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DETERMINANTS OF ANGOLA'S REAL EXCHANGE RATE, 1992–2002

ENRIQUE GELBARD
JUN NAGAYASU

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This paper estimates Angola's equilibrium parallel market real exchange rate, during the period 1992–2002, taking into account possible structural shifts in the data. Our results fail to support the purchasing power parity hypothesis and indicate that two exogenous variables—the price of oil and the foreign interest rate—explain most of the variation in the equilibrium real exchange rate. These results contrast with the tenet that the exchange rate is mainly influenced by rapid monetary growth, and we suggest that the current flexible exchange rate regime is likely to be more appropriate for Angola than a fixed exchange rate regime.

I. INTRODUCTION

THE purchasing power parity (PPP) hypothesis is often used for assessing the degree of misalignment of a particular level of exchange rate or the adequacy of an exchange rate policy. However, persistent and unexplained departures from PPP are quite common, and convergence of the real exchange rate towards PPP is often too slow or is overtaken by real shocks. In this event, PPP becomes a less useful tool, whereas obtaining an estimate of an equilibrium time-varying real exchange rate could be more beneficial. This paper conducts an empirical examination of Angola's parallel market real exchange rate during the period 1992–2002. We test the PPP hypothesis and estimate a time-varying real exchange rate based on two key variables: the price of oil and the world interest rate.

We use the parallel market rate because Angola's official market exchange rate had been, up until mid-1999, distorted by unsustainable fixed exchange rates and a highly regulated environment. High inflation and a number of balance of payments crises had prompted several devaluations of the official exchange rate in the early 1990s.[1] As a result, there was a large and volatile discrepancy between the parallel

[1] High correlations among changes in the money supply, domestic prices, and the nominal parallel market rate have been observed (Ferrari 1998).

and official exchange rates. In mid-1999, the official exchange rate was allowed to float, leading to virtual unification of the foreign exchange market. Throughout the period, therefore, the parallel market exchange rate had reflected supply and demand conditions in the foreign exchange market more accurately.[2]

The paper is divided into five sections. Section II describes the theoretical framework, and Section III examines the time-series properties of the data and reports on the testing of the PPP hypothesis. Section IV discusses the time-series properties of the real exchange rate equation, and Section V contains concluding remarks.

II. THEORETICAL BACKGROUND

For decades, the PPP hypothesis has remained a focal point of policy discussions, models, and empirical work. The hypothesis postulates an underlying tendency for changes in the nominal exchange rate to be fully offset (at least after some period of time) by changes in the ratio of foreign to domestic price levels. Therefore, even if PPP does not hold at all times, any deviations from it should be eliminated eventually, thus implying that the real exchange rate should be mean-reverting. Empirical studies have produced little evidence in favor of this hypothesis, and in those that supported it, the speed of convergence of the actual exchange rate to its PPP level has been found to be very low, with half-lives of three years or more.[3] Such slow convergence has been attributed to nominal price rigidities, either related to price-wage stickiness or to market segmentation and pricing-to-market policies. A well-known blend of PPP with the monetary model contends that, since nominal rigidities prevent a quick adjustment of prices and wages in goods markets, monetary innovations are the cause of the temporary deviations from PPP (Dornbusch 1976). This view, however, which implies that there should be minimal persistence in the real exchange rate (i.e., it could not follow a random walk), is supported mainly by the analysis of high-inflation episodes, where movements in prices appear to dominate other factors that could lead to deviations from PPP (Zhou 1997).

In a different line of research, attempts were made to model and test for deviation from PPP, as a more permanent phenomenon, by highlighting that real exchange rate movements might be caused by changes on the real side of the economy (e.g., Stockman 1988 and Neary 1988). These models vary depending on the factors that are considered to affect the behavior of the real exchange rate. Models based on productivity differentials were highlighted by Balassa (1964), Samuelson (1964), and Obstfeld (1993); while Marston (1987) and Chinn and Johnston (1996) analyzed the effect of real interest rate differentials and demand shocks, respectively.

[2] During the 1992–98 period, the parallel market exchange rate was, on the average, 2.9 times higher than the official rate.

