3

How To Calculate FEERs

This chapter specifies the partial-equilibrium model we use to calculate FEERs. Chapter 4 estimates key relationships from this model and chapter 5 uses the model to calculate FEERs. In addition, because econometric trade equations are central to our model, this chapter discusses their strengths and weaknesses.

One approach to calculating a FEER is to use a complete macroeconomic model. For example, a version of the medium-term model set out in chapter 1 could be estimated and then solved. Cointegration techniques could be used to determine steady state relationships directly, or any estimated dynamics could be stripped out. For an example of such an approach, see Stein (1994).[1]

A more common "complete model" approach is to use an existing econometric model that is not exclusively medium term. This can be done with a single-country model, given exogenous assumptions about the rest of the world (e.g., Wren-Lewis et al. 1991; Church 1992) or a multicountry model (e.g., Bayoumi et al. 1994). The model can be used to calculate the level of the FEER (i.e., an unconditional forecast) or to examine how the FEER might change given some shock (i.e., a model simulation such as the COMPACT simulation shown in chapter 2).

Is the use of an existing econometric model to calculate FEERs any different from forecasting with that model? Most forecasting exercises focus on short-term developments, whereas a model-based analysis of FEERs

1. Stein calculates a natural real exchange rate (NATREX) rather than a FEER. However, the two concepts appear to have a good deal in common, as the discussion in Williamson (1994) makes clear.

would be largely indifferent to the short term (provided that hysteresis is not a problem). However, forecasts that extend into the medium term often fulfill the condition of internal balance required for the FEER. As a result, this medium-term forecast can be viewed as a FEER calculation, provided that the model has the structural characteristics set out in chapter 1.

The approach based on complete (either existing or newly estimated) econometric models has two advantages. First, it is consistent. There is no danger that one element of the projection (e.g., trend output) is inconsistent with another (asset accumulation) given the structure of the model. In particular, the model takes care of any feedback from the FEER to other variables that in turn influence the FEER. Second, as an existing econometric model will produce projections for the exchange rate for each period in the future, there is no need to worry about the precise meaning of medium term.

However, for practical reasons, FEER calculations using existing dynamic econometric models are likely to relate to the medium term rather than today. A forecast based on an econometric model will project variables into the future, so that in the absence of shocks a stable model with a well-defined equilibrium will settle down into an equilibrium path. It is much more difficult to strip out the dynamics from a short-term forecast or the recent past in a large model. Therefore, the conditions necessary for the real exchange rate to be at the FEER will probably not be satisfied in the short term.

The complete-model method of producing a FEER is of course only as good as the model used to produce it. In particular, if the model does not have well-defined medium- or long-term properties, as is often the case (see Turner 1991), then the estimate of the FEER will not make sense.

A projection of the FEER based on a large model may also lack clarity. This would not be a problem for an estimated version of equations 1.1–1.4, but most existing econometric models are much larger than this, and it may be difficult to understand why a model is producing the answer it is, and why different models produce different answers. (For a valiant attempt at such a comparison, see Williamson [1994].) Projections that lack clarity also lack conviction.

Examination of equation 1.5 suggests an alternative, computationally easier approach. Leaving aside the debt-interest terms for the moment, if a reasonable "off model" projection could be made for the level of output consistent with internal balance (hereafter referred to as trend output) and the medium-term equilibrium level of foreign asset accumulation (hereafter the medium-term current account), then the FEER could be calculated by modeling only the trade balance. (For an early example of this partial equilibrium approach, see Barrell and Wren-Lewis [1989].)

We use this "partial-equilibrium" approach in this book. It has the advantage of simplicity and clarity. It is relatively easy to determine the factors behind a particular FEER and to examine the FEER's sensitivity to key assumptions. Steady state relationships are estimated, so that short-term dynamics are not a problem.

