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Construction of Equilibrium Real Exchange Rate for Ethiopia

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Abstract

The paper presents an attempt to construct the equilibrium real exchange rate (ERER) of the Birr for the years 1970/71-2002/03. A model was used to identify the significant determinants of the ERER. The study took, terms of trade, government consumption as a percent of GDP, exchange controls, parallel-official premium, nominal devaluation and capital flows as the fundamentals of ERER.

After checking for stationarity and cointegration the study estimates the model using the OLS estimation method. Nominal devaluation, parallel-official premium, exchange control, capital flows and terms of trade were found to be significant in the long run. In the short-run parallel-official premium, nominal devaluation (both lagged and level), capital flows and the error correction term have been found to be significant. The paper then constructs the equilibrium real exchange rate by smoothing out the fundamentals using the 5-year moving average. The recent trends show that the Birr has been undervalued from the years 1992/93 to 1996/97 then becoming briefly overvalued until 2001/02 and then again become undervalued in the years 2002/03 and 2003/04.

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List of Acronyms

REER – Real Effective Exchange Rate

ERER – Equilibrium Real Exchange Rate

RER – Real Exchange Rate

GDP – Gross Domestic Product

TOT – Terms of Trade

2SLS – 2 Stage Least Squares

UNCTAD – United Nations Conference on Trade And Development

GCGDP – Government Consumption as a percent of GDP

EXCON – Exchange Control

EXCRD – Excess Credit

TECHPRO – Technological Progress

NOMDEV – Nominal Devaluation

PREM – Parallel Official Premium

CAPINF –Capital Flows

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1. Introduction

Exchange rate policy has recently been a very important policy instrument that affects major macro-economic variables especially external sector ones. In addition, the status of the real exchange rate of a given country is taken as a relatively good measure of external competitiveness. In order to make the policies that use the exchange rate effective and to measure competitiveness more accurately it is crucial to identify the real exchange rate of a given country and further construct the equilibrium exchange rate. The construction of equilibrium exchange rate will help in understanding where the real exchange rate is and where it should be. These, in turn, will enable to devise the appropriate policy to monitor the stability and movements of real exchange rate.

It is because of this importance of equilibrium exchange rate that it has recently been subject to diverse study in different countries. With an increasing supremacy of globalisation and increasing global pressure for more competitiveness and openness, it has become vital to identify the position of a country with respect to others, thereby making the role of identifying the equilibrium real exchange rate more pressing. This becomes more pronounced in the less developed countries, which are caught between greater pressure of globalisation and protection of relatively underdeveloped domestic economies. Therefore, the proper identification of the Equilibrium real exchange rate would again be important in determining the extent of openness to which the country would be better off.

The Ethiopian case is no different from the case of underdeveloped countries presented above. During the past decade the country has been engaged in reform programs aimed at transforming the economy into a more market oriented economy. Accordingly, it has been involved in opening the country's markets to the global economy by acting upon major macro-economic policy

measures. The country's exchange rate regime is one of the major macro-economic variables that went through reform programs. The exchange rate has been continuously devaluated throughout the decade through policy measures to enhance the competitiveness of the country. Constructing the equilibrium real exchange rate for Ethiopia will, therefore, help to set a target for the formulation of exchange rate policies.

The construction of equilibrium exchange rate has been attempted in different studies through different approaches. The purpose of this study is, therefore, to make yet another, possibly improved, attempt to construct the equilibrium real exchange rate of the country by taking into account the different approaches that have already been employed so far.

In constructing the equilibrium exchange rate, the first important step is to construct the real effective exchange rate (REER) by adjusting the nominal exchange rate to prices and weighting it to the major trading partners of the country. By identifying the major determinants of the REER it would then be possible to construct the equilibrium real exchange rate. This is done by smoothing out the relationship of the REER with its major determinants, which will give us the equilibrium real exchange rate.

The paper is organised in the following manner. The next section will review some literature pertaining to the subject. The section after will describe the methodology used to construct the equilibrium real exchange rate. The Fourth section will empirically estimate the determinants of real exchange rate and establish empirical estimates of the equilibrium real exchange rate. This will be followed by conclusions and recommendations.

2. Review of Related Literature

2.1 Theoretical Literature

2.1.1 Importance of Equilibrium Real Exchange Rate

"The equilibrium exchange rate is defined as the relative price of tradables to non-tradables that results in the simultaneous attainment of equilibrium in the external sector and in the domestic (that is non-tradables) sector of the economy. This means that when RER is in equilibrium, the economy is accumulating (or running down) assets at the 'desired' rate and the demand for domestic goods equates its supply." (Edwards 1992, 46)

In the wake of an inevitable venture into the global markets/economy, the developing countries are faced with the critical question of when to make what moves in opening the economy to international markets. A related question in this area is the question of competitiveness. In an increasingly dynamic international market, competitiveness requires intensive policing of external sector variables that impact upon the competitiveness of the particular country. To do this, it is important to identify the real value of traded goods in international markets, which, in turn, is expressed by the real effective exchange rate. The term real is used to express the adjustment of the nominal exchange rate with price changes. When nominal exchange rates are weighted to the trade share and prices of partner countries it becomes effective exchange rate. The real effective exchange rate is, therefore, obtained by adjusting the nominal exchange rate to domestic prices and trade shares of partner countries. The equilibrium value of the real effective exchange rate (equilibrium real exchange rate), determined by the real value of its explaining fundamentals, is the optimum point in which external competitiveness is enhanced and the demand for tradable goods equals their supply. Equilibrium in our case, as stated above, is a situation in which the demand and supply of domestic goods and services are equal both internally and externally along with the demand and supply of foreign goods and services. The deviation of the real exchange rate from its equilibrium value on the other hand gives a wrong signal to the economy and misleads policy makers away from optimum measures that need to be taken.

In light of this, Edwards (1992), asserts that while devising policies, developing countries need to take into account the equilibrium real exchange rate and the misalignment of the real effective exchange rate from this equilibrium value. He distinguishes between two types of misalignment namely, the macroeconomic-induced misalignment and the structural misalignment. The macroeconomic-induced misalignment occurs when macroeconomic policies (especially monetary ones) that are inconsistent with the existing exchange rate practice are enacted. This would affect the real effective exchange rate, as it responds to changes that occur in both real and monetary sectors. The equilibrium real exchange rate, on the other hand, is a function of real variables only so policies that don't affect the real sector don't bring about any change in the equilibrium exchange rate. Therefore, inconsistent macroeconomic policies could cause the deviation of the real effective exchange rate from its equilibrium value. The structural misalignment on the other hand is a case when changes in the real fundamental of the equilibrium exchange rate change and thereby bringing about misalignment of the REER from the equilibrium value.

