The collapse of the Smithsonian agreement in March of 1973 marked the end of the Bretton Woods system of fixed exchange rates among the major industrial countries. Initially, many developing countries responded to this event by attempting to sustain their fixed exchange rate parities. Over time, however, the majority of these countries have also moved toward exchange rate arrangements involving more frequent adjustments in nominal exchange rates. Most such arrangements, however, have not left exchange rate determination to the market. Instead, whether in the form of crawling pegs or managed floating, they have invariably featured an important role for the authorities in the setting of nominal exchange rates and thus have led to increased activism in exchange rate management. Consequently, the question of how to choose the appropriate value of the nominal exchange rate has remained a key concern of macroeconomic policy in developing countries. In this context, a broad consensus has emerged in recent years that the overriding objective of exchange rate policy should be to avoid episodes of prolonged and substantial misalignment—meaning situations in which the actual real exchange rate (RER) differs significantly from its long-run equilibrium value.

Unfortunately, following this advice is not as simple as it sounds, even for the most well intentioned policymaker. Leaving aside the substantial difficulties that may arise in setting the actual nominal and real exchange rates, we focus on the procedures that authorities might use to choose the nominal exchange rate.
exchange rates on their intended paths, two fundamental issues have to be confronted. The first is defining exactly what is meant by the long-run equilibrium real exchange rate. The second is estimating what the value of this long-run equilibrium rate is for a given country at any moment in time. Neither issue is trivial. Even though exchange rate misalignment is an important concern for policymakers, the economics profession has yet to reach a consensus on precisely what is meant by the long-run equilibrium real exchange rate. And not surprisingly, therefore, it has provided little systematic guidance on how to measure it.²

Despite the absence of consensus, not only do developing-country policymakers continue to confront these issues on a daily basis, but the urgency of getting this key macroeconomic relative price “right” may be increasing over time, as growing financial integration has arguably escalated the costs associated with real exchange rate misalignment. In the developing-country context alone, recent episodes such as the January 1994 devaluation of the CFA francs in West and Central Africa,³ the Mexican currency crisis at the end of 1994, the Asian crisis that erupted in mid-1997, and the Brazilian devaluation in January 1999 have served as reminders of the macroeconomic disruptions that can be caused by real exchange rate misalignment. The severe macroeconomic dislocations experienced during these episodes suggest that the importance of being able to estimate the degree of misalignment may, if anything, have increased in recent years.

This volume arose from one such episode of misalignment. Most of the papers collected here originated in the course of a practical exercise in measuring real exchange rate misalignment at the World Bank. During the long dialogue over the degree of overvaluation of the CFA francs, World Bank staff were confronted with the problem of estimating the extent of real exchange rate misalignment in a context where it was important to ensure that the estimates were both theoretically defensible and empirically accurate. Hence, the staff did a considerable amount of analytical work on various methodologies for calculating indexes of the actual real exchange rate and for estimating the value of the long-run

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². An interesting perspective on the evolution of these issues is provided by John Williamson’s introduction to his edited book on the topic, *Estimating Equilibrium Exchange Rates* (1994). The somewhat apologetic tone of that introduction suggests that, in the authors’ opinion, the very concept of estimating long-run equilibrium exchange rate needed to be defended within the economics profession.

³. CFA is the abbreviation for Communauté Financière Africaine. The CFA francs are the currencies of the West and Central African Monetary Unions, which together constitute the CFA zone.
equilibrium real exchange rate. This methodological work focused on the types of analysis that could be carried out relatively quickly with (a) the limited amount and periodicity of data usually available in small African countries (for example, a monthly consumer price index (CPI), standard annual national accounts aggregates, annual export and import price indexes, and monthly official and parallel market exchange rates) and (b) the limited staff inputs (for example, one economist and a researcher) that are typically available for work on small developing countries. The staff also directed considerable attention to some empirical problems encountered during this work that are relatively more important in developing than industrial countries, such as unrecorded trade, parallel exchange markets, shifting trade patterns, and large fluctuations in export prices.

This book is intended to preserve and disseminate this work on measuring misalignment because the methodologies that were used are likely to be of practical relevance in many other developing-country applications. The book’s objectives are thus to bring this work together, set it in an analytical framework, and complement it with other techniques that—while not employed in the CFA franc context because the operational restrictions described above prevented doing so or because the particular structure of the CFA economies did not make them suitable—might well be applicable in other developing countries. What we hope to achieve is to provide policymakers and their advisers with a compendium of practical techniques for estimating equilibrium real exchange rates, as well as to further the development of this area of research by taking stock of the current state of the art.

The objective of this first chapter is to present an overview of the book and to place the subsequent chapters in context. The remainder of this overview is divided into five sections, corresponding to each of the four parts of the book, plus a concluding section.

Part I of the book considers issues that arise in the definition and measurement of the actual real exchange rate. It is indispensable to treat these first because the choices made in selecting the appropriate actual real exchange rate for a particular application will obviously affect the equilibrium concept relevant to it and also because the reliability of the estimates of the equilibrium exchange rate will clearly depend on how closely empirical proxies can approximate the “true” variable being measured. These definition and measurement issues are reviewed and summarized in the second section of this overview.

Part II turns to the long-run equilibrium real exchange rate (LRER) itself. It contains two chapters that provide overviews of existing literature. The first chapter considers conceptual issues that arise in defining the long-run equilibrium real exchange rate and surveys existing
techniques for its empirical estimation. The following chapter sets out an analytical model that synthesizes existing theories about the determinants of the LRER. The basic findings of these two chapters are described in the section below on the determinants of the equilibrium RER.

Part III then analyzes in some detail four methodologies for the empirical estimation of the long-run equilibrium real exchange rate: a PPP-based approach, a recursive trade-equations approach, and two general equilibrium approaches—one based on structural econometric models and the other on a reduced-form methodology utilizing unit-root econometrics. These methodologies are described in the four chapters contained in Part III of the book. They are summarized and evaluated in this overview’s section on methodologies for estimating the equilibrium RER.

Part IV of the book, reviewed below in the section on policy and operational considerations, takes up some important related issues. The first chapter in Part IV examines the empirical role of the real exchange rate in promoting external balance, a mechanism that is featured prominently in traditional definitions of the long-run equilibrium real exchange rate but the empirical effectiveness of which has sometimes been questioned. The two remaining chapters in Part IV assess the usefulness of the parallel market premium as an indicator of the LRER and describe operational techniques for estimating the magnitude of nominal exchange rate changes required to correct a given real exchange rate misalignment.

The overview concludes with a final section presenting our assessment of where the enterprise of defining and estimating equilibrium real exchange rates in developing countries currently stands. We find, in brief, that recent developments justify optimism. The three techniques that have traditionally been used for the estimation of equilibrium real exchange rates—based on purchasing power parity, on the trade equations, and on simulations of empirical general equilibrium models—each suffer from particular limitations; but each can be useful under appropriate circumstances. What we have dubbed the reduced-form general-equilibrium approach is a relatively recent technique. Although this method of estimation is not without its own pitfalls, it appears to hold promise of future progress in the empirical estimation of equilibrium real exchange rates for developing countries.

The Real Exchange Rate: Concepts and Measurement

The point of departure for estimating the long-run equilibrium real exchange rate (which we call the LRER) is the measurement of the actual real exchange rate (RER). Unfortunately, this is not a straightforward
matter. The difficulties are both conceptual and empirical. Multiple conceptual definitions of the real exchange rate, drawn from different analytical frameworks and suitable for use in different circumstances, have long complicated the analysis of real exchange rate issues. This multiplicity poses the problem of how to choose among alternative definitions of the real exchange rate. In addition, in the empirical measurement of the RER in many developing-country applications one confronts a large number of practical problems that are not often encountered in the case of industrial countries and thus have not been as widely discussed as other more general issues. The first three chapters in Part I of the book take up these definitional and measurement issues in detail.

As discussed subsequently in Part II, the development of LRER theories has followed somewhat different lines in industrial- and developing-country applications. Somewhat surprisingly, the differences have extended to the very definition of the RER itself.

In the context of industrial countries, economists have focused on the “external” RER for both analytical and empirical purposes. When defined in this manner, the RER is measured as the ratio of the foreign to the domestic values of some broad-based price index such as the CPI or the deflator for gross domestic product (GDP), expressed in a common currency by using the nominal exchange rate to convert the price level in one country into the currency of the other. Unfortunately, matters are complicated by the fact that alternative conceptual frameworks imply alternative choices of price indexes. As a result, even within the external real exchange rate category there exist multiple definitions from which to choose. This multiplicity of concepts would be of little consequence if the alternative measures all tended to move together, but they cannot be counted upon to do so—that is, empirically, the choice of price index tends to matter.

In the developing-country context, moreover, the RER tends to be defined in two different ways for analytical purposes: either as the relative price of traded goods in terms of nontraded goods, which is referred to in this book as the two-good internal real exchange rate, or as the relative prices of exportable and importable goods in terms of nontraded goods, which are referred to here as the three-good internal real exchange rates. To complicate matters further, despite the analytical preference for the use of internal RER concepts, the external RER tends to be used for empirical purposes in developing-country applications. This practice raises a number of issues. For example, when is it appropriate to use one definition rather than another? What is the relationship between the definitions? Are there specific pitfalls to which practitioners should be alerted in formulating hypotheses using one RER concept and testing them using another as an empirical proxy? The three
chapters in Part I by Hinkle and Nsengiyumva take up these questions, considering each of the three broad definitions of the RER in turn.