Using this method, the calculation of the FEER can be broken down into two stages, which illustrate quite clearly the assumptions being made. The first stage is to calculate the trend current account, which differs from the recorded current account in two ways. To start with we replace the actual level of imports and exports with the levels that the model predicts. The difference between actual and predicted trade can be described as the result of shocks (e.g., bad harvests). By econometric assumption, these shocks are temporary and, therefore, can be stripped out in calculating an equilibrium. Then, we use the estimated trade equations to examine what exports and imports would have been (or would be) if output moved to its trend level—the level consistent with internal balance.

This first stage shows what the medium-term equilibrium current account would be if the real exchange rate remained unchanged. However, the real exchange rate must move to clear the balance of payments, so the trend current account matches medium-term, or structural, capital flows.

The second stage, therefore, involves calculating the real exchange rate that delivers this match, that is, the exchange rate that produces a (medium-term equilibrium) current account that matches the off-model assessment of structural capital flows.

We look at FEERs for the G7. Considering the G7 as a whole has a number of advantages. We can translate the FEER, which is in terms of an effective rate for an individual country, into an internally consistent set of bilateral rates among the G7. In addition, estimates of trend exports for any country are consistent with reasonable assumptions about growth rates and import behavior in the rest of the G7.

The same logic suggests that estimates of FEERs that cover the OECD or the newly industrialized countries (NICs) would be better still.[2] There are two countervailing points. First, because the same econometric analysis is required for each country, however small, covering many countries could obscure the big picture with too much detail. Second, while the methodology outlined below is clearly applicable to an advanced country, it might need important modification when applied to a developing or newly industrialized economy. By restricting our analysis to the G7, we implicitly assume that the FEER for the G7 relative to the rest of the world is close to the actual rate, and does not change significantly over time.

The Costs of Simplification

One of the disadvantages of the partial-equilibrium approach is that there is no model to ensure that the assessment of trend output and structural

2. For recent estimates of FEERs for some NICs, see Barrell et al. (1996).

capital flows are mutually consistent. This would not matter if the two were independent, but this seems unlikely. For example, the desired level of wealth for the private sector is likely to depend on income, and for a given asset position desired wealth will determine medium-term asset accumulation. We recognize this problem and conduct a sensitivity analysis in chapter 5.

The more serious difficulty with the partial-equilibrium approach is that it rules out any feedback from the FEER to the inputs for trend output and structural capital flows. In essence, we assume that the complete model (i.e., the economy) has a simple recursive structure—variables such as trend output and structural asset flows influence the FEER, but there is no feedback from the FEER to the rest of the model. This is unlikely to be strictly true, but are feedbacks of this kind quantitatively important enough to compromise the exercise?

There are many reasons why trend output is unlikely to be independent of the real exchange rate. We will note three here. First, any change in the real exchange rate changes the relationship between real labor costs and real after-tax income, because the former uses the price of domestically produced output as a deflator while the latter uses the price of consumer goods, which includes imports. Theory normally suggests that the underlying production technology fixes real labor costs, so that any appreciation in the real exchange rate will raise real after-tax income. If the labor supply curve is positively sloped, this increase in real after-tax income will increase labor supply and the level of trend output.

The distinction between real labor costs and real after-tax income is also important in a second potential link between the real exchange rate and trend output. In models of the natural rate of unemployment based on bargaining between unions and firms, the wedge between real labor costs and real take-home pay can sometimes be an important determinant of the natural rate. An appreciation will reduce the size of this wedge and, thus, raise the level of output consistent with constant inflation.[3]

A third feedback from the real exchange rate to trend output supply comes through imported capital goods and the cost of capital (see Serven 1995). Industrial countries typically import a significant percentage of their investment needs; therefore, an appreciation in the real exchange rate will reduce the relative price of investment goods and lower the cost of capital. A reduction in the cost of capital will raise output supply. This increase in output supply will have implications for investment and, therefore, for the composition of domestic asset accumulation and structural capital flows. Any change in the terms of trade is also likely to influence saving and, therefore, structural capital flows (see Harberger 1950; Laursen and Metzler 1950).

3. For a discussion of the theoretical conditions under which this effect might be present, see Layard, Nickell, and Jackman (1991).