[3] See, for instance, Phylaktis and Kassimatis (1994) and MacDonald (1995).

Exogenous changes in the terms of trade have also been found to play an important role in determining the real exchange rate behavior (Edwards 1994; Ostry 1988). Moreover, it can be argued that real exchange rates in developing or rapidly transforming countries are likely to be particularly dependent on these real shocks, and that the extent to which different shocks affect the behavior of the real exchange rate depends on country-specific factors.

If deviations from PPP are persistent and possibly permanent, the appropriate approach is to postulate a function of selected factors that allow for underlying shifts in the real exchange rate. For instance, Lothian and Taylor (1997), point out that the half-life of deviations from PPP could be reduced to about 2.5 years by allowing for the presence of Balassa-Samuelson effects. Based on the fundamental equilibrium exchange rate (FEER) approach originally proposed by Williamson (1983), the model presented below postulates that the time-varying real exchange is the equilibrating variable counteracting shocks to the basic balance.[4] The FEER essentially embodies a medium-run current account theory of exchange rate determination. The use of basic balance in the definition of external balance is essentially the same as using a medium-term equilibrium concept of the current account, where the latter becomes equal to the desired or target rate of accumulation of net long-term foreign assets (see, for instance, Faruqee 1995). The concept of equilibrium external balance is defined here as being equal to the size of the basic balance (i.e. the balance on the current account balance plus long-term capital inflows):

$$\overline{BBA}_t = g(r_t, \bar{q}_t, oil_t), \tag{1}$$

where *BBA* is the basic balance, *oil* is the world price of oil, q is the real exchange rate, and r is the real foreign interest rate.[5] A bar over a variable indicates that its level is consistent with the external balance. The real exchange rate is defined as the nominal exchange rate (units of domestic currency per unit of foreign currency) times the foreign price level divided by the domestic price level. The world oil price is a key determinant of export revenue in Angola.

The volume of imports is assumed to be negatively related to the real exchange rate. It is further assumed that foreign prices and interest rates are exogenous, and that oil output is not consumed at home. These assumptions are well suited to Angola: the country is a price taker in world markets, 95 percent of the oil produced is exported, and the domestic consumption basket consists of imported and nontradable domestic goods. The foreign real interest rate enters the equation on account of its impact on the service balance and, possibly, on cross-border direct foreign invest-

[4] The model used here does not address the issue of internal balance.

[5] Lack of data on other potential determinants of the real exchange rate, including output developments in the oil sector and the destruction of productive capacity in the non-oil sector, precludes the inclusion of these variables in the analysis.

ment.[6] Equation (1) implies that the terms of trade shocks and changes in the foreign interest rate will require an adjustment in the real exchange rate (q) to restore the basic balance to an equilibrium level.[7]

Following the basic balance condition in equation (1) therefore, the equilibrium real exchange rates can then be derived as:

$$\bar{q}_t = z(r_t, oil_t, \overline{BBA_t}). \tag{2}$$

Equation (2) asserts that Angola's equilibrium real exchange rate is a function of the price of its major export, oil, the foreign interest rate, and the basic balance. An increase in the price of oil improves the current account and the basic balance, and a real exchange rate appreciation would be required to restore the external balance via an increase in imports. Similarly, an increase in foreign interest rates leads to a rise in debt-service payments and a worsening of the current account, hence requiring a real exchange rate depreciation to restore the external balance. Thus, since the depreciation of the Angolan equilibrium exchange rate indicates an increase in $\bar{q}_t$ according to our definition, parameters for *oil* should be negative, while the interest rate must be positively correlated with the exchange rate.

