

IMF Working Paper

The Equilibrium Real Exchange Rate
of the Malagasy Franc:
Estimation and Assessment

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African Department

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Abstract

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Employing cointegration techniques, the long-run determinants of Madagascar's real exchange rate are examined from a stock-flow perspective. The long-run behavior of the real effective exchange rate is explained by the net foreign asset position and factors affecting trade flows. An index of the long-run equilibrium real exchange rate is developed to assess the degree of misalignment. The general conclusions are that the Malagasy franc has experienced significant misalignment in the past, but that the recent appreciation of the real effective exchange rate is consistent with changes in the fundamentals, particularly anticipated improvements in the net foreign assets position stemming from Madagascar's eligibility for assistance under the enhanced HIPC Initiative.

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I. INTRODUCTION

Beginning in 1999 and through mid-2001, the Malagasy franc appreciated quite rapidly in both nominal and real effective terms (Figure 1), giving rise to the following question. Is the recent increase in external value of the Malagasy franc consistent with an equilibrium real exchange rate appreciation, or is it a reflection of an incipient misalignment, with concomitant implications for the competitiveness of Madagascar's exports? Motivated by this question, this paper investigates the fundamental determinants of the real exchange rate of the Malagasy franc and, based on these results, assesses the degree of current real exchange rate misalignment.

In examining the fundamental determinants of the real exchange rate, this paper implements a version of the macroeconomic balance approach, which defines the equilibrium, or sustainable, real exchange rate as that value, or path, consistent with both internal and external macroeconomic balance.² Internal balance corresponds to output being at its potential level, with a nonaccelerating rate of inflation, while external balance requires a balance of payments position in which any current account imbalance is financed by a sustainable rate of capital flows. The empirical analysis, following Faruqee (1995), integrates stock variables and stock-flow equilibrium relationships. Other fundamental determinants of the long-run real exchange rate considered include factors that affect the country's net trading position and capital accounts. On the trade side, structural determinants include relative productivity, the stance of trade and exchange policy, and variations in the international terms of trade. In a developing country context, Edwards (1989) presents a theoretical and empirical analysis of real exchange rate determination emphasizing these and other factors. Employing this framework and cointegration estimation techniques, this paper develops models of the long-run determinants of the real effective exchange rate of the Malagasy franc.

Based on the estimated long-run parameters of a cointegration vector, an index of the estimated equilibrium real value of the Malagasy franc is constructed, along with measures of misalignment. This analysis indicates that the exchange rate of the Malagasy franc has experienced significant overvaluation in the past, but that during most of the 1990s, the real exchange rate tended to track movements in its fundamental real determinants, despite being modestly undervalued during certain periods. The real appreciation of the Malagasy franc between 1999 and 2001 is consistent with developments in the fundamentals, improving relative productivity, tariff rate reductions, and, particularly in 2001, anticipated improvements in Madagascar's net foreign assets position associated with its eligibility for debt relief under the enhanced Initiative for Heavily Indebted Poor Countries (HIPC Initiative).

² See Isard and others (2001) and Edwards (1989) for discussions regarding this approach to equilibrium real exchange rate determination.

The paper is organized as follows. The following two sections outline econometric methodology and present the empirical results. The fourth section develops estimates of the long-run equilibrium real exchange rate, based on the estimated models, and assesses the degree of real exchange rate misalignment over the sample period. Section V concludes. An appendix outlines the institutional arrangements for the determination and management of the nominal exchange rate of the Malagasy franc since 1960.

II. ECONOMETRIC METHODOLOGY

The central objective of this paper is the identification and estimation of a stable long-run relationship between the real exchange rate and its fundamental real determinants. Estimation of the the speed of adjustment to equilibrium, while an important topic in its own right, is of less concern in this paper. Cointegration analysis provides a natural conceptual framework for examining the long-term comovements of a set of time-series variables. Intuitively, cointegrated variables may drift apart temporarily, but systematically converge over time. A model that features a deterministic long-run relationship between a set of integrated variables, while allowing those variables to deviate over the shorter run, will exhibit cointegration. Cointegration estimation techniques are therefore particularly well suited to the study of real exchange rate determination, since short-run shocks, or speculative and cyclical factors, may cause the real exchange rate to deviate temporarily from its equilibrium or sustainable path, as defined by the movements of its (nonstationary) fundamental determinants.

To take advantage of these properties, this paper models the long-run determinants of the real exchange rate of the Malagasy franc using two different cointegration estimation methodologies. The preferred method is the multivariate maximum likelihood estimation technique developed by Johansen (1991, 1995), which corrects for autocorrelation and endogeneity parametrically using a vector error correction mechanism (VECM) specification. However, Engle-Granger (1987) single equation estimation methods are also employed, despite their poorer small sample properties and no correction for autocorrelation, to compare with Johansen estimates when more than one cointegration vector might exist or, when there are insufficient observations available to properly implement the Johansen method.