So far, we have only discussed the direct effects of the real exchange rate on trend output or structural capital flows. Equally important feedbacks may come through the real interest rate, via the UIP condition in real terms. Suppose that for some reason a current account surplus is expected for several years, leading to a gradual build up of net foreign assets. As net assets increase, ceteris paribus, interest income will rise, implying a gradual reduction in the trade surplus and an appreciating FEER. The appreciation in the FEER, given UIP, requires that the domestic real interest rate be below world levels. This lower real interest rate could have implications for domestic savings and investment patterns, as well as output supply. (The same point would apply if we introduced a risk premium that depended on net assets into the UIP condition.)

A simple illustrative example may be helpful to clarify this point. In chapter 5, we find that a difference in the medium-term current account of 1 percent of GDP can change the FEER by as much as 8 percent. Suppose that a country trying to reduce government debt ran a medium-term current account surplus of 1 percent of GDP for some period but then reverted to current account balance as it reached long-term equilibrium. Looking ahead, currency traders would require a negative real interest rate differential to compensate for the expected long-term real appreciation. If the long term is only 20 years, the real interest rate differential could be as high as 0.4 percentage points, an amount that could have important implications for medium-term supply.[4]

These points emphasize that the partial-equilibrium approach to calculating FEERs cuts corners for the sake of greater simplicity and clarity. How critical are these simplifications? Driver and Wren-Lewis (1996) examine the sensitivity of FEERs to feedback from the real exchange rate to output and conclude that the effects are relatively small. Wren-Lewis et al. (1991) calculate a FEER for the United Kingdom using both the partial-equilibrium and complete-model approach and arrive at similar estimates. However, more comprehensive research on this issue is required. For example, the trade equations could be extracted from a complete model, and these and the complete model could be used to calculate FEERs under alternative exogenous assumptions.

The full model and the partial-equilibrium framework are structural approaches. A different method would be to estimate reduced forms for the real exchange rate directly (e.g., Elbadawi 1994; Chinn 1996; and Clark and MacDonald 1997). Cointegration techniques provide a natural way of distinguishing medium- and long-term relationships from short-term movements. However, the resulting cointegrating relationship is a statistical rather than an economic construct. We noted in chapter 1 that most studies find that real exchange rates are not stationary. However, if the

4. This point is reinforced by noting that because the current account surplus will cause debt interest receipts to build up, the extent of the expected appreciation will also increase.

Table 3.1 Specification of trade-volume equations

	Demand	Competitiveness
Goods exports	World trade	Relative export prices
Services exports	OECD output	Relative consumer prices
Goods imports	Domestic output	World export prices to domestic prices
Services imports	Domestic output	Relative consumer prices

theory behind the FEER is correct, then it should be possible to find a cointegrating vector that links the real exchange rate to key exogenous determinants of the FEER, such as fiscal policy or demographic trends. The relative merits of this direct estimation method compared to the approach pursued below, therefore, largely depend on the advantages and disadvantages of reduced-form estimation compared to structural modeling.

Modeling Aggregate Trade

Our partial-equilibrium model is essentially an elaboration of equation 1.5 from the model in chapter 1, and it is similar to the model used in Barrell and Wren-Lewis (1989). As trend output and structural capital flows are exogenous (see chapter 4 and appendix A), the behavioral part of the model concerns trade flows. Trade is split between imports and exports, goods and services, and prices and volumes.