In order to make the concept in equation (2) operational, we shall consider the following general exchange rate equation:

$$q_t = \beta_0 + \beta_1 r_t + \beta_2 oil_t + \beta_3 BBA_t + \beta_4 t + \varepsilon_t, \tag{3}$$

where βs are parameters and ε_t is a residual term. The term β_0 represents a constant term, and t is a time trend. Then, the equilibrium exchange rate can be obtained by imposing the parameter restriction: $\beta_3 = 0$ (i.e., $\bar{q}_t = \beta_0 + \beta_1 r_t + \beta_2 oil_t + \beta_4 t$). As an equilibrium concept, Equation (3) can be statistically valid if the data support the existence of cointegration in the specification. This implies that each variable is non-stationary and that ε_t follows a stationary process. Following the standard statistical properties, we assume that only non-stationary data enable to explain the equilibrium exchange rate. Therefore, when some explanatory variables are found to be stationary, these variables will be removed from equation (3), without yielding a misspecification bias. In the presence of cointegration, OLS estimates of these parameters are superconsistent and asymptotic variance is $O(1/T^2)$.

6 A large part of Angola's external debt is guaranteed with oil at market interest rates plus a premium, implying that changes in foreign interest rates exert a direct impact on the balance of payments. Similarly, changes in the foreign interest rate could affect direct foreign investment flows through their effect on investment projects' internal rates of return. However, foreign exchange restrictions isolate Angola's financial system from the rest of the world, which suggests that the traditional role ascribed to trade in financial assets is not relevant here.

7 In other words, stock equilibrium is not required, and the current account need not necessarily equal zero. This approach is essentially consistent with a given rate of accumulation of net foreign debt d that reflects, for instance, the country's long-term investment opportunities. For given values of the price and output of oil, the foreign interest rate, and the stock of net foreign assets, the current account becomes equal to $-d$ due to the equilibrium level of the real exchange rate.

TABLE I

UNIT ROOT TESTS

	Critical Value	Critical Value / Trend
q	–1.563 (0)	–1.850 (0)
r	–2.042 (0)	–2.031 (0)
oil	–1.680 (0)	–1.788 (0)
BBA	–3.431 (1)	–3.449 (1)
Δ*rer*	–9.054 (1)	–9.059 (1)
Δ*r*	–11.689 (0)	–11.680 (0)
Δ*oil*	–9.456 (0)	–9.416 (0)

Note: The critical values are obtained from MacKinnon (1991). For the test with the constant, the critical values are –2.89 and –3.49 at the 5 percent and 1 percent levels. For the test with the constant and trend terms, the critical values are –3.45 and –4.05. The lag length used in the test is determined by the Schwarz' Bayesian information criterion (BIC) and is indicated in parentheses.

III. DATA ANALYSIS

The data, obtained largely from the National Bank of Angola, *International Financial Statistics*, and the statistical database used for *World Economic Outlook*, cover the January 1992–January 2002 period. The real exchange rate (q) is calculated as the bilateral parallel market exchange rate of the readjusted kwanza[8] vis-à-vis the U.S. dollar times the U.S. consumer price index and divided by the domestic consumer price index.[9] Thus, an increase in q represents a real depreciation of the domestic currency. The world price of oil (*oil*) is based on a composite of Brent, Dubai, and Texas intermediate real oil prices, which is roughly equivalent to the Angolan mix. The real interest rate (r) is constructed by deflating the ten-year U.S. bond rate by a twelve-month moving average of U.S. inflation rates.[10] Finally, monthly data on *BBA* are based on IMF estimates for the annual data, which are converted to monthly ones providing the same amount of increase in each time period.[11]

The time-series properties of each variable are examined using the standard augmented Dickey-Fuller (ADF) test, and the results and details of the test are summarized in Table I. The upper half of the table examines the null hypothesis that the

8 The official denomination of Angola's currency as of May 1999.

9 Only U.S. data are used since more than 50 percent of Angola's trade is conducted with the United States that is the main source of foreign investment in the country.

10 MacDonald and Nagayasu (2000), for instance, observe that longer-term interest rates are more relevant in a long-run or equilibrium context.

11 See the series of Article IV staff reports for Angola.

variables are integrated of order one, $I(1)$, against the alternative of stationarity, while the lower half tests the null of $I(2)$ against $I(1)$. Our study considers two cases involving different combinations of the deterministics—the time trend and/or the constant. The results lead to the conclusion that all the time-series correspond to $I(1)$ except for *BBA* that corresponds to $I(0)$. The non-stationary characteristic of the data allows us to analyze the equilibrium properties of the real exchange rate equation. Since the long-run or equilibrium concept of PPP requires that the real exchange rate be stationary, our finding that the real exchange rate has a unit root over a ten-year period implies that PPP is not a useful benchmark to assess the level of the real exchange rate in Angola. Furthermore, since stationary variables are statistically irrelevant to a long-run analysis, the basic balance data should be removed when estimating the equilibrium exchange rate. These data, however, will be reconsidered in our analysis of the dynamic exchange rate movements.