Annual data spanning the period 1970 to 2000 were obtained.³ Exchange rates of the Malagasy franc were drawn from the International Monetary Fund's Information Notice

³ This represents a relatively small sample period, especially when the estimation strategy includes use of the Johansen estimator. The short sample period did constrain the choice of estimation techniques to some extent; nevertheless, it was felt that the alternative of converting annual observations to a quarterly frequency via mechanical techniques as a means to increase the the number of available observations could alter the statistical results and unduly influence inference.

System (INS);⁴ the real effective exchange rate (REER) is measured as an index with base years of 1990 and country weights reflecting 1988-90 trade data; the REER for Madagascar is calculated using relative consumer price indices.⁵ Along the lines of Faruqee (1995) and Edwards (1989), explanatory variables considered include the following: the stock of net foreign assets, measured on an end-of-period basis and as a ratio to GDP (NFA);⁶ an index of the terms of trade (TOT),⁷ constructed as the ratio of export unit values to import unit values; and a comparative index of labor productivity (RPROD), intended to account for Balassa-Samuelson effects and measured as an index of real per capita GDP in Madagascar relative to an index of manufacturing labor productivity in OECD countries.⁸ Other real factors considered include: investment expenditures, measured as a percent of GDP (INV),⁹ and the effective tax rate on international trade (ITT), calculated as the sum of the ratios of import tax revenue to imports and of export tax revenue to exports.¹⁰ The international trade tax variable tends to be highly correlated with other trade restrictions and, therefore, also reflects the openness of the Malagasy trade and exchange regime.

III. EMPIRICAL RESULTS

Prior to the testing for cointegration and estimation of cointegrating vectors, all of the above-mentioned variables were investigated to determine their order of integration. To test for stationarity, augmented Dickey-Fuller (ADF) test statistics were calculated for the period 1970-2000. These unit root tests, reported in Table 1, fail to reject the presence of a unit root for each time-series in levels, but not in first differences, at the 1 percent level for NFA, RPROD, ITT, INV, and at 5 percent critical values for REER and TOT. Thus, all of the

⁴ Source: IMF, International Financial Statistics database.

⁵ The INS methodology for construction of real effective exchange rates is discussed in Zanello and Desruelle (1997).

⁶ Sources: IMF, International Financial Statistics and World Bank, Global Development Finance databases.

⁷ Source: World Bank, Global Development Finance database. TOT is measured as an index with base year 1990 and expressed in log levels.

⁸ Source: World Bank, Global Development Finance database for OECD manufacturing labor productivity and IMF Recent Economic Developments papers for Madagascar. RPROD is measured as an index with a base year of 1990 and is expressed in log levels.

⁹ Sources: IMF, World Economic Outlook database and Recent Economic Developments for Madagascar, (IMF), various issues from 1970 to 1982.

¹⁰ Sources: IMF, World Economic Outlook database and Recent Economic Developments papers for Madagascar, various issues from 1970 to 1982.

Table 1. Tests of Order of Integration, 1970–2000¹

Variables ² /Test Statistics						
	REER	TOT	INV	RPROD	NFA	ITT
LEVELS						
ADF	-2.07	-2.63 (<i>k</i> =1)	-2.56	-2.84	-1.98	-2.13
ADF	-4.00 ³	-3.68 ³	-6.05 ⁴	-5.04 ⁴	-6.49 ⁴	-5.20 ⁴

¹ The null hypothesis is a unit root versus a trend-stationary alternative. The ADF(*k*) test statistic is for the variable x_t is given by the *t*-statistic for the estimated coefficient attached to x_{t-1} in the following regression (including a constant and a trend):

$$\Delta x_t = \pi_0 + \pi_1 \text{trend} + \pi_2 x_{t-1} + \sum_{j=1}^k \gamma_j \Delta x_{t-j},$$

where *k* is determined by the highest order lag for which the corresponding γ_j is significant. Unless otherwise indicated, *k* = 0.

² REER, RPROD, and TOT are indices with base years 1990 and are measured in natural logarithms, NFA and INV are measured in relation to GDP, and ITT is measured in percentage terms.

³ Indicates significance at the 5 percent level.

⁴ Indicates significance at the 1 percent level.

times-series variables to be considered in the estimated equations discussed below can be characterized as I(1) variables, that is, nonstationary in levels, but stationary in first differences.

As noted above, estimation with the Johansen method is preferred; however, prior to estimation of a vector error-correction model (VECM), lag length must be determined. Initial lag length tests, performed using vector autoregressions (VARs)¹¹ in the levels of all the above-mentioned variables, indicated that a lag of three years was appropriate, a result reinforced by residual normality tests. Unfortunately, due to the short sample period, specification of a VECM with a lag length of three precluded the inclusion of more than three variables in the model.