In both the above cases the misalignment of the REER from its equilibrium value implies the under-valuation or overvaluation of foreign assets that give inappropriate signals to the stakeholders in the market thereby causing disequilibria in the market as a whole. If, for instance, there is a monetary policy that is too expansionary it would cause a rise in the price of domestic products and therefore, causing an appreciation of the REER and away from its equilibrium level. This would in relative terms reduce the foreign price of tradables and would reduce exports. If, on the other side, terms of trade deteriorates the equilibrium real exchange rate depreciates and unless the actual REER depreciates along with it misalignment occurs overvaluing foreign assets. Identifying the equilibrium real exchange rate is therefore very crucial in devising policies especially concerning external sector variables.

2.1.2 Determinants of Equilibrium Exchange Rate

In the attempt to construct the equilibrium real exchange rate different authors have taken different approaches. One difference between the approaches is in identifying the

determinants of equilibrium real exchange rate. Theoretically, though, the determinants of equilibrium exchange rate are real external sector variables. Equilibrium exchange rate means the combined values of these fundamentals that would bring the discounted value of the current account to zero both in the current and future periods.

In general, external trade variables that impact upon the equilibrium level of the external sector include, international prices (terms of trade), international transfers including foreign aid flows and world real interest rates. Variables that impact upon the equilibrium level in the domestic economy include, policy related ones like, import tariffs, quotas, export taxes, exchange controls and non-policy related ones like technological progress. It is worth looking at each variable briefly (Edwards 1992, 48)

Among the external sector variables that affect the external equilibrium, the major one is international terms of trade. International terms of trade is said to have a significant impact on the real value of traded goods with respect to non-traded ones. If for example the terms of trade deteriorates, it causes an appreciation on the real effective exchange rate. This is because deterioration in the terms of trade implies that the international price of imports had increased and their demand declines, therefore, an appreciation of the REER occurs. On the other hand, the deterioration of the terms of trade also has a negative income effect that leads to a depreciation of the REER. Depending on which side dominates the level of equilibrium real exchange rate changes (Ibid).

Another external sector variable is the international transfers and capital inflows (including foreign aid flows). An increase in the amount of incoming transfer leads to an increase in expenditure on both tradables and non-tradables. This leads to an increase in the price of non-tradables as the price of tradables doesn't respond to domestic changes. This entails an appreciation of REER as REER is defined as the ratio of the price of tradables to the price of non-tradables.

Still another variable that is believed to determine the REER is technological progress. Technological progress enhances international competitiveness as a result of increased exports and entails an appreciation of the REER.

According to MacDonald and Ricci government fiscal balance is another variable that would determine the real exchange rate. But its relation is ambiguous to establish. This is because improvement in fiscal balance could cause both depreciation and appreciation. If the improvement is caused by a reduction in expenditure this would cause a decline in the price of non-tradables and this in turn will result in depreciation. In the long run, however, an appreciation occurs to bring about a current account deficit in order to offset the temporary depreciation. (MacDonald and Ricci, 5)

The size of net foreign assets also affects the REER. Increased net foreign assets induces expenditure on non-tradables raising their prices which would in turn appreciate the real exchange rate. (Ibid)

2.1.3 Misalignment and Macroeconomic Policy

Since equilibrium real exchange rate is a function of real variables only changes in monetary policy would not change it. This is because equilibrium real exchange rate is the combination of real fundamentals. The actual real effective exchange rate, on the other hand, responds to changes in macroeconomic policy. This is one cause of misalignment. This is mainly because exchange rates respond more to policy changes than do prices.

2.2 Empirical Literature

With differing circumstances different countries choose their own mechanisms of identifying and dealing with real exchange rate. Different economies would have different determinants for the real exchange rate, even though; they are all conceptually real external sector variables. Presented here are experiences of some countries in constructing equilibrium real exchange rate and some attempts in the Ethiopian case.

2.2.1 The Case of South Africa

MacDonald and Ricci (2003) have tried to estimate the equilibrium real exchange rate of South Africa. In their attempt they have taken real interest rate differential, GDP per capita (both relative to trading partners), real commodity prices, trade openness, the fiscal balance and the extent of net foreign assets to determine the real effective exchange rate.

Increase in interest rate differential, GDP per capita, real commodity prices and net foreign assets are theoretically associated with appreciation of the real exchange rate while trade openness is associated with depreciation. The improvement in fiscal balance could result in either appreciation or depreciation depending on the effect explained above.

The study used Johansen cointegration estimation methodology to construct equilibrium real exchange rate. According to the results, in the long run, an increase of real interest rate by 1 percent is associated with 3 percent appreciation of the real effective exchange rate. A percent increase in GDP per capita is related to 0.1-0.2 percent appreciation of the real effective exchange rate. Around 0.5 percent appreciation is related to a percent increase in commodity prices. Increase in openness of 1 percentage point of GDP is associated with 1 percent depreciation of the real effective exchange rate. A one percent improvement in fiscal balance of 1 percent is related to 2 percent depreciation of the real effective exchange rate. Finally, an increase in the foreign assets of 1 percentage point of GDP is linked to 1 percent appreciation of the real effective exchange rate.

In the short run the only variable found to be significant is the net foreign assets, which was found to cause depreciation of the real effective exchange rate when increased by 1 percent. This was probably caused by the temporary impact of changes in reserve on the nominal exchange rate.

The equilibrium real exchange rate is then constructed using the equilibrium values on the fundamental variables. It was estimated using the cointegrating values of the equilibrium values of the explanatory variables.

In conclusion it was found that the real effective exchange rate of the Rand is more depreciated than its equilibrium level owing to the changes in explanatory variable of the ERER and temporary shocks like financial market pressures of the Rand.

2.2.2 The Case of Russia

Another attempt made was on Russia, a commodity exporting country, by Nikola Spatafora and Emil Starev (May 2003). Basically they used the same methodology that was applied in the South African case but the number and types of explanatory variables were different. The study has taken world price of Russian Urals oil, industrial productivity relative to trading partners and a dummy for structural break for the post-1998 crisis.