IV. TIME-SERIES PROPERTIES OF THE REAL EXCHANGE RATE EQUATION

In order to test the existence of a long-run relationship in equation (3), the time-series method of Hansen (1992a), based on the Fully Modified OLS estimation, is used to test parameter stability in the model. Since the alternative hypothesis of this test encompasses the special case of parameter instability, the test results can provide evidence for or against parameter stability. Hansen's method may be more appropriate than conventional cointegration techniques such as the Johansen test due to the likely existence of a structural shift in Angola's data.[12]

Hansen's parameter stability tests can be summarized as follows. Consider a linear relationship between two time-series, Y_t and X_t, which can be written as $Y_t = \beta X_t + \varepsilon_t$. If a structural break takes place at time $t(1 < t < T)$, the following is true: $\beta_1 = \beta_i$ for $i \le t$ and $\beta_2 = \beta_i$ for $i > t$. Among several statistics proposed by Hansen, this paper uses *SupF* and *MeanF*. The first test statistic, *SupF,* analyzes the null hypothesis ($H_0 : \beta_1 = \beta_2$) and the alternative hypothesis ($H_1 : \beta_1 \neq \beta_2$).

$$SupF = \sup_{t/n \in T} F_{nt}, \tag{4}$$

where F_{nt} can be obtained using the standard Wald statistics to examine the equivalence of β_1 and β_2 that are used for a certain sample period ($0.15T$ to $0.85T$) recursively in order to avoid the statistics diverging to infinity (Hansen 1992a). Since T is equivalent to the end point (January 2002) of our data samples, the trimmed sample period corresponds to July 1993–August 2000. The parameter estimation is based on OLS.

[12] Price controls were prevalent prior to 1995, while discrete adjustments in utility prices have caused rapid shifts in the real exchange rate since 1996.

TABLE II

FULLY MODIFIED OLS ESTIMATES AND HANSEN'S STABILITY TEST STATISTICS

	Coeffi. [SE]	Coeffi. [SE]
r	1.228 [0.352]	0.442 [0.162]
oil	–0.221 [0.937]	–0.857 [0.422]
cst	5.049 [4.330]	7.809 [1.913]
trend	—	0.014 [0.003]
	Stat.	Stat.
SupF	19.660	5.820
MeanF	3.979	2.902

Note: The critical values at the 5 percent significance level for *SupF* and *MeanF* statistics are obtained from Hansen (1992a) and are 14.8 (17.3) and 6.17 (7.69), respectively, for the model with a constant term (constant and trend terms).

The second test statistic, *MeanF*, analyzes variance constancy under the null hypothesis, and is expressed as follows.

$$MeanF = (1/n)\sum_{t/n \in T} F_{nt}. \tag{5}$$

We obtain these statistics from the models with the constant term as well as the constant and time trend terms. The results are presented in Table II along with the Fully Modified OLS estimators. In addition, the sequence of F_{nt} is plotted in Figures 1 and 2. The conclusion regarding parameter stability seems to be very sensitive to the model specification. While evidence for parameter constancy can be obtained when both the constant and trend terms are included in the test, the model with the constant term produces evidence against the stability of the model. Although it is difficult to provide economic reasons for the importance of the time trend in the cointegrating relationship, our results suggest that the inclusion of the time trend in the model is more appropriate since this term is statistically significant. It follows that the parameters in equation (3) appear to be constant during our sample period. Furthermore, the signs of the explanatory variables are consistent with the rationale behind our model, namely that the real exchange rate is a negative function of the price of oil and a positive function of the long-term foreign interest rate. The discrepancy between actual and long-run exchange rates, known as the error correction term ($ECM_t = q_t - 0.442r_t + 0.857oil_t - 7.809 - 0.014t$), is plotted in Figure 3. The existence of parameter stability and thus cointegration suggests that *ECM* is stationary.