Testing over various combinations of variables, then testing parameter stability through recursive estimation, indicated that a very stable cointegrating relationship between NFA, INV, and RPROD existed for the real effective exchange rate.¹² The cointegration test results (consisting of the maximal eigenvalue and trace test statistics) and maximum likelihood estimates of the (normalized) cointegrating vector, estimated over the period 1974-2000, are reported as Equation 1 in Table 2. The null hypothesis of no cointegration can be rejected and only one cointegrating relationship exists when both cointegration test statistics, evaluated at the 1 percent critical level, are considered together.¹³

The normalized long-run coefficients of the cointegrating vector have signs conforming to theoretical priors, are of plausible magnitudes, and are statistically significant different from zero at conventional testing levels. Accepting the estimated cointegrating vector as economically meaningful, the interpretation of individual coefficients as semi-elasticities (NFA and INV) and elasticities (RPROD) is as follows: an increase (decrease) net foreign assets position by 1 percent of GDP leads to appreciation (depreciation) of the real exchange

¹¹ These tests include the Schwartz, Akaike, Hannan-Quinn information criteria.

¹² A dummy variable, D82, taking unit values for 1981 to 1983 was included as an exogenous variable in the VAR, to account for the substantial decline in per capita output due to the sharp decline in industrial activity attributed to the scarcity of foreign and imported inputs during the period.

¹³ The reported VECM also performed well when subjected to various model selection criterion and other statistical tests, including the Jarque-Bera test for the normality of residuals and Box-Ljung Q statistics against serial correlation. Wald lag restriction tests indicated that the lag length of three years could not be rejected. When this specification was estimated over various sample periods the hypothesis of cointegration could always be accepted and the normalized coefficient estimates of the cointegrating vector were consistently of the same sign and magnitude, as was the case with the speed of adjustment coefficient.

Table 2: Estimation Results

Equation	1	2	3	4	5
Estimation method	Johansen	Engle-Granger	Engle-Granger	Engle-Granger	Johansen
Sample period	1974-2000	1970-2000	1970-2000	1970-2000	1973-2000
Lags in VAR	3	...	...	...	2
Number of cointegration vectors (where applicable)					
Trace Statistic					
5 percent level	2	...	...		3
1 percent level	2	...	...		2
Maximum Eigenvalue Statistic					
5 percent level	2	...	...		1
1 percent level	1	...	...		1
Parameter Estimates¹					
INV	-0.073 (-9.03)	-0.033 (-3.54)	-0.028 (-3.13)	-0.029 (-3.37)	-0.030
NFA	0.006 (18.43)	0.005 (7.01)	0.005 (7.27)	0.005 (7.53)	0.005
ITT			0.006 (2.05)	0.006 (1.99)	0.006
TOT			0.047 (0.69)		
RPROD	0.564 (7.58)	0.579 (4.19)	0.441 (2.57)	0.514 (3.84)	0.635 (8.29)
D82	In VAR	0.413 (5.76)	0.395 (5.75)	0.394 (5.80)	In VAR
CONSTANT	3.724 (10.50)	3.026 (4.29)	2.93 (4.15)	3.083 (4.65)	2.553 (7.39)
Estimated speed of adjustment coefficient ²	-0.557 (-1.57)	-0.418 (-2.69)	-0.467 (-2.34)	-0.458 (-2.50)	-0.585 (-2.39)
Adjusted R-squared	...	0.911	0.919	0.921	...
ADF test statistic, where applicable	...	-3.48 ³	-4.00 ³	-3.81 ³	...

¹ *t*-statistics are reported in parentheses below estimated coefficients.

² For the Johansen method, estimated simultaneously with cointegration vector. For the Engle-Granger method, estimated from auxiliary regression with the lagged residuals from the initial regression and changes in original independent variables; the estimation period starts one year later due to the lagged residual.

³ Indicates significance of ADF test statistics at the 1 percent level.

rate of about a 0.06 percent; an increase (decrease) in investment expenditure of 1 percent of GDP leads to a 0.7 percent depreciation (appreciation) of the real exchange rate; and a percent increase (decrease) in Madagascar's productivity relative to key trading partners leads to a 0.6 percent appreciation (depreciation) of the real exchange rate.¹⁴

The estimated coefficient of the error-correction term is -0.56, indicative of gradual convergence toward long-run equilibrium. It indicates that when the fundamentals in the previous period call for a higher (lower) REER than observed, the REER in the current period will tend to appreciate (depreciate) toward the equilibrium value predicted by the cointegration vector. The speed of adjustment to equilibrium is, of course, determined by the coefficient attached to the error-correction term, which, at about one half, implies a half life of REER deviations from equilibrium of about 1½ years, broadly in line with estimates made by Elbadawi (1994) for several other developing countries.

Equation 1 is quite satisfactory from both statistical and economic perspectives. Nevertheless, we wanted to determine if other cointegration vectors, involving some of the other structural variables noted above, exist. VECMs with two lags involving NFA, INV, RPROD as well as other variables (tested sequentially, due to the lack of degrees of freedom) did not detect any additional economically meaningful single cointegration vectors. Multiple cointegration vectors were frequently detected through this exercise, but the estimated relationships were not considered stable and there was no statistical means to identify the "correct" cointegrating vector. Thus Engle-Granger estimation techniques were employed to determine if other cointegration vectors involving additional variables exist, and if so, whether or not their estimated coefficients were similar to those of Equation 1.