It is expected that an increase in the world price of Russian Urals oil will cause the equilibrium exchange rate to appreciate, as it would obviously improve the current account balance. The rationale for taking this variable as explanatory variable is to represent the terms of trade of the country as it comprises for significant portion of the total exports. An increase in the productivity of the industrial sector is assumed to bring about appreciation to the real effective exchange rate by enhancing competitiveness. Industry is chosen to substitute the tradable sector. And finally, the dummy is expected to be related with depreciation as it is assumed that any pre-crisis real exchange rate is overvalued.

The study has also taken factors that affect the adjustment of the actual RER to the equilibrium one. It has been identified that excess growth in international reserves, excess supply of domestic credit and increase in fiscal deficit affect the adjustment of the actual RER with its equilibrium value.

Using the Phillips-Loretan long-run cointegration estimator the paper estimates both the long-run and the short run relationships and along with that construct the equilibrium real exchange rate. The results imply that productivity and oil price account for 60 percent

and 40 percent of the appreciation of the equilibrium exchange rate, respectively. The structural change dummy was also significant with an elasticity of around 0.6.

In general, in Russia and in other transition economies empirical analysis suggests that productivity is highly related to ERER.

2.2.3 Ethiopian Case

Before reviewing the literature on the determinants of the equilibrium real exchange rate it is first essential to review a literature on the construction of the REER index. This study adopts the methodology used by Melesse Minale (Melesse 2001) in the construction of the REER index. He took 14 trading partners of Ethiopia based on the strength of trade. He constructed their trade weights and selected 1996/97 as a base year since the year is considered as a normal year and its current account deficit to exports ratio is minimum. Using quarterly price and nominal exchange rate data from 1971/72 - 2000/01 he constructed the real effective exchange rate based on the nominal exchange rate of Birr/USD. This study has extended the construction up to 2003/04 to analyze the data.

Different attempts have been made to construct equilibrium real exchange rate of Ethiopia. The different studies employ different methodology in constructing the equilibrium real exchange rate.

Andualem Berhanu (1996), has constructed the equilibrium real exchange rate by taking foreign price of exports to that of imports (TOT); import tariff rate to proxy trade controls; government consumption to real GDP to proxy government expenditure on non-tradables; excess supply of credits and the ratio of government deficit to lagged high powered money as the determinants of the equilibrium exchange rate. The results show that only government consumption to real GDP and excess supply of credit are found to be significant in the long-run. The review of the short-run dynamics reveals that all the variables in group are very significant while they are insignificant taken individually. By calculating the fitted value of the fundamentals in the long-run equation the equilibrium

real exchange rate is estimated. After doing that it has been found that the actual real exchange rate of the Birr has been over valued because of the existing trade controls.

A more recent and more intensive study on the equilibrium real exchange rate is one made by Equar Desta (2001). This study took TOT, government consumption to real GDP, net capital inflows, the ratio of import tariffs to total imports, exchange control, excess credit and nominal devaluation as explanatory variables. The study estimated two types of real effective exchange rate; one based on the official exchange rate and the other based on weighted official and parallel rates. In the long-run relationship of the official based equation, terms of trade, government consumption and import tariff are found to be statistically significant while only terms of trade and capital flows are significant in the weight based exchange rate equation. The cointegration test however reveals that the variables are cointegrated at 1 percent of significance when estimated using Johansen cointegration estimator. The short run result, on the other hand, reveals that simultaneous relationship exists between terms of trade and RER when using the official based RER. So the first equation was estimated using 2SLS-estimating method. The second equation, which is based on the official-parallel weighted RER didn't have this problem, so was estimated using a single equation model. The results show that terms of trade, capital inflow and import tariffs are found to be statistically significant while government consumption and exchange control are not significant in both equations. Also, excess credit and nominal devaluation were found to be significant though they were insignificant in the long run relationship.

The study then estimates the equilibrium real exchange rate by smoothing the fundamentals using the moving average technique. It was found that misalignment exists between the actual REER and the equilibrium value. The actual REER is below the equilibrium level. This misalignment is wide before 1994 but is narrow since 1994.

Another attempt to construct equilibrium real exchange rate for Ethiopia was made by Melesse Minale (Melesse, 2001) in 2001, about the same time as the one made by Equar. Melesse took external terms of trade, level and composition of government consumption,

control on capital flows, exchange and trade controls, technological progress and capital accumulation (ratio of investment to GDP) as the fundamentals that determine the behavior of real exchange rate. He used Johansen Cointegration Estimation method to estimate the coefficients of the determinants based on quarterly data starting from 1986/87-2000/01. According to the results; terms of trade with a positive sign, exchange and trade controls with a negative sign, ratio of investment to GDP with a positive sign and nominal devaluation with a positive sign, have been found to be statistically significant. In the short-run vector error correction model, the differenced lag of REER, fiscal deficit to lagged high-powered money, nominal devaluation (both lagged and level), excess credit, a dummy for war, the differenced lag of terms of trade and investment to GDP, along with the error correction term found to be statistically significant. Using the OLS estimation the paper then tries to estimate the coefficients of the significant variables so as to plot the trends in equilibrium real exchange rate. The moving average method is used to smooth out the trends in the data of the fundamentals. He found out that the Birr has been overvalued until 1989/90, undervalued from 1992/93-1994/95 and 1995/96-1997/98, overvalued from late1997/98-1999/00 and undervalued until 2000/01.

3. Data, Methodology and Model Specification

3.1 Data Source

The data for this paper is taken from different Annual publications of the National Bank of Ethiopia, IFS publication and UNCTAD handbook. Data for the past 30 (1970/71-2003/04) years has been used to perform econometric estimations.

3.2 Data Definition

3.2.1 Real Effective Exchange Rate

The first step prior to the identification and regression of the determinants of the REER is the identification and construction of the dependent variable itself. The definition of the REER for this paper is the same as the one constructed by Melesse Minale (2001). In

order to properly weight the degree of competitiveness the trade weighted multilateral real effective exchange rate is used.

$$REER_t = \frac{\sum_j w_j E_{tj} (P^*_{tj} / P_t)}{\sum_j w_j E_{oj} (P^*_{oj} / P_o)} \times 100 \dots\dots\dots(I)$$

Where

REER = Multilateral real effective exchange rate of the home country in period t.