**The External RER**

Chapter 2, the first chapter in Part I, provides a general summary of conceptual and empirical issues that arise in defining and measuring the external real exchange rate. Three alternative definitions, based on different price indexes, are reviewed; and both their theoretical underpinnings and empirical counterparts are described. Chapter 2 also provides a critical evaluation of the usefulness of external RER measures in developing countries from a conceptual perspective. On a more practical level, issues such as the choice of weighting schemes in the construction of real effective exchange rate (REER) indexes and alternative decompositions of such indexes for analytical purposes are also discussed. Finally, particular attention is given to measurement problems that arise with special force in developing countries because of parallel exchange rates, unrecorded trade, and rapidly shifting trade patterns.

The three external real exchange rate measures examined are the relative expenditure PPP-based RER, which uses domestic and partner country CPIs; the Mundell-Fleming or aggregate production cost RER, which uses GDP deflators; and the traded-goods RER, which can be constructed using relative unit labor costs in manufacturing, wholesale prices, manufacturing-sector deflators, or export unit values. The CPI-based measure has the important empirical advantage that the domestic price data required are widely available on a current basis for most developing countries so that REERs with reasonably comprehensive partner country representation can be computed. The aggregate production cost RER, in contrast, relies on GDP deflators that are available at much lower frequencies for developing than for industrial countries. This shortcoming also affects some versions of production cost–based RERs for traded goods, such as that based on manufacturing deflators. Both of these cost-based RERs (the aggregate and traded-goods versions) can, in principle, be improved upon as measures of competitiveness through the use of unit labor cost measures, since these take into account intercountry differences in average labor productivity. However, lack of data on unit labor costs limits the usefulness of such measures in developing countries.

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4. However, traded-goods RERs computed using wholesale prices, when these are available, do permit the use of higher-frequency data as discussed in Chapter 2.
A more fundamental problem with the cost-based RERs, however, is that they are based on a concept of competitiveness between domestic and foreign goods that are not perfectly substitutable. For countries with a large share of standardized commodities in their exports, the applicability of cost-based RERs may, therefore, be limited. For such countries the relevant concept of competitiveness is not the ability to produce at lower costs and thus sell at lower prices (expressed in a common currency) than other countries producing similar products. Rather, it is the adequacy of domestic incentives to produce goods that are not greatly differentiated from (and thus must sell at similar prices to) those produced by other countries. This difference makes such cost-based concepts seriously misleading in the presence of terms-of-trade changes. An increase in the price of domestic exports—which would increase internal incentives to produce such goods—would, for example, show up as an increase in the GDP deflator or wholesale price index (WPI) and thus inaccurately suggest a deteriorating relative cost performance. Cost-based measures are therefore not usually considered to have particular conceptual advantages over expenditure-based measures in the developing-country context. In view of the data availability advantages of the latter, Chapter 2 concludes that for most developing countries the REER computed using domestic and foreign CPIs is the most useful of the various external RER measures.

However, both expenditure-based and cost-based external RER measures can be very sensitive to the existence of parallel markets and unrecorded trade, as well as to shifting trade shares and weighting schemes. Calculations for Côte d’Ivoire illustrate the significant difference that such factors can make to estimated REERs. Hence, a variety of measures should be calculated and interpreted together to permit cross-checks, rather than relying on a single measure.

Finally, a presentational point noted in Chapter 2, and worth repeating here to avoid subsequent confusion, is that, like nominal exchange rates, all RER measures can be expressed both in foreign-currency terms and inversely in domestic-currency terms. When expressed in foreign-currency terms (that is, in units of foreign currency per unit of domestic currency), an increase in the RER represents an appreciation. However, when the RER is expressed in domestic-currency terms (that is, in units of domestic currency per unit of foreign currency), the inverse is true: an increase in the RER represents a depreciation. Since for some purposes it is useful to express RERs in foreign-currency terms and for others in domestic-currency terms, both versions are widely used in the literature and in this volume. In the interest of clarity, we have noted throughout the text and in the graphs and tables whether the RER is
measured in foreign- or domestic-currency terms, but readers should be alert to shifts between the two measures.

**The Two-Good Internal RER for Tradables and Nontradables**

Chapter 3 turns to the two-good internal real exchange rate, the definition of which is based on the familiar Swan-Salter “dependent economy” model and which is in widest use for analytical purposes in the developing-country context. Although the two-good internal real exchange rate has strong analytical appeal, difficulties with this definition arise in practical applications, stemming from the absence of generally available price indexes for “traded” and “nontraded” goods. Chapter 3 describes and evaluates alternative approaches to the construction of such indexes, which differ according to whether they attempt to measure border prices or domestic prices as well as to whether the relative price indexes are expenditure-based or production-based. These may diverge significantly in developing countries. A familiar proxy for the internal RER, based on partner country WPIs as measures of traded-goods prices and the domestic CPI as an indicator of the price of nontraded goods, may be reasonable as long as the terms of trade and commercial policies are stable. When the terms of trade change, the measure is likely to be a better proxy for the internal RER for importables than for exportables. However, as in the case of the external RER, this measure also proves quite sensitive to parallel exchange rates, unrecorded trade, and changes in trade patterns.

Hinkle and Nsengiyumva also consider the theoretical and empirical relationships between the external RER and two-good internal RER. This is a particularly important problem in the developing-country context since, as indicated above, analysis of RER issues tends to be formulated using the two-good internal RER concept, while for data availability reasons empirical work tends to rely on the external RER. Conceptually, the relationship between the two measures is well known—the home country’s internal RER is a function of its external RER as well as of the internal RER of the foreign country and the relative prices of tradable goods in the two countries. Because of the role of the last two factors, a country’s internal and external RERs need not move together. Moreover, even if these factors were unchanged, movements in a country’s internal RER are likely to be larger than those in its external RER. In Chapter 3, the two measures are compared for a specific country, and the effects on the measured RER of changes in a subset of fundamentals—specifically productivity and trade taxes—are analyzed. The chapter illustrates the familiar result that faster productivity growth in the traded than in the nontraded sector will cause the internal RER to
appreciate. Further, it shows that differentially faster productivity growth in the traded-goods sectors of partner countries than in the domestic economy could cause the external RER to depreciate at the same time.

A final important caveat noted by Hinkle and Nsengiyumva concerns the role of the law of one price. The quantitative relationships between the measured internal and external RERs all depend upon the law of one price holding for tradable goods, a supposition that has been strongly challenged by much recent empirical work on large industrial countries. If the law of one price does not hold or holds only loosely as a long-run tendency, then the effect of exchange rate movements on the internal RER will be muted, the internal and external RERs will diverge, and the external RER will not be a reliable indicator of movements in domestic relative prices. The various caveats articulated in Chapter 3 concerning the relationship between the two RER concepts are relevant for the rest of the book, in which some of the empirical work utilizes the external RER.

Chapter 3 thus concludes that, despite its analytical appeal, the two-good internal RER is of limited empirical utility for low-income countries. Data problems make it extremely difficult to measure the two-good internal RER with any accuracy in most countries. In addition, many of these countries experience significant exogenous variations in their terms of trade, which cannot be addressed in a two-good framework.

The Three-Good Internal RERs for Exportables and Importables

The final chapter in Part I, Chapter 4, considers the three-good internal real exchange rate, which disaggregates tradable goods into exportables and importables and produces two real exchange rate measures—corresponding to the relative prices of exportables and importables, respectively, in terms of nontraded goods. Here, the central conceptual issue concerns the choice between a two-good and a three-good framework. Chapter 4 analyzes the conditions under which each of these may be appropriate. The three-good framework is strongly advocated for most cases since fluctuations in the terms of trade and commercial policies are often important in developing countries. These shocks tend to move exportable and importable RERs in opposite directions, making a two-good internal RER essentially meaningless. Hence, in most cases, analysts will want to examine the behavior of both the exportables and importables real exchange rates.5

5. If for presentational reasons a single RER measure is needed, the price of domestic goods measured in foreign exchange may be used for this purpose as illustrated in Chapter 8.
Overall, the three chapters by Hinkle and Nsengiyumva make the case that for low-income countries, the most useful RER measures are the CPI-based external RERs (or those using unit labor costs if the data are available) and the three-good internal RERs for exportables and importables. The external RER and its components are particularly useful for analyzing the effects of nominal shocks such as nominal exchange rate movements and foreign and domestic inflation. The three-good internal RERs are useful for measuring the effects on domestic relative prices of real shocks such as changes in the terms of trade and commercial policy.

If the law of one price holds for traded goods, it is possible to calculate any of the various internal and external RER measures from given values of the others. However, empirically the law of one price holds at best only loosely for traded goods, and (unknown) measurement errors affect the accuracy of all the empirical RER measures. Since inconsistencies in the data may pose serious analytical problems in some cases, best practice will typically involve constructing and analyzing several RER measures. In the case of the external RER, these would examine alternative assumptions about trade through parallel markets, unrecorded trade, and trade shares. Similarly, different approaches to the estimation of the three-good internal RERs should be compared to the extent possible in each case.

