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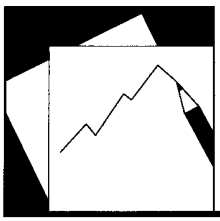

IMF Working Paper

To Smooth or Not to Smooth—The Impact of Grants and Remittances on the Equilibrium Real Exchange Rate in Jordan

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To Smooth or Not to Smooth—The Impact of Grants and Remittances on the Equilibrium Real Exchange Rate in Jordan

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Abstract

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The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

This paper estimates the effect of grants and workers' remittances on Jordan's long-term equilibrium real exchange rate. We estimate an equilibrium path for the Jordanian real exchange rate using the Johansen cointegration methodology over the period 1964 to 2005. Controlling for other fundamentals, we find that both grants and workers' remittances appreciate the equilibrium real exchange rate in a statistically and economically significant way. We also find that assessing deviations of the actual real exchange rate from the estimated equilibrium real exchange rate is nontrivial because different smoothing methodologies and the nonsmoothed estimates give very different results.

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I. INTRODUCTION

In the past four decades, Jordan's real effective exchange rate (REER) has exhibited large fluctuations. From the end of 1995—when the Jordanian dinar was fixed to the U.S. dollar—through the beginning of 2002, the REER appreciated by about 28 percent. Then, between 2002 and 2005, the REER depreciated by about 10 percent. It would be useful to know whether these fluctuations can be considered an equilibrium phenomenon (that is, consistent with movements of economic variables that affect the real exchange rate) or whether they reflect deviations from an underlying equilibrium real exchange rate (ERER), which may call for policy actions to correct these misalignments.

There is a large and growing body of literature on ERERs.[2] This literature indicates that the oldest ERER theory, purchasing power parity (PPP), is not an appropriate assumption in practice because of the slow mean reversion of real exchange rates to a constant level (which is the long-run equilibrium implied by the PPP assumption). This has resulted in a shift away from PPP-based measures of the equilibrium exchange rate to others that focus on the link between the real exchange rate and the various so-called real determinants (see Hinkle and Montiel, 1999). The most commonly used fundamentals in this respect are the terms of trade, productivity, trade openness, fiscal deficits, and capital inflows.

Capital inflows and transfers such as grants and remittances have received much attention recently in the debate about aid absorption and the dangers of Dutch disease.[3] The question asked in the debate is whether aid leads to an appreciation of the real exchange rate with a possible adverse impact on competitiveness and growth. Similarly, there is a debate about the benefits and costs of remittances to a country and whether different types of capital inflows have a different impact on the economy and the real exchange rate. Jordan represents an ideal case for the study of grants and remittances, because both have been very high and variable throughout Jordan's economic history. Private sector capital inflows have become important only very recently.

For the study, we had to extend the sample of the REER and the nominal effective exchange rate (NEER). The available data—calculated by the IMF Statistics Department—only covers the period from 1981 to 2005, which is somewhat limited for reaching econometrically robust results. Using the same methodology used for the calculation of the REER and NEER, we were able to extend the data series back until 1964, representing 42 years of annual data.

We use cointegration techniques to identify persistent patterns of co-movements among variables affecting the real exchange rate. We estimate an equilibrium path for the Jordanian REER by using the Johansen cointegration estimation methodology over the period from 1964 to 2005. Besides grants and remittances, we use a variety of potential explanatory

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[2] See for example, the surveys by Froot and Rogoff (1995), Rogoff (1996), and, for developing countries, Edwards (1989), Hinkle and Montiel (1999), and Edwards and Savastano (2000).

[3] See IMF (2005) and Gupta (2006).

variables for the ERER, namely, terms of trade, trade openness, and budget balances. We find that both grants and workers' remittances appreciate the ERER in a statistically and economically significant way. A deterioration in the terms of trade and an increase in trade openness depreciate the real exchange rate, as does—somewhat unexpectedly and with a small impact—a deterioration in the budget balance.

We apply the coefficients of the vector error correction model (VECM) to determine the ERER over the sample period. The real exchange rate misalignment is computed as the difference between the actual values of the REER and the estimated ERER. In several papers in the literature, the smoothed values of the fundamentals are used for this exercise. We use both Hodrick-Prescott (HP) and Band-Pass (BP) filters to smooth the ERER determinants and compare them with the nonsmoothed values. We find that assessing deviations of the actual real exchange rate from the estimated ERER is nontrivial because different smoothing methodologies and the nonsmoothed estimates give very different, and sometimes contradictory, results. We discuss the methodological problems with smoothing for the calculation of the ERER, and argue that less smoothing is preferable in the context of developing countries. Despite these caveats, we find that Jordan's ERER is likely to have depreciated over the past few years.

The remainder of this paper is organized as follows. Section II presents major developments in the Jordanian exchange rate since 1964, main determinants of the REER, and the econometric methodology. Section III presents the results for the long-run impact of grants and remittances and other fundamentals on the equilibrium exchange rate. Section IV calculates the equilibrium real exchange rate and measurements of misalignment. Finally, Section V offers conclusions.

II. Data and Methodology

A. Extending the Existing Sample of the Jordanian NEER and REER

The REER and NEER for a country are calculated using trade weights. Thus the NEER is normalized to the level of 100 in the year 2000. Any changes in the bilateral nominal exchange rates are then applied with the respective trade weight that the country has with Jordan. The trade weights used are shown in Table 1, which are the weights for the years 1999–2001.[4] The countries included represent more than 98 percent of Jordan's total trade.[5] For the REER, the respective changes in partner country consumer price index (CPI) rates relative to that of Jordan is also taken into account. The result is a CPI-based REER, which is the most commonly used concept. Given the same methodology as used by the IMF Statistics Department, our measure of the REER and NEER has a near perfect correlation of over 98 percent with the original numbers for the period 1988–2005.

[4] For in-depth information on the methodology, see Bayoumi, Jaeves, and Sarma (2005).

[5] Excluding Iraq. Iraq is an important trading partner for Jordan (the most important throughout most of the period); however, data were not available for this analysis.

Table 1. Jordan: Weights for the Calculation of the NEER and REER

Country	Weight	Country	Weight
United States	13.78	Israel	3.01
Germany	10.73	Netherlands	2.59
Saudi Arabia	7.21	Spain	2.42
Japan	7.05	Belgium	2.39
China	5.97	Turkey	2.04
United Kingdom	5.90	Indonesia	1.71
Italy	5.79	Canada	1.55
India	5.35	Switzerland	1.53
France	4.94	Greece	1.44
Egypt	4.51	Russia	1.36
Korea	4.32	Syrian Arab Republic	1.34
Lebanon	3.05	**Total**	**100.0**

Source: IMF INS database.

B. Evolution of NEER and REER Under Different Exchange Regimes in Jordan

Since it was introduced in 1950, the Jordanian dinar has always been under some kind of fixed or semi-fixed exchange rate regime, with the exception of 1988–89 when it was floating.[6] The dinar was initially (1950–64) issued under a currency board, using the pound sterling as an anchor. The Central Bank of Jordan (CBJ) began operations in 1965, and since then the dinar has been managed under various softer peg arrangements. Until 1975, the dinar remained pegged to the British pound. During 1975–88 it was pegged to the SDR, but with a fluctuation margin of 2.25 percent. In 1988, following intense pressure in the foreign exchange market, the dinar was allowed to float, but it was pegged again in May 1989 to the five currencies then comprising the SDR basket. Between 1989 and October 1995, the peg was adjusted frequently with the aim of ensuring competitiveness. Since October 1995 the dinar has been firmly pegged to the U.S. dollar.

In 1988/89, the Jordanian economy was hit by a devastating exchange rate crisis that nearly halved the living standard of the average Jordanian and left the government heavily indebted. The crisis was the outcome of a protracted history of high fiscal deficits leading to an increasing debt burden, which was exacerbated by persistent overvaluation of the exchange rate and the failure to take corrective measures. At the time, the dinar was formally pegged to the SDR with a 2.25 percent fluctuation margin, but in practice the dinar had been allowed to move within a wider band since the mid-1980s to allow for real depreciation in response to

[6] According to Reinhart and Rogoff (2002), Jordan's regime is listed as a managed float during 1989–92 and had limited flexibility during 1993–95.

the worsened external environment. The authorities attempted to stimulate domestic demand through expansionary fiscal and monetary policies, but this, combined with a drop in public grants and an increasingly difficult regional security situation (the first Intifada), ultimately led to a sharp drop in reserves.

Table 2. Jordan: Evolution of Exchange Rate Regime, 1950-2005

Period	Regime	REER (2000=100)		NEER (2000=100)		U.S. dollars per JD	
		High	Low	High	Low	High	Low
1950-64	Currency board 1/	80.0	80.0	56.3	56.3	2.80	2.80
1965-75	Peg to British pound	103.8	82.3	61.4	57.1	3.13	2.80
1975-88	Peg to SDR	134.5	103.8	105.1	61.4	3.35	2.54
1988-89	Float	109.0	87.6	98.0	68.2	2.69	1.75
1989-95	Peg to SDR	89.3	81.5	79.8	59.3	1.75	1.42
Since 1995	Peg to U.S. dollar	103.9	83.0	105.1	78.6	1.43	1.41

Sources: Jordanian authorities; and authors' calculations.
1/ Data for 1964 only.

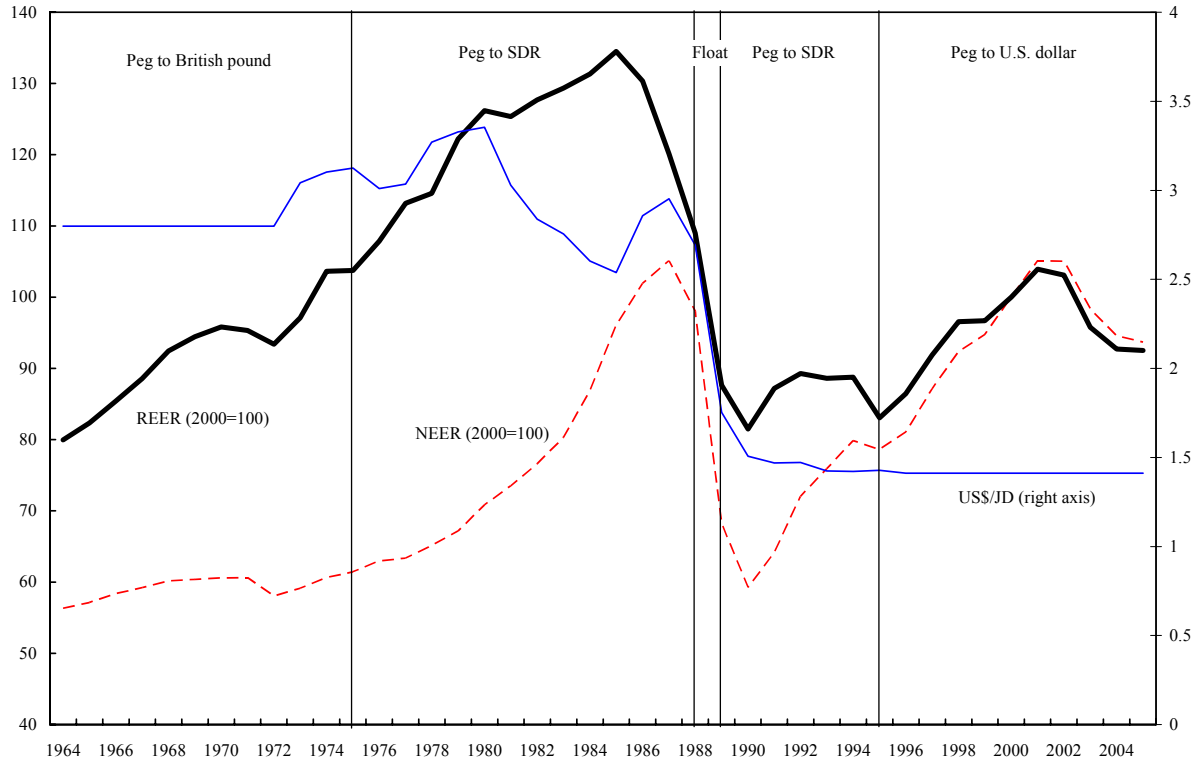
By mid-1988, the situation had become unsustainable, and the government quickened the pace of exchange rate adjustment until October 15, 1988, when it was forced to let the dinar float. Speculative pressures continued until May 1989, when the dinar was again pegged to the SDR with the five currencies then comprising the SDR basket weighted by their trade importance to Jordan. A dual exchange rate system was formally established in July 1989, with an initial gap of 35 percent between the official and commercial rates. The official rate continued to depreciate in nominal effective terms, and in February 1990 the rates were unified at the more depreciated commercial bank rate. Between May 1988 and February 1990, the dinar depreciated by a total of 40 percent in nominal effective terms (49 percent against the U.S. dollar) and 30 percent in real effective terms.