P^*_{tj} and P^*_{oj} = Wholesale price index of partner j in period t and the base period, respectively.

P_t and P_o = Consumer price index of Ethiopia in period t and base period, respectively.

E_{tj} and E_{oj} = nominal exchange rate defined as foreign currency of partner j per unit of domestic currency in period t and base period, respectively; and

W_j = the trade weight attached to partner j.

3.2.2 Terms of Trade (TOT)

Terms of trade data is taken as ratio of the price of exports to the price of imports. For this study the terms of trade data is taken from UNCTAD handbook. This is because there is no enough data of all the value of exports for all commodities and their volume to calculate the index from the customs data. One limitation here is the fact that the handbook presents the data in European year and the rest of the data is presented in Ethiopian fiscal year. The European year includes all the months and seasons and may not pose a problem in the long run but it might create some problem in the short-run dynamics.

Terms of trade is taken to be a major variable explaining the equilibrium exchange rate since it shows the competitiveness of the country. Its sign is expected to be negative since an improvement in the terms of trade is assumed to bring about appreciation, which in turn is expressed by a decline in the REER. This is because an improvement in the terms of trade implies that the price of exports is relatively higher than the price of imports,

which results in a rise in real income. The rise in real income in turn causes the price of non-tradables to rise thereby appreciating the real effective exchange rate. Some writers (Edwards 1992; 48) on the other hand, assert that it is not possible to determine the effect of terms of trade on real effective exchange rate since it depends on the cause of the improvement or deterioration. This brings us to an income and substitution effect and depreciation or appreciation will depend on which outweighs. If, for example, the improvement is caused by an increase in the price of exports the rise in real income caused by this increase will increase the price of non-tradables bringing appreciation (income effect). If on the other hand the improvement were caused by a decline in the prices of imports there would be some shift of consumption away from the non-tradables to imported goods. This would result in the decline of non-tradable's price bringing depreciation (substitution effect).

This paper therefore takes the sign of the terms of trade to be undetermined.

3.2.3 Government Consumption of Non-tradables (GCGDP)

As described above it has been proven that government consumption of non-tradables is a significant variable that affects equilibrium real exchange rate. This paper takes government consumption of non-tradables to be one of the fundamentals of equilibrium real exchange rate (ERER), but as there is no ready-made data on government consumption of non-tradables, government consumption expenditure as a percent of GDP is taken. This proxy has proven to be effective in many studies (Equar Desta [2001]).

It is asserted that an increase of government consumption on non-tradables would increase their prices and this would appreciate the REER. As an appreciation of the REER is expressed by a decrease in the actual values, government consumption as a percent of GDP is expected to have a negative sign.

3.2.4 Exchange Controls (EXCON)

Another variable that obviously affects the REER is the degree of controls imposed on international trade and the exchange system. Theory states that increases in trade and exchange controls results in the appreciation of the REER by limiting the free outflow of

foreign exchange. For this paper exchange and trade controls is proxied by the amount of tax revenues from import as a ratio of total value of actual imports. This proxy is also used in other studies (Melesse Minale [2001]).

3.2.5 Technological Progress (TECHPRO)

Still another variable that impacts upon REER is technological progress. Advancement in technology improves the countries competitiveness. This is because advancement in technological progress implies increase in productivity, thus an increase in income. This increase in income will result in a rise in the price of non-tradables, which in turn results in an appreciation of the REER. However, because of lack of proper measure of technological progress this variable is not included in the model. Some studies include productivity of capital and labor as a proxy for technological progress but since productivity data is not available this variable is dropped.

3.2.6 Nominal Devaluation (NOMDEV)

The devaluation measures taken on the nominal exchange rate also affect the REER. The devaluation of the nominal exchange rate will cause the REER to depreciation. That is, nominal devaluation will have an effect of increasing the domestic price of tradables. This will basically entail depreciation in the REER.

3.2.7 Parallel-Official Premium (PREM)

In order to include the exchange control not covered by tariff the parallel-official premium is included as one explanatory variable. Premium is expected to have a negative relationship since increased premium implies greater gap between the actual demand and the existing rate, in turn implying increased exchange control in the country.

3.2.8 Capital Flows (CAPINF)

The other variable that is included in the model is capital flows. It is expected that increased capital inflow will increase the amount of foreign exchange and it would have an appreciating impact on the REER.

3.3 Methodology

Peculiar to most economic time series data is the problem of non-stationarity. That is economic data tend to move together with time. The classical linear regression method requires that times series data become stationary. This means the error term of the equation should have a zero mean and constant variance through time. But most economic time series are non-stationary resulting in what is known as spurious regressions giving significant results with no meaningful relationship. In order to tackle the problem of non-stationarity attempt is made in this paper to check whether the data used here are non-stationary or not and correct using (the necessary tools if the problem exists) the Augmented Dickey Fuller test (is used) to identify whether the data have the problem of stationarity.

Stationarity by itself doesn't disqualify the data or its economic significance. If the explanatory variables together are stationary it is possible to have a meaningful relationship between the dependent and independent variables. When this case happens there exists what is known as a cointegrated relationship. In this paper Engel-Granger Cointegration analysis is used to check for cointegration between the variables. This analysis will establish the long run relationship between the dependent and the explanatory variables and in our case between the REER and its fundamental determinants. Having estimated the long-run relationship the paper uses the error correction model to estimate the short-run relationship.

The equilibrium real exchange rate is then constructed by smoothing out the outliers in the general trend of the explanatory variables. When these smoothed figures are fitted into the equation it would be possible to have a fairly accurate picture of what the equilibrium real exchange rate of the country looks like.

3.4 Model Specification

Including the above stated variables as fundamentals for equilibrium real exchange rate the model for this paper is specified as follows;

$$\log REER_t = \beta_1 - \beta_2 \log(TOT_t) + \beta_3 \log(GCGDP_t) - \beta_4 \log(EXCON_t) - \beta_5 \log(NOMDEV_t) - \beta_6 \log(PREM_t) - \beta_7 \log(CAPINF_t) + e_t$$

Where,

REER_t = Real Effective Exchange Rate at time *t*.

TOT_t = Terms of Trade at time *t*.

GCGDP_t = Government Consumption as a percent of GDP at time *t*.