In a number of low-income countries the unavailability of the data required for timely and accurate measurement of the three-good internal and the external RER for traded goods is still a serious analytical constraint. In these cases, improved data collection is a prerequisite for more accurate measurement and analysis of the real exchange rate.

Determinants of the Equilibrium Real Exchange Rate

In Part II, the book turns to the long-run equilibrium real exchange rate (LRER) itself. The two chapters, 5 and 6, in this part, both by Montiel, are overviews: the first of the existing empirical literature devoted to the estimation of the LRER, and the second of theory linking the LRER to its long-run fundamental determinants.

Conceptual Issues and Empirical Research

Chapter 5 actually takes up two separate topics. Since it is the first chapter in the volume that explicitly considers the question of the definition and measurement of the LRER, its first section is devoted to conceptual issues, examining in particular what is meant by the long-run equilibrium
real exchange rate, before describing how economists have attempted to estimate it. The purpose of this first section is to sort out some conceptual problems that have arisen in defining and measuring the LRER. These are of various types, two of which are worth mentioning here.

First, some economists question the very notion of distinguishing between the actual RER and its notional equilibrium value, since the actual RER is itself the outcome of the economy’s macroeconomic equilibrium. This argument appears to be somewhat confused, however. The distinction between the actual RER and the LRER is not one between disequilibrium and equilibrium, but rather between different types of equilibriums—that is, equilibriums conditioned on different values of macroeconomic variables. The actual RER observed at any moment may be influenced by a variety of factors that may prove to be transitory. These include speculative “bubble” factors, actual values of predetermined variables that differ from their long-run values, and transitory movements in both policy and exogenous variables. When at least some of the variables on which the actual “equilibrium” RER depends are unsustainable, the actual RER will tend to change over time, tracing out an equilibrium path.

It is possible, then, to think of alternative “equilibrium” RERs, for which the notion of equilibrium is defined over different time horizons. For example, we can distinguish conceptually between the actual RER and a “short-run equilibrium” RER (SRER). The latter refers to the value of the RER that would be observed in the absence of speculative (bubble) factors. This value depends on “short-run fundamentals” such as the actual values of predetermined variables as well as actual and expected future values of policy and exogenous variables. Similarly, we can distinguish between this SRER and a long-run equilibrium RER (LRER). In contrast to the SRER, the LRER is a function of the steady-state values of the predetermined variables and the permanent (sustainable) values of policy and exogenous variables, rather than of the actual values of these variables. Finally, we can also distinguish between the LRER and the “desired” LRER (DRER), which is conditioned on optimal values of the policy variables, permanent values of the exogenous variables, and steady-state values of the predetermined variables.

Second, even if one accepts these distinctions and is specifically interested in measuring the LRER, a further complication arises in determining the duration of the “long run” that is relevant for policy purposes. The traditional definition of the LRER based on the simultaneous attainment of internal and external balance, established by Nurkse (1945), suggests that the long run should be long enough for cyclical effects to have worked themselves out. However, in specifying “external balance” as a situation in which the current account is financed by sustainable
net capital inflows, this definition leaves open the question of whether the long run implies that the economy has reached a steady-state international net creditor position. Alternative definitions of external balance, built on different assumptions about the economy’s net external creditor position, are examined in Chapter 5.

The second part of Chapter 5 surveys existing methods of estimating the LRER (based on various definitions of “external balance”) in both industrial and developing countries. After reviewing evidence on the validity of purchasing power parity (PPP) as a theory of the LRER, applications of three alternative approaches to empirical estimation of the LRER are surveyed: (a) a recursive partial-equilibrium trade-equations approach, (b) an approach based on the simulation of macroeconometric models, and (c) two varieties of reduced-form estimation, a traditional one and one based on unit-root econometrics. Each of these techniques is subsequently described, analyzed, and illustrated in detail in Part III of this book. Thus, the role of this survey is to provide background for the individual estimation techniques to be described later, as well as to explore the relationships among them.

An Analytical Model
Chapter 6 then presents a theoretical model of the determination of the LRER that is intended to synthesize previous literature on the determinants of the LRER. The role of this chapter is to identify the set of variables that may potentially act as long-run fundamentals and to determine the qualitative nature of their influence on the LRER. The variables identified there are domestic supply-side factors, fiscal policy, changes in the international economic environment, and commercial policy. Each of these is discussed in turn below.

Domestic supply-side factors. These essentially refer to differences in sectoral productivity growth rates—particularly, the Balassa-Samuelson effect. Traditionally, this effect has been interpreted as arising from faster productivity growth in the traded-goods sector than in the nontraded-goods sector. Differential productivity growth of this type requires an appreciation of the long-run equilibrium value of the internal RER.

Fiscal policy. Permanent changes in the distribution of government spending between traded and nontraded goods affect the LRER in different ways. Additional tax-financed spending on nontraded goods, for example, creates incipient excess demand in that market, requiring a real appreciation to restore equilibrium. By contrast, tax-financed increases in spending on traded goods put downward pressure on the trade balance and require a real depreciation to sustain external balance.

Changes in the international economic environment. Changes in an economy’s external terms of trade, the flows of external transfers, the
world inflation rate, and the level of world real interest rates, all may potentially influence the LRER. Improvements in the terms of trade tend to appreciate the equilibrium real exchange rate for importables by improving the trade balance and creating excess demand for nontraded goods. Whether the long-run real exchange rate for exportables depreciates or appreciates is ambiguous in the theoretical model. Empirically, however, the exportables RER almost always depreciates when the terms of trade improve because the price of exports tends to rise much more than the price of nontraded goods. Increases in the flow of external transfers received also appreciate the equilibrium RER through positive effects on the sustainable current account balance.

In the model analyzed in Chapter 6, changes in world inflation affect the equilibrium real exchange rate through effects on transactions costs associated with changes in real money balances. The direction of these effects on the LRER depends on whether such costs are incurred primarily in the form of traded or nontraded goods. The absorption of either type of goods by transactions costs effectively reduces their supply. Hence, when transactions costs are incurred in the form of traded goods, an equilibrium real depreciation is required to maintain external balance; but when they are incurred in the form of nontraded goods, an equilibrium real appreciation is required to maintain internal balance.

The effects on the LRER of changes in world real interest rates depend on the nature of the domestic economy’s financial links with the rest of the world. In the analytical model described in this chapter, although the domestic economy is financially open, its real interest rate is independent of the world rate in the long run, being determined instead by the domestic rate of time preference. In this model, reductions in world real interest rates cause the long-run equilibrium real exchange rate to depreciate. The reason is that lower world interest rates induce capital inflows that reduce the country’s net creditor position over time, and the long-run loss of net interest receipts requires a real depreciation to maintain external balance. The opposite result is, however, possible with alternative assumptions about the determination of domestic interest rates as explained in footnote 12 below.

Commercial policy. Finally, trade liberalization is associated with a long-run depreciation of the equilibrium RER. The effect of liberalization is to switch resources into the nontraded (or non-import-competing) sector. The emergence of incipient excess supply in the nontraded-goods market requires a depreciation of the real exchange rate.

The challenge in estimating the LRER, of course, is assessing the quantitative influence on the LRER—if any—of changes in each of the above variables. Alternative methods of doing so are described in Part III of the book.
Methodologies for Estimating the Equilibrium RER: Empirical Applications

The heart of the book is Part III, in which alternative techniques for estimating the LRER are presented. Four such techniques—all of them briefly reviewed earlier in the empirical survey—are analyzed individually and illustrated with specific empirical applications in the four chapters, 7 to 10, that make up this part of the book. Chapter 7 focuses on the two estimation techniques that are in widest operational use: the purchasing-power-parity (PPP)-based approach and a recursive partial-equilibrium approach based on adjustments in the economy’s external resource balance, which we have dubbed the trade-equations approach. There are two versions of the trade-equations approach in wide use. The first one is a Mundell-Fleming version that takes export volumes to be determined on the demand side of the market; export supply is taken to be perfectly elastic. The second one is a three-good version that takes export demand to be perfectly elastic; export volumes are correspondingly determined on the supply side of the market. Empirical application of the trade-equations approach also involves two analytical tasks—measurement of the underlying (or structural) resource balance and determination of a target long-run resource balance—that are common to most other methodologies for estimating the LRER empirically. Chapter 7 provides a general overview of the trade-equations approach with an illustration for Côte d’Ivoire. Chapter 8 presents an application of the three-good trade-equations approach, which focuses on the role of one specific “fundamental” (the terms of trade), and applies the technique to a larger group of 12 CFA countries. The last two chapters in Part III analyze the two more explicitly general-equilibrium approaches. Chapter 9 describes how simulations of fairly traditional empirical macroeconomic models can be used to estimate the LRER in developing countries. Chapter 10 provides a detailed description and two applications of a relatively new approach based on single-equation reduced-form estimation using unit-root econometrics. The following section summarizes the findings of each of these four chapters.

The Relative PPP-Based Approach

The simplest and most venerable technique for estimating the LRER in developing countries, no less so than in industrial countries, is the PPP.

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6. The term “resource balance” is used throughout this volume to refer to the difference between exports and imports of goods and nonfactor services. It is equal to gross domestic savings less gross investment.
approach. Chapter 7 of Part III, by Ahlers and Hinkle, describes the PPP-based method, as well as the trade-equations method discussed below. The Ahlers and Hinkle exposition is based on an illustration of how the simple PPP method could have been used to estimate the degree of misalignment that characterized Côte d'Ivoire prior to the devaluation of the CFA franc.