The dinar also came under some downward pressure in February–March 1998 and again in 1998–99. The pressures in early 1998 were related to heightened tensions in Iraq and a rapid reduction in CBJ CD interest rates from 8.4 percent in July 1997 to 5.4 percent in January 1998. The pressure in late 1998–early 1999 was related to a central-bank-financed fiscal expansion and the prolonged illness and eventual death of H.M. King Hussein. Improved monetary and fiscal policies, combined with the smooth ascension of H.M. King Abdullah II, averted further pressure on the exchange rate.

The REER, the NEER, and the nominal exchange rate vis-à-vis the U.S. dollar are plotted over the period 1964–2005 in Figure 1. Some interesting patterns found in the data are worth highlighting, particularly for the past decade. Since end-1995, the period during which the Jordanian dinar was fixed to the U.S. dollar, Jordan's REER appreciated until 2001, peaking at a level some 27 percent above its average for 1991–96. Since its peak in early 2002, however, the REER has depreciated to some degree and in 2005, it was only about 3 percent

above the 1991–96 average. As shown in Figure 1, the fluctuations of the REER are mainly derived by the fluctuations of the NEER, particularly since end-1995. This reflects mainly U.S. dollar movements.

Figure 1. Jordan: REER, NEER, and U.S. Dollar Exchange Rates, 1964–2005

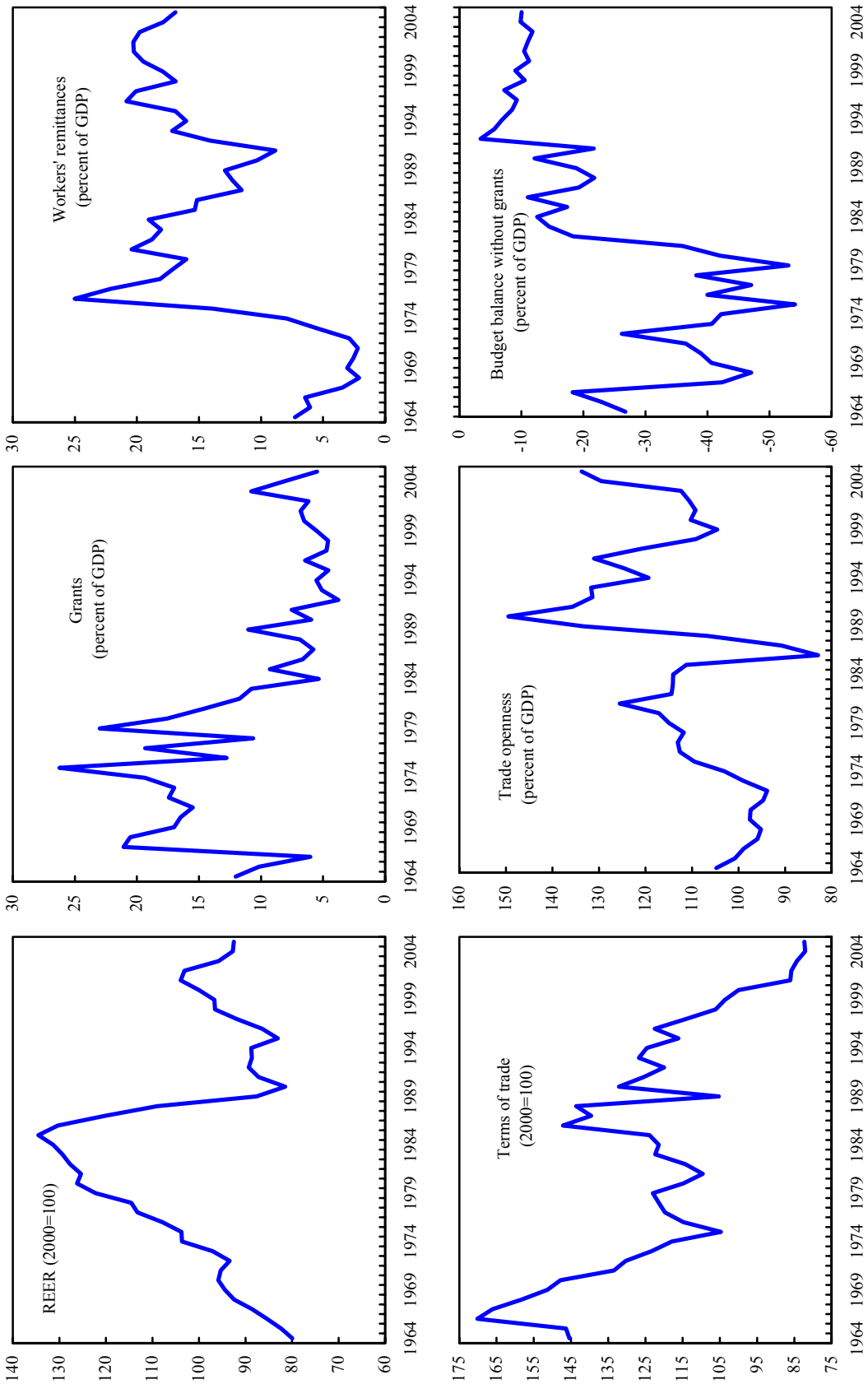


Sources: Central Bank of Jordan; and authors' calculations.

C. Theoretical Determinants of the Real Equilibrium Exchange Rate

The main determinants of the real exchange rate considered in this study are presented in Figure 2. The rationale for most variables is based on a simple neoclassical theoretical framework that assumes the prices of tradable goods are equalized across countries and investigates how changes in the real exchange rate arise mainly from relative movements in the prices of nontradables across countries. The chosen variables explain why the real exchange rate can be expected to vary over time and provide a rationale for deviations from PPP.

Figure 2. Jordan: Determinants of the Real Effective Exchange Rate, 1964–2005



Sources: Central Bank of Jordan; IMF, World Economic Outlook (WEO); and authors' calculations.

Capital inflows and transfers

An important factor in identifying the equilibrium real exchange rate is the role of capital inflows or transfers. According to the Dutch Disease theory (Corden and Neary, 1982), capital inflows lead to a real appreciation of the exchange rate through its impact on both the tradables and nontradables sectors of the recipient economy. However, different types of capital inflows or transfers may have different effects on the ERER because they affect it through different channels.[7] In this paper we focus on two types of transfers: grants and remittances.

Grants[8]

Depending largely on the exchange rate regime, there are at least two possible channels through which aid affects the real exchange rate. First, aid inflows could push up the price of nontraded goods. Foreign grant flows augment domestic resources, leaving the economy as a whole better off. Because the aid accrues initially to the government, it is similar to a resource windfall in state-owned natural resource sectors. It is for this reason that parallels are often drawn between issues of aid management and the so-called resource curse. The higher demand for domestic goods requires their prices to rise. In other words, the real exchange rate would appreciate. The second channel is that in a flexible exchange regime aid inflows may also push up the nominal exchange rate (for example, when the central bank sells foreign currency derived from aid inflows in the foreign exchange market). These two effects are not mutually exclusive—they ultimately lead to a real exchange rate appreciation.[9] In Jordan, the impact of aid will act mainly through the first channel because of its fixed exchange rate regime.

Worker remittances

An increase in remittances would also imply an appreciation of the real exchange rate. The effects of remittances may be different from those of grants because grants go mainly to the public sector and remittances to the private sector, and because the structure of consumption—in terms of tradable and nontradable goods—can be different. Governments typically spend more on nontraded goods because a large part of their budget is for wages and purchases of domestic services. In addition, a large part of remittances are saved and not consumed. Most of the grants are consumed by the government and not saved, which will also have more of an effect on the real exchange rate.

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[7] Appreciation as a result of capital inflows depends also on the degree of reversibility of the particular inflow in question. Some inflows are more prone to reversal (or more likely to be associated with outflows) and therefore will have different effects on national income and the real exchange rate than other flows that are less reversible (or more permanent in nature). See Opoku-Afari, Nomssey, and Lloyd (2004) for an example of the effects of capital inflows according to their degree of reversibility.

[8] In this paper, we use grants and aid interchangeably. The data on grants include in-kind oil grants from Iraq and Saudi Arabia, although there may be valuation issues in some years.

[9] Real exchange rate appreciation is associated with reduced growth (Rajan and Subramanian, 2005).

Terms of trade

For developing countries whose primary commodities dominate their exports, fluctuations in world commodity prices should explain a large share of the movements of their terms of trade.[10] Thus, for these countries, movements in their real exchange rates are affected by movements in the prices of their commodities. However, this "commodity currency" hypothesis may not apply to Jordan, because the share of commodity exports in total exports is low. More generally, the terms of trade and real exchange rate co-move over the long run. An improvement in the terms of trade leading to a boom in the exporting sector would have real income or wealth effects. This would tend to increase wages in this sector. Because wages are assumed to be equal across sectors, the increase in wages will raise the relative price of the nontradable goods and thus raise the real exchange rate.

Trade openness

A more open trade regime increases competition in tradable goods, reducing their price and thus lowering the real exchange rate. In this paper, we use the sum of exports and imports as a percent of GDP. Trade openness is also an indicator of trade liberalization, which has been used in other studies, but is substantially more difficult to measure.[11] Trade restrictions reduce competition, which leads to higher domestic prices resulting in increased real exchange rates. While trade openness and the real exchange rate are likely to be endogenous because a depreciation in the exchange rate increases trade openness, this is not a problem because the econometric methodology used in this paper controls for endogeneity.

Fiscal balance

An improvement in the fiscal balance has an ambiguous effect on the real exchange rate. On the one hand, an improved fiscal balance would normally induce a less than proportional reduction in private saving, so that total domestic demand would decrease while overall saving would increase.[12] This tends to reduce the demand for nontradable goods and thus lowers the real exchange rate.[13] On the other hand, fiscal tightening may have an

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[10] Chen and Rogoff (2002), and Cashin, Cespedes, and Sahay (2002). Import prices usually reflect world prices and are an important determinant for an oil-importing country such as Jordan.

[11] In the literature, trade openness is often considered as an outcome indicator of trade restrictions. However, it is not determined only by trade policy but also by structural factors. For a panel of developing countries, Combes and Saadi-Sedik (2006) decompose trade openness (imports plus exports of goods and services as a percentage of GDP) into natural openness and trade-policy-induced openness. Natural openness is computed by estimating what level of trade openness a country should have based on structural factors. Trade-policy-induced openness is the difference between trade openness and natural openness.

[12] Assuming that full Ricardian equivalence does not hold, for example, because of uncertainty about the duration of the improvement in the fiscal balance. Under Ricardian equivalence, other things being equal, a reduction in tax revenue will not affect the consumption behavior of private agents, thus the effect on nontraded goods is neutral.

[13] The fiscal balance effect may also depend on whether the improvement results from a reduction in spending or an increase in tax revenue.

expansionary impact on the economy implying an appreciation of the real exchange rate. The so-called anti-Keynesian (that is, expansionary fiscal contractions) episodes are associated with fiscal adjustment in high-debt countries. As the government gains credibility in being able to service its debt and the threat of higher taxes and default subsides, risk premiums on interest rates fall, confidence rises, and aggregate demand is stimulated.[14] In this paper, we define the fiscal balance as the central government budget balance excluding grants as a percentage of GDP.[15]

Productivity and other factors

We present the effect of the five variables presented above. Other determinants of the real exchange rate have been used in the empirical literature. Because of the relatively long period covered by this study (1964–2005), many variables were not available and some were available but appeared to be statistically insignificant (e.g., the interest rate differential).

Choudhri and Khan (2004) found that the Balassa-Samuelson effect is relevant for developing countries. Thus, if productivity in the tradables sector grows faster than in the nontradables sector, the resulting higher wages in the tradables sector will put upward pressure on wages in the nontradables sector, resulting in an increase in the aggregate price level and a real appreciation. Productivity data are not easily available for Jordan, and using the per capita income relative to the United States did not yield any significant results.

Other papers have used net foreign assets, arguing that debtor countries need a more depreciated real exchange rate to generate the trade surpluses necessary to service their external liabilities. Also, economies with high net foreign assets can temporarily sustain more appreciated real exchange rates because they can finance the associated trade deficits.

D. The Econometric Methodology

We use cointegration techniques to identify a long-run relationship between the REER and its fundamentals. We use Johansen's (1995) maximum likelihood estimator, which corrects for autocorrelation and endogeneity. We interpret the cointegration relationship as the long-run relationship between the REER and its fundamentals.