We have also confirmed the robustness of our findings by re-estimating the exchange rate equation using the Autoregressive Distributed Lag (ADL) method. In

Fig. 1. Hansen's *F* statistics and Critical Values (5 Percent) for the Model with the Constant Term

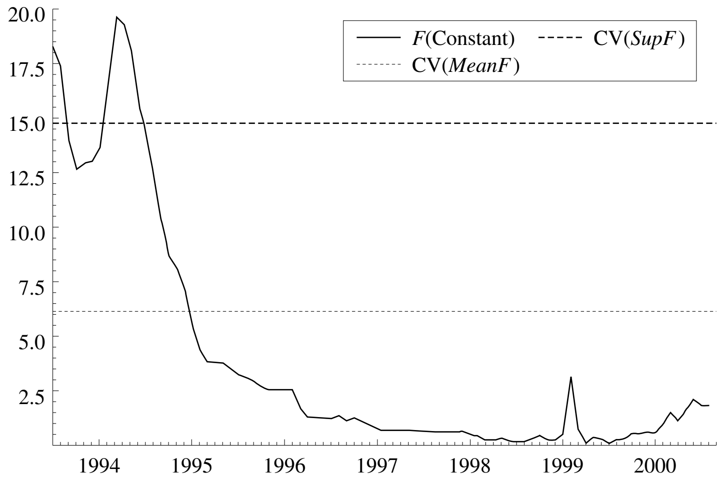
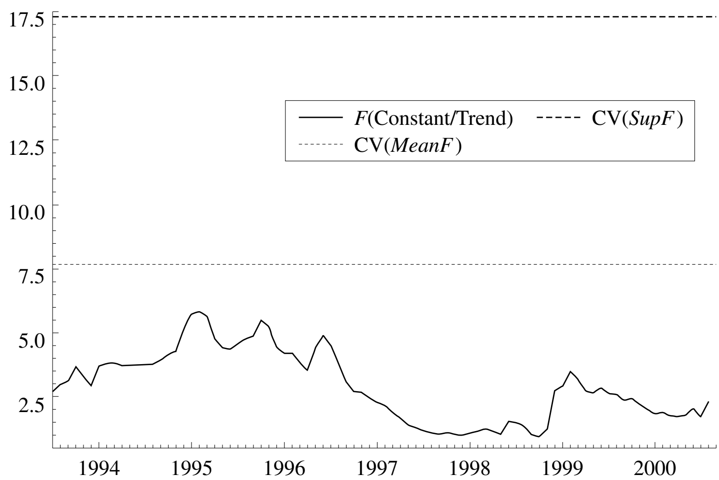
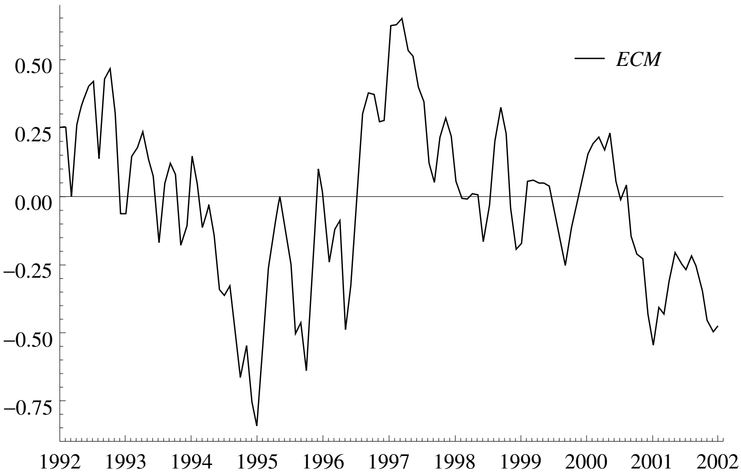


Fig. 2. Hansen's *F* statistics and Critical Values (5 Percent) for the Model with Constant and Trend Terms



order to apply the ADL method, a maximum lag length of three is initially used for all the variables except for the constant and trend terms. Then, the appropriate lag length is determined using the Schwarz' Bayesian information criterion (BIC); as a result, our model is based on only one lag for the real exchange rate, which is estimated by the OLS.

