Appendices to Chapter 8

Capital Mobility, Monetary Policy, and Exchange Rate Management in Kenya

by

Stephen A. O’Connell, Benjamin O. Maturu, Francis M. Mwega, Njuguna S. Ndung’u and Rose W. Ngugi

April 29, 2010

---

Appendix 1. The real exchange rate and the investment environment for exports

To illustrate the determinants of the investment environment for exports, we consider a simple two-sector model in which the economy produces nontraded goods and exports using Cobb-Douglas technologies with sector-specific capital stocks. In sector \( j (= N \text{ or } X) \), therefore, the production function is \( Y_j = A_j K_j^{\alpha_j} L_j^{1-\alpha_j} \), where \( K \) and \( L \) are capital and labor, \( A \) is a measure of total factor productivity, and \( \alpha_j \) is an elasticity between 0 and 1. Our focus is on investment incentives over the long run, so we ignore the short-run period during which wages and prices may prevent markets from clearing. In our ‘short run’, therefore, wages and prices are flexible and markets clear; this corresponds to the medium run of standard macroeconomic models, a period of perhaps 1-3 years. We assume that firms are competitive. Labor can move between the two sectors but capital cannot: once it is installed, it is sector-specific. We solve for the short-run full-employment equilibrium and then consider incentives facing private investors in the two sectors. Differences in labor intensity are not essential to our story, so we suppress them for simplicity by setting \( \alpha_j = \alpha \). Differences in tax treatment of the two sectors, in contrast, are important; we assume that sector \( j \) faces a tax rate \( \tau_j \) on the income of fixed capital (i.e., on total revenue net of labor costs).

Labor moves in the short run to equalize wages between the two sectors. This means that employment decisions by firms end up equating marginal revenue products of labor across the two sectors. Given the Cobb-Douglas technologies, each sector’s marginal product of labor is proportion to output per worker in that sector: \( MPL_j = (1 - \alpha_j) \cdot y_j \), where \( y_j = Y_j / L_j \) is output per worker in sector \( j \). The condition \( P_Y MPL_X = w = P_N MPL_N \) then implies

\[
y_X = e \cdot y_N, \tag{A2.1}
\]

where \( e = P_N / P_X \) is the real exchange rate for exports. Substituting the per-worker production functions, this condition says that the allocation of labor between the two sectors is proportional to sector-specific capital stocks:

\[
\frac{L_X}{L_N} = \left[ \frac{A_X}{e \cdot A_N} \right]^{1/\alpha} \frac{K_X}{K_N}. \tag{A2.2}
\]

The properties of (A2.2) are intuitive: given the existing sectoral capital stocks, a real depreciation, or a greater relative productivity advantage for the export sector, shifts labor into the export sector.
The short-run output supply curve for each sector can be determined by solving (A2.2) together with the labor-market-clearing condition \( L_N = L - L_X \). The equilibrium real exchange rate is determined in the short run, as a function of total spending, relative preferences for traded and nontraded goods, sectoral capital stocks, and sectoral productivities, by equating the demand and supply of nontraded goods. A rise in total spending has a Dutch disease impact in this economy: the real exchange rate appreciates and labor moves out of the export sector, so that exports fall (e.g., Hinkle and Montiel 1999). Aid, terms of trade improvements, and reductions in world real interest rates can all have a similar impact, depending on the strength of the spending response and the degree to which it is biased in favor of nontraded goods. The hallmark of a Dutch disease episode, in each of these cases, is an increase in the trade deficit accompanied by a real appreciation that reduces the profitability of producing for the world market. Following earlier work by Edwards (1989) and others, Mwega (2007) and IMF (2008) estimate real exchange rate equations for Kenya that confirm the role of these macroeconomic fundamentals in determining the equilibrium real exchange rate.

What do investment incentives look like in this economy? The net private return to (an additional unit of) capital in sector \( j \) \( (NPRK_j) \) is the after-tax marginal revenue product there\(^2\): \( NPRK_j = a(1 - \tau_j)P_jK_j^{\alpha - 1}L_j^{1-\alpha} = a(1 - \tau_j)(y_X/k_X) \). The ratio of these private returns in a full-employment equilibrium is given by

\[
NPRK_X/NPRK_N = \frac{(1-\tau_X)}{(1-\tau_N)} \cdot \frac{y_X}{y_N} \cdot \frac{k_N}{k_X} \cdot \frac{1-\tau_X}{1-\tau_N} \cdot \frac{k_N}{k_X'},
\]

(A2.3)

where we obtained the final equality by using (A1.1) to substitute out for the ratio of outputs per worker. We can then substitute for \( k_N/k_X \) using equation (A2.2), which yields the expression

\[
NPRK_X/NPRK_N = \frac{(1-\tau_X)}{(1-\tau_N)} \cdot \left( \frac{A_X}{e^{A_N}} \right)^{1/\alpha}.
\]

(A2.4)

Equation (4) plays a critically important role in determining the investment environment for exports. In a standard user-cost approach, the demand for investment in each sector is an increasing function of the after-tax marginal revenue product of capital in that sector, and of the expected rate of capital gains. It is a decreasing function of the rate of depreciation and the real interest rate (with appropriate adjustments for tax treatment in each case, as we did with the marginal revenue products), and, finally, of the price of capital equipment relative to that sector’s output. This gives us a manageable list of potentially important variables.
determinants of the incentive environment for investment in export capacity. To support strong growth in exports,

- Maintain a real exchange rate that is competitive and expected to remain so.
- Keep the cost of borrowing roughly in line with the social discount rate.
- Maintain low taxes on imported capital equipment.
- Keep explicit taxes and bureaucratic predations on exports relatively low, or subsidize the sector.
- Address financing constraints that differentially penalize exporters, particularly exporters of nontraditional goods.
- Support productivity with investments in public infrastructure and improvements in public service delivery.