One of the key advantages of the Johansen methodology in the current application is that the estimated coefficient—the β-vector—can be used to compute a measure of the equilibrium

[14] The consolidation episodes of some North European countries (e.g., Denmark and Ireland) have been associated with expansionary economic activities. The episodes of North European countries have been well documented (e.g., Giavazzi and Pagano, 1990). There is also evidence of expansionary fiscal contractions elsewhere-in particular, in high-debt emerging market economies such as Turkey. For developing countries, Ary, Combes, and Plane (2005) found that the effect is nonlinear. The anti-Keynesian effect appears for levels of debt-to-GDP ratios higher than 83 percent.

[15] Some papers have used government consumption (as a ratio to GDP) because such consumption is likely to fall more on nontradables than tradables, thereby raising the relative price of the former, which would tend to appreciate the real exchange rate. See Montiel and Ostry (1994), and Gregorio, Giovannini, and Wolf. (1994).

real exchange rate and, as a result a quantification of misalignment, that is, the difference between the actual real exchange rate and its equilibrium. Box 1 summarizes our approach.

Box 1: Steps to Calculate the Long-Run REER

In practice, to compute the REER and as a consequence its misalignment, we follow the subsequent steps:

- **Unit root tests**: to determine that the series are nonstationary and integrated of order one, that is, the series are I(1).
- **Cointegration tests**: to test the existence of at least one cointegration relationship between the variables.
- **Estimate the vector error correction model (VECM)**: this is a restricted vector autoregression (VAR) designed for use with nonstationary series that are known to be cointegrated. To determine the long-run values of the REER, we apply the coefficients of the VECM to the long-run values of the fundamentals.
- **Long-run values of the fundamentals:** we use both the Hodrick-Prescott (HP) and Band-Pass (BP) filters to remove the cyclical component of variables.
- **Misalignment from long-run equilibrium**: is computed as the difference between the actual values of the REER and the estimated long-run REER.

III. Modeling and Interpreting the Equilibrium Real Exchange Rate

A. Econometric Results

Unit root tests

The unit root tests for REER and its determinants suggest that the series have one unit root.[16] We performed unit root tests for the variables presented above (Table 3). We performed both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for nonstationarity of these series. Both the ADF and PP tests do not reject the null hypothesis of a unit root. However,

[16] The existence of a unit root in the REER could be interpreted as the rejection of PPP hypothesis.

they do reject the null hypothesis that any of the series is I(2), and hence we conclude that the series have one unit root I(1). [17]

Table 3. Jordan: Unit Root Tests For Explanatory Variables 1/

	Levels				First differences			
	ADF		PP		ADF		PP	
	t-Statistic	Lag length 2/	Adjusted t-statistic	Band-width 3/	t-Statistic	Lag length 2/	Adjusted t-statistic	Band-width 3/
Log REER	-2.32	1	-1.85	2	-3.51	0	-3.53	2
Log terms of trade	-2.24	0	-2.18	2	-8.26	0	-8.27	1
Log trade openness	-2.19	1	-2.23	2	-5.70	0	-5.70	0
Log grants	-2.69	1	-2.22	2	-10.34	0	-12.25	6
Budget balance without grants	-1.36	2	-2.93	5	-8.31	0	-8.64	6
Log worker remittances	-2.22	1	-2.15	4	-4.46	0	-4.38	2

Source: Authors' calculations.

1/ A constant and a linear time trend are included in the test equation. Test critical values are: -4.20 at 1 percent level; -3.52 (5 percent); and -3.19 (10 percent).
2/ Automatic based on Schwarz information criterion (SIC), MAXLAG=17.
3/ Newey-West using Bartlett kernel.

Multivariate cointegration

Because the VECM specification only applies to cointegrated series, we first run the Johansen cointegration test and determine the number of cointegrating relations (Table 4). We perform two tests to detect a cointegration relation: the trace test and the maximum-eigenvalue test. Both the trace test and the max-eigenvalue test indicate one cointegrating equation at the 1 percent level.[18]

Small sample bias

An important shortcoming with the Johansen approach is the bias that results from small samples. That is, the test fails to reject the null hypothesis of non-cointegration even if there is no cointegrating vector. Thus, as the sample size (*T)* falls, or the number of variables (*n*) or lags (*j*) increases, the critical values should be adjusted upwards. Reinsel and Ahn (1988) suggest that the critical values be adjusted upwards by a multiplicative scaling factor or "degrees-of-freedom correction term" given by T/(T - nj). Our results are robust to this upward adjustment.

[17] The series should be *I(1)*, that is, there should be one unit root. A difference stationary series is said to be integrated and is denoted as *I(d)* where *d* is the order of integration. The order of integration is the number of unit roots contained in the series, or the number of differencing operations it takes to make the series stationary. Here the differences of the variables are stationary *I(0)*, that is, the series are *I(1)*.

[18] We performed the Schwarz information criterion (SIC) test to select the appropriate number of lags to be used in the VAR. The SIC test suggests that only one lag is necessary in the VAR.

Table 4. Jordan: Multivariate Cointegration Results

Cointegration tests 1/ H0 (r)	Trace Test		Maximum Eigenvalue Test	
	Trace statistic	Proba-bility 2/	Max-eigen statistic	Proba-bility 2/
None (r=0)	109.978	0.004	47.623	0.006
At most 1 (r<=1)	62.354	0.170	29.902	0.139
At most 2 (r<=2)	32.451	0.587	15.936	0.671
At most 3 (r<=3)	16.515	0.675	11.855	0.562
At most 4 (r<=4)	4.659	0.843	4.605	0.791
At most 5 (r<=5)	0.053	0.817	0.053	0.817

Source: Authors' calculations.

1/ Linear trend in the data, and an intercept, but no trend in the cointegrating equation.
2/ MacKinnon-Haug-Michelis (1999) *p* -values.

B. Interpretation of the Vector Error Correction Model

The results of the VECM are presented in Table 5. The coefficients of the cointegrating vector are significant and have an economically meaningful sign.[19] As expected, the coefficients on grants and workers remittances are negative, which means that an increase in either will result in an appreciation of the real equilibrium exchange rate. Similarly, an improvement in the terms of trade will appreciate the real exchange rate, whereas an increase in the openness of the economy will depreciate the real exchange rate.

The sign of the coefficient of the fiscal balance is consistent with the expansionary fiscal contractions hypothesis explained above. This is not entirely surprising, given the high level of debt in Jordan throughout most of the years under consideration. Jordan's debt peaked in 1991 at over 200 percent of GDP and was reduced gradually to 83 percent of GDP at end-2005. The empirical literature suggests that, at debt levels above about 80 percent in developing countries, a fiscal contraction is likely to be expansionary because private sector spending increases in anticipation of a lowered fiscal burden and government involvement in the future (Ary, Combes, and Plane, 2005). Fiscal contraction may appreciate the ERER through its effect on foreign direct investment: an improvement of budget balance would increase the foreign direct investment inflows by increasing the foreign investors' confidence. This would appreciate the ERER.

Recent changes in the fundamental variables, particularly grants, have had an important impact on the ERER. The size of the coefficients needs to be considered in relation to their statistical significance in order to assess their economic importance. Since the variables are

[19] A negative coefficient implies that higher values of the explanatory variable result in an appreciation of the equilibrium exchange rate and vice versa.

expressed in logs, the coefficients of the model can be interpreted as the long-run elasticity of the REER with respect to these variables.[20]

Table 5. Jordan: Selected Results from Cointegration Estimation

	Coefficient 1/	t-statistics
Estimates of the cointegrating relationships		
REER (logs)	1.00	
Grants (logs of percent of GDP)	-1.07	(-8.43)
Workers remittances (logs of percent of GDP)	-0.40	(-8.68)
Terms of trade (logs)	-0.86	(-4.39)
Trade openness (logs of percent of GDP)	0.33	(-1.71)
Budget balance without grants (percent of GDP)	-0.03	(-6.00)
Memorandum items:		
R-squared	0.47	
Error correction term (CointEq1)	-0.15	(-2.96)

Source: Authors' calculations.

1/ A negative coefficient implies that an increase in the explanatory variable results in an appreciation of the equilibrium REER.

For example, a reduction in grants of 1 percent would cause a depreciation of about 1.07 percent. Thus, the reduction in grants between 2003 and 2005 from 11.7 percent of GDP to 5.0 percent of GDP represents a change of 57 percent resulting in an estimated depreciation of the ERER by 61 percent.[21] In practice, the impact is likely to have been smaller because the high value of grants in 2003 was not likely to have been a permanent level for grants. It does show, however, that grants do have a powerful effect on the

[20] However, the coefficient of the fiscal deficit should be interpreted as a semi-elasticity. In a model where the dependent variable has been log-transformed, but the predictors are not, the interpretation is that the dependent variable changes by 100*(beta coefficient) percent for a one-unit increase in the independent variable.

[21] It is the percentage change of the variable, which is defined as percentage of GDP, that is relevant. The examples cited in this section assume that the change between 2003 and 2005 in the fundamental variables is permanent—an assumption that will be discussed below.

Jordanian ERER. However, it does not mean that grants are negative for the economy as a whole; in fact, there is a large body of literature that suggest that grants are useful. It does mean that a country has to adjust to the macroeconomic consequences of grants.[22] In terms of the aid absorption debate, it suggests that grants are spent and only partially absorbed in Jordan.

The coefficient on workers' remittances is only a little bit more than a third of the grant coefficient. An increase in workers' remittances of 1 percent will appreciate the equilibrium real exchange rate by 0.4 percent. The impact appears to be smaller because the structure of consumption—in terms of tradable and nontradable goods— is different. Between 2003 and 2005, workers' remittances declined from 19.4 percent of GDP to 17.1 percent, which represents a decline of 11.9 percent. As a result, the long-run ERER would depreciate by 4.7 percent.

An improvement of 1 percent in the terms of trade would cause an appreciation in the ERER of the Jordanian dinar of 0.86 percent. Between 2003 and 2005, the terms of trade declined from 78.1 percent to 70.4 percent—a reduction of 10 percent, which implies a long-run depreciation of the real equilibrium exchange rate of almost 9 percent.

A decrease in the fiscal deficit without grants of 1 percent of GDP results in a 3 percent appreciation of the ERER, which implies that the effect is moderate. For example, the fiscal deficit, excluding grants, declined by 2.5 percent of GDP during 2003–05, resulting in a 7.5 percent appreciation of the ERER. The fiscal deficit excluding grants remained high at over 10 percent of GDP in 2005, which implies that it could be an important policy tool to counter some of the above changes resulting in a depreciation of the ERER. However, given that Jordan's debt is now lower than 80 percent of GDP, the anti-Keynesian effect of the fiscal deficit might decline.

IV. Assessing the Equilibrium Real Exchange Rate

We use the estimated coefficient in Table 5—the β-vector—to compute a measure of the ERER and quantify the misalignment by calculating the difference between the actual real exchange rate and its equilibrium. Much of the previous literature has argued that the coefficients should be applied to the long-run level of the variables. Since the long-run level of the variables is unobservable, filtering methodologies are applied to the variables to rid them of their cyclical components. The two filters most commonly used in the literature are the Hodrick-Prescott (HP, 1997) filter and the Baxter and King (1999) filter.

[22] Both grants and remittances can have a positive effect on the economy if they are used to enhance the economy's long-run productive capacity in either physical or human capital. For example, aid inflows should be able to reduce at least part of the adverse impact of exogenous shocks such as terms of trade or natural disasters to which low-income countries are more prone (Guillaumont and Chauvet, 2001).

