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An Evaluation of the KIPPRA-Treasury Macro Model and Kenya's Economy Using Historical Simulations

Maureen Were

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THE KENYA INSTITUTE FOR PUBLIC POLICY RESEARCH AND ANALYSIS (KIPPRA)

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Kenya Institute for Public Policy
Research and Analysis

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Abstract

Model simulations are performed for different reasons, such as policy evaluation, historical policy analysis and model testing. Ex ante simulations tend to be more popular, particularly for the purposes of evaluating policies before they are implemented. Although there is less experience with ex post modeling, simulations concerning the past are just as interesting as those concerning a future period. The KIPPRA-Treasury Macro Model (KTMM) is a macroeconomic model for the Kenyan economy and a vital tool in planning and policy making process. It has been in operation since August 2000. After a period of time, it is generally important to analyse the performance of the model, particularly in predicting specific variables. Using historical simulation analysis, the paper evaluates KTMM in terms of robustness of its predictive power and, more importantly, provide a better understanding of the past structural economic changes and policy regimes focusing on the period 1973-2003. The analysis shows that most of the variables, such as levels of private investments and private consumption, have been operating below their potential values, based on the simulated trends depicted by the respective equations in the model, particularly in the later years. The exchange rate simulations show a marked appreciation of the Kenya shilling against the US dollar since the early 2000s. This has implications for sectors like the export sector, which is key to spearheading economic growth. The simulation analysis also shows that (total) wages in the formal private sector increased significantly in the most recent period considered (1998-2003). In general, there is potential for the economy to perform better and what is needed are measures aimed at resuscitating the economy.

On average, the (behavioural) equations in the model perform fairly well in terms of predictive power. Generally, there is a very close match between simulated and actual values in the 1970s and 1980s when the economy was controlled and less open than in the liberalized, market-oriented period of 1990s and 2000s, perhaps indicating the kind of forecasting difficulty associated with a liberalized, free market economy. For the purposes of improving future forecasts, there is need to re-estimate some of the behavioural equations using recent data. That notwithstanding, it is inadvisable to judge policy models like KTMM purely by forecast accuracy since such models play a far much more important role in policy analysis and evaluation via policy simulations. Moreover, uncertainty is a fact of life in the modeling world. However, continuous update of the model with latest economic data and incorporation of new information in the economy is vital, and can go a long way in improving the forecast. Given the critical role of KTMM, more analysis and monitoring of variables is important.

Abbreviations and Acronyms

BOP	Balance of Payments
CBS	Central Bureau of Statistics
CPS	Cumulative Production Structure
GDP	Gross Domestic Product
KEPSA	Kenya Private Sector Alliance
KTMM	KIPPRA-Treasury Macro Model
MMC	Micro Macro Consultants
MTEF	Medium Term Expenditure Framework
SNA	System of National Accounts
VAT	Value Added Tax

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1. Introduction

Simulations of a model are performed for different reasons, such as model testing and evaluation, historical policy analysis, forecasting, etc. The time horizon over which the simulation is performed depends on the objective of the simulation. *Ex ante* simulations tend to be more popular, particularly for the purpose of evaluating policies (policy analysis) before implementation (Were and Karingi, 2002). However, simulations concerning past periods are just as interesting as those concerning a future period (van Schaaijk, 1993). Unfortunately, there seems to be less experience with *ex post* modeling than with *ex ante* modeling. Also, there seems to be few models that suit the specific *ex post* simulation needs without adaptation. For instance, models rarely include all relevant policy instruments that the post evaluations need to deal with. However, most models that are originally conceived for forecasting and policy simulation purposes, such as the KIPPRA-Treasury Macro Model (KTMM) can, in many cases, be used as a starting point for the *ex post* counterfactual analysis.

KTMM is a macroeconomic model for the Kenyan economy. It has been in operation since August 2000. The model outputs help in forecasting the resource envelope within which the national budgets are prepared and, more importantly, provide guidance in the policy making process, for example on issues of prioritization of expenditure and economic policy options by way of simulations. So far, the model has performed well in terms of overall macroeconomic projections and *ex ante* policy simulation analysis. After a period of five or so years, it is often desirable to re-estimate the (behavioural) equations, based on the premise that the structure of the economy may have changed. Inadequate specification or inaccurate estimates can induce poor forecasts. Additionally, unanticipated changes are insidious -- the economy may converge to new equilibrium, yet the forecasting model remains at old values (Banerjee

et al., 2005). However, it is generally important to analyse how well the model has performed, particularly in predicting specific variables, before embarking on a re-estimation exercise. So far, this has not been done. Using historical simulation analysis, the paper seeks to evaluate KTMM in terms of robustness of its predictive power and, more importantly, makes a first attempt to use KTMM for historical analysis of the economy, thereby providing a better understanding of the past structural economic changes and policy regimes.

The rest of the paper is organized as follows. Section 2 gives a brief overview of historical simulation analysis. Section 3 describes the economic overview of the economy in the past while section 4 outlines the structure and main features of KTMM. Historical analysis by way of simulations is discussed in section 5. Section 6 gives the conclusion and policy implications.

2. What Does Historical Simulation Entail?

In a way, *ex post* evaluation or modeling is different from the conventional modeling for forecast and scenario analysis. The *ex post* or historical simulation uses historical data in which the model is simulated backwards in time – the values of the endogenous variables are determined by the simulation solution (Pindyck and Rubinfeld, 1998). A historical simulation uses a baseline in the past – actual values of variables in a year or years in the past.

