this is reinforced by the improvement in Canada's international debt position.

The *Chilean peso* is currently strong by historical standards, but it was kept deliberately weak in the late 1980s and throughout the 1990s in the pursuit of export-led growth. We estimate that it is currently very close to equilibrium. This seems entirely reasonable in the light of the prospective price of copper, Chile's main primary product export.

The *Colombian peso* is strong relative to its past average. We also estimate it to be significantly overvalued, although not to the same extent as its strength relative to the past. Perhaps this is because a majority of its exports consist either of energy or other primary products.

The figures for the *United States* show the dollar to be weak relative to its past average. We nonetheless estimate that a further decline in its value will be needed to restore equilibrium, even defining equilibrium to be a 3 percent of GDP deficit in the current account. The major explanation is presumably that the dollar has been overstrong for many years (as a result of which the United States has changed from the world's largest net creditor to its largest debtor), a disequilibrium that our method assumes needs to be reduced to a prudent level.

The *Venezuelan bolivar* does not seem to be especially out of line by the standards of the past ten years, though it is strong on a longer historical perspective. Since the bolivar is an oil currency, we have not estimated its FEER in the central case.

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