Relative PPP may be applied either broadly to the external RER for all goods or more narrowly to just the RER for traded goods. The rationale for applying relative PPP to traded goods, as an application of the law of one price, is stronger; and this is the standard practice in industrial countries. However, lack of data on the RER for traded goods, as in the Côte d'Ivoire example considered in Chapter 7, usually limits one to the use of RER for all goods in developing countries.

The use of the relative PPP-based method can be justified in one of two ways. On the one hand, the analyst may simply adopt ex ante the traditional relative-PPP view on the determination of the long-run equilibrium real exchange rate, which essentially takes the LRER to be a constant. On the other hand, the LRER may be considered by the analyst to be determined by a broad set of fundamentals, which may turn out ex post to be stationary in a time-series sense for the specific application at hand. In the first case, the decision to apply the PPP approach would be made before looking at the data. In the second case, the PPP approach would be adopted only after the RER in the country under review passes a test of stationarity.

When relative PPP is assumed to hold ex ante, measuring the equilibrium real exchange rate essentially involves removing the effects of nonsystematic transitory shocks. In practice these are eliminated by identifying a base period in which such shocks are believed, on the basis of independent evidence, to have been negligible—a procedure that ensures that the actual real exchange rate coincided with its equilibrium (PPP) value during that period. Thus the actual real exchange rate in the base period represents the estimate of the equilibrium rate. The nominal exchange rate consistent with the LRER from that moment on can then be calculated by simply adjusting the nominal exchange rate for the cumulative difference between domestic and foreign inflation.

The alternative case is that the LRER is interpreted as subject to change in response to changes in underlying fundamentals but turns out empirically to be stationary for a particular country. In this case, the stationarity of the RER forces the analyst to take the position that its

7. This is in contrast to the absolute version of PPP, which takes the LRER to be unity.
fundamental determinants are either individually stationary—that is, that the “permanent” values of the fundamentals have not changed during the sample period, though the fundamentals may have been subject to transitory fluctuations—or that any nonstationary fundamentals must be cointegrated among themselves. In either situation, the LRER can still be measured using a base-year value, though the identification of a suitable base year is more complicated under this interpretation, as explained below. Ahlers and Hinkle refer to the PPP-based method that estimates the LRER using the value of the RER during some base year as the “PPP base-year” approach. It calculates misalignment by simply plotting the real exchange rate over time and comparing its value during the period of interest to the corresponding value in the base year in which the real exchange rate was judged to be at its long-run equilibrium value.

The empirically oriented exposition of the PPP base-year approach by Ahlers and Hinkle is particularly appropriate because in this methodology everything depends on the identification of a suitable base year. As mentioned above, how the base year is chosen depends on whether the rationale underlying the procedure is a simple ex ante relative PPP-based one or a more sophisticated one in which the real exchange rate is driven by stationary fundamentals. In the simple PPP case, the “independent evidence” of equilibrium referred to previously is likely to concern the behavior of a particular outcome variable, such as the resource balance. In contrast, from the “stationary fundamentals” perspective, the base year chosen should be a recent year in which the actual exchange rate is believed to have been close to its equilibrium value because all the fundamentals were close to their sustainable values. This requirement makes the application of the PPP methodology more complicated in the latter case.

As explained in the survey of empirical estimation in Chapter 5, the set of fundamentals to be considered in choosing a base year may include both exogenous and policy variables. In assessing the behavior of the exogenous variables, the analyst may look, for example, for terms of trade that are reasonably close to their likely long-run trend levels and for capital flows that are consistent—in amount and terms—both with the likely long-term availability of capital and the country’s debt-servicing capacity. For assessing the permanence of the policy stance, the relevant criteria may involve the attainment of growth, investment, and inflation targets during various years over the sample period.

A common problem in selecting appropriate base years is that, because of policy shortcomings and external constraints, years in which exogenous variables were at sustainable levels are not always years in which policy variables were at desirable levels. Thus, the choice of a base year tends to call for subjective judgments in determining when
the real exchange rate was near its long-run equilibrium value. For example, historically, desirable growth and investment levels have sometimes been attained only when the terms of trade were temporarily inflated or when capital flows were unsustainable. Conversely, sustainable terms of trade and capital flows have often been associated with undesirable growth and investment outcomes. Hence, in applying the PPP base-year approach under the “stationary fundamentals” interpretation, the analyst is often forced to make tradeoffs between the sustainability of exogenous variables and that of policy variables.

One way to deal with this problem is to estimate the sustainable values of the fundamentals on the basis of their sample means or, in the trend-stationary case, as their trend values within the sample. In effect, this procedure amounts to estimating the LRER as the sample mean or the trend value of the RER within the sample, rather than as the particular value of the RER in a specified base year. This procedure can be referred to as the PPP average or trend approach. Ahlers and Hinkle also illustrate this alternative method of estimating the LRER in applications of the PPP-based method. Empirically, a large appreciation of the RER relative to its trend value in a short period of time is one of the most reliable statistical indicators of misalignment and a potential exchange rate crisis.

The relative PPP-based approach, however, has one severe limitation: if the RER is nonstationary, its equilibrium value will be affected by changes in the fundamental variables that determine it. If these fundamentals are subject to permanent changes, and the evidence suggests that they usually are, then techniques for estimating the long-term value of the equilibrium exchange rate must take these changes into account. In other words, estimates of the LRER must depend on the estimated permanent changes in the fundamentals.

**The Trade-Equations Approach**

The PPP-based approach described above was originally motivated by the relative-PPP theory of exchange rate determination. Similarly, the trade-equations methodology is also based on a venerable analytical tool in open-economy macroeconomics—in this case, the partial-equilibrium “elasticities” approach to exchange rate determination. This methodology is based on the notion that the primary macroeconomic role of the real exchange rate is to influence the resource balance through expenditure-switching mechanisms. It is more sophisticated than the simplest interpretation of the empirical PPP approach in that it acknowledges that the equilibrium real exchange rate is not necessarily constant.

Ahlers and Hinkle describe and illustrate the trade-equations approach as well as the relative-PPP approach. As mentioned previously,
there are two standard versions of the trade-equations approach. The version most commonly used in industrial countries is based on the Mundell-Fleming production structure. In this framework, complete specialization in the production of one good by both the domestic and foreign countries (each country’s own GDP) makes export supply functions perfectly elastic, while the domestic and foreign goods are taken to be imperfect substitutes in demand. Export and import quantities are consequently both demand-determined, and the real exchange rate exerts its effect on the trade balance through its influence on the domestic demand for imports and on the external demand for the country’s exports. This perspective is typically adopted for industrial countries, as well as for some developing countries whose exports are dominated by differentiated manufactured goods. The alternative version is usually applied to developing countries in which exports are instead dominated by undifferentiated primary products. In this case, it is more appropriate to consider export demand as being infinitely price-elastic and to recognize a finite export supply elasticity.\(^8\) The quantity of exports is thus determined by the elasticity of export supply.

In both versions of the trade-equations approach, the resource balance will in general depend on the real exchange rate as well as other variables. For given values of the latter, the “equilibrium” value of the real exchange rate must be that which generates the “equilibrium” value of the resource balance—that is, that value of the resource balance that is consistent with balance of payments equilibrium. Given a target for external reserves and an exogenously determined volume of net resource flows (net capital inflows plus net interest receipts plus net transfers), the equilibrium value of the resource balance is determined. Alternatively, for fully creditworthy countries in which capital markets can be assumed to provide the financing required to cover a resource deficit, a sustainable or trend saving-investment balance can be projected separately and assumed to determine the equilibrium resource balance. In either case, the equilibrium value of the real exchange rate can then be calculated from the required change in the initial resource balance for given initial values of exports and imports if the relevant import and export demand or supply elasticities are known.

The three key empirical requirements for implementing the trade-equations approach are: (a) estimates of the elasticity of exports and imports with respect to the real exchange rate; (b) methods for determining a target resource balance to be used in the analysis; and (c) techniques for estimating the effects on the initial resource balance of

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8. Conceptually, this approach implies supposing that the home country produces at least one other type of good besides the exportable good.
variables that affect it, other than the real exchange rate. Empirical estimates of the relevant elasticities needed for step (a) are given in Chapter 11 on trade flows and the RER. Steps (b) and (c), which are also required in many applications of the other methodologies discussed subsequently, are analyzed in detail by Ahlers and Hinkle.