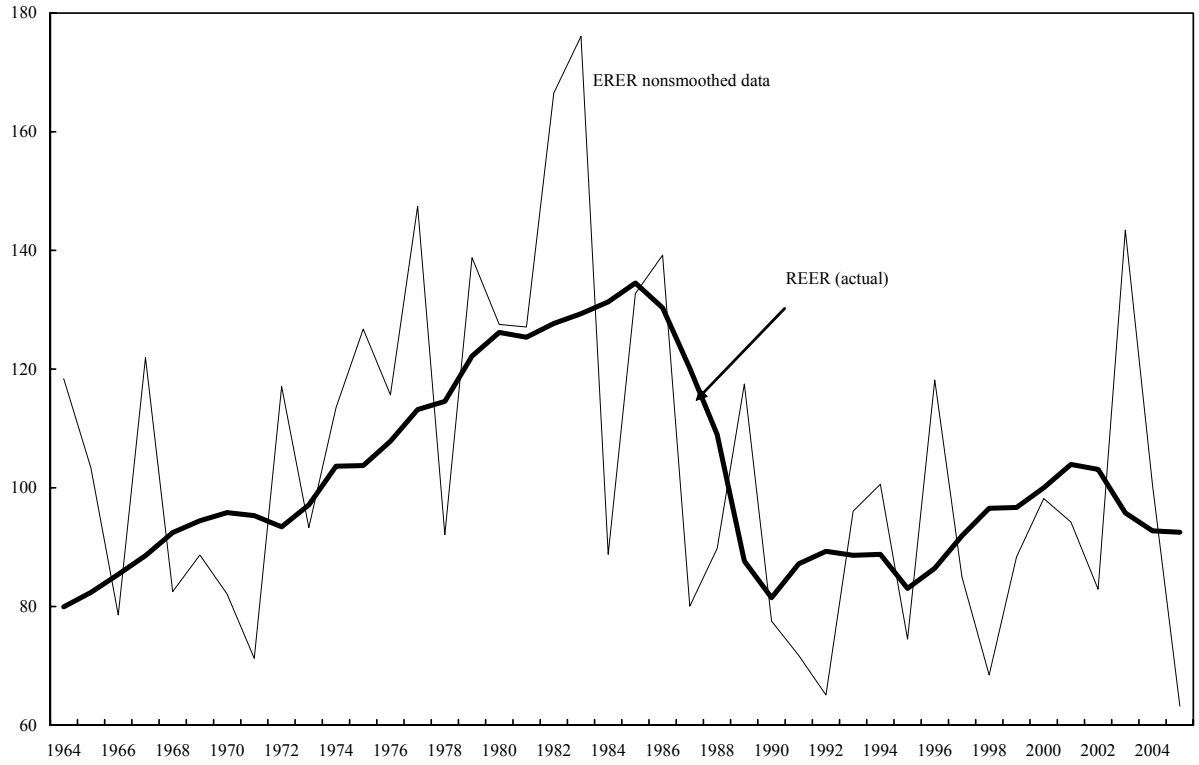
A. Techniques for Estimating the Equilibrium Real Exchange Rate

We compute the ERER in three ways by applying the β-vector to (i) the non-filtered variables; (ii) the filtered variables using the Hodrick and Prescott (1997) method; and the filtered variables using a variant of the Baxter and King (1999) filter, namely the Christiano-Fitzgerald (2003) method.[23]

Estimating the ERER with nonsmoothed data

The results for the nonsmoothed (raw) data appear to contain a substantial degree of "noise" or fluctuation (Figure 3). The results are difficult to interpret because the equilibrium real exchange rate seems to fluctuate a lot. This appears to be a reason why smoothing is applied in many papers. For example, the equilibrium real exchange rate is substantially higher than the actual real exchange rate in 2003—indicating an undervalued exchange rate—but this changes the year before and after.

Figure 3. Jordan: Actual and Nonsmoothed ERER, 1964–2005



Source: Authors' calculations.

[23] This filter uses all of the observations in the sample, which is important for the end-of-sample estimation.

Estimating the ERER with the Hodrick-Prescott filter

The results for the smoothed data using the HP filter are presented in Figure 4.[24] The HP-derived ERER appears to follow the actual REER reasonably well. We find some overvaluation during 1997–2005, with a peak of about 15 percent in 2001. However, in 2005 there was a substantial reduction to about 2 percent with little apparent misalignment, although it is important to note that the HP filter performs badly at the beginning and the end of the sample, so there is a caveat in this interpretation.

Figure 4. Jordan: Actual and ERER Using the HP Filter, 1964–2005

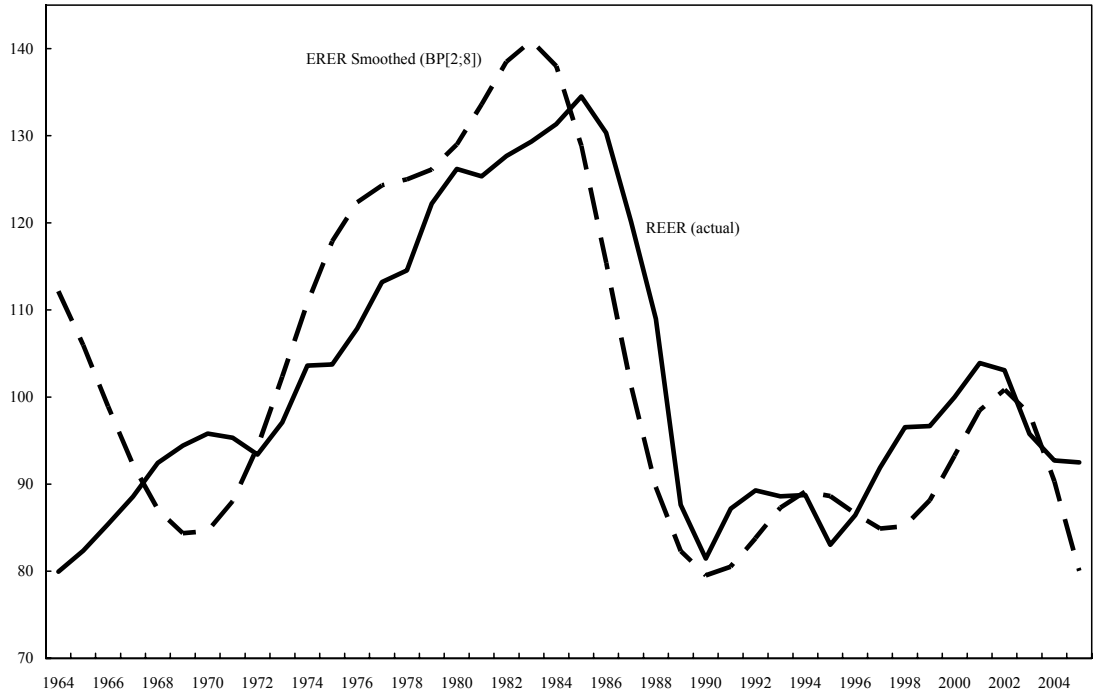
Source: Authors' calculations.

Estimating ERER with the Band-Pass filter

The estimation of the equilibrium real exchange rate using the BP filter at first sight appears to indicate results similar to those with the HP filter (Figure 5). The period 1997–2005 is also identified as a period of exchange rate overvaluation, with the exception of 2003, which shows a small undervaluation of about 3 percent. However, the estimated overvaluation under the BP-filter approach shows the highest overvaluation in 2005 with a value of about 15 percent.

[24] We use $\lambda = 100$ corresponding to the original Hodrick and Prescott values for λ using annual data.

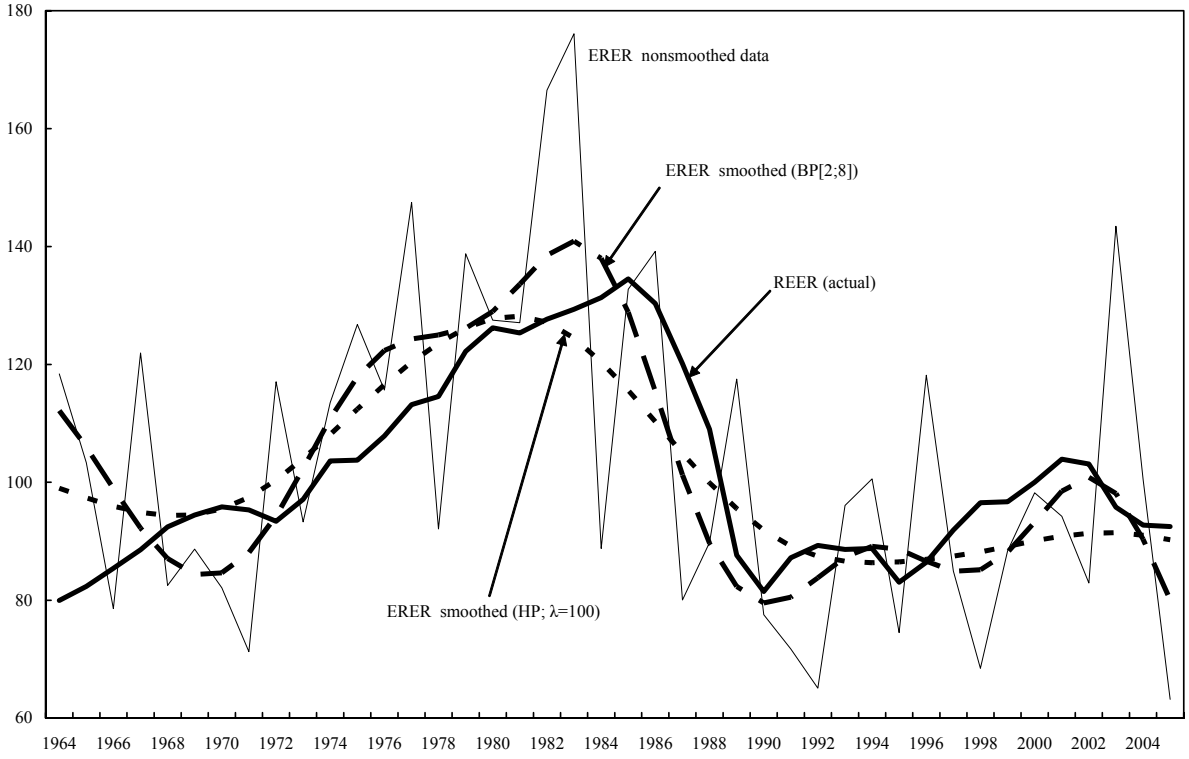
Figure 5. Jordan: Actual and ERER Using the BP Filter, 1964–2005



Source: Authors' calculations.

Comparing the two estimates more carefully yields surprisingly different results (Figure 6 and Table 6). The maximum deviation between the two filters is 15 percentage points and occurs in 1989, when the HP filter indicates an undervaluation of 8 percent and the BP filter shows an overvaluation of almost 7 percent. Several other years also have large differences in the estimated ERER and, more important, indicate overvaluation with one method and undervaluation with the other method. This suggests that the interpretation of the appropriateness of the ERER is much more difficult to assess in practice, as will be shown in the next section. Moreover, drawing policy conclusions from the estimates is very difficult. For example, in 1988 the year of the exchange rate crisis, the HP filter shows a minor overvaluation of 9.1 percent, whereas the BP filter shows a more problematic overvaluation of almost 22 percent. Clearly, the results have to be treated with caution.

Figure 6. Jordan: Measurements of the ERER, 1964–2005



Source: Authors' calculations.

Table 6. Jordan: Differences Between HP- and BP-Filter-Based Estimates of the ERER

Year	REER (2000=100)	Estimates of Real Exchange Rate Misalignments		
		Hodrik-Prescott 1/	Band-pass 1/	Difference HP-BP
		(In percent of estimated equilibrium exchange rate)		
1971	95.32	-2.2	8.3	10.4
1983	129.34	3.9	-8.2	12.1
1984	131.33	9.1	-4.8	13.9
1988	108.99	9.1	21.6	12.5
1989	87.63	-8.3	6.5	14.8
1990	81.47	-11.3	2.5	13.8
2005	92.50	2.5	15.6	13.1

Source: Authors' calculations.

1/ A positive value indicates an estimate of overvaluation of the dinar.

B. Interpreting the Equilibrium Real Exchange Rate—The Need for Caution

There are several methodological problems associated with filtering or smoothing.[25] Filtering is "measurement without theory" (Koopmans, 1947), because there is no theory explaining the mechanism generating economic fluctuations. Thus, without knowing the properties of the secular component of a time series, the theoretical relationship between trend and cycle is unknown and the choice among various decompositions is arbitrary (Canova, 1998a and 1998b).

Different detrending methods (filters) extract different "types" of business cycle information from the original series, resulting in significant qualitative and quantitative differences. For example, the two most used methods of filtering, the HP filter and the BP filter, can produce a spurious relationship between variables and can generate business cycle dynamics even if none are present in the original data. The previous section illustrates this point, since the various detrending methods yield qualitatively and quantitatively different results.