Trade volumes are modeled as a demand curve, with the two arguments being a measure of total demand and a measure of competitiveness:

$$\textit{trade volume} = f_1\,(\textit{demand}, \textit{competitiveness}), \qquad (3.1)$$

where the functional form used is the traditional log-linear specification. Table 3.1 specifies the measures used for demand and competitiveness in each case. Appendix B gives the individual equations and appendix D provides the data definitions. Although this demand-curve approach to modeling trade volumes is entirely conventional, it is not without its problems, which we discuss at length below. For trade in goods, trade prices are assumed to be a weighted function of commodity prices, domestic prices, and world export prices:

$$\textit{goods trade prices} = f_2\,(\textit{commodity prices}, \textit{domestic prices}, \textit{world export prices}). \qquad (3.2)$$

Commodity prices are divided into five categories: oil prices, food prices, world beverages prices, world agricultural nonfood prices, and world metals and minerals prices. Their importance for trade prices is derived from the commodity composition of trade (see chapter 4). The relative importance of domestic and competitors' prices in determining the price of manufactured trade will depend, among other things, on the openness of the economy, and these weights are estimated in chapter 4. For trade in services, export prices are assumed to be identical to domestic consumer prices, and import prices identical to OECD consumer prices in domestic currency.

The trade volume equations involve two measures of world activity (trade and output) and two measures of domestic prices (manufacturing wholesale prices and consumer prices). In addition, we use a third price measure, the GDP deflator, when converting variables into a GDP share. World trade and OECD output are linked using a simple log-linear equation that includes a trend term, and similar linking equations are used for consumer prices and the GDP deflator. (Once again, the individual equations are set out in appendix B.) The trends in the price equations will contain, for example, the impact of differences in productivity growth rates between traded and nontraded sectors.

The equations for trade volumes and prices can be combined and simplified (see appendix B) to yield the following expression:

$$\textit{trade balance/GDP} = f_3(\textit{domestic output, world output, real exchange rate, real commodity prices}). \quad (3.3)$$

This is essentially the formulation used in equations 1.1 and 1.5 in chapter 1, with the addition of the term in real commodity prices. Real commodity prices are nominal commodity prices divided by world export prices and are modeled as log-linear trends.

Our linking equations for prices allow us to define the real exchange rate in terms of consumer prices, output prices, or trade prices. We define the real exchange rate as world export prices (in dollars) times the nominal exchange rate (domestic currency units per dollar) divided by domestic wholesale prices. This measure of the real exchange rate is also the measure of competitiveness used in the goods-imports volume equations. Thus, an appreciation leads to a fall in the real exchange rate. This definition of the real exchange rate in terms of traded goods will reduce the extent of the "productivity bias," which would lead to an appreciation in faster-growing countries (Balassa 1964).

Limitations of the Demand-Curve Trade-Volume Specification

The key behavioral equations in our partial-equilibrium model of FEERs are those for trade volumes. Our method of modeling these real flows, based on a demand-curve approach, has a long tradition in empirical macroeconomics and remains the standard way to model trade flows.

Houthakker and Magee (1969) provide a definitive early example of this approach. However, frequency of use and an absence of established alternatives do not imply that the method is beyond reproach: the demand-curve specification has serious empirical and theoretical inadequacies.

Trade equations based on a demand-curve specification generally involve large errors within sample and tend to be rather unstable out of sample. In addition, unexplained trends have to be included to make the equations work at all, and these trends sometimes shift over time (see Anderton 1991). Chapter 4 includes our estimates of the coefficients, which share these general problems. There is still much about the determination of real trade flows that we do not understand.

Partly because of these empirical shortcomings, there have been a number of theoretical criticisms of the simple demand-curve approach. One line of attack has focused on the omission of nonprice competitiveness factors, although in practice measurement problems prevent much progress here. Another criticism has concerned the log-linear functional form used in import equations (see Anderton et al. 1992). In addition, it is doubtful that a single measure of demand is appropriate. While the measure of demand relevant to intermediate imports is output, for final goods some measure of final demand is preferable. The two measures may differ in the medium term if assets are being accumulated (see Wren-Lewis 1992). However, the most serious critique has been the claim that these equations neglect supply-side factors and, in particular, decisions over the location of production.

The aggregate demand-curve approach implicitly assumes that the mapping from types of goods to economies is fixed. While this may be a reasonable approximation in the short term, it becomes more questionable over the medium and long term. Multinational companies, for example, may be able to switch production from high-cost to low-cost countries even if the price of the good produced in each country remains unchanged. Therefore, some argue that relative costs rather than relative prices would be a better measure of competitiveness in empirical trade equations. The evidence is at best mixed, though. There is some evidence that competitiveness elasticities tend to be higher in the long term compared to the medium term. This would be consistent with firms moving production to countries with cheaper long-term costs.