The specification of the target resource balance, step (b), is often one of the most problematic steps in the empirical estimation of the LRER. A particularly useful contribution of the Ahlers-Hinkle chapter, therefore, is its inclusion of a comprehensive discussion of practical methods for specifying the volume of net capital inflows and reserve accumulation required to derive the target resource balance. The authors describe two polar ways of establishing sustainable capital flows and a target resource balance: one for noncreditworthy countries that must rely entirely on aid flows and the other for creditworthy countries that have full access to credit markets. In the case of noncreditworthy countries—that is, countries that absorb external resources primarily in the form of aid flows—resource balance targets are essentially based on projections of aid availability. Such projections can be derived from independent information (for example, from donor sources) or can be projected on the basis of past history. For countries that are judged creditworthy by international financial markets, a variety of means is available to project sustainable capital flows. These can be based on demand-side or supply-side determinants. The former refer to domestic saving-investment balances that are deemed desirable or are otherwise judged sustainable. The latter may be based on debt stocks that are judged compatible with a country’s intertemporal budget constraint or on credit allocation rules of thumb used by international lenders. However calculated, an increased inflow of capital permits the accommodation of a larger “equilibrium” resource balance deficit and is thus consistent with a more appreciated value of the equilibrium real exchange rate.9

As noted above, the resource balance may depend on variables other than the real exchange rate, such as the level and composition of aggregate demand, the external terms of trade, and commercial policy. Hence, it is usually necessary to determine the underlying or structural resource balance corresponding to a particular value of the RER by adjusting the actual resource balance in the given year for cyclical, exogenous, and policy changes that affect it.

The simplest solution to this problem is to identify a base year, similar to that used in the relative PPP-based approach, in which the actual

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9. For a description of the application of this methodology in the context of financial programming exercises, see Khan, Haque, and Montiel (1990).
RER and its fundamental determinants are believed to have been close to their equilibrium levels. This technique is sometimes employed in empirical applications of all of the methodologies for estimating the LRER as explained in Chapters 8 to 10.

However, for the reasons explained on pages 16 and 17 above, a suitable base year may not be available in many cases. Ahlers and Hinkle demonstrate an alternative two-step procedure for taking into account the effects of changes in variables other than the RER that influence the resource balance such as the terms of trade, taxes on international trade, and underutilized productive capacity. First, the initial resource balance is adjusted to reflect the impact of changes in these variables, resulting in an "adjusted" resource balance. Second, the required change in the real exchange rate is calculated as that which would cause a change in the resource balance equal to the difference between its adjusted and target values. For example, for a given target resource balance, the achievement of a higher long-run growth target for the economy may require a shift in the composition of aggregate demand from consumption to investment. If the import intensity of investment spending exceeds that of consumption, an increase in the share of investment in aggregate demand would increase the resource balance deficit associated with any given real exchange rate. Thus, such a change in the composition of demand would result in a larger adjusted resource balance deficit. To reconcile the larger projected resource balance deficit with the unchanged projected long-run equilibrium value of capital inflows, a larger real depreciation would be required. Hence, the adoption of a more ambitious long-run growth target would imply a more depreciated long-run equilibrium real exchange rate.

The second chapter in Part III, Chapter 8 by Devarajan, links the partial-equilibrium trade-equations approach with general equilibrium models. Devarajan shows how the trade-equations approach can be extracted from a restricted form of a computable general equilibrium (CGE) model. The particular model on which the Devarajan chapter is based (taken from Devarajan, Lewis, and Robinson (DLR, 1993)) utilizes a three-good framework, with exports, imports, and domestic goods. As indicated above, the extension to three goods has important advantages in

10. To the extent that the composition of aggregate demand (for example, between consumption and investment, between private or public expenditure, or between different categories of government spending) affects the resource balance, the change in the real exchange rate required to achieve the target resource balance target will depend on how the target resource balance is attained. The adjustment procedure suggested by Ahlers and Hinkle also permits taking into account such effects.
developing-country applications. Because of its two-good production structure, the Mundell-Fleming approach cannot distinguish between the terms of trade and the real exchange rate. Thus, it cannot be used to analyze the impact of changes in fundamentals that involve changes in the domestic relative price of exportables and importables, such as the terms of trade and commercial policy. A three-good framework is necessary to analyze how the LRER is affected by changes in the relative prices of imports and exports. The particular concern of the Devarajan chapter is to demonstrate how the effects on the LRER of changes in such fundamentals can be handled in this expanded framework.\footnote{Devarajan also shows how the DLR methodology can be applied to examine the effects of changes in other fundamentals conventionally considered in the trade-equations approach in industrial countries such as capital flows.}

The DLR method is based on three equations: (a) a “transformation function” linking the exports-GDP ratio to the relative price of exports in terms of domestic goods, (b) a “substitution function” relating the imports-GDP ratio to the relative price of imports in terms of domestic goods, and (c) an identity deriving the resource balance–GDP ratio from the export and import ratios. Given a target value for the resource balance, as well as exogenously determined export and import prices, the system can be solved for the equilibrium value of the price of domestic goods and, therefore, for the real exchange rates for exportables and importables. Devarajan’s chapter thus illustrates how a general-equilibrium “fundamentals” approach to the determination of the LRER can be simplified and tailored to a specific application. An attractive feature of this method relative to the more explicitly general equilibrium approaches described below is that it benefits from the primary operational advantage of partial-equilibrium approaches: it requires minimal data and is easy to implement.

To illustrate the relative ease with which this methodology can be implemented empirically, the DLR model was applied to the estimation of misalignment in 12 of the 13 countries in the CFA zone on the eve of the devaluation of the CFA franc. Since the CFA countries are specialized primary exporters, changes in the terms of trade proved to be the dominant influence on the LRER in this case, justifying the focus on this variable. The results indicated a substantial degree of misalignment, averaging 31 percent but varying substantially among the CFA countries, with middle-income countries and oil producers exhibiting the most pronounced degree of misalignment. As we shall see below, these estimates are consistent with those obtained in the subsequent chapter by Baffes, Elbadawi, and O’Connell for Côte d’Ivoire and Burkina Faso, using a single-equation methodology. Both Devarajan and Baffes,
Elbadawi, and O’Connell find a substantial degree of overvaluation in Côte d’Ivoire by 1993. In contrast, the real exchange rate for Burkina Faso is found to be quite close to the LRER estimated under both methodologies.

The two operational estimation techniques described in Chapters 7 and 8 impose minimal data requirements, appear to make few demands on empirical knowledge about the structure of the relevant economy, and are computationally straightforward. Thus, they have been the techniques of choice for estimating the LRER when research resources are limited or when the context in which estimates of the LRER are needed does not allow time for further research. They remain extremely useful under both sets of circumstances.

**The Structural General-Equilibrium Approach**

A key shortcoming of the trade-equations approach, however, is that it may not do enough justice to the general-equilibrium nature of the process by which the equilibrium RER is determined. While the demand for imports and exports undoubtedly depends on their relative prices in terms of other goods, it also depends on the level and composition of domestic spending (as the “absorption” approach of Alexander (1951) emphasized), as well as on the costs of production of exportables and importables. The problem is that variables such as these and the capital flows that determine the “equilibrium” value of the resource balance are themselves endogenous and thus are determined by the ultimate fundamentals identified in the discussion above of the long-run equilibrium RER. Consequently, the real exchange rate is deeply embedded in the economy’s short-run macroeconomic equilibrium. The trade-equations approach, however, employs a recursive partial-equilibrium methodology. Given required changes in an economy’s resource balance, it determines new equilibrium values for the RER, imports, and exports but not for other important macroeconomic variables such as government revenue, saving, and investment. Nor does it explicitly allow for feedback from the RER to the variables determining the target resource balance (capital flows or the saving-investment balance). While rough adjustments can be made for some of the more important income and feedback effects, one would be more confident of the results if they were determined in a complete general-equilibrium framework that takes into account all important macroeconomic interactions in a fully consistent manner.

Chapters 9 and 10, the two remaining chapters in Part III, implement general-equilibrium methods for detecting empirically the influence of changes in some fundamentals on the LRER. By and large, these chapters take a practical approach. Their objective is to estimate the value to
which a country’s RER would tend to converge over time, given sustained values of certain “fundamentals,” including both policy variables and variables that are exogenous to the economy. It is important to emphasize that these chapters set a limited task for themselves. They are concerned neither with deriving optimal values of the policy variables, which have been considered necessary for some definitions of the LRER, nor with detailed exploration of the time-series properties of the truly exogenous variables. These restrictions greatly simplify both the conceptual and empirical issues and are logically defensible. Both the optimal setting of the broad range of policy instruments that may influence the long-run equilibrium real exchange rate and the specification of appropriate techniques for decomposing movements in exogenous variables into permanent and transitory components are logically separate from the issue of how particular values of the policy and exogenous variables affect the long-run equilibrium real exchange rate. Thus, Chapters 9 and 10 focus on the task of assessing how the value of the LRER is empirically affected by once-and-for-all changes in the values of whatever subset of these variables is relevant for the particular technique being used.

Chapter 9, by Haque and Montiel, adopts a structural general-equilibrium modeling approach. The model employed, taken from Haque, Lahiri, and Montiel (HLM, 1993), is based on a Mundell-Fleming production structure and assumes a high degree of integration of the domestic economy with international financial markets. In that sense, the HLM model is best suited for applications to middle-income developing countries with diversified manufactured exports and an open capital account. The model was estimated with panel data from a large sample of developing countries. Consequently, the simulations produced with the HLM model are intended to be representative of such economies, illustrating the outcomes in a model economy, rather than generating an estimate of the LRER for a specific country.