Fig. 3. Differences between Actual and Fitted Equilibrium Real Parallel Exchange Rates



$$q_t = \phi q_{t-1} + \theta_1 r_t + \theta_2 oil_t + \theta_3 + \theta_4 t + \varepsilon_t. \qquad (6)$$

The long-run estimates are obtained by re-parameterization of equation (6) based on the following equation:

$$\bar{q}_t = \frac{\theta_1}{(1-\phi)} r_t + \frac{\theta_2}{(1-\phi)} oil_t + \frac{\theta_3}{(1-\phi)} + \frac{\theta_4}{(1-\phi)} t + \frac{1}{(1-\phi)} \varepsilon. \qquad (7)$$

The results from equations (6) and (7) are reported in Table III. Consistent with the results obtained from the Fully Modified OLS method, this table shows that the exchange rate is a positive (negative) function of the interest rate (the oil price), and that the residual in equation (7) is stationary (the ADF unit root test). Finally, we analyzed the consistency between the ADL long-run and Fully Modified OLS parameters, and the Wald test examining the joint null hypothesis of $\beta_1 = \theta_1 / (1 - \phi)$, $\beta_2 = \theta_2 / (1 - \phi)$, $\beta_3 = \theta_3 / (1 - \phi)$, and $\beta_4 = \theta_4 / (1 - \phi)$ confirms that these parameters are statistically identical.

Figure 3, however, suggests that the actual exchange rate is not always identical with the long-run exchange rate. Therefore, we extend our analysis here to elucidate the adjustment mechanism of the exchange rate to this long-run path. For this purpose, the exchange rate model is constructed following the general-to-specific principle. In other words, initially, a general model, consisting of 3 lags ($t, \ldots, t-3$) of the first difference in the exchange rate, the interest rate, and the oil price; 3 lags of the basic balance (*BBA*) that were found to be stationary; and the ECM_{t-1} based on the Fully Modified OLS estimates, is examined during the period December 1992–August 2000. (The end point of this sample period is consistent with that

TABLE III

AUTOREGRESSIVE DISTRIBUTED LAG (ADL) MODEL

Regressor	Coefficient	Standard Error
$q(1)$[a]	0.898	0.042
r	0.057	0.029
oil	–0.038	0.064
Constant	0.602	0.396
t	0.739E–3	0.732E–3
Long-run estimate		
r	0.557	0.270
oil	–0.372	0.574
Constant	5.883	2.582
t	0.007	0.005
Unit root test (1)[a]	–2.955	
Wald test[b]	Chi^2(4) = 1.997	

[a] The number in parentheses refers to the lag length. The critical value (5 percent) for the unit root test is –2.890.

[b] The Wald statistic is used to determine whether the long-run estimates based on the ADL model are consistent with those obtained by the Fully Modified OLS method.

used for Hansen's test.) The specific model is obtained by removing the statistically nonsignificant variables from the general model as follows:

$$\Delta\hat{q}_t = 0.208\Delta q_{t-1} - 0.221\Delta q_{t-2} + 0.184\Delta r_t - 0.300\Delta oil_{t-2} - 0.091ECM_{t-1}. \quad (8)$$
$$[0.095] \qquad [0.097] \qquad [0.066] \quad [0.194] \qquad [0.048]$$