Initially, Equation 2, a cointegrating equation equivalent to Equation 1, was estimated using the Engle-Granger two-stage error-correction model estimation method. The ordinary least squares errors from the estimated cointegrating equation tested as stationary (at the 1 percent level), indicative of cointegration, since the linear combination of nonstationary variables cointegrate to produce a stationary error term. The coefficient estimates of Equation 2 are very similar to those of Equation 1, supporting the notion that both estimated equations have identified a similar cointegrating vector. Notably, the coefficient attached to the error-correction term (estimated via an auxiliary equation of the change in the independent variable on the lagged residuals from the initial regression and changes in the original independent variables), at -0.42, is somewhat lower than the Johansen method estimate of -0.56 (although the estimates are statistically different from each other), implying a half life of just under 2 years compared to 1½ years. Equation 2 exhibits autocorrelation, and the differences between the estimated half lives could be attributed to the fact that the Johansen estimation technique corrects for autocorrelation while the Engle-Granger method does not.

¹⁴ The import content of investment spending averaged over 70 percent during the period 1970-2000.

Equation 3 reports coefficient estimates of a cointegration equation involving INV, NFA, as well as the tax rate on international trade, the international terms of trade, and the relative productivity term. Unit root tests on the estimated residuals indicate that the hypothesis of cointegration cannot be rejected and the coefficient estimates conform to theoretical priors in sign and magnitude. The signs, magnitudes, and t-statistics of coefficients attached to INV and NFA are comparable to those of both Equations 1 and 2. Of the remaining coefficients, all are positively signed, as expected, and of reasonable magnitudes and all but the international terms of trade are statistically significant. High correlations (above 0.8) exist over the sample period between RPROD and TOT, and this estimated equation may, therefore, suffer from multicollinearity. To investigate this possibility, the equation was tested alternately excluding RPROD and TOT. With RPROD excluded (equation not reported), the estimated coefficient attached to the terms of trade remained positive but statistically insignificant. Equation 4, includes the relative productivity variable and excludes TOT, with the result that the estimated coefficient of RPROD increases modestly and remains strongly significant. We conclude, at least over this sample period, that the terms of trade exert a very weak influence on the real effective exchange rate. Unit root tests on the estimated residuals of Equation 4 continue to indicate cointegration and the statistically significant coefficient of the error-correction term, estimated at -0.46, remains in the range of all previous estimates.

This exercise with Engle-Granger estimation permits the following two conclusions. First, there is relatively strong statistical evidence to support the notion that in addition to net foreign assets, investment, the Balassa-Samuelson effect, and taxes on international trade exert a positive influence in the determination of the long-run equilibrium exchange rate of the Malagasy franc. Higher (lower) taxes on international trade call forth an appreciation (depreciation) of the real exchange rate. Second, there is some evidence that the terms of trade may have a positive effect on the long-run real exchange rate, but that it is not strong and far from conclusive. On the basis of the above, the preferred estimated equation is Equation 4.

As a final check, rather than a formal test, Equation 5 reports estimates from a VECM estimated with the Johansen method, involving three lags and all of the variables contained in Equation 4, but with the coefficients of NFA, INV, and ITT constrained to 0.005, -0.03, and 0.006, respectively (representative of the Equation 4 estimates). With three constraints there are sufficient degrees of freedom available to estimate a constant term and the coefficients attached to RPROD and the error correction term. The Johansen cointegration tests considered together permit acceptance at the 1 percent level of the hypothesis that a single cointegration vector exists. The estimated coefficients attached to relative productivity and the error-correction term are statistically significant and while somewhat higher, both remain within the range of previous estimates. These similarities serve to support the notion that the preferred estimates of Equation 4 represent a uniquely identified long-run cointegrating vector.

IV. ESTIMATION OF THE LONG-RUN EQUILIBRIUM REAL EXCHANGE RATE AND ASSESSMENT OF MISALIGNMENT

Based on the estimated coefficients of the preferred cointegration vector (Equation 4 in Table 2), estimates of the trend component of the real exchange rate (REER*) can be computed for the sample period by using actual observations for the independent variables, which can be interpreted as estimates of the long-run equilibrium real effective exchange rate.¹⁵ In this paper, the variables representing the fundamentals, or real factors, have simply been smoothed utilizing the Hodrick-Prescott filter.¹⁶ It is also possible to calibrate such calculations by placing some normative structure on the variables representing the fundamentals.¹⁷ Constant term adjustments have also been made to ensure that the sample period means of the estimated equilibrium and actual real effective exchange rates are equal.