EXCON_t = Exchange Control at time *t*.

NOMDEV_t = Nominal Devaluation at time *t*.

PREM_t = Parallel - Official Exchange Rate Premium

CAPINF_t = Total net capital inflows expressed as total disbursement minus total debt service.

4 Estimation and Results

4.1 Test of Stationarity

As stated above, one peculiarity of economic time series is that the data follows specific trends over time and most economic variables trend together. This results in what is called spurious regression with a senseless result and a high R². It is therefore important to check whether the variables are stationary. That is the disturbance term needs to have constant mean and zero variance. The most commonly used method to check for stationarity is the Dickey-Fuller test or the Augmented Dickey- Fuller test of stationarity. According to this test if a variable is stationary as it is said to be integrated of order zero [I (0)]. If on the other hand the data is not stationary at level and needs to be differenced once it is said to be integrated of order one [I (1)].

The Augmented Dickey Fuller test is employed in this study to test for stationarity. The results show that except for capital inflows, which is stationary at level all the other variables are integrated of order one [I (1)]. This implies that they are stationary at a first difference. This means that just estimating the model at level may cause spurious regression.

But this does not close the case. Even if the individual variables are non-stationary if the linear combination of the variables is stationary the problem of spurious regression will not exist. Variables whose linear combination is stationary are said to be cointegrated. It is also very important to check whether the linear combination of the variables is stationary. The Engle-Granger cointegration test is a common tool to do this. After undertaking this test for cointegration the variables are found to be cointegrated at five percent significant level.

4.2 Long-run Estimation Results

Some of the variables included above only have short - run effects on the REER and could not be considered as long-run determinants. Therefore they are omitted from the long-run specification. Accordingly, the long-run equation is stated as,

$$\log REER_t = \beta_1 + \beta_2 \log(TOT_t) - \beta_3 \log(EXCON_t) - \beta_4 \log(PREM_t) + \beta_5 \log(NOMDEV_t) - \beta_6 \log(CAPINF_t) + e_t$$

These are assumed to be the long-run determinants of REER. The estimated results are expressed as

$$\begin{aligned} \text{LogREER}_t = & 2.64 - 0.234 \log(\text{PREM}_t) + 0.507 \log(\text{EXCON}_t) + \\ & (2.02) \qquad \qquad (-7.950) \qquad \qquad (3.868) \\ & 0.089 \log(\text{CAPINF}_t) - 0.226 \log(\text{TOT}_t) + 0.574 \log(\text{NOMDEV}_t) \\ & (1.773) \qquad \qquad (-3.238) \qquad \qquad (3.010) \end{aligned}$$

t - values in parenthesis

F - statistics = 14.6

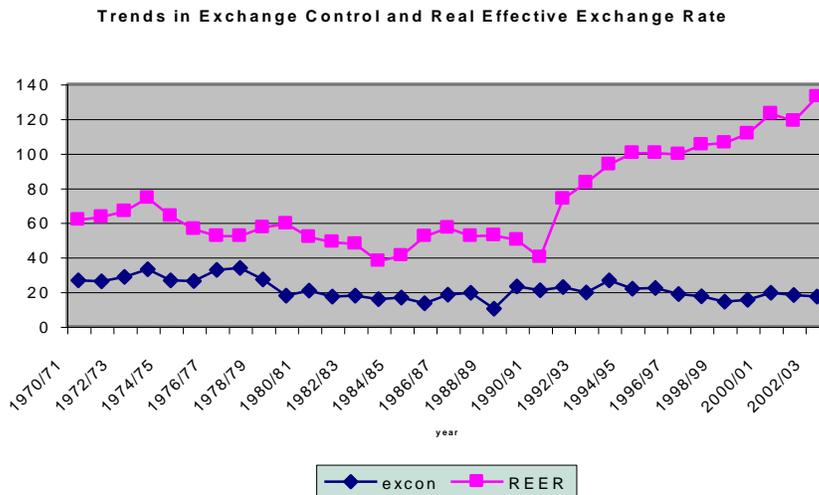
R - squared = 0.75

As the result indicates three variables, terms of trade, parallel-official premium and exchange control have been found to be significant. However exchange control has the opposite sign than the expected sign. All the other variables were found to be insignificant. Capital inflow has neither the expected sign nor is it significant.

As stated above, theoretically, terms of trade could have both positive and negative relationship, though most empirical studies show that they are negatively related in developing countries. Theoretically, the sign of terms of trade depends on the cause of deterioration or improvement. If for example deterioration is caused by the increase in foreign price of imports there will be a shift of consumption from tradables to non-tradables. This will increase the price of non-tradables thereby causing an appreciation (substitution effect). If on the other hand the deterioration were caused by a decline in the price of exports then the decline in real income would cause a decline in the price of non-tradables causing depreciation (income effect). According to the result in this study terms of trade has a negative relationship with REER, implying that a deterioration of terms of trade by 1 percent would cause 0.226 percent depreciation in REER. This means the income effect dominates.

The parallel-official premium is found to be significant and has the expected sign, which is negative. This is because the increase in the premium implies the tighter control in foreign exchange. And this in effect is related to appreciation of the REER. Thus, it has been found that one percent increase in the parallel-official premium causes 0.234 percent appreciation of the REER.

An ambiguous result is observed in the sign of the exchange control. Although the expected sign was negative the result shows that there is a significant positive relationship between REER and exchange control. This result contrasts the findings of earlier studies made on Ethiopia. Both Melesse Minale and Equar Desta found that there is a significant negative relationship between REER and exchange control. But since their estimates are based on quarterly and recent data the trend follows the negative relationship. But looking at the trend for the past thirty years, especially in the Derg regime the trend shows that a REER appreciation is associated with declining import tax revenue to total imports ratio.



This could be the cause for the difference in the expected sign and the actual sign. During the Derg regime the then prevailing command economy was not conducive for the expected market relationship between the exchange control and real effective exchange rate. In the present regime it can be observed that there is a decline in exchange control while the REER has significantly depreciated.