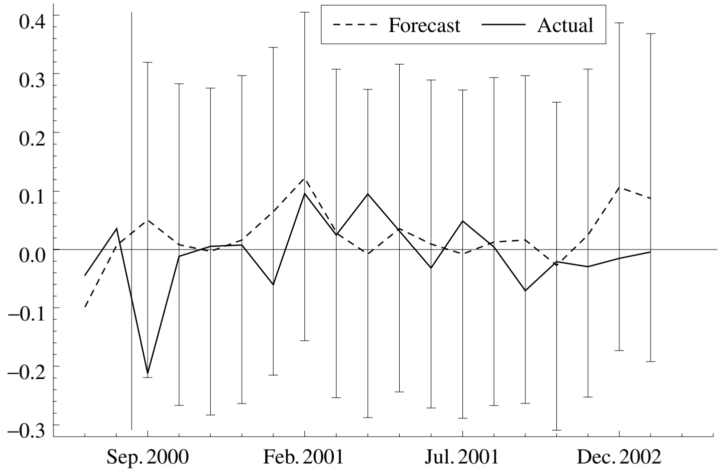
Diagnostic tests

AR F (2, 93) = 1.382; ARCH F (1, 93) = 0.072; Normality test Chi^2(2) = 0.903
Heteroskedasticity test F(10, 84) = 0.852; RESET F(1, 94) = 0.002
Instability tests:
Variance 0.292
Joint 1.345
Individual instability tests:
q_{t-1} 0.147
q_{t-2} 0.300
Δr_t 0.290
Δoil_{t-2} 0.324
ECM_{t-1} 0.035
One-step forecast performance (September 2000–January 2002) Chi^2(17) = 7.374.

Note: $ECM_{t-1} = q_{t-1} - 0.442r_{t-1} + 0.857oil_{t-1} - 7.809 - 0.014t$.

The results suggest that the dynamic movement of the equilibrium exchange rate can be explained by the lagged real exchange rate, the interest rate, and the *ECM*. The real interest rate and oil price have parameter signs consistent with the economic theory, and the former is statistically significant. The oil price is left in the final model in order to ensure that the residual is random. Furthermore, the statisti-

Fig. 4. One-Step Ahead Forecast and Actual Exchange Rates



cally significant and negative sign of the *ECM* confirms the existence of cointegration (Engle and Granger 1987).

Equation (8) seems to capture well the short-term movements of the exchange rates. Diagnostic tests show that the residual of this equation is random as it passes tests for autocorrelation (AR), autoregressive conditional heteroskedasticity (ARCH), normality, heteroskedasticity, and regression specification (RESET). Furthermore, parameter stability is confirmed by the test developed by Hansen (1992b).

The robustness of the model is further verified by the forecasting performance of equation (8) since the high explanatory power of the price of oil and interest rate data does not necessarily imply the existence of a reliable performance in the out-of-sample context. The statistic presented below equation (8) shows evidence in support of the adequacy of the model. A one-step (ex post) forecast analysis is conducted during the period September 2000–January 2002. The good forecasting performance of the model is also confirmed by Figure 4, in which the actual and forecast real exchange rates are plotted. The forecast exchange rate is well within the 5 percent confidence band.

V. CONCLUDING COMMENTS

Using the parallel market exchange rate, we have obtained empirical evidence that may be useful in analyzing exchange rate regimes in Angola. First of all, we found that the real exchange rate follows a unit root process, thus leading to a rejection of the PPP hypothesis for Angola. In other words, we failed to reject the hypothesis that Angola's real exchange rate follows a random walk, which implies that the real exchange rate is not mean-reverting (i.e., it does not revert toward PPP). These results also suggest that monetary innovations affecting the price level would not be sufficient to explain the behavior of the parallel market exchange rate in Angola.

Secondly, we observed a strong long-run relationship between the real exchange rate, on the one hand, and the world price of oil and foreign interest rates, on the other. The latter two variables displayed plausible signs and were statistically significant. The long-term analysis was extended to examine the short-term deviation of the real exchange rate from its equilibrium path, implying that only interest rates and the *ECM* are important determinants of short-term real exchange rate movements. Further studies could be conducted as soon as enough data on monetary aggregates become available.

Lastly, by demonstrating the dependence of Angola's foreign exchange market on the world oil price, our long-run study suggests that the current flexible exchange regime is appropriate for Angola even if its historically high rate of inflation (116 percent in 2001) could be brought down to the levels prevalent in developed economies. Given the time series properties of the real exchange rate and the country's vulnerability to changes in oil prices and foreign interest rates, a fixed nominal exchange rate regime—even if accompanied by prudent financial policies—may prove very difficult to maintain.

REFERENCES

Balassa, Bela. 1964. "The Purchasing-Power Parity Doctrine: A Reappraisal." *Journal of Political Economy* 72, no. 6: 584–96.