The top portion of Figure 1 depicts the actual real effective exchange rate and calculated equilibrium rate (REER*) for the period 1970-2001. The most striking feature of the behavior of both time series is the significant decline over the sample period and, most dramatically, over the period 1983-87. The proximate causes for these adjustments were the rapid and significant decline in the net foreign assets position of the country during the 1983-87 period, the secular decline in aggregate productivity relative to trading partners, and possibly the international terms of trade, all of which are quite evident in the individual time-series charts of the independent variables provided in Figure 2.

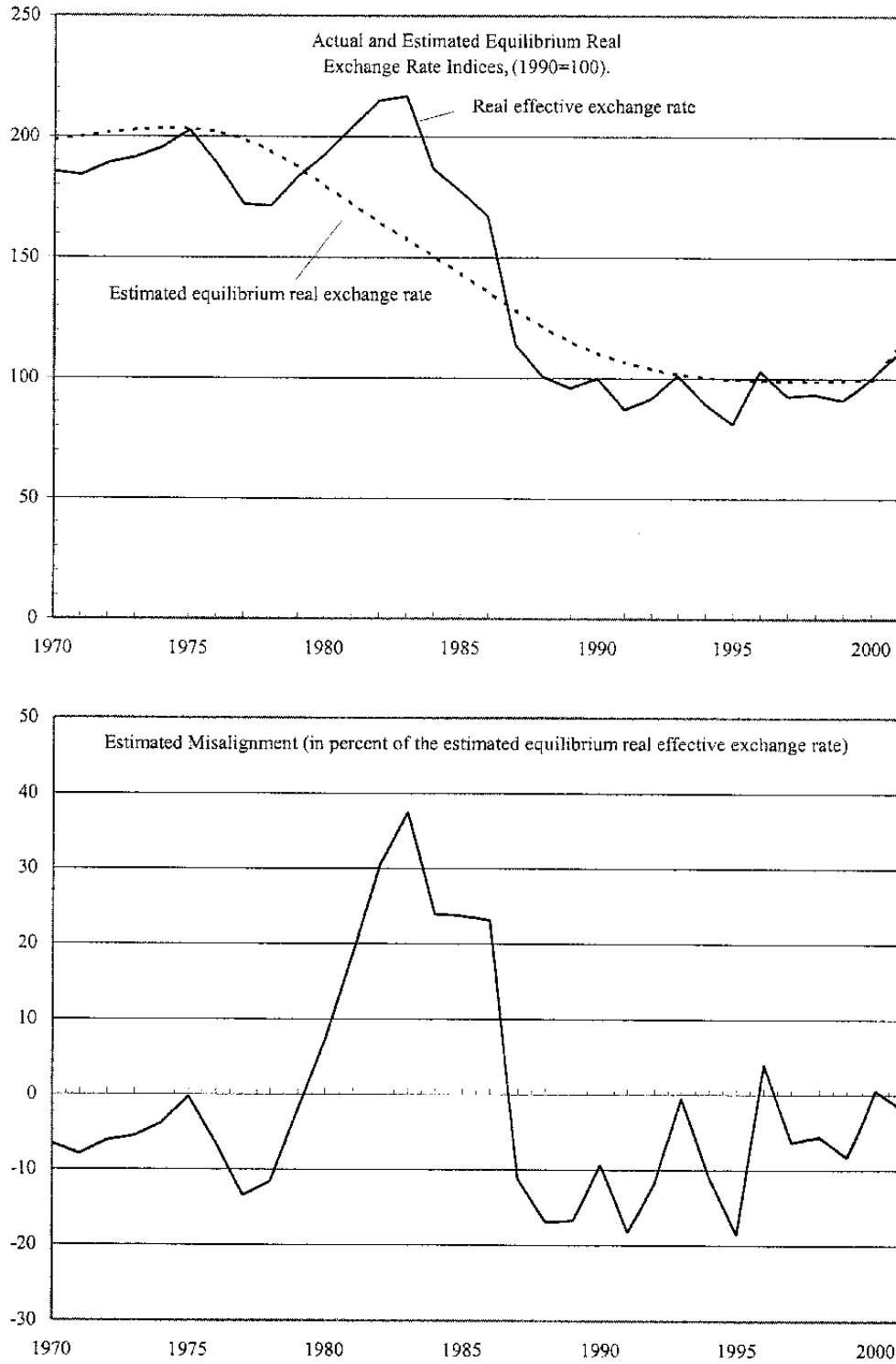
The lower portion of Figure 1 depicts the degree of estimated real exchange rate misalignment, measured as the percentage difference between REER* and the observed REER. The figure illustrates that the computed index succeeds in generally replicating both overvaluation and undervaluation episodes in Madagascar's macroeconomic history since 1970. Between 1970 and 1975, the real exchange rate of the Malagasy franc tended to be modestly undervalued, a trend that intensified in the next two years before abating in 1979. From 1980 until 1986, the exchange rate was generally overvalued; this time frame corresponds to the period when Madagascar pursued socialist policies, including the nationalization of

¹⁵ Since it is possible for the fundamental variables to diverge from their respective equilibrium values, it may not strictly be appropriate to term these estimates as "equilibrium" real exchange rates.