In estimating changes in the LRER using simulations from an empirical macroeconomic model, the Haque-Montiel chapter is closely related to the work of Williamson (1994) and others on the estimation of the LRER for industrial countries. However, in addition to being based on a “representative” economy, the simulation exercises in Chapter 9 differ from those conducted by Williamson in two other ways. First, in contrast to the Williamson approach, Haque and Montiel make no attempt to identify “desirable” values of the policy fundamentals. Second, they report “analytic” simulations, consisting of tracing the dynamic responses of the model economy to permanent shocks administered to individual fundamental variables, with a view to exploring how such shocks would affect the equilibrium real exchange rate that characterizes the new postshock steady state. In such simulations, policy
and external variables are exogenous, and the sustainable trade balance is endogenously determined simultaneously with the LRER. By contrast, the simulations in Williamson (1994) are “real-time” simulations, which solve for the value of the RER associated with the achievement of internal and external balance targets within a specified policy-relevant period of time. Since the external balance target is specified exogenously and the time frame allowed to attain it will in general be shorter than that required for the model to approach its steady-state configuration, the attainment of such targets in general requires endogenous adjustment of policy variables.

The simulations in Chapter 9 confirm that nominal variables—namely, the nominal exchange rate and monetary policy—have no effect on the LRER, which is a real variable. This result is a consequence of the model’s long-run neutrality to monetary shocks. In contrast, permanent changes in “real” fundamentals do affect the LRER. To complement the exercises conducted in the preceding chapters, the simulations of real shocks by Haque and Montiel analyze the effects of changes in some fundamentals not considered there. These are the effects of a permanent change in the world real interest rate and in external demand, considered separately, as well as a shift in the composition of government spending from foreign to domestic goods. A permanent increase in the world real interest rate depreciates the LRER in the HLM model, while increases in both external demand and in government spending on domestic goods cause the LRER to appreciate.12

The Haque-Montiel simulations are used to estimate the elasticity of response of the LRER to permanent changes in the set of fundamentals considered. These results can be used in a number of ways:

a. The elasticities themselves can be used directly to estimate changes in the LRER in specific applications when one of the fundamentals has changed in a known way,

b. The structural parameter estimates of the model can be imposed in a structural model of an actual economy for which the LRER is

12. The qualitative result for the external real interest rate here is the opposite of that derived in the theoretical model in Chapter 6. The reason is that the way that imperfect capital mobility is modeled in the theoretical paper causes the domestic real interest rate to remain unchanged in response to increases in the external rate (since it is determined by the exogenous domestic rate of time preference). The Haque-Montiel model, in contrast, assumes that the domestic interest rate is determined by the world interest rate so that the domestic real interest rate rises one-for-one with increases in the world rate. The negative effect of the higher domestic interest rate on the demand for domestic goods causes the LRER to depreciate in the Haque-Montiel model.
to be estimated, and then simulations similar to those of Haque and Montiel can be run using data for that economy.

c. The model’s specification can be used as guidance for actual estimation of a similar structural model for the economy in question, and the required simulations can be based on the estimated model.

Haque and Montiel illustrate the second of the above possibilities in an application to Thailand. Retaining the estimated representative parameters but using Thai macroeconomic data, they estimate the LRER for Thailand in 1995 on the assumption that the actual and equilibrium real exchange rates coincided in 1991. They find that between 1991 and 1995 the Thai LRER depreciated by 17 percent. Since the actual real exchange rate depreciated by only about 4 percent over the same time, Haque and Montiel estimate that the baht was overvalued by about 13 percent in 1995.

In principle, the general-equilibrium modeling approach illustrated in Chapter 9 is the most attractive method for estimating the LRER. It permits the incorporation of the full range of macroeconomic influences that may potentially affect the LRER and imposes a minimum of restrictive and possibly erroneous assumptions about the structure of the economy. Two traits argue strongly in favor of this methodology: the richness of the macroeconomic interactions that can be taken into account in estimating the LRER by simulating a fully dynamic aggregate macroeconomic model and the flexibility that this method offers in defining alternative versions of the LRER over different time horizons. Moreover, an important feature of this approach for policy purposes is that its structural nature makes transparent the mechanism through which the LRER is determined, at least in principle.

This structural general-equilibrium approach, however, is subject to a variety of limitations. Some of these are shared with other approaches. For example, when implemented in “real-time” simulations—which are its most operationally relevant form—the structural general-equilibrium approach relies, like the trade-equations approach, on an exogenous specification of the equilibrium resource balance. More important, the estimation of general-equilibrium macroeconomic models places very strong demands on economic theory, on the power of statistical techniques, and on the availability and quality of data. Even in industrial countries, where off-the-shelf models with known track records are often available, doubts about model specification, empirical estimation, and parameter stability have eroded confidence in these models during recent years. With no previous track record, made-to-suit models for individual developing countries with limited data and more frequently changing economic structures and policy regimes confront a higher
hurdle of credibility. Furthermore, the modeling approach has serious operational limitations. In the absence of a previously existing model, it is likely to be very time consuming and expensive to implement. It may thus be more suited to large research projects in countries with long time-series data than to operational applications in most low-income developing countries. For the near future, estimates of the LRER derived from simulations of dynamic macroeconomic models should be treated as indicative in developing-country applications and used to supplement and inform other approaches to estimation.

The Reduced-Form General-Equilibrium Approach

The final chapter in Part III—Chapter 10, by Baffes, Elbadawi, and O'Connell—abandons the specification of structural models, adopting a single-equation reduced-form methodology. It relies on unit-root econometrics to measure the effect that potential fundamentals have on the LRER in two CFA franc countries, Côte d'Ivoire and Burkina Faso. The attraction of this method is that, like the structural general-equilibrium approach, it incorporates the full general-equilibrium interaction of the fundamentals in a dynamic structure that generates a time series, rather than just a point estimate, for the LRER. Yet, relative to the structural general-equilibrium approach, it places fewer demands on both theory and data. From the perspective of theory, the method requires an appropriate specification of long-run relationships, but the dynamic structure of the economy does not need to be imposed ex ante. Instead, it is determined entirely by the data. The data required, in turn, are only those that would enter the reduced-form equation for the real exchange rate in a short-run macroeconomic equilibrium model. Structural equations for the economy do not have to be estimated, and data on other short-run endogenous macroeconomic variables are not required.

The fundamentals considered by Baffes, Elbadawi, and O'Connell for the two countries in their study include many of those examined in the previous chapters: the terms of trade, trade openness (as a proxy for commercial policy), capital flows, and the composition of domestic absorption (the share of investment in GDP). Interestingly, these variables prove to be nonstationary and cointegrated with the real exchange rate in Côte d'Ivoire but stationary in Burkina Faso. In the case of Burkina Faso, all but the composition of absorption prove to be statistically significant determinants of the (stationary) real exchange rate. Thus, Burkina Faso provides an illustration of how in certain cases PPP can continue

13. Previous applications of this methodology to developing countries include Elbadawi (1994), as well as Elbadawi and Soto (1994, 1995).
to provide an adequate representation of the behavior of the LRER, despite the role of “fundamentals” in influencing the LRER. As mentioned previously, the key ingredient in reconciling PPP with a fundamentals-driven theory of the LRER is stationarity of the fundamentals, as in Burkina Faso.

Baffes, Elbadawi, and O’Connell show how their estimated cointegrating equations can be used to construct estimates of the LRER. Given the estimated cointegrating equation, they utilize a variety of statistical techniques to estimate the permanent values of the fundamentals (including employing the actual values, calculating moving averages, and computing Beveridge-Nelson decompositions). In addition, Baffes, Elbadawi, and O’Connell employ counterfactual simulations of the fundamentals, an innovation that can allow these variables to take on out-of-sample values and permits measuring normative as well as positive misalignment. Substituting their estimates of the permanent or sustainable values of the fundamentals into the cointegrating regressions, they derive for both countries LRER estimates that can be compared with the actual RER to provide measures of misalignment. The results suggest that overvaluation was severe in Côte d’Ivoire in 1993 (approximately 34 percent in domestic-currency terms), just prior to the devaluation of the CFA franc, but that Burkina Faso escaped major episodes of overvaluation during the sample period.14 This finding is consistent with the widely held view that overvaluation was a more serious problem among the middle-income CFA countries than for the low-income countries.

As already indicated, the reduced-form methodology has significant advantages over both the traditional PPP and trade-equations approaches, on the one hand, and simulations of general-equilibrium models, on the other. Accordingly, it has begun to receive a substantial amount of attention from researchers as a technique for estimating the LRER in both industrial- and developing-country contexts.15 Because of these advantages, it is a promising avenue for further research. Nevertheless, the methodology is not without its own shortcomings. Chief among these are that the statistical tests involved have low power in small samples and that the dynamic specifications required in some of the statistical techniques employed absorb a large number of degrees of freedom, particularly when a priori exclusion restrictions cannot be imposed on the set of included fundamentals. As a result, estimates of the LRER derived using this technique may be fragile. In particular, they may not

14. Devarajan also found only a mild misalignment in Burkina Faso.
15. See the survey of empirical research in Chapter 5.
prove to be robust with respect to the set of included fundamentals or to procedures for selecting the “best” model in circumstances in which the set of potential fundamentals is large and time series are short, as is typically the case in developing countries. Operationally, like the trade-equations and structural general-equilibrium approaches, the procedure usually requires an exogenous specification of the equilibrium resource balance. In addition, use of the reduced-form methodology may be hindered not only by inadequate time-series data in low-income countries but also, in crisis situations, by the time-consuming nature of the fairly sophisticated econometric analysis that is involved in implementing it.