4.3 Error-Correction Model

Having covered the long-run relationship between the variables a further analysis of the short-run dynamics is required in order to see factors affecting the real effective exchange rate in the dynamic short-run. After taking three lags and differencing all the variables, the equation was estimated including the differenced lag of REER and the residual of the long-run equation. The result of this estimation is presented below;

Table 1: Results of the Error –Correction Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000558	0.013713	-0.040687	0.9679
DLNPREM	-0.186868	0.037896	-4.931053	0.0001
DLNINVGDP	0.232124	0.080725	2.875486	0.0094
ECM(-1)	-0.205177	0.086514	-2.371591	0.0279
DLNNOMDEV	0.523968	0.095377	5.493643	0.0000
DLNNOMDEV(-1)	0.217039	0.090605	2.395425	0.0265
DLNCAPINF	0.096576	0.025991	3.715766	0.0014
DLNCAPINF(-1)	0.069041	0.023857	2.893964	0.0090

R-squared 0.853871 Akaike info criterion -2.211529
Adjusted R-squared 0.802725 Schwarz criterion -1.830899
S.E. of regression 0.071206 F-statistic 16.69501
Log likelihood 38.96141 Prob. (F-statistic) 0.000000
S.D. dependent var 0.160317

The coefficient for the error correction term is found to be significant and with the expected negative sign. It signifies the speed at which the short-run dynamics adjusts to the long-run equilibrium.

The constant have been found to be insignificant in the short-run; capital inflow, the lagged value of error correction term, nominal devaluation (both lagged and level), investment as percent of GDP and the parallel-official premium have been found to be significant at 1% significance level. The estimation for all variables is done after transforming the original data into their logarithmic form and after differencing them once.

As expected, the nominal devaluation accounts for the biggest influence on the change in REER in the short-run with a coefficient of 0.523. This means that a one percent increase

in nominal devaluation is bound to create a 0.523 percent change in the REER. The other most important variable is the lagged value of investment as a ratio of GDP itself having a coefficient of 0.232. The error correction term then follows suit with a coefficient of -0.20. The result also shows that parallel-official premium and capital inflows affect REER with respective coefficients of -0.186, 0.092.

4.4 Trends in Equilibrium Exchange Rate

By using the estimated equilibrium values of the fundamentals of REER, most studies attempt to construct the equilibrium real exchange rate. Different methods of estimating the equilibrium values of the fundamentals of REER are proposed by different writers. But the most commonly used is the method of smoothing out temporary fluctuations in the data of the fundamentals in order to create fairly permanent trends. Using five year moving average to smooth the data this study has attempted to estimate the equilibrium real exchange rate based on the smoothed fundamentals. This method of constructing the ERER considers the equilibrium not as a fixed but a transitory and flexible variable that moves when its fundamentals change. According to the analysis of this paper the equilibrium real exchange rate takes the following trend.

Figure 2: Trends in Equilibrium and Actual Real Effective Exchange Rates

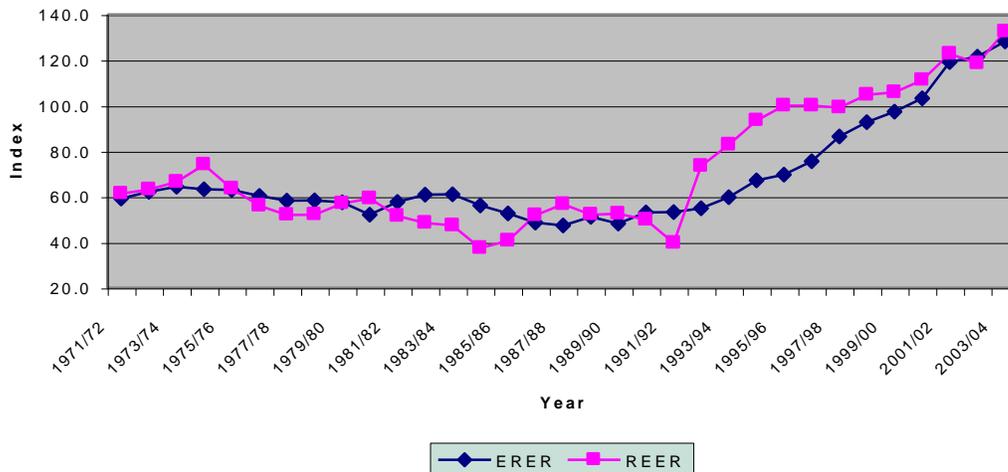
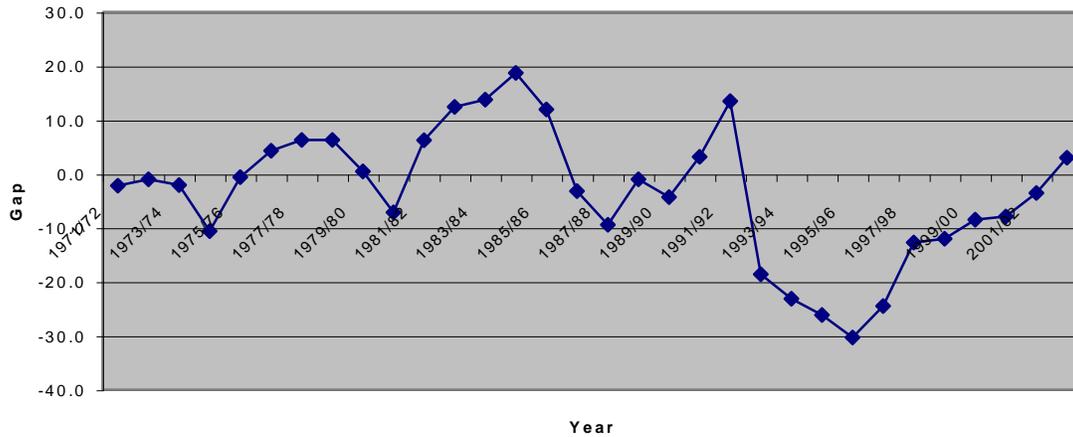


Figure 3: The Misalignment of the REER from its Equilibrium



The misalignment of the REER from the equilibrium value is presented in figure 2 above. As can be seen from the above figures both the equilibrium and the actual REER appreciated in general, but with a varying degree, until the end of the Derg regime which is expected considering the over valuation of the Birr and the fixed exchange rate regime prevailing at the time. In this period the nature of the economy (command economy) has inhibited the workings of the market which would make it difficult to properly associate the trends in the equilibrium exchange rate with its fundamentals. Taking a look at the recent trends, the Birr has been undervalued from the years 1992/93 to 1996/97 then becoming briefly overvalued until 2001/02 and then again become undervalued in the years 2002/03 and 2003/04. In the post 2001/02 period the actual and equilibrium real exchange rates seem to have a lower gap owing to the introduction of the inter-bank market, which is a relatively liberalized market. In general, the recent trend reveals that both the equilibrium and the actual REER have been depreciating (although with a varying degree) owing to a more liberalized external sector.