¹⁶ Using a smoothing parameter of 50.

¹⁷ Of course other smoothing and constant term adjustment techniques are available, including the use of moving averages of the fundamentals as in Elbadawi (1989) and MacDonald (2000), and choosing constant terms and equilibrium values for fundamentals as determined by other techniques, as in Paiva (2001).

Figure 1. Madagascar: Indices of Actual and Estimated Equilibrium Exchange Rates and Misalignment, 1970-2001¹



Source: IMF, Information Notice System; and author's calculations.

¹ In the top panel, the 2001 value for the estimated equilibrium real effective exchange rate has been simulated assuming a 50 percent increase in the net foreign assets position reflecting HIPC debt relief.

industries, financial institutions, and insurance companies, and introduced significant trade restrictions and tariff increases. The degree of misalignment, peaked at over 35 percent in 1983,¹⁸ and is indicative of the extent of financial repression prevailing during this period.

Starting in late 1985, the Malagasy government began negotiations on structural adjustment programs with the Bretton Woods institutions; these programs were implemented over 1986 and 1987, and involved significant capital account and trade liberalization through the elimination import and export licensing and quotas, as well as sizable nominal depreciations under a crawling peg arrangement. By 1987, the real exchange rate was broadly in line with the estimated equilibrium real exchange rate. Madagascar continued to pursue IMF-supported programs in the period 1988-91. On balance, over this period, the calculated index suggests that the real exchange rate tended to be broadly consistent with the estimated equilibrium rate.

A period of particularly intense political instability ensued over the period 1991-94, when very few significant reforms were implemented. In 1994, major reforms of the monetary and exchange regimes were initiated, leading to the introduction of an interbank foreign exchange market and the adoption of a floating exchange rate regime, with limited central bank intervention. As a result, the real exchange rate depreciated sharply over the period 1994-95, and becoming somewhat undervalued, before stabilizing in 1996 and remaining relatively constant until 1998.

The real (and nominal) appreciation of the Malagasy franc between 1999 and 2001 appears consistent with an equilibrium real appreciation of the currency associated with the following factors: a decline in international trade taxes stemming from Madagascar's tariff rate reduction commitments in the context of the Regional Integration Facilitation Forum (RIFF); increases in the terms of trade in 2001; and the anticipated improvement in the net foreign assets position stemming from Madagascar's eligibility for debt relief under the enhanced HIPC Initiative. Madagascar was declared eligible for assistance under the enhanced HIPC Initiative at end-2000, with assistance equivalent to a 50 percent reduction in the stock of debt. The simulation of 2001, assuming a 50 percent reduction in NFA, with all other variables maintained at their smoothed values, results in a simulated 13 percent increase in the equilibrium real exchange rate, broadly consistent with the actual 10½ percent increase.

V. CONCLUSION

Modeling the real effective exchange rate of the Malagasy franc, employing stock-flow relationships and other real variables affecting trade flows, using cointegration estimation techniques, proved feasible. The long-run behavior of the real exchange rate can be explained

¹⁸ Anecdotal evidence concerning parallel market exchange rates suggests that premiums also peaked during this period.