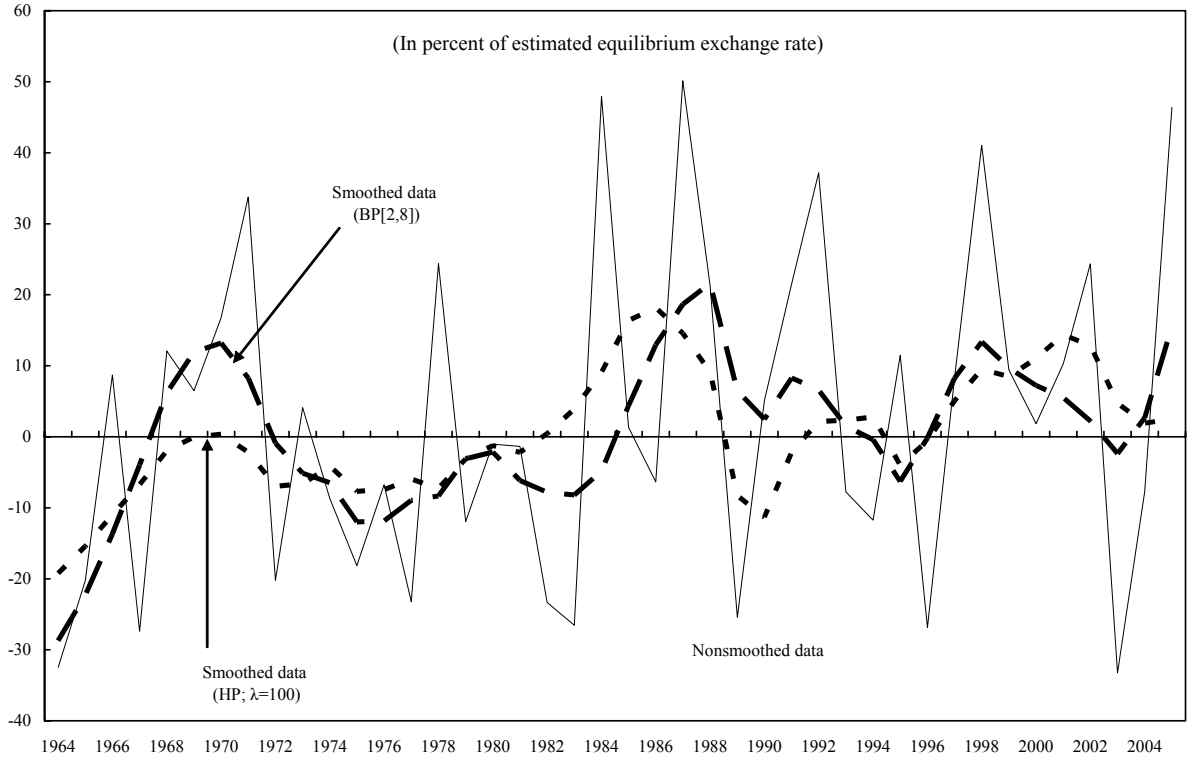
There is no independent criterion for choosing filters, because there are fundamental disagreements on the properties of a trend and on its relationship with the cyclical component of a series. Since the issue of what is an "appropriate" statistical representation of the trend cannot be solved in small samples, and since the choice of the relationship between the cyclical and secular components is arbitrary, statistical approaches to detrending do not allow reaching robust conclusions about the estimated detrended variable (Canova, 1998a and 1998b). This point is well illustrated in our estimates of misalignments of the ERER, which vary substantially (Figure 7). It would be difficult to reach strong conclusions regarding the misalignment of the ERER for Jordan based on the different detrending methods. Some caution in interpreting the results is thus required. In addition, there are several reasons why filtering might be inappropriate for developing countries.[26]

The results for estimating the ERER vary not only with different filter methodologies. For a given filter, there is a parameter, which determines the amount of smoothing. In the case of the HP filter, the smoothing parameter is called λ, and it is usually set at a value of 100 for annual data (HP(100)), which yields very smooth estimates. However, the ERER might have shorter cycles, and thus it may be more appropriate to choose a value of λ more accommodative of this feature—for example, by setting λ equal to 10 (HP(10)). The smoothing parameter for the BP filter is related to the length of the cycle, which is indicated by the upper and lower bound. With annual data, the standard choice is 2 and 8 (BP[2,8]), respectively, for the lower and upper bound, or 2 and 4 (BP[2,4]) for shorter cycles.

[25] The Appendix has a more detailed exposition of methodological problems with smoothing.

[26] See the Appendix and Mongardini and Saadi-Sedik (2003) for a review of the issues related to filtering in an emerging country like Jordan.

Figure 7. Jordan: Measurements of Real Exchange Rate Misalignments, 1964–2005



Source: Authors' calculations.

The ERER may not have a cycle. In fact, if the equilibrium exchange rate is determined by its fundamentals, and there is a shock to the fundamental, then the ERER should also be affected by the shock, and smoothing would seem inappropriate. Thus the only rationale for smoothing would be to reduce measurement errors in the variables, but then the smoothing should be relatively minor. Thus, for the purpose of this ERER analysis, the BP[2,4] and HP(10) filters would probably be preferable (see Appendix for details).

The "long-run" values derived from smoothing are probably not appropriate for assessing current and future misalignments. What matters for current misalignment is whether the current values of the fundamentals are thought to be permanent or not. If the current values are thought to be permanent, then misalignment should be derived by comparing the actual REER with the equilibrium rate calculated using the current values, otherwise the expected values should be used to assess any potential misalignment.

The above suggests that substantial subjective judgment is required to make any assessment regarding the misalignment of the current exchange rate. Filtering is not a method that should be applied without some critical thinking. It does help with measurement errors because it applies an averaging process, which might be useful for identifying historical periods of past misalignments. Also, with annual data, it would appear that using filters with less smoothing, such as the BP(2,4) or HP(10) filters, would be more appropriate because they use less averaging, which seems reasonable in the context of developing countries, which tend to have shorter cycles, if any.

There are, of course, other factors, perhaps as or more important than smoothing, that suggest caution in interpreting the results from the econometric exercise. These include (i) the uncertainty whether the empirical long-run relationship estimated by the model reflects the actual real equilibrium relationship; (ii) the uncertainty related to the fundamentals chosen (results in similar studies show a significant sensitivity of the ERER to the choice of fundamentals); and (iii) data and measurement uncertainty.

C. Policy Implications

The results of the econometric model have some important implications.[27] The speed of adjustment or convergence is only 15 percent per year, which is slow but in line with the literature. It implies that the actual exchange rate needs about 4 years on average to adjust half-way to a change in the equilibrium exchange rate resulting from a shock.[28] Consequently, policy actions to speed up the adjustment to equilibrium could be beneficial.

Despite the caveats regarding the estimation of the ERER in general, there is some evidence that the Jordanian dinar was overvalued in 2005, although it is difficult to say by how much. All estimates of exchange rate misalignments show an overvaluation in 2005, but there is considerable uncertainty about the extent of the overvaluation, particularly because it is difficult to say whether the 2005 values are the permanent values that are necessary for an assessment of misalignment. The terms of trade could improve if oil prices were to come down, and grants may decline even further or remain stable. On the other hand, with higher oil prices workers' remittances are likely to increase, which would decrease the overvaluation because it would appreciate the ERER. The estimated effect of the budget balance without grants could change now that the debt ratio has been reduced, in which case a reduction in the deficit might result in a real effective depreciation according to the standard Keynesian effect.

Structural reform policies should contribute to reducing any potential overvaluation. Based on the structural reforms undertaken during the past decade and a half, the Jordanian economy is probably more flexible, and the adjustment speed has likely increased to more than the 15 percent estimated by the model. Moreover, further structural reforms aimed at increasing the economy's flexibility in all factor markets, but particularly in the labor market, could further contribute to eliminating potential misalignments. Continuing the high productivity growth of recent years would go a long way in reducing any potential overvaluation. In this respect, maintaining a stable macroeconomic environment with low inflation will be important in limiting any potential real appreciation from increased domestic petroleum prices during 2006 and 2007. In this context, restrictive monetary and fiscal policies would help lower domestic inflation to below partner countries' inflation, which

[27] The results need to be interpreted with caution; the R-squared of the model is 0.47, which is not bad, but implies that it explains only about half of the long-run variation of the equilibrium exchange rate. Thus, there are several important factors not captured by the model.

[28] It would take 14 years to eliminate 90 percent of the gap.

would reduce overvaluation over time, and it would reduce the economy's vulnerabilities resulting from relatively high debt levels.

There are important factors outside the estimated model that also affect the ERER. The most important of these variables is the U.S. dollar REER, which, given the dinar peg to the U.S. dollar, strongly influences the actual dinar REER. Since most market observers expect the U.S. dollar REER to depreciate, the Jordanian dinar will likely depreciate with it, thus decreasing the potential misalignment. Also, the effect of declining grants may be offset by the increase in foreign direct investment and portfolio investments to the Amman Stock Exchange, whose performance was exceptional over the last few years.[29] Foreign direct investment and portfolio inflows are capital inflows that should have an effect similar to grants and workers' remittances in appreciating the ERER. It appears reasonable to assume that these inflows will continue at a higher level in the future, thus counteracting some of the depreciation pressures from the loss of grants.

V. CONCLUSIONS

We estimate a long-run equilibrium model for the Jordanian REER by applying the Johansen cointegration estimation methodology over the period 1964 to 2004 to a newly calculated and expanded REER data set. The impact of our explanatory variables on the long-run real exchange rate is consistent with economic theory. Thus, an increase in grants, workers' remittances, and the terms of trade will appreciate the real equilibrium exchange rate, while an increase in trade openness will depreciate it. A fiscal contraction will result in a small appreciation consistent with the anti-Keynesian effect for highly indebted countries. We apply the coefficients of the VECM to derive the ERER and calculate the exchange rate misalignment as the difference between the actual values of the REER and the estimated ERER. Our findings contribute to the aid-absorption and exchange rate misalignment debates.

This paper adds to the debate on aid-absorption by showing that, in the case of Jordan, aid leads to a statistically and economically significant appreciation of the ERER. Similarly, workers' remittances appreciate the real exchange rate, although the effect is less than half that of grants because workers' remittances are spent more on tradable goods than grants with a lesser effect on relative prices between tradable and nontradable goods.

The paper adds to the equilibrium real exchange rate literature by highlighting the difficulties of calculating potential misalignments. Some of the previous literature has applied filtering (mostly HP or BP) to the fundamental variables. Abstracting from well-documented difficulties with filtering or smoothing, this appears to be based on the misconception that "long-run values" of the fundamentals are required to calculate misalignments. However, we argue that what matters for policy purposes is whether the current values of the fundamentals are thought to be permanent, and how much the current REER deviates from the thus calculated equilibrium rate. This type of analysis requires considerable judgment, which is

[29] See Saadi-Sedik and Petri (2006).

why pronouncements of misalignments have to be qualified significantly. Moreover, less smoothing appears to be preferable in the context of developing countries because of their greater susceptibility to shocks and shorter economic cycles, if any.

In the case of Jordan, as of 2005, it is difficult to decide whether the actual exchange rate was over- or undervalued. There is considerable evidence that the ERER depreciated between 2003 and 2005, and there is some evidence that the Jordanian dinar may have been overvalued in 2005. In light of the peg to the U.S. dollar, an obvious policy implication is to continue improving productivity at the high rate of recent years. In addition, to the extent that the U.S. dollar depreciates in the future as many market observers expect, the Jordanian dinar would follow.

The paper has some obvious implications for further research. First, it would be useful to apply different methodologies to estimating the ERER. The literature has identified two other approaches to calculating the ERER, which are based on macroeconomic balances (external current account) and external sustainability (net foreign assets position). It would also be useful to explore the topic of expansionary fiscal contractions in the specific context of Jordan, and determine the thresholds above which the anti-Keynesian or non-Keynesian effects appear. Particularly since the debt level has now declined below the level of 80 percent of GDP—the threshold level found for other developing countries.