While a neglect of these supply-side factors may lead us to underestimate long-term competitiveness elasticities, it may also lead us to exaggerate the implications of different demand elasticities or trends in traditional demand-curve equations. As Houthakker and Magee noted (1969), without either a steadily depreciating FEER or an unsustainable increase in the current account deficit, economies such as the United States or the United Kingdom that have high import-demand elasticities or a tendency for world trade shares to fall (for given levels of the real exchange rate) will not be able to grow as rapidly as other countries that have the opposite tendency (e.g., Japan). However, Krugman (1989) has suggested that this may confuse cause and effect. The poor trade performance may be the result of low growth and not its cause.

Recent developments in trade theory have emphasized the variety and quality of goods produced in an economy. If the variety of goods produced in an economy increases relative to the variety in its trading partners, then the demand for its products is also likely to increase (and the demand for imports as a share of total output would fall), even though there may have been no change in that nation's aggregate level of price competitiveness. The traditional demand-curve approach to modeling trade would completely miss this change. If countries with fast growth rates also tended to increase the variety of goods they produced more rapidly than did other countries, then this would show up in traditional trade equations as favorable activity elasticities or unexplained trends. Some recent work has supported these ideas using proxies for variety or innovation such as research and development (R&D) and investment (e.g., Owen and Wren-Lewis 1993; Blake and Pain 1994).

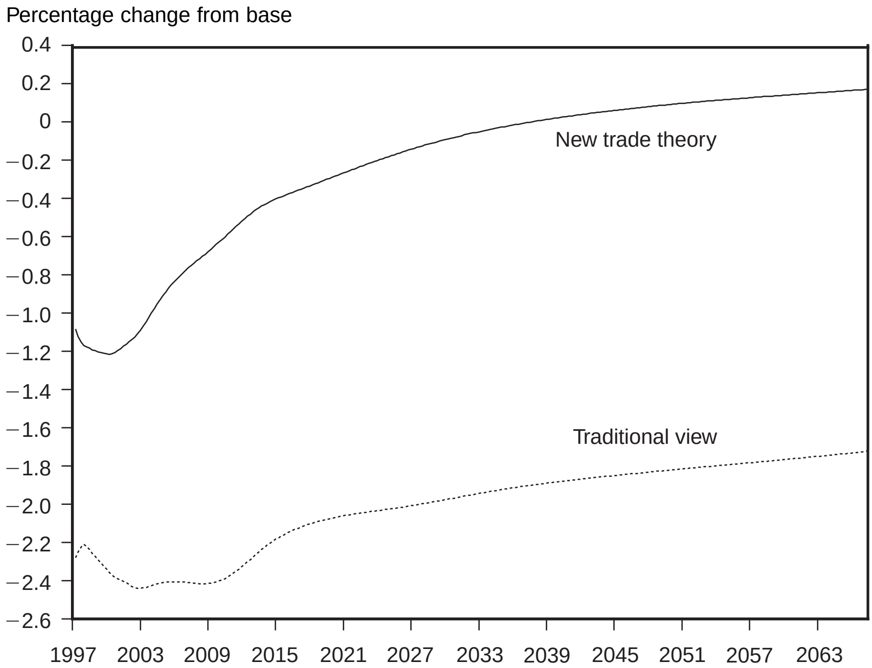
At present we have little idea of what implications these points might have for FEER analysis. They may provide some support to PPP, but only in the very long term. Analysis based on recent research, including analysis of foreign direct investment equations, suggests that these processes take many years. The COMPACT model of the United Kingdom's economy illustrates this clearly. The model is particularly useful in this context because it attempts to modify the traditional demand-curve approach by including cumulated investment as a proxy for innovation.