Chinn, Menzie, and Louis Johnston. 1996. "Real Exchange Rates, Productivity and Demand Shocks: Evidence from a Panel of 14 countries." NBER Working Paper 5709. Cambridge, Mass.: National Bureau of Economic Research.

Dornbusch, Rudiger. 1976. "Expectations and Exchange Rate Dynamics." *Journal of Political Economy* 84, no. 6: 1161–76.

Edwards, Sebastian. 1994. "Real and Monetary Determinants of Real Exchange Rate Behaviour: Theory and Evidence from Developing Countries." In *Estimating Equilibrium Exchange Rates*, ed. John Williamson. Washington, D.C.: Institute for International Economics.

Engle, Robert F., and Clive W. J. Granger. 1987. "Co-integration and Error Correction: Representation, Estimation, and Testing." *Econometrica* 55, no. 2: 251–76.

Faruqee, Hamid. 1995. "Long-Run Determinants of the Real Exchange Rate: A Stock-Flow Perspective." *IMF Staff Papers* 42, no. 1: 80–107.

Ferrari, Cesar. 1998. "Stabilization and Growth in Angola: A Financial Program for 1998." Luanda: National Bank of Angola.

Hansen, Bruce E. 1992a. "Tests for Parameter Instability in Regressions with I(1) Processes." *Journal of Business and Economic Statistics* 10, no. 3: 321–35.

———. 1992b. "Testing for Parameter Instability in Linear Models." *Journal of Policy Modeling* 14, no. 4: 517–33.

Lothian, James R., and Mark P. Taylor. 1997. "Real Exchange Rate Behavior" *Journal of*

International Money and Finance 16, no. 6: 945–54.
MacDonald, Ronald. 1995. "Long-Run Exchange Rate Modeling: A Survey of the Recent Evidence." *IMF Staff Papers* 42, no. 3: 437–89.
MacDonald, Ronald, and Jun Nagayasu. 2000. "The Long-Run Relationship between Real Exchange Rates and Real Interest Rate Differentials: A Panel Study." *IMF Staff Paper* 47, no. 1: 116–28.
MacKinnon, James G. 1991. "Critical Values for Cointegration Tests." In *Long-run Economic Relationships: Readings in Cointegration*, ed. Robert F. Engle and Clive W. J. Granger. Oxford: Oxford University Press.
Marston, Richard 1987. "Real Exchange and Productivity Growth in the United States and Japan." In *Real-Financial Linkages among Open Economies*, ed. Sven W. Arndt and J. David Richardson. Cambridge, Mass.: MIT Press.
Neary, Peter. 1988. "Determinants of the Equilibrium Real Exchange Rate." *American Economic Review* 78, no. 1: 210–15.
Obstfeld, Maurice. 1993, "Model Trending Real Exchange Rates." Center of International and Development Economics Research, Working Paper C93-011. Berkeley, Calif.: University of California at Berkeley.
Ostry, Jonathan D. 1988. "The Balance of Trade, Terms of Trade, and Real Exchange Rate: An Intertemporal Optimizing Framework." *IMF Staff Papers* 35, no. 4: 541–73.
Phylaktis, Kate, and Yiannis Kassimatis. 1994. "Does the Real Exchange Rate Follow a Random Walk? The Pacific Basin Perspective." *Journal of International Money and Finance* 13, no. 4: 476–95.
Samuelson, Paul A. 1964. "Theoretical Notes on Trade Problems." *Review of Economics and Statistics* 46, no. 2: 145–54.
Stockman, Alan C. 1988. "Real Exchange-Rate Variability under Pegged and Floating Nominal Exchange-Rate Systems: An Equilibrium Theory." *Carnegie-Rochester Conference Series on Public Policy* 29: 259–94.
Williamson, John. 1983. *The Exchange Rate System*. Washington, D.C.: Institute for International Economics.
Zhou, Su. 1997. "Purchasing Power Parity in High-Inflation Countries: A Cointegration Analysis of Integrated Variables with Trend Breaks." *Southern Economic Journal* 64, no. 2: 450–67.