The relative importance of these objectives cannot be determined in the abstract. Adam and Bevan (2008) develop a detailed intertemporal simulation model for low-income countries and show how complicated the situation can be. We have also omitted features that may be important for Kenya, including human capital and labor market imperfections. But two robust and critically important points emerge clearly. First, the real exchange rate is only one of many determinants of investment incentives for exports. Second, the equilibrium real exchange rate is a function of the path of total spending as compared with full-employment output. It is independent of the exchange rate regime, unless the exchange rate regime affects the path of total spending or the allocation of spending between current and capital spending. Regardless of exchange rate regime, maintaining a depreciated real exchange rate over time requires some device for restricting economy-wide spending on nontraded goods. Unless public spending on nontraded goods can be reduced, this requires a reduction in overall private spending.
Appendix 2. An alternative measure of real exchange rate overvaluation

The chapter discusses two real exchange rate measures, both of which appear in panel 1 of Figure 7 of the chapter. The CBK’s real effective exchange rate (REER) is defined as a trade-weighted average of bilateral CPI-based real exchange rates with Kenya’s 8 biggest trading partners. The second measure is a multilateral real exchange rate constructed by ourselves, defined as a simple average of bilateral CPI-based real exchange rates vis-à-vis a group of ‘3rd-party exporters’ (REER3p). We use the term ‘3rd-party exporters’ to denote developing countries whose exports have grown rapidly in recent years and may compete against existing or potential Kenyan exports in industrial country markets. These two multilateral real exchange rates are both CPI-based, which means that their levels are arbitrary (we set them both to 100 in 2000). They can tell us about changes in competitiveness over time, but not about absolute levels of competitiveness.

Figure A2.1 expands this comparison to include a second third-party real exchange rate, denoted RES3p. This measure tells a similar story to REER3p over time, but in contrast to REER3p it is constructed from measures of competitiveness that are directly comparable across countries. Its level is therefore informative. Here we describe how this variable is constructed.

Following Johnson, Ostry and Subramanian (2007), we use the Penn World Tables to calculate the deviation of domestic prices from purchasing power parity (see also Rodrik 2008). These deviations are strongly correlated across countries with real income per capita across countries, reflecting the so-called Balassa-Samuelson effect – the tendency for cross-country productivity differences to be greater in sectors that with traded outputs (e.g., manufactures) than in sectors with nontraded outputs (e.g., many services). To correct for this, we run a set of yearly regressions of the log of the price deviation on the log of real GDP per capita. We then construct an overvaluation measure for each country that is the year-by-year residual from this regression. Panel 1 shows the difference over time between Kenya’s residual and the average residual for the six 3rd-party exporters. We have added 100 to this variable, so that a value of 100 indicates that prices in Kenya – and, almost certainly, wage costs – are on a par with third-party prices and costs. Given the prominence of FDI in the strategies of these countries, an important mechanism through which this variable may operate is the relative attractiveness of these countries as destinations for direct investment designed to serve industrial-country markets.

Changes in the deviation-based measure are qualitatively in line with those of the CPI-based measures, and indicate a cumulative real appreciation since the late 1990s and particularly recently. The

---

3 Brazil, Chile, China, India, Malaysia, and Tunisia.
4 The most striking manifestation of the Balassa-Samuelson effect is the low price of nontraded goods in low-income countries.
deviation-based measures also tell us about level, however: the 3rd-party group also appears to be modestly undervalued in absolute terms, relative to Kenya.
Figure A2.1 Kenya and 3rd-party exporters

Notes on panel 1: REER is the CBK’s trade-weighted real exchange rate, built up from country-level real exchange rates of the form $r_i = CPI_{\text{KENYA}}/(E_i \times CPI_i)$, where $E_i$ is the bilateral nominal exchange rate in Ksh per unit of currency of country $i$ (each bilateral index is converted to 2000=100). The CBK applies separate weights to imports and exports for Kenya’s 8 largest trading partners (USA, the Euro area, South Africa (imports), UK, India, Japan, Uganda (exports), and Tanzania (exports)). REER3p is a simple average of Kenya’s CPI-based bilateral real exchange rate indexes vis-a-vis Brazil, Chile, China, India, Malaysia, and Tunisia. The third series shown (bold line) is based on the Johnson, Ostry and Subramanian (2007) measure of overvaluation. It equals 100 plus the difference between the Kenya residual and the average 3rd party residual (discussed in detail in the text). The difference between this variable and 100 is the excess of Kenyan overvaluation over 3rd-party overvaluation. Sources: IMF and CBK.

Notes on panels 2-6: Growth of nominal dollar exports; growth of constant local currency GDP. Gross (domestic) saving = GDP – Private Consumption – Government Consumption. Gross investment = gross fixed capital formation. CA surplus = trade surplus + net factor income + net unilateral transfers received. The number of 3rd-party exporters in panels 2-6 varies depending on data availability. Source: World Bank, World Development Indicators online.
References