4.5 An Alternative Way of Determining Equilibrium Real Exchange Rate

The above exercise of determining equilibrium real exchange rate is prone to a lot of statistical flaws that would deviate the real picture of equilibrium exchange rate pragmatically. This can be substantiated in a number of ways.

First of all, the use of proxies in the equations forces the analysis to be limited to only certain features of the originally intended fundamentals, thereby leaving out important information that could be useful in policy and decision making. For example, the use of government consumption as a percentage of GDP to substitute government consumption of non-tradables has its own problems. This is because it would be highly unrepresentative if most of the government expenditure is made on tradable goods. Similarly the use of parallel-official premium to substitute exchange controls is also prone to discrepancy since other external factors such as border controls, also determine movements in parallel market thereby the parallel official premium. Therefore, the movement in the premium might not necessarily signify the presence or absence of exchange control.

The other shortcoming of relying on the econometric estimates, involves the assumptions related to statistical estimation methods. The theoretical underpinnings of statistical estimation methods involve assumptions, which in reality may not prevail. This would greatly undermine the results obtained from the estimation. For example, in order to comply with the multicollinearity assumption, important variables, which in theory affect

Table 2: Trends in Equilibrium and Actual Real Effective Exchange Rates

Year	ERER	REER	Misalignment (in %)
1971/72	59.1	61.3	-2.2
1972/73	62.1	63.1	-1.0
1973/74	64.3	66.4	-2.1
1974/75	63.3	74.0	-10.6
1975/76	63.0	63.6	-0.6
1976/77	60.3	56.0	4.3
1977/78	58.2	52.0	6.3
1978/79	58.3	52.0	6.3
1979/80	57.5	57.0	0.5
1980/81	52.1	59.2	-7.1
1981/82	57.7	51.5	6.2
1982/83	60.9	48.5	12.4
1983/84	61.1	47.3	13.7
1984/85	56.1	37.4	18.7
1985/86	52.6	40.7	12.0
1986/87	48.5	51.8	-3.2
1987/88	47.3	56.8	-9.4
1988/89	51.1	52.1	-1.0
1989/90	48.1	52.4	-4.3
1990/91	53.0	49.9	3.2
1991/92	53.2	39.7	13.4
1992/93	54.9	73.5	-18.7
1993/94	59.7	82.9	-23.1
1994/95	67.2	93.3	-26.2
1995/96	69.6	99.9	-30.3
1996/97	75.5	100.0	-24.5
1997/98	86.5	99.2	-12.7
1998/99	92.7	104.7	-12.0
1999/00	97.3	105.8	-8.5
2000/01	103.1	111.1	-7.9
2001/02	119.1	122.7	-3.6
2002/03	121.5	118.5	3.0

the REER, are omitted from the equation. The omission of government consumption as a percent of GDP in the long-run equation is one example. Another example is that the sign of exchange control is positive as it was estimated using the data trend of the last thirty years. This would cause a problem in forecasting the equilibrium exchange rate for future

years. This along with the technical shortcomings of the estimators again may conceal the exact picture of the equilibrium exchange rate.

In light of these shortcomings another more simple method of determining equilibrium real exchange rate is offered in this paper. This method involves selecting a base year in which economic activity is believed to be in or close to equilibrium. By taking a year in which most of the balance of payments or more specifically, the current account is in or near equilibrium, the REER in that year would be taken as the equilibrium exchange rate. Although this method is relatively simple it is used in most pragmatic decision-making issues. For instance, price indices, used for lots of decision-making, are constructed based on a base year.

For this paper the base year, which was used to calculate the REER by Melese Minale, is used since it is the year in which the trade deficit to exports ratio is the smallest. Other writers, like Equar Desta (2001) also use this base year. In this case the year 1996/97 is used as a base year because of the above stated criteria. Therefore the equilibrium exchange in 1996/97 is considered as the equilibrium real exchange rate.

This method assumes that the equilibrium real exchange rate is a fixed amount as opposed to the econometric calculation of the ERER exercised above. This is one shortcoming of this method since obviously a change in the fundamentals of the real exchange rate is bound to bring about a change in the equilibrium level. In addition to this, a basic assumption for this method is that there is both external and internal equilibrium in the chosen base year. But this assertion is made based on the relative comparison of recent years. In absolute terms, there could have been dis-equilibrium in the markets. Besides this, the small trade deficit to exports ratio doesn't imply the saturation of the market as implied by both external and internal equilibria.

The above shortcomings, however, don't disqualify the use of values in the base year as an approximation of the equilibrium value of exchange rate. As stated above, many macroeconomic indices consider the base year values as relative equilibrium. And using

these values would ensure consistency in devising macroeconomic policies based on the equilibrium real exchange rate.

5 Conclusions and Remarks

5.1 Conclusions

The above finding has helped to identify both the long run and the short-run determinants of the real effective exchange rate using econometric analysis. The paper has also involved the construction of the equilibrium exchange rates in two ways, using econometric analysis and selecting a base year value.

The econometric analysis has revealed a moving equilibrium exchange rate estimate. It has been found that in the long run parallel-official premium, terms of trade, and exchange control are the significant determinants of the equilibrium exchange rate. A short-run dynamic model has also been estimated to reconcile the long run and the short-run movements in the exchange rate. In this model, the lagged values of the REER; the official-parallel premium, capital inflow and nominal devaluation have been found to be significant in the short-run.

Based on the above model the equilibrium real exchange rate was estimated using moving averages of the fundamentals to estimate the equilibrium value of the fundamentals. It can be seen that both the actual REER and equilibrium exchange rate seem to appreciate until the end of the Derg regime and depreciate after that. The actual REER is seen to have been undervalued during the years 1992/93 to 2001/02, become overvalued in 2002/03 and undervalued again until the present period.