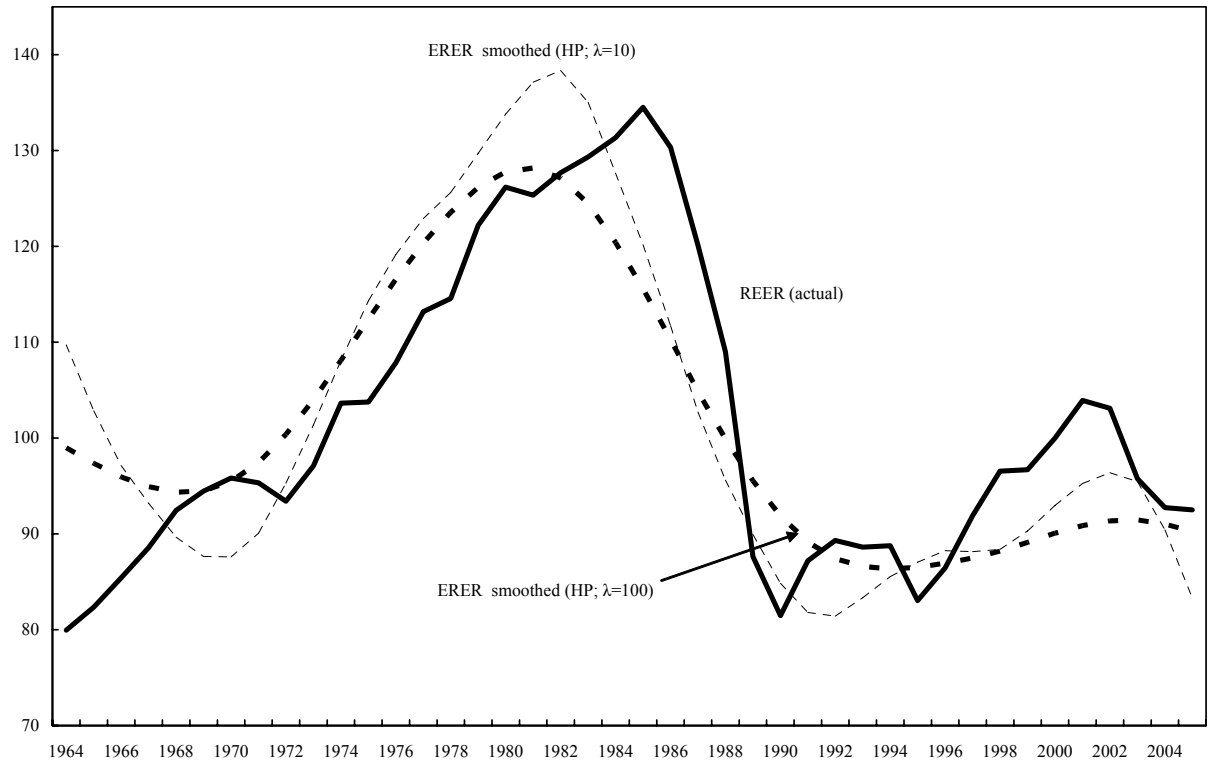
Appendix: Methodological Problems with Smoothing

A. The Choice of Smoothing Parameters

The value of λ for the HP filter

The results for estimating the ERER do not only vary with different filter methodologies, but even for a given filter, there is a choice of parameters, which gives a decisively different result. In the case of the HP filter, the smoothing parameter is called λ, and it is usually set to the value of 100 for annual data (HP(100)). This choice yields very smooth estimates, which might be appropriate for variables with longer cycles. However, the ERER might have shorter cycles, and thus it may be more appropriate to choose a value of λ more accommodative of this feature, which is done in Figure 8, where λ is equal to 10 (HP(10)). The results are quite different because the estimated ERER is more variable with the maximum deviation between the estimated ERER at 9 percent. In many cases, the results using the different smoothing parameters yield over- and undervaluation of the ERER, as for example in 1991, 1983, 1982, 1971, and 1968.

Figure 8. Jordan: ERER Estimates Using Different HP Filters, 1964–2005



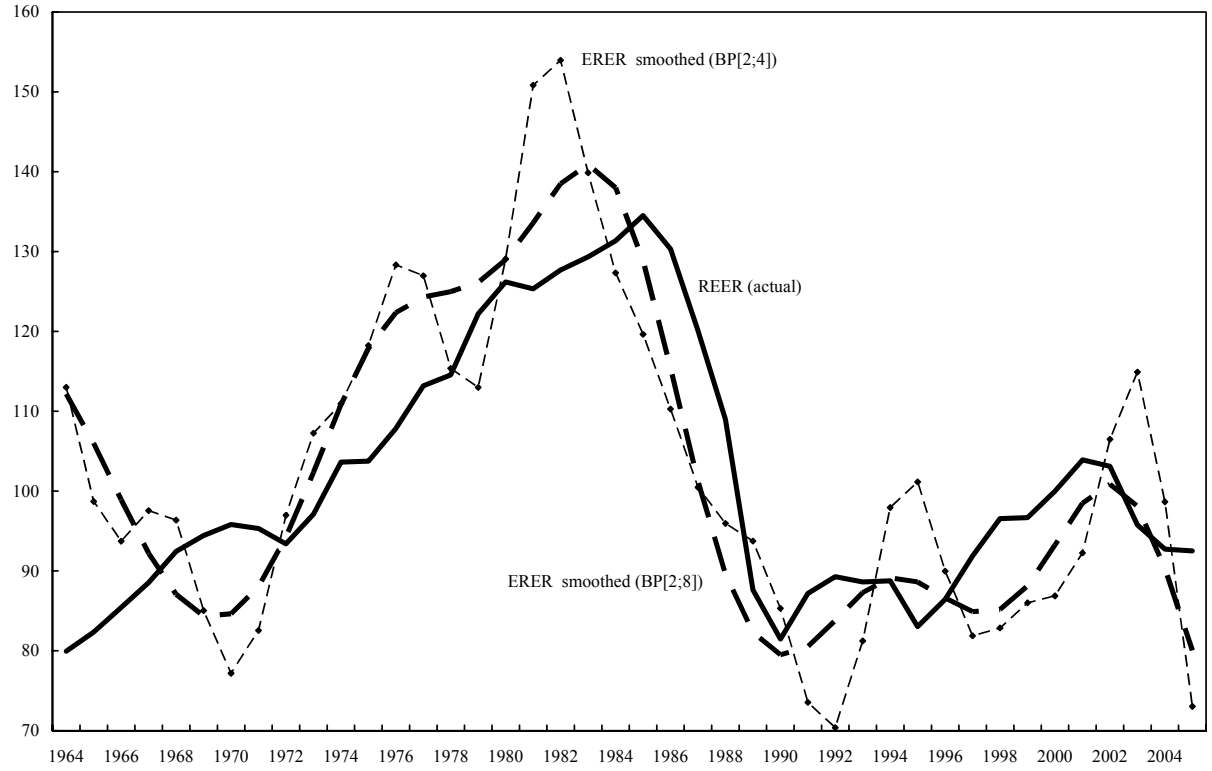
Source: Authors' calculations.

The value of the lower and higher band for the BP filter

The smoothing parameter for the BP filter is related to the length of the cycle, which is indicated by the upper and lower bound. With annual data, the standard choice is 2 and 8, (BP[2,8]), respectively, for the lower and upper bound, but for comparison purposes we also chose 2 and

4 (BP[2,4]) (Figure 9). The results are strikingly different for the two choices. The maximum deviation for the two estimates is 20 percent. Moreover, the years 1967, 1979, 1984, 1989, 1990, 2002, and 2004 show undervaluation under one method and overvaluation under the other.[30]

Figure 9. Jordan: ERER Estimates with Different Band-Pass Filters, 1964–2005



Source: Authors' calculations.

B. Methodological Problems with Filtering

There are three main problems with filtering: (i) it is "measurement without theory" (Koopmans, 1947); (ii) different detrending methods extract different "types" of business cycles from the original series, resulting in significant qualitative and quantitative differences; and (iii) there is no independent criterion to choose filters (Canova, 1998a and 1998b).

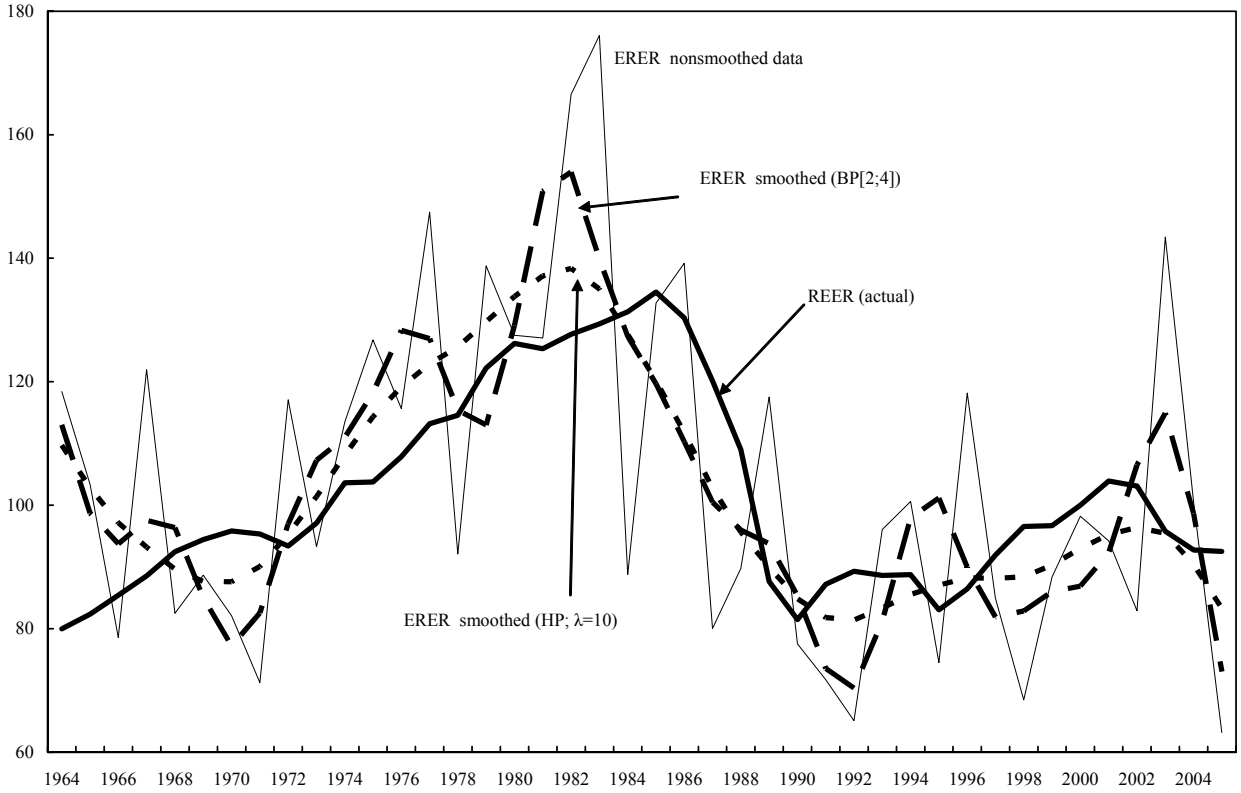
There is no theory explaining the mechanism generating economic fluctuations. A series Y_t might be decomposed into $Y_t = T_t + C_t + I_t$, where T_t is the trend component (long-run value) of the variable, C_t is the cycle component (short-run value), and I_t is the error term. Short-run fluctuations are then identified as deviations from the trend of the process (C_t). Because $T_t + C_t + I_t$ are unobservable, numerous trend-cycle decompositions have been proposed in the literature. These efforts are devoted to extracting $Z_t = C_t + I_t$, or T_t devolved into extensive discussions of what are appropriate "trend removal" filters. However, dynamic economic theory does not indicate the type of economic trend that a series may display nor the exact relationship between

[30] See Appendix Table 3 for details.

secular and cyclical components. In other words, without a set of statistical facts pinning down the properties of the secular component of a time series, the theoretical relationship between trend and cycle is unknown, and the choice among various decompositions is arbitrary. In reality, decompositions are attempts to approximate unknown features of an unknown series and, therefore, are subject to specification errors (Canova, 1998a and 1998b).

Different detrending methods extract different "types" of business cycle information from the original series, resulting in significant qualitative and quantitative differences. For example, the two most used methods of filtering, the HP filter and the BP filter, can produce a spurious relationship between variables and can generate business cycle dynamics even if none are present in the original data. Benati (2001) shows that using the BP filter can produce a spurious correlation between the cyclical component of the variables of interest.[31] The previous section illustrates this point, since the various detrending methods yield qualitatively and quantitatively different results. Figure 10 provides a further graphical representation of ERER measurements using limited smoothing—that is, the HP(10) and BP[2,4] filters.