Policy and Operational Considerations

The last part of the book, Chapters 11 to 13, rounds out the analysis of techniques for estimating the LRER by discussing three operational considerations. The first has to do with the applicability of the analysis in this book to small low-income countries. All of the approaches to estimating the LRER described here rely on the key macroeconomic role of the real exchange rate in influencing the trade balance by allocating demand and supply between traded and nontraded (or foreign and domestic) goods. Many observers, however, question the empirical strength of this influence, particularly for small low-income countries, on the basis of various types of elasticity pessimism. This issue is taken up in Chapter 11, the first chapter in Part IV. The second consideration has to do with countries having dual exchange markets. The question in this case is how much information the parallel exchange rate—which can be observed directly—contains about the LRER that would prevail if the exchange markets were unified. In an extreme case, if the parallel rate is simply taken as revealing the value of the “true” long-run equilibrium real exchange rate, one would circumvent the need to implement any of the techniques described in this book for measuring the LRER in countries with dual exchange markets. The validity of this approach is considered in Chapter 12. The final issue taken up in Part IV is not directly related to the estimation of the LRER but is likely to be of interest in operational attempts to correct misalignment. It concerns how to estimate, in operational applications, the nominal exchange rate movement required to eliminate any misalignment identified using one of the previously described techniques for measuring the LRER.

Empirical Estimates of Trade Elasticities

Chapter 11 by Ghei and Pritchett analyzes a topic that is central to the macroeconomic role of the real exchange rate and therefore that must be addressed in the definition and estimation of the LRER: what effect does
the real exchange rate have empirically on trade flows and external adjustment in developing countries? While the role of relative prices in adjusting trade balances has long been a central tenet of open-economy macroeconomics, this tenet has been questioned by “elasticity pessimists” as well as by advocates of “global monetarism.” More recently, the effects of real exchange rate changes on the trade balance have also been called into question by sophisticated empirical analysis (see Rose 1990).

Since most definitions of the LRER emphasize the role that the RER plays in the simultaneous achievement of internal and external balance, this issue is an important one for this book.

Ghei and Pritchett ask whether the empirical effectiveness of the real exchange rate in adjusting the trade balance is sufficiently strong to link “external balance” outcomes to the path of the RER, particularly in small low-income countries, for which “elasticity pessimism” has been most widespread. They further ask how, if the RER does significantly affect trade flows, useful estimates of the relevant elasticities can be obtained even for countries in which notional import demand cannot be observed in the historical data because of the prevalence of foreign exchange rationing. Ghei and Pritchett group reasons for doubting elastic import and export responses under three types of elasticity pessimism regarding the elasticity of import demand and export supply in the developing country itself as well as the elasticity of demand for the country’s exports in world markets. They find that none of the three pessimisms is justified, even for small low-income countries for which such concerns are most often articulated. Along the way, they provide representative values of the relevant elasticities for small low-income countries. These values can be used by practitioners in empirical applications of the trade-equations approach for countries where the accurate estimation of such elasticities proves to be impractical. Ghei and Pritchett conclude that a reasonable range for the aggregate price elasticity of demand for imports is –0.7 to –0.9, even for low-income countries, and that elasticities of export supply tend to be in the range of 1.0 to 2.0. Consequently, given the typically high world price elasticity of demand for exports from individual countries, RER movements should generally be expected to have significant effects on trade balances.

Using the Parallel Market Premium as an Indicator of Misalignment

The frequent use of quantitative restrictions on the availability of foreign exchange under managed exchange rate systems in many developing countries has in the past given rise to parallel exchange rates as excess demand for foreign exchange spills over into the unofficial market. Since private traders buy and sell foreign exchange at a price that is
freely determined in the parallel market, it is natural to interpret the freely determined exchange rate in the unofficial market as a “shadow” exchange rate—that is, as an indicator of the value that the official exchange rate would reach if left to market forces and thus as an estimate of the LRER. Chapter 12, by Ghei and Kamin, on the use of the parallel market premium as an indicator of misalignment, emphasizes that there are at least two reasons why this interpretation is not appropriate.

First, even if the parallel rate accurately represented the value that a freely floating rate would reach if a unified floating system were in effect, that floating rate would not necessarily equal the LRER at any given moment. The reason is that, as an asset price, the spot value of the floating rate would in part depend on its expected future value as well as on the current stock of foreign exchange in residents’ hands, both of which are dynamic variables that need not be at their steady-state values for any arbitrarily chosen initial configuration of the economy. When macroeconomic conditions and policies are volatile, as frequently is the case in developing countries with parallel exchange markets, adverse expectations may drive the parallel exchange rate to levels much more depreciated than the LRER.

Second, even when financial markets are tranquil and macroeconomic conditions are close to their average levels, the parallel market exchange rate may still provide a poor approximation of the rate that would prevail under a unified float and hence of the LRER as well. As Ghei and Kamin show, the very conditions that may give rise to a parallel market in the first place—an overvalued official exchange rate, combined with foreign exchange rationing to conserve international reserves—may lead to scarcities of and excess demand for foreign exchange in the parallel market. Unless these demands are restrained by other barriers to imports, therefore, the parallel market exchange rate is likely to be more depreciated than the equilibrium unified rate and would be even more so under unstable macroeconomic conditions.

Ghei and Kamin conduct some empirical exercises to evaluate this conclusion. They compare the parallel market exchange rate with estimates of the equilibrium unified rate computed using averages of the official rate over long periods in which the exchange market was uni-

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16. This point is simply the familiar one that in flexible exchange rate models shocks typically trigger exchange-rate dynamics as in Dornbusch (1976). Note that if under a floating exchange rate regime the market-determined exchange rate were always equal to the LRER, there would be no need to estimate the LRER for major industrial countries during clean floats as in the research on these countries described in the empirical survey in Chapter 5.

17. Montiel and Ostry (1994) reached a similar conclusion.
fied. They find that, consistent with their theoretical analysis, for Latin American countries the parallel rate tended to be substantially more depreciated than their estimate of the equilibrium unified rate. For countries in Africa and South Asia, in contrast, the parallel rate was not significantly more depreciated than the estimated equilibrium unified rate. However, Ghei and Kamin attribute this outcome to special circumstances prevailing in these countries—namely, poorly enforced exchange controls in African countries and extremely well-enforced import controls in Asian countries. Overall, they conclude that under general conditions the parallel premium is a biased and volatile indicator of misalignment between the official rate and a unified long-run equilibrium exchange rate.

**Setting the Nominal Exchange Rate**

The primary purpose of estimating the degree of misalignment, of course, is to move the nominal exchange rate in the direction of equilibrium. As mentioned at the outset, moving the nominal exchange rate to attain a desired path of the actual RER is not a straightforward task. The degree to which a domestic price level response will erode any gains in competitiveness achieved through a nominal devaluation, for example, is likely to depend on structural characteristics of the economy such as the nature of the wage-price mechanism, as well as on the nature of the accompanying macroeconomic policies and the initial degree of misalignment. Without a complete and reliable structural model of the economy with endogenous nominal variables, ex ante estimates of the real exchange rate change that will accompany a given change in the path of the nominal exchange rate in any given application can only be crude approximations.

Nevertheless, such approximations must inevitably be made in the course of exchange rate management since most policy variables are set in nominal terms. In the absence of a macroeconomic model that determines nominal as well as relative prices, two sources of guidance are available on the relative sizes of the nominal and real changes that are likely to follow a devaluation: the experience of other countries that have successfully devalued and the accounting relationships between the nominal and real changes. The last chapter in this book, by Ghei and Hinkle, examines the usefulness of these two sources of information for estimating the change required in the nominal exchange rate when one has already made an estimate of the real change required using one or more of the methodologies discussed above.

Both theoretically and empirically any combination of RER realignment and inflation is possible after a devaluation—a depreciation, an appreciation, or no change in the RER, accompanied by an acceleration
of the trend inflation rate or a return to predevaluation price trends. The key to a successful devaluation is monetary discipline and appropriate demand management policies. Successful devaluations (that is, those accompanied by appropriate macroeconomic policies) in open developing economies have typically led to a depreciation of the external RER of 30–65 percent of the nominal devaluation in domestic-currency terms. The RER typically depreciates on impact by the full amount of the devaluation and then gradually appreciates as the domestic price level shifts upward. In successful devaluations, the aggregate price level has generally shifted upwards by 20–55 percent of the nominal devaluation expressed in percentage terms in domestic currency with no increase in the long-term trend inflation rate.

Chapter 13 by Ghei and Hinkle describes a simple method for preparing “first-pass” estimates of the effects of nominal exchange rate changes on actual RERs in developing countries. The chapter sets out a consistent accounting framework in the form of an eight-equation structure, which can easily be incorporated into a spreadsheet format. This framework can be used to calculate the nominal exchange rate required to achieve a given real exchange rate target, conditional on an assumption about the response of domestic nominal wages to the nominal devaluation or to the change in domestic prices. Alternatively, the framework can be used to calculate the real exchange rate adjustment that a given nominal exchange rate would produce, on the basis of assumptions about the behavior of nominal wages or the degree of pass-through. Although the methodology, not being based on a general-equilibrium model, can provide only first-pass approximations to the nominal changes, it can be a useful tool in the hands of informed analysts. As an illustration of its usefulness, the authors analyze various policy scenarios used to determine the effectiveness of the nominal CFA franc devaluation in altering the real exchange rate and compare these with the actual outcome.