Figure 2. Madagascar: Basic Data, 1970-2000

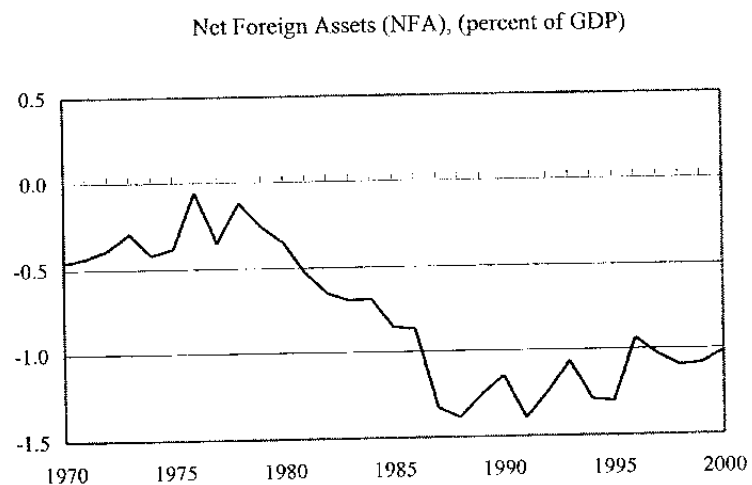
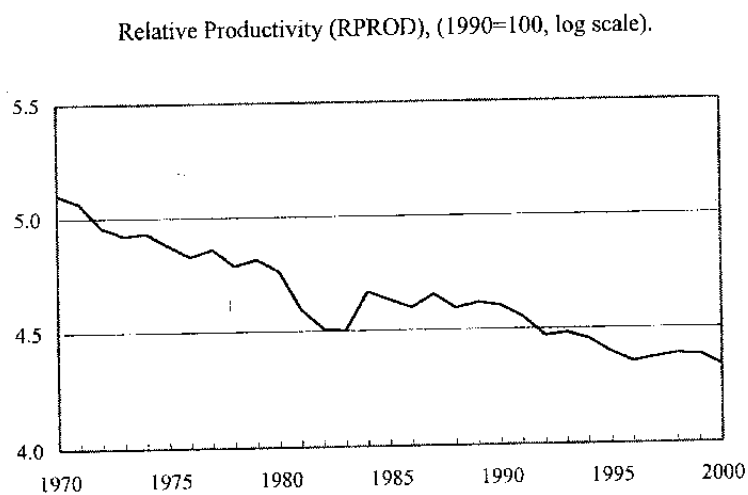
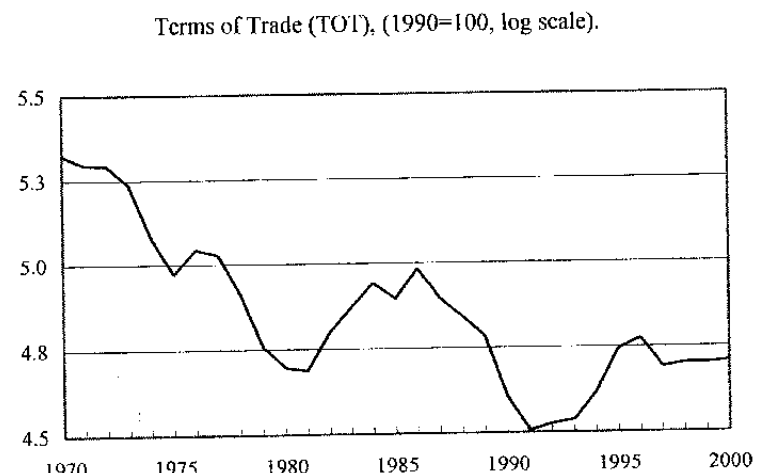
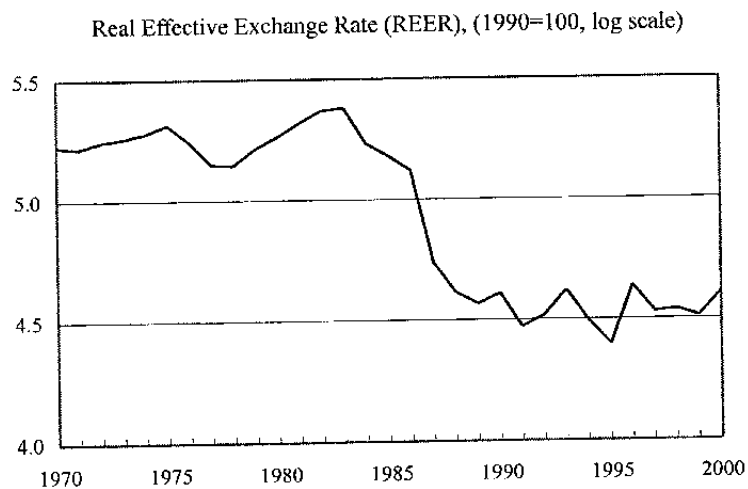
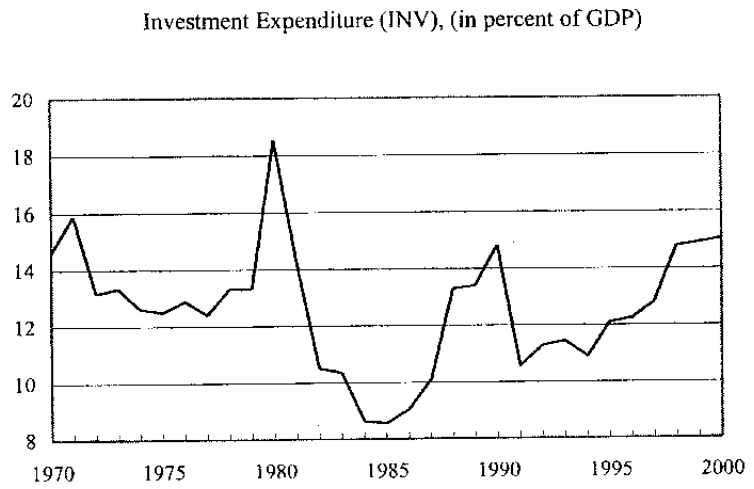
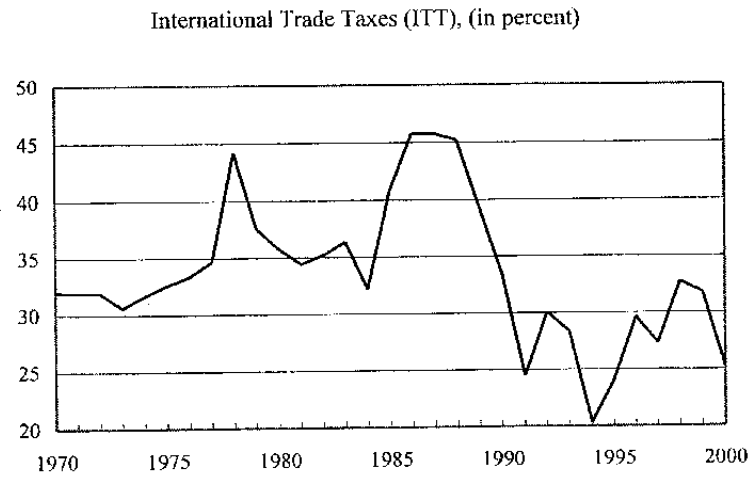