Consider an increase in domestic supply that is caused by an increase in labor supply. In the traditional analysis, the medium- and long-term effect will be to raise output supply; however, the increase in the demand for domestic output will fall short of this supply, because some of the additional domestic income will be spent on foreign goods and export demand will remain unchanged.[5] The gap between domestic supply and demand has to be closed by a depreciation in the real exchange rate to encourage demand. Figure 3.1 shows a COMPACT simulation that uses a traditional trade equation approach: a 1 percent increase in supply leads to a 2 percent depreciation in the medium to long term.

The figure also shows the same simulation with the traditional trade equation replaced by one that proxies the variety of production with the level of cumulated investment. As output increases, so does investment. Although some of this investment increases capacity in existing products,

5. The long-term effect of higher output supply on the real exchange rate can be theoretically ambiguous, for similar reasons to those discussed for fiscal policy in chapter 2. If the increase in domestic income is spent entirely on domestic goods and wealth increases in line with income, then the exchange rate would appreciate because of additional interest receipts on higher foreign assets. However, if all the additional income is spent on foreign goods, then a long-term depreciation would be required to sell the additional supply.

Figure 3.1 COMPACT simulation: impact on the real exchange rate of an incrDease in supply, March 1997–March 2063



some expands the variety of products produced domestically. In this case, the medium- and long-term consequences for the real exchange rate are different. Whereas the medium term still requires a depreciation to take place, in the long term the need for a depreciation disappears. To the extent that the exchange rate returns to its original level, it behaves as PPP would suggest in the long term. However, this is a very long-term effect, and the real exchange rate returns to its original level only after 40 years.

Modeling Debt Interest Flows

We do not provide a complete model of the behavior of net foreign asset stocks. However, we allow two crucial feedbacks from the rest of the model to these stocks, one static and the other dynamic.

For the G7 economies, most domestic assets held by foreign residents are likely to be denominated in domestic currency, and most foreign assets held by domestic residents are likely to be denominated in foreign currency. Therefore, the domestic currency value of foreign asset stocks will change when the exchange rate changes (i.e., a revaluation effect).

This leads to a change in the domestic currency value of debt-interest receipts from these assets and, therefore, to a change in the current account. Specifically, a devaluation, by raising the domestic-currency value of foreign assets, will increase domestic-currency interest flows from these assets and improve the current account. This has become an increasingly important way for a devaluation to improve the current account, because portfolios have increased their foreign diversification and that must be allowed for in assessing how far the real exchange rate has to change to achieve an equilibrium current account.

We also allow for a dynamic feedback from the medium-term current account to stocks of assets when assessing how the FEER changes over time. An economy that has a structural capital account outflow (i.e., a medium-term current account surplus) will be either increasing its stock of foreign assets, or the stock of domestic assets held overseas will be falling. Over time, this will increase net interest receipts and, therefore, improve the current account. This mechanism is of some importance in assessing FEERs in 2000 for countries with significant structural capital flows. In addition to the impact of structural capital flows and revaluation effects, the model of changes in asset stocks over time uses simple trends. The detailed model is set out in appendix B.

An important assumption in our analysis is that debt-interest flows and asset stocks are not systematically changed by the move to internal balance. This is clearly a strong assumption that is unlikely to hold in practice. The difficulty, however, is that the move to internal balance is likely to have many effects on debt-interest flows that are difficult to model and that work in different directions. For example, if trend output is above actual output, then higher output may bring with it an increase in holdings of foreign assets. The move to trend output may also involve a change in domestic interest rates, which is likely to influence debt interest flows. When calculating the trend current account, we do, however, attempt to subjectively smooth any movements in debt-interest flows that are clearly erratic.[6]

6. Our concept of internal balance is a counterfactual construct. That is why we can calculate the trend current account and a FEER for 1995 and 2000. The move from the actual to the trend current account does not occur over time. In contrast, Artis and Taylor (1995) view the move to internal balance as a dynamic process, and they allow for feedback from the disequilibrium (nontrend) current account to asset stocks, producing hysteresis in the FEER.