In short, the accounting framework described in this last chapter describes a simple yet reasonably accurate method for translating a desired real exchange rate movement into a required adjustment in the instrument actually controlled by the authorities—the nominal exchange rate. It thus complements the methodologies for measuring real exchange rate misalignment that came before.

**Conclusions**

Developing countries that avoid extreme exchange rate arrangements—currency boards and floating rates with purely domestic objectives for monetary policy—need to manage the nominal exchange rate. In doing so, they have long been enjoined to avoid misalignment—that is, the
emergence of large gaps between the actual real exchange rate and some notion of a sustainable “equilibrium” real exchange rate. Defining and measuring this sustainable equilibrium real exchange rate, however, has not proven to be an easy task, either for practitioners or for researchers. Unfortunately, the urgency of doing so has not gone away and may even have increased in recent years as the result of increasing financial integration.

This book provides a unified overview of the conceptual and empirical problems that arise in defining and measuring the real exchange rate in specific applications. It then explores and illustrates alternative empirical methods for measuring the long-run equilibrium real exchange rate. Four distinct approaches to doing so are considered. Although all of these approaches have shortcomings, there are circumstances under which the use of each may be appropriate. Hence, to conclude this overview, we briefly summarize the main advantages and disadvantages of each approach and describe the situations for which each is best suited.

The relative PPP-based approach can be justified as a method of estimating the LRER when the RER is shown to be stationary in a time-series sense. In this case, estimation of the LRER boils down to choosing an appropriate base period consisting of one or more years during which the RER was close to its equilibrium value (the PPP base-year approach) or taking a sample average of the actual RER (the PPP-average or trend approach). However, the applicability of these relatively simple methods is restricted by the empirical observation that real exchange rates in developing countries often prove to be nonstationary. Nevertheless, because of the simplicity of its application and the complexity of alternative methodologies, the PPP approach is likely to continue to be the only feasible approach for the estimation of misalignment in large multicountry research studies and hence to remain the method of choice for such studies. It is also useful for initial detection of misalignment, particularly in high-inflation countries, and for identification of hypotheses for subsequent analysis using more sophisticated techniques.

When the RER is nonstationary, this nonstationarity must be the result of nonstationarity in some subset of its fundamental determinants. Estimating the LRER then consists of three steps: identifying the relevant set of nonstationary fundamentals, determining their “long-run equilibrium” (sustainable) values, and determining how these fundamentals are empirically linked to the LRER. The remaining three methods of estimation described in the following paragraphs permit the incorporation of permanent changes in the fundamentals into the analysis.

The trade-equations approach is a well-established estimation technique that allows the estimated LRER to depend on the values taken by fundamentals. This approach is structural so the determination of the LRER can be understood. It makes use of a small set of behavioral parameters
that are widely estimated and thus readily available, and it is relatively simple to apply. Hence, the trade-equations approach has been the workhorse of empirical analysis and is still widely used by the IMF and others for industrial as well as developing countries.\(^\text{18}\) However, it relies on an ad hoc specification of the trade balance, and its recursive partial-equilibrium framework may ignore potentially important macroeconomic interactions. Furthermore, like other methodologies, the trade-equations approach requires often problematic estimates of the underlying and target resource balances and forecasts of the “permanent” values of potentially volatile fundamental variables such as the terms of trade and private capital flows. Nevertheless, in country applications in which data limitations or time constraints do not permit the implementation of the more sophisticated approaches described below, the trade-equations approach may be the only feasible way of taking into account changes in the fundamentals. Under these circumstances the trade-equations approach, despite its limitations, may be the method of choice.

In principle, *simulation of empirical general-equilibrium models* should dominate other estimation methods. This approach allows the estimated LRER to reflect the full range of known macroeconomic interactions in the economy. Since the entire dynamic path of the RER from its current value to the steady-state (or semisteady-state, if conditioned on some slowly adjusting variable) LRER can be simulated, the approach also provides complete information about the dynamics. The model-based general-equilibrium method, however, suffers from a variety of shortcomings. When implemented in the form of “real-time” simulations, it remains dependent, like the trade-equations approach, on an exogenous specification of the equilibrium resource balance and on forecasts of sometimes volatile exogenous variables. Moreover, it places relatively strong demands on economic theory, on the power of statistical techniques, and on the availability and quality of data. Made-to-suit models for individual developing countries with limited data and possibly unstable economic structures are vulnerable to doubts about model specification and parameter stability. Estimates derived from such models may thus fail to command much credibility, particularly when the models on which they are based have no previous track record. For the near future, it is likely that estimates of the LRER derived from simulations of macroeconomic models should be treated as indicative and used to supplement and inform other approaches to estimation. Model simulations may be most attractive in applications in which an existing model

\(^{18}\) See, for example, Isard and Faruqee (1998) and Wren-Lewis and Driver (1998).
has demonstrated its usefulness through an established record of tracking the macroeconomic performance of a particular economy.

Recent developments in unit-root econometrics seem to hold special promise for the estimation of long-run equilibrium real exchange rates. Estimates of the LRER based on cointegrating equations are derived from a single-equation reduced-form approach. This approach follows naturally from the time-series tests for stationarity required to assess the applicability of the simple PPP-based approach. Relative to the general-equilibrium models, it places fewer demands on economic theory since the theory required is about long-run relationships, not short-run macroeconomic dynamics. Moreover, fewer data (time series) are required since the researcher needs time-series data only for the variables that can be expected to appear in the reduced-form equation for the real exchange rate in short-run macroeconomic equilibrium. For these reasons, the reduced-form methodology has the potential to significantly advance our ability to generate credible empirical estimates of the LRER in specific country cases.

Despite these advantages, it would be premature to suggest that cointegration-based estimation of the LRER should dominate the other techniques under all circumstances. The method shares some of the other approaches’ limitations and is subject to others that are specific to it. When net capital inflows are treated as a fundamental, for example, the problematic estimation of a target resource balance is a required input for this approach, just as it is for several others. Even when they are not, an independent method for estimating the “permanent” values of the fundamentals such as the terms of trade is indispensable for the implementation of the reduced-form single-equation approach. Determining the permanent value of these may prove to be as problematic as the estimation of a target resource balance. Moreover, as indicated above, the statistical tests associated with this approach tend to have low power in small samples. They are particularly vulnerable to low degrees of freedom when a priori exclusion restrictions cannot be imposed on the fundamentals or when the time-series data of the country under study is characterized by structural breaks. Thus, while the method may require fewer time-series than general equilibrium models, achieving results of reasonable confidence may only be possible with time series of greater length than may be available in many developing countries. Estimates of the LRER derived using the reduced-form technique may thus prove to be too fragile to dominate those from the more transparent structural approaches, particularly in policy applications.

Nonetheless, the results achieved with the reduced-form method to date, both in the previous research surveyed in Part II of the book as well as in Chapter 10 in Part III, provide justification for additional work
using this approach. More research is also needed comparing the results from the reduced-form methodology with those obtainable from the other approaches set out here. Our hope is that this book will contribute to motivating such research.

Where, then, do we currently stand in our ability to estimate the LRER in developing countries, and what are the policy implications of the current state of the art? The “true” value of the LRER, of course, is unobservable, even ex post. Thus, we cannot evaluate the various methodologies examined in this book in the same manner that theories of nominal exchange rate determination under floating exchange rates are evaluated empirically—that is, by their ability to track the variable being explained in sample or to predict it out of sample. However, other methods of evaluating these techniques are available. Two such methods are described in the survey of empirical work in Chapter 5. First, empirical estimates of the LRER for particular countries can be judged by how well measures of misalignment derived from such estimates are able to replicate historical episodes for which RER misalignment has emerged as the consensus diagnosis ex post. Second, if the notion of the LRER has any meaning, then a current gap between the actual RER and the estimated LRER should have predictive value for (that is, should Granger-cause) the future actual RER. Both of these tests have been met by available techniques for estimating the LRER. Moreover, error-correction equations based on lagged estimates of misalignment from the reduced-form general-equilibrium methodology, as well as on lagged changes in fundamentals, have proved able to explain a substantial part of the variance of the change in the actual RER (a stationary variable) in several applications.

Although much has been learned about the estimation of the LRER in recent years, much still remains to be learned. Accurately establishing precise targets for a managed exchange rate—for example, for a new pegged rate after a devaluation—is currently beyond the state of the art. Furthermore, if some of the fundamental variables determining the LRER such as the terms of trade or capital flows are completely unpredictable or subject to repeated shock to their “permanent” values, the LRER will also be unpredictable or volatile. More research is also needed on how the results from different methodologies for estimating the LRER are likely to be related to each other in different country cases.

Yet, while we may not at present know enough to calculate the LRER in specific applications with great precision, we do know enough to sound warning signals of serious misalignment. 19 The implication for

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nominal exchange rate policy is this: except perhaps for periods of large economic dislocations, ignorance about the empirical value of the LRER cannot be used to underpin arguments for extreme exchange rate arrangements—for example, currency boards or completely clean floats with only monetary targets—that imply abandoning the management of nominal exchange rates. We hope that the cautiously optimistic tone of this conclusion can be put to the test in future work motivated by the contents of this book.