Figure 2. Madagascar: Basic Data, 1970-2000 (concluded)



in terms of real factors, such as the Balassa-Samuelson relative productivity effect, taxes on international trade, investment expenditures, and the factors influencing Madagascar's stock of net foreign assets. There is some evidence that the terms of trade may also play a role in the determination of the real exchange rate. Model-derived estimates of the long-run equilibrium exchange rate, when used to evaluate misalignment of the real effective exchange rate, replicate recognized periods of currency overvaluation in Madagascar. Additionally, the analysis supports the notion that real exchange rate misalignment since 1996 has been quite modest, and that changes in the real exchange rate of the Malagasy franc have been broadly consistent with changes in the equilibrium real exchange rate and its underlying determinants. Finally, the appreciation of the real exchange rate of the Malagasy franc between 1999 and 2001, is predicted by the model as a response to underlying changes of real factors such as tariff reform and the anticipated improvement in the net foreign assets position stemming from Madagascar's eligibility for debt cancellation under the enhanced HIPC Initiative. The recent appreciation of the real exchange rate therefore appears consistent with developments in its fundamental determinants and therefore should not be detrimental to Madagascar's competitiveness.

Madagascar: Institutional Exchange Rate Arrangements Since 1960

From independence in 1960 until 1973, Madagascar was a member of the French franc zone, with the exchange rate of the common currency pegged to the French franc. Although Madagascar withdrew from the franc zone in 1973, the Malagasy franc remained pegged to the French franc until April 2, 1982. From 1982 to late 1991, the nominal exchange rate was determined under an adjustable peg to a basket of ten currencies, with the peg periodically adjusted to compensate for inflation differentials vis-à-vis Madagascar's key trading partners. A second operational phase under this arrangement began in October 1991 when, in the midst of a deepening economic and political crisis, the Malagasy authorities introduced a highly restrictive exchange and trade system. Although in principle the adjustable peg system remained in place, for a period of over two years the authorities refrained from adjusting the peg. A new exchange rate regime was initiated in May 1994, when the exchange and trade system was substantially liberalized, an interbank foreign exchange market (the *Marché Interbancaire de Devises (MID)*) established, and the exchange rate permitted to float. From early 1994 to the present date, the external value of the Malagasy franc has been freely determined by supply and demand in the interbank market.¹⁹

¹⁹ Creation of the MID led to the unification of the interbank and parallel market exchange rates shortly thereafter. Nevertheless, informal foreign exchange transactions still occur in Madagascar, with parallel market participants reportedly seeking to avoid the "paper trail" implicit in interbank market foreign exchange transactions.

References

- Edwards, Sebastian, 1989, *Real Exchange Rates, Devaluation and Adjustment: Exchange Rate Policies in Developing Countries* (Cambridge, Massachusetts: MIT Press).
- Elbadawi, Ibrahim A., 1994, "Estimating Long-Run Real Exchange Rates", in *Estimating Equilibrium Exchange Rates*, ed. by John Williamson (Washington: Institute for International Economics).
- Engle, R., and C.W. Granger, 1987, "Cointegration and Error-Correction Model: Representation, Estimation and Testing," *Econometrica*, Vol. 55, No.2, pp. 251-76.
- Faruqee, Hamid, 1995, "Long-Run Determinants of the Real Exchange Rate: A Stock-Flow Perspective," *Staff Papers*, International Monetary Fund, Vol. 42 (March), pp. 80–107.
- Isard, Peter, and others, 2001, *Methodology for Current Account and Exchange Rate Assessments*, IMF Occasional Paper No. 209 (Washington: International Monetary Fund).
- Johansen, Søren, 1991, "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models," *Econometrica*, Vol. 59, pp. 1551-80.
- Johansen, Søren, 1995, *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models* (Oxford: Oxford University Press).
- MacDonald, Ronald, 2000, "Concepts to Calculate Equilibrium Exchange Rates: An Overview," Economic Research Group Discussion Paper 3/00 (Frankfurt am Main: Deutsche Bundesbank).
- Paiva, Claudio, 2001, "Competitiveness and the Equilibrium Exchange Rate in Costa Rica," IMF Working Paper No. 01/23 (Washington: International Monetary Fund).
- Zanello, Alessandro, and Dominique Desruelle 1997, "A Primer on the IMF's Information Notice System," IMF Working Paper No. 97/71 (Washington: International Monetary Fund).