Figure 10. Jordan: Measurements of the ERER with Limited Smoothing, 1964–2005

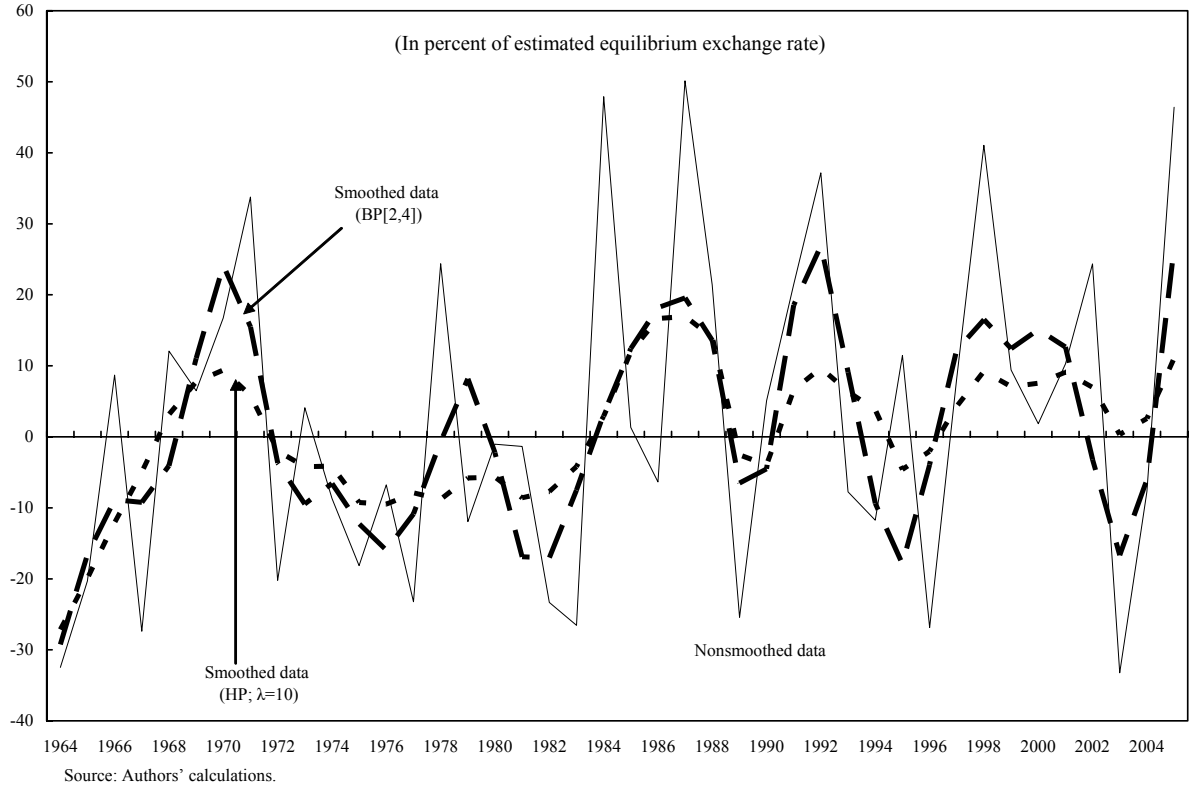


Source: Authors' calculations.

[31] For example, even if there is a negative relationship between GDP and another variable of interest, because of the cointegration relationship between these two variables, filtering can produce a positive relationship. In other words, countercyclical behavior can be estimated to be procyclical. Harvey and Jaeger (1993) and Cogley and Nason (1995) note that the HP filter may induce business cycle periodicities and comovement in data series that do not contain cycles.

Within the empirical literature, there are fundamental disagreements on the properties of a trend and on its relationship with the cyclical component of a series. Since the issue of what is an "appropriate" statistical representation of the trend cannot be solved in small samples and since the choice of the relationship between the cyclical and secular components is arbitrary, statistical approaches to detrending do not allow reaching robust conclusions about the estimated detrended variable (Canova, 1998a and 1998b). This point is well illustrated in our estimates of misalignments of the ERER using limited smoothing (HP(10) and BP[2,4]), which also vary substantially (Figure 11). It would be difficult to reach strong conclusions regarding the misalignment of the ERER for Jordan based on the different detrending methods. Some caution in interpreting the results is thus required.

Figure 11. Jordan: Measurements of Real Exchange Rate Misalignments with Limited Smoothing, 1964–2005



Source: Authors' calculations.

In addition, there are several reasons why the filtering approach seems inappropriate for developing countries.[32] Relying on the parameters of filters used in the context of industrial countries when studying developing countries is at best ad hoc, and may lead to inappropriate conclusions as regards the stylized facts that characterize macroeconomic fluctuations. In an extreme case, inappropriate models might be validated and vice versa, depending on the choice of smoothing parameter (Rand and Tarp, 2001).

[32] See Mongardini and Saadi-Sedik (2003) for a review of the issues related to filtering in a emerging country like Jordan.

C. More Methodological Caveats

There are additional fundamental problems with filtering relating to the fact that the variables used probably do not have cycles and that the "long-run" values resulting from filtering are inappropriate for analyzing current misalignment. This suggest further caution in interpreting misalignments.

There is no reason to believe that the variables used in the analysis have cycles. The filtering techniques were developed in the context of business cycle determination, but there is no evidence that the explanatory variables undergo any cycles. In fact, if the equilibrium exchange rate is determined by its fundamentals, and there is a shock to the fundamental, then the ERER should also be affected by the shock and smoothing seems inappropriate. Thus the only rationale for smoothing would be to reduce measurement errors in the variables, but then the smoothing should be relatively minor.

The "long-run" values derived from smoothing are not appropriate for assessing current and future misalignments.[33] Even if they are appropriate for analyzing some past misalignment, where the averaging property of filtering may be of value, they are utterly meaningless for assessing current misalignment. What matters for current misalignment is whether the current values of the fundamentals are thought to be permanent or not. What the values might have been in the past is not relevant for today or tomorrow. If the current values are thought to be permanent, then misalignment should be derived by comparing the actual REER with the equilibrium rate calculated using the current values. If the current values of the fundamentals are expected to change, then the expected values should be used to assess any potential misalignment.

The above suggests that substantial subjective judgment is required to make any assessment regarding the misalignment of the current exchange rate. Filtering is not a method that should be applied without some critical thinking. It does help with measurement errors because it applies an averaging process, which might be useful for identifying historical periods of past misalignments. Also, with annual data, it would appear that using filters with less smoothing, such as the BP(2,4) or HP(10) filters, would be more appropriate because they use less averaging, which seems reasonable in the context of developing countries, which tend to have shorter cycles, if any.

[33] From $Y_t = T_t + C_t + I_t$, where T_t is the trend component (long-run value) of the variable, C_t is the cycle component (short run value), and I_t is the error term.

Appendix Table 1. Jordan: Annual Data Series of Explanatory Variables, 1964–2005

Year	US Dollars/ Jordanian Dinar	NEER (2000=100)	REER (2000=100)	Terms-of-Trade (2000=100)	Grants	Workers Remittances	Trade Openness	Budget Balance Without Grants
					(In percent of GPD)			
1964	2.80	56.34	79.95	145.42	12.04	7.27	104.80	-26.77
1965	2.80	57.12	82.35	146.31	10.16	6.04	100.78	-22.95
1966	2.80	58.39	85.41	170.14	6.03	6.45	98.89	-18.24
1967	2.80	59.23	88.55	166.10	21.08	3.44	95.93	-42.33
1968	2.80	60.18	92.45	158.24	20.54	2.09	95.19	-47.04
1969	2.80	60.38	94.44	151.32	17.00	3.06	97.57	-40.64
1970	2.80	60.58	95.82	147.82	16.48	2.56	97.43	-38.91
1971	2.80	60.61	95.32	133.48	15.49	2.19	94.71	-36.48
1972	2.80	58.05	93.40	130.26	17.43	2.90	93.86	-26.18
1973	3.04	59.14	97.09	123.31	16.99	5.48	98.95	-40.70
1974	3.10	60.63	103.63	117.92	19.35	7.93	103.04	-42.18
1975	3.13	61.44	103.75	104.72	26.24	13.90	109.45	-54.11
1976	3.01	62.98	107.85	114.78	12.78	25.01	112.61	-39.98
1977	3.04	63.37	113.19	119.75	19.35	22.13	113.07	-47.03
1978	3.27	65.15	114.56	121.43	10.63	18.13	111.76	-38.19
1979	3.33	67.18	122.20	123.01	22.99	17.10	114.97	-53.05
1980	3.35	70.83	126.19	114.83	17.58	16.02	117.11	-42.05
1981	3.03	73.49	125.35	109.61	14.59	20.43	125.55	-35.97
1982	2.84	76.60	127.69	114.23	11.73	18.78	114.37	-18.33
1983	2.75	80.32	129.34	122.38	10.77	18.05	114.09	-14.47
1984	2.60	86.86	131.33	121.44	5.35	19.05	114.05	-12.55
1985	2.54	96.02	134.51	123.90	9.30	15.34	111.23	-17.40
1986	2.86	101.94	130.34	147.17	6.64	15.16	82.92	-11.04
1987	2.95	105.12	120.14	139.58	5.78	11.56	90.80	-19.28
1988	2.69	98.02	108.99	143.65	6.86	12.30	106.69	-21.76
1989	1.75	68.20	87.63	105.29	11.03	12.91	133.38	-18.83
1990	1.51	59.25	81.47	132.12	5.95	10.32	149.45	-12.12
1991	1.47	64.16	87.18	125.48	7.53	8.85	135.70	-21.68
1992	1.47	72.02	89.30	120.01	3.76	14.10	131.37	-3.43
1993	1.42	75.91	88.62	126.76	5.09	17.16	131.65	-5.64
1994	1.42	79.85	88.77	124.66	5.53	16.03	119.34	-6.94
1995	1.43	78.61	83.04	116.16	4.58	16.90	124.58	-8.51
1996	1.41	81.06	86.44	122.50	6.45	20.85	131.04	-9.28
1997	1.41	87.13	91.90	114.13	4.72	20.08	120.86	-7.24
1998	1.41	92.34	96.55	106.16	4.59	16.88	109.17	-10.54
1999	1.41	94.76	96.69	103.65	5.52	17.92	104.60	-9.03
2000	1.41	100.00	100.00	100.00	6.52	19.47	110.31	-11.23
2001	1.41	105.12	103.92	86.10	6.81	20.26	109.24	-10.44
2002	1.41	105.04	103.10	85.79	6.18	20.30	110.66	-11.06
2003	1.41	98.35	95.76	84.33	10.78	19.77	112.36	-11.81
2004	1.41	94.59	92.73	82.10	8.17	17.88	129.50	-9.88
2005	1.41	93.70	92.50	82.30	5.48	16.90	133.72	-10.05
Average	2.32	76.43	101.65	122.10	11.00	13.78	112.30	-23.46
Std. dev.	0.75	16.50	15.90	21.68	6.01	6.46	14.35	15.05
Minimum	1.41	56.34	79.95	82.10	3.76	2.09	82.92	-54.11
Maximum	3.35	105.12	134.51	170.14	26.24	25.01	149.45	-3.43

Sources: Jordanian authorities; and authors' calculations.

Appendix Table 2. Jordan: Various Estimates of the ERER, 1964–2005

Year	REER (2000=100)	Estimates of the Equilibrium Real Exchange Rate				
		Non-smoothed	Hodrick-Prescott filter		Band-pass filter	
			λ=100	λ=10	Lower/upper bound = 2/8	Lower/upper bound = 2/4
1964	79.95	118.39	98.98	109.72	112.16	113.00
1965	82.35	103.34	97.36	102.84	105.97	98.70
1966	85.41	78.57	95.93	97.13	98.92	93.73
1967	88.55	121.94	94.92	93.19	92.22	97.56
1968	92.45	82.49	94.35	89.64	87.07	96.37
1969	94.44	88.68	94.48	87.65	84.36	85.04
1970	95.82	82.08	95.47	87.59	84.64	77.17
1971	95.32	71.26	97.44	90.07	88.04	82.55
1972	93.40	117.07	100.38	95.29	94.25	96.97
1973	97.09	93.28	103.99	101.36	102.35	107.25
1974	103.63	113.50	108.10	108.10	110.81	110.95
1975	103.75	126.75	112.39	114.32	117.88	118.24
1976	107.85	115.65	116.55	119.15	122.36	128.33
1977	113.19	147.47	120.36	122.90	124.31	126.98
1978	114.56	92.10	123.56	125.62	124.99	115.37
1979	122.20	138.76	126.16	129.73	126.13	112.98
1980	126.19	127.51	127.78	133.79	128.98	129.08
1981	125.35	127.09	128.18	137.13	133.60	150.83
1982	127.69	166.52	127.14	138.35	138.50	153.95
1983	129.34	176.09	124.47	135.03	140.90	139.86
1984	131.33	88.79	120.40	127.64	138.00	127.33
1985	134.51	132.73	115.59	120.18	128.86	119.65
1986	130.34	139.18	110.29	111.73	115.40	110.27
1987	120.14	80.03	104.87	102.72	101.24	100.48
1988	108.99	89.77	99.89	95.60	89.63	95.96
1989	87.63	117.51	95.54	89.94	82.30	93.74
1990	81.47	77.52	91.88	84.85	79.51	85.32
1991	87.18	71.74	89.15	81.80	80.51	73.54
1992	89.30	65.09	87.42	81.40	83.79	70.37
1993	88.62	96.06	86.59	83.33	87.29	81.24
1994	88.77	100.58	86.35	85.54	89.14	97.95
1995	83.04	74.50	86.49	87.04	88.62	101.16
1996	86.44	118.17	86.93	88.23	86.60	89.97
1997	91.90	84.95	87.47	88.14	84.90	81.89
1998	96.55	68.45	88.19	88.38	85.17	82.87
1999	96.69	88.36	89.11	90.30	88.15	86.01
2000	100.00	98.20	90.07	92.98	93.26	86.88
2001	103.92	94.23	90.85	95.26	98.48	92.25
2002	103.10	82.91	91.35	96.37	100.86	106.50
2003	95.76	143.43	91.46	95.45	98.09	114.91
2004	92.73	100.46	91.01	90.41	90.31	98.66
2005	92.50	63.18	90.24	83.30	80.04	73.04

Source: Authors' calculations.