Although a plausible result seems to have been found, the real picture of the equilibrium real exchange rate might not be represented by this figure. This is because of the fact that the analysis involves proxies that might misrepresent the actually intended variables. This along with the flaws in the statistical methodology may have constrained the result's capacity to represent the actual equilibrium exchange rate. Because of this reason another method of determining equilibrium exchange rate is forwarded.

This new methodology involves choosing a value of the REER in a base year in which both external and internal equilibria are experienced in relative terms. Since the choice of base year is used in calculating other major macro-economic variables like prices, it would help to have a consistent estimate for policy purposes. Although this is true this methodology has its own problems too. Initially, the basis of selection of a base year does not necessarily signify the presence of equilibrium since equilibrium requires the current account balance to be zero or near zero implying the saturation of the market. But the selected base year might not be characterized by these features of equilibrium.

5.2 Remarks

Considering the above facts, this study puts forward the following suggestions to be taken into consideration.

It can be seen from the results that the actual real effective exchange rate has increased in recent periods relative to its equilibrium value. However during the past two and three years the actual REER is seen to be relatively becoming closer to each other compared with past trends. This is probably due to the starting of the inter-bank foreign exchange market, which relatively reflects the market situation. It is therefore important to increase the means to encourage the workings of the market, as it will help in realigning the REER with its equilibrium value.

As stated above, the real effective exchange rate is a function of macroeconomic variables, which can be affected through policy measures. The major determinants like nominal devaluation and parallel-official market premium can be influenced using policy instruments that would duly change the REER. It is, therefore, very essential to follow up the movement of the major determinants of the REER in order to monitor its movements away from its equilibrium level.

The other issue is that the choice of equilibrium exchange rate should be based on the selection of a base year for the purpose of policy making since it would ensure

consistency of measurement with other macroeconomic decisions although it has sizable shortcomings. The choice of a base year is the most important issue here and it should basically be chosen taking into account the criteria that the year has a trade deficit to exports ratio to a minimum level.

The next step would be to make arrangements to interpret the movements in the REER and EREER into actual movements in the nominal effective exchange rate. But this would require the projection of prices of partner countries and nominal exchange rates of partner countries so as to see what percent change in the nominal exchange rate would bring about the desired change in the REER to realign it with the EREER.

The last but not the least recommendation is that this study should be continuously revised so as to update the relationships and have a more timely and reliable estimates.

Annex I: Test and Examination Results (E-Views)

Test of Cointegration

Unit Root Test on the Residual.

ADF Test Statistic	-3.629839	1% Critical Value*	-3.6852	
		5% Critical Value	-2.9705	
		10% Critical Value	-2.6242	
*MacKinnon critical values for rejection of hypothesis of a unit root.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(ECM)				
Method: Least Squares				
Date: 04/01/04 Time: 02:09				
Sample(adjusted): 1974 2001				
Included observations: 28 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic Prob.	
ECM(-1)	-0.806949	0.222310	-3.629839	0.0013
D(ECM(-1))	0.313024	0.198239	1.579026	0.1269
C	0.006382	0.033865	0.188439	0.8521
R-squared	0.349297	Mean dependent var	0.012452	
Adjusted R-squared	0.297241	S.D. dependent var	0.213339	
S.E. of regression	0.178844	Akaike info criterion	-0.503654	
Sum squared resid	0.799625	Schwarz criterion	-0.360918	
Log likelihood	10.05116	F-statistic	6.710007	
Durbin-Watson stat	2.029238	Prob(F-statistic)	0.004648	

Estimation Output (e-views)
Long Run Estimation Output

Dependent Variable: LNREER				
Method: Least Squares				
Date: 09/30/04 Time: 04:25				
Sample(adjusted): 1972 2001				
Included observations: 30 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.643317	1.308454	2.020183	0.0547
LNPREM	-0.234330	0.029475	-7.950059	0.0000
LNEXCON	0.507097	0.131096	3.868133	0.0007
LNTOT	-0.226642	0.069973	-3.238974	0.0035
LNNOMDEV	0.574047	0.190696	3.010268	0.0061
LNCAPINF	0.089822	0.050651	1.773366	0.0889
R-squared	0.866138	Mean dependent var	4.174474	
Adjusted R-squared	0.838250	S.D. dependent var	0.338350	
S.E. of regression	0.136078	Akaike info criterion	-0.974318	
Sum squared resid	0.444414	Schwarz criterion	-0.694079	
Log likelihood	20.61477	F-statistic	31.05789	
Durbin-Watson stat	1.157169	Prob(F-statistic)	0.000000	

Short-Run Dynamics

Dependent Variable: DLNREER				
Method: Least Squares				
Date: 09/30/04 Time: 05:32				
Sample(adjusted): 1974 2001				
Included observations: 28 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000558	0.013713	-0.040687	0.9679
DLNPREM	-0.186868	0.037896	-4.931053	0.0001
DLNINVGDP	0.232124	0.080725	2.875486	0.0094
ECM(-1)	-0.205177	0.086514	-2.371591	0.0279
DLNNOMDEV	0.523968	0.095377	5.493643	0.0000
DLNNOMDEV(-1)	0.217039	0.090605	2.395425	0.0265
DLNCAPIINF	0.096576	0.025991	3.715766	0.0014
DLNCAPIINF(-1)	0.069041	0.023857	2.893964	0.0090
R-squared	0.853871	Mean dependent var	0.021928	
Adjusted R-squared	0.802725	S.D. dependent var	0.160317	
S.E. of regression	0.071206	Akaike info criterion	-2.211529	
Sum squared resid	0.101405	Schwarz criterion	-1.830899	
Log likelihood	38.96141	F-statistic	16.69501	
Durbin-Watson stat	1.419068	Prob(F-statistic)	0.000000	

Annex II: Selection of Base Year

Picking Out the year in which the trade deficit to export ratio is the smallest, 1996/97 was selected. (Melesse, 2001)

Year	Trade Balance	Export	Ratio
1993/94	-3321.1	1419.2	-2.34012
1994/95	-3711.2	2835.1	-1.30902
1995/96	-6255.5	2607.1	-2.39941
1996/97	-4613.7	3891.5	-1.18558
1997/98	-5196.4	4141.6	-1.25469
1998/99	-8064.7	3637.3	-2.21722
1999/00	-9158.0	3957.8	-2.31391
2000/01	9287.9	3679.8	2.524023
2001/02	11020.0	3465.3	3.1801
2002/03	11787.0	4142.4	2.845452

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