Appendix Table 3. Jordan: Various Estimates of RER Misalignments, 1964–2005

Year	REER (2000=100)	Estimates of Real Exchange Rate Misalignments 1/						
		Non-smoothed	Hodrick-Prescott filter		Band-pass filter		Min	Max
			λ=100	λ=10	Lower/upper bound = 2/8	Lower/upper bound = 2/4		
1964	79.95	-32.5	-19.2	-27.1	-28.7	-29.2	-32.5	-19.2
1965	82.35	-20.3	-15.4	-19.9	-22.3	-16.6	-22.3	-15.4
1966	85.41	8.7	-11.0	-12.1	-13.7	-8.9	-13.7	8.7
1967	88.55	-27.4	-6.7	-5.0	-4.0	-9.2	-27.4	-4.0
1968	92.45	12.1	-2.0	3.1	6.2	-4.1	-4.1	12.1
1969	94.44	6.5	0.0	7.8	11.9	11.1	0.0	11.9
1970	95.82	16.7	0.4	9.4	13.2	24.2	0.4	24.2
1971	95.32	33.8	-2.2	5.8	8.3	15.5	-2.2	33.8
1972	93.40	-20.2	-7.0	-2.0	-0.9	-3.7	-20.2	-0.9
1973	97.09	4.1	-6.6	-4.2	-5.1	-9.5	-9.5	4.1
1974	103.63	-8.7	-4.1	-4.1	-6.5	-6.6	-8.7	-4.1
1975	103.75	-18.1	-7.7	-9.2	-12.0	-12.2	-18.1	-7.7
1976	107.85	-6.7	-7.5	-9.5	-11.9	-16.0	-16.0	-6.7
1977	113.19	-23.2	-6.0	-7.9	-8.9	-10.9	-23.2	-6.0
1978	114.56	24.4	-7.3	-8.8	-8.3	-0.7	-8.8	24.4
1979	122.20	-11.9	-3.1	-5.8	-3.1	8.2	-11.9	8.2
1980	126.19	-1.0	-1.2	-5.7	-2.2	-2.2	-5.7	-1.0
1981	125.35	-1.4	-2.2	-8.6	-6.2	-16.9	-16.9	-1.4
1982	127.69	-23.3	0.4	-7.7	-7.8	-17.1	-23.3	0.4
1983	129.34	-26.5	3.9	-4.2	-8.2	-7.5	-26.5	3.9
1984	131.33	47.9	9.1	2.9	-4.8	3.1	-4.8	47.9
1985	134.51	1.3	16.4	11.9	4.4	12.4	1.3	16.4
1986	130.34	-6.4	18.2	16.7	12.9	18.2	-6.4	18.2
1987	120.14	50.1	14.6	17.0	18.7	19.6	14.6	50.1
1988	108.99	21.4	9.1	14.0	21.6	13.6	9.1	21.6
1989	87.63	-25.4	-8.3	-2.6	6.5	-6.5	-25.4	6.5
1990	81.47	5.1	-11.3	-4.0	2.5	-4.5	-11.3	5.1
1991	87.18	21.5	-2.2	6.6	8.3	18.6	-2.2	21.5
1992	89.30	37.2	2.2	9.7	6.6	26.9	2.2	37.2
1993	88.62	-7.8	2.3	6.3	1.5	9.1	-7.8	9.1
1994	88.77	-11.7	2.8	3.8	-0.4	-9.4	-11.7	3.8
1995	83.04	11.5	-4.0	-4.6	-6.3	-17.9	-17.9	11.5
1996	86.44	-26.9	-0.6	-2.0	-0.2	-3.9	-26.9	-0.2
1997	91.90	8.2	5.1	4.3	8.2	12.2	4.3	12.2
1998	96.55	41.1	9.5	9.2	13.4	16.5	9.2	41.1
1999	96.69	9.4	8.5	7.1	9.7	12.4	7.1	12.4
2000	100.00	1.8	11.0	7.5	7.2	15.1	1.8	15.1
2001	103.92	10.3	14.4	9.1	5.5	12.6	5.5	14.4
2002	103.10	24.4	12.9	7.0	2.2	-3.2	-3.2	24.4
2003	95.76	-33.2	4.7	0.3	-2.4	-16.7	-33.2	4.7
2004	92.73	-7.7	1.9	2.6	2.7	-6.0	-7.7	2.7
2005	92.50	46.4	2.5	11.1	15.6	26.6	2.5	46.4
Average 2000-05	98.00	6.99	7.89	6.26	5.14	4.75	-5.71	17.94
Average	101.65	2.46	0.33	0.43	0.55	0.87	-9.32	11.60
Std. dev.	15.90	23.05	8.62	9.48	10.51	14.23	12.19	16.48
Minimum	79.95	-33.23	-19.23	-27.13	-28.72	-29.25	-33.23	-19.23
Maximum	134.51	50.12	18.18	16.96	21.59	26.91	14.56	50.12

Source: Authors' calculations.

REFERENCES

Ary, Tanimoune N., Jean-Louis Combes, and P. Plane, 2005, "Les effets non linéaires de la politique budgétaire: le cas de l'Union Économique et Monétaire Ouest Africaine," CERDI, Études et Documents, N. 20.

Baxter, Marianne, and Robert G. King, 1999, "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series," *The Review of Economic and Statistics,* Vol. 81, No. 4, pp. 575–593.

Bayoumi, Tamim, Lee Jaewoo, and Jayanthi Sarma, 2005, New Rates from New Weights, IMF Working Paper No. 05/99 (Washington: International Monetary Fund).

Benati, Luca, 2001, "Band-Pass Filtering, Cointegration, and Business Cycle Analysis," Working Paper (London: The Bank of England).

Canova, Fabio, 1998a, "Detrending and Business Cycles Facts," *Journal of Monetary Economics*, Vol. 41, pp. 475–512.

———, 1998b, "Detrending and Business Cycles Facts: A User's Guide," *Journal of Monetary Economics*, Vol. 41, pp. 533–540.

Cashin, Paul A., Luis Cespedes, and Ratna Sahay, 2002, "Keynes, Cocoa, and Copper: In Search of Commodity Currencies," IMF Working Paper No. 02/223 (Washington: International Monetary Fund).

Chen, Yu-chin, and Kenneth Rogoff, 2002, "Commodity Currencies and Empirical Exchange Rate Puzzles," IMF Working Paper No. 02/27 (Washington: International Monetary Fund).

Choudhri, E. U., and M. S. Khan, 2004, "Real Exchange Rates in Developing Countries: Are Balassa-Samuelson Effects Present?" IMF Working Paper 04/188 (Washington: International Monetary Fund).

Christiano, Lawrence J., and Terry J. Fitzgerald, 2003, "The Band Pass Filter," International Economic Review, 44(2), pp. 435–465.

Cogley, Timothy, and James M. Nason, 1995, "Effects of the Hodrick-Prescott Filter on Trend and Difference Stationary Time Series: Implications for Business Cycle Research," *Journal of Economic Dynamics and Control*, Vol. 19, Nos. 1–2, pp. 253–78.

Combes, Jean-Louis, and Tahsin Saadi-Sedik, 2006 , "How Does Trade Openness Influence Budget Deficits in Developing Countries?" forthcoming, *Journal of Development Studies.*

Corden W.M., and J.P. Neary, 1982, "Booming Sector and De-industrialisation in a Small Open Economy." The Economic Journal Vol. 92 (December): 829-831.

Edwards, Sebastian, 1989, *Real Exchange Rates, Devaluation and Adjustment,* Cambridge, MA: MIT Press.

Edwards, Sebastian, and Miguel Savastano, 2000, "Exchange Rates in Emerging Economies: What Do We Know?" in *Economic Policy Reform: The Second Stage,* edited by Anne Krueger, Chicago: University of Chicago, Press.

Froot, Kenneth A., and Kenneth Rogoff, 1995, "Perspectives on PPP and Long-Run Real Exchange Rates," in *Handbook of International Economics*, Vol. 3, edited by Gene M. Grossman and Kenneth Rogoff, Amsterdam: Elsevier Science Publishers, pp. 1647-88.

International Monetary Fund, 2005, "The Macroeconomics of Managing Increased Aid Inflows: Experiences of Low-Income Countries and Policy Implications," prepared by the Policy Development and Review Department, Washington, August 8, 2005.

Giavazzi, Francesco, and Marco Pagano, 1990, "Can Severe Fiscal Contractions be Expansionary? Tales of Two Small European Countries," NBER Working Paper 3372.

Gregorio, Jose de, Alberto Giovannini, and Holger C. Wolf, 1994, "International Evidence on Tradables and Nontradables Inflation," *European Economic Review*, June 1994, v. 38, No. 6, pp. 1225–44.

Guillaumont, Patrick, and Lisa Chauvet, 2001, "Aid and Performance: A Reassessment," *Journal of Development Studies*, Vol. 37 (August), No. 6, pp. 66–92.

Gupta, Sanjeev, Robert Powell, and Yongzheng Yang, 2006, "Macroeconomic Challenges of Scaling Up Aid to Africa—A Checklist for Practitioners," International Monetary Fund, Washington, DC, March 20, 2006.

Harvey, A. C., and A. Jaeger, 1993, "Detrending, Stylized Facts and the Business Cycle," *Journal of Applied Econometrics*, Vol. 8, No. 3, pp. 231–247.

Hemming, Richard, Michael Kell, and Selma Mahfouz, 2002, "The Effectiveness of Fiscal Policy in Stimulating Economic Activity—A Review of the Literature," IMF Working Paper No. 02/208 (Washington: International Monetary Fund).

Hinkle, Lawrence E., and Peter J. Montiel, 1999, *"*Exchange Rate Misalignment: Concepts and Measurement for Developing Countries," Oxford: Oxford University Press.

Hodrick, Robert J., and Edward C. Prescott, 1997, "Postwar U.S. Business Cycles: An Empirical Investigation," *Journal of Monetary, Credit, and Banking,* Vol. 29, pp.1–16.

Johansen, Søren, 1995, Likelihood-Based Inference in Cointegrated Autoregressive Vectors, Oxford: Oxford University Press.

Koopmans, J.T., 1947, "Measuring Without Theory," *Review of Economics and Statistics*, Vol. 29, pp. 161–172.

Macdonald, Ronald, and Luca A. Ricci, 2003, "Estimation of the Equilibrium Real Exchange Rate for South Africa," IMF Working Paper No. 03/44 (Washington: International Monetary Fund).

Mongardini, J., and T. Saadi-Sedik, 2003, "Estimating Indexes of Coincident and Leading Indicators: An Application to Jordan," IMF Working Paper No. 03/170 (Washington: International Monetary Fund).

Montiel, Peter J., and Jonathan D. Ostry, 1994, "The Parallel Market Premium: Is It a Reliable Indicator of Real Exchange Rate Misalignment in Developing Countries?" *International Monetary Fund Staff Papers*, March 1994, v. 41, No. 1, pp. 55–75.

Opoku-Afari, Maxwell, Oliver Morrissey, and Tim Lloyd (2004), "Real Exchange Rate Response To Capital Inflows: A Dynamic Analysis For Ghana," *CREDIT Research Paper*, No. 04/12.

Rajan, Raghuram, and Arvind Subramanian, 2005, "What Undermines Aid's Impact on Growth?" IMF Working Paper No. 05/126 (Washington: International Monetary Fund).

Rand, John, and Finn Tarp, 2001, "Business Cycles in Developing Countries: Are They Different?" *CREDIT Research Paper*, No. 01/21.

Reinhart, C. M., and K. Rogoff, 2002, "The modern history of exchange rate arrangements: a reinterpretation," NBER Working Paper No. 8963,

Reinsel, G. C., and S. K. Ahn, 1988, "Asymptotic properties of the likelihood ratio test for cointegration in the nonstationary vector AR model," Technical Report, Department of Statistics, University of Wisconsin-Madison.

Rogoff, Kenneth, 1996, "The Purchasing Power Puzzle," *Journal of Economic Literature*, Vol. 34, No. 2, June, pp. 647–68.

Saadi-Sedik, Tahsin, and Martin Petri, 2006, "The Jordanian Stock Market—Should You Invest in it for Risk Diversification or Performance?" IMF Working Paper No. 06/87 (Washington: International Monetary Fund).