Unlike *ex ante* modeling, it is not meant to assess the impact of future policies; rather, it is meant to assist in assessing the effectiveness and efficiency of policy instruments with respect to policy objectives (target variables), by comparing alternative (policy) scenarios to the actual reference scenario. Actual policies are checked and compared to what would have happened without them. The change in policy (e.g. a new policy rule) is confronted with the estimates of shocks that actually occurred in some historical time period. If the model is correct, the historical simulations can help us determine whether the alternative policy would have performed better or worse than the actual historical policy prescribed. For instance, one can use a macroeconometric model to examine the consequences of what might have occurred from changes in the level of government spending, tax rates or money supply.

The overall goal in this paper is first, to contribute to evaluation process of the KTMM, i.e testing the effectiveness of not just policy instruments but also behavioural equations in the model. A comparison of the original data series with the simulated series for each endogenous variable is a powerful test of the validity of the model, e.g. dynamic stability or gauging the magnitude of simulation errors. Secondly, historical simulations give us a framework for contextualised historical thinking about the past. There is often a tendency to take the past for granted, to think about the past in overly simplistic ways – why did they not it get

right? – without appreciating the context under which the conclusions (different from one's own possible outcomes) were made. Through historical simulation analysis, we are able to understand and gauge the structural changes and breaks in the economy over time.

3. Economic Overview of the Past (1973-2003)

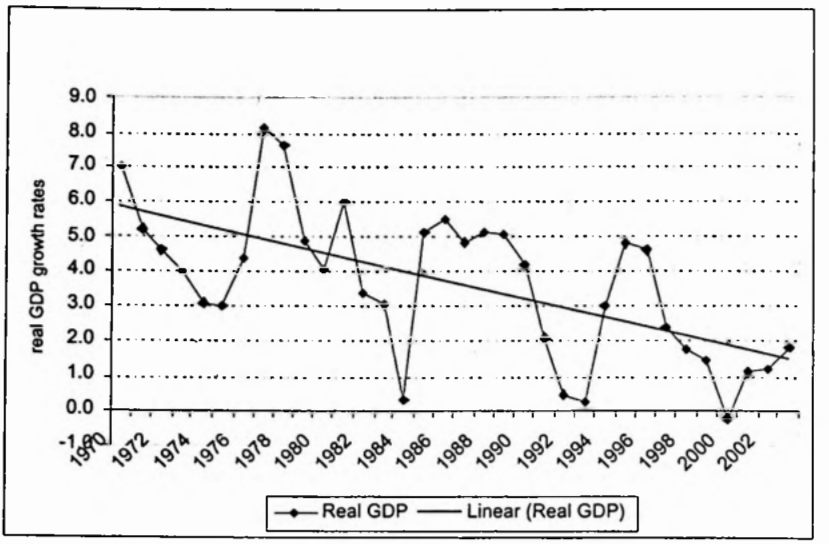
A critical aspect of good historical analysis is understanding the historical context (Polman, 2002). This section gives an overview of the economy over the past, focusing on the period 1973-2003 since time series data in KTMM starts from 1972/1973, and from 2004 onwards, national accounts data has been changed to the new System of National Accounts (SNA) 1993 format, which in some cases, may not be consistent with the previous (SNA 1963) data series[1].

The economic history of Kenya can be broadly classified into pre- and post-liberalization era. The 1970s were characterized by controls and regulations in virtually all the key sectors (interest rates, domestic prices and foreign exchange rates were controlled). With mounting pressure from the Bretton Wood institutions, the government started slowly relaxing the price controls and liberalizing the economy in the 1980s. However, progress was slow and it was not until the 1990s that the economy was earnestly liberalised. In spite of this, Kenya's economic performance has been dismal, as depicted by a declining trend in real Gross Domestic Product (GDP) growth rates over the past three decades (Figure1).

For analytical purposes, the past is split into specific periods of about 5 year-interval. This allows us to capture regime changes, historical and other economic events unique to a particular period. A brief excursion of the specific periods is highlighted below.

[1]For details about SNA1993, see United Nations website: http://unstats.un.org/unsd/sna1993/. The model has already been adjusted to conform to the SNA 1993 that was recently introduced by the Central Bureau of Statistics (CBS). However, for the purposes of this paper, and now that CBS started reporting in this format only recently (2004), historical simulations will be conducted using the model version with the old data series. In any case, the equations were estimated using the old data series. Note that not all variables in the model are national accounts variables.

Figure 1: Trend in real GDP growth rates, 1970-2003



1973-1977: This period experienced terms of trade shocks coupled with fiscal indiscipline. The economy experienced escalating Balance of Payments (BOP) and current account problems following the first oil shock of 1973. For the 1973-75 period, inflation rose from 9.3 percent to 19.2 percent, domestic credit increased by over 60 percent and government's external and internal borrowing also increased (Ndung'u, 1993). The commodity (coffee) boom of 1977 sparked of a spending spree for both government and private sectors, leading to a fiscal deficit of 9.5 percent of GDP in 1975/76. The momentous economic performance (with a real GDP growth rate of over 6%) in the first decade of independence was slowed down, and the economy managed to achieve only a modest real GDP growth rate of 4.5 percent during the period. Overall, the period experienced considerable economic turbulence.

1978-1982: The foreign reserves that had been built up to record levels following the coffee and tea booms were depleted in 1978 when imports increased and exports fell remarkably. The second oil crisis of 1979 (due to Iraq-Iran war) resulting in near doubling of crude oil prices coupled

with severe drought in the same year had far reaching effects. The government responded by tightening the controlled trade regime and resorting to external financing from the Bretton Woods institutions. However, funding was predicated on undertaking liberalization reforms. Therefore, in the early 1980s, the government slowly started deregulating and liberalising the economy under the Structural Adjustment Programme[2]. However, there was lack of commitment and not much was achieved. The expanded private and public spending following the coffeee boom of 1977 created excess aggregate demand, leading to inflation rate of 22 percent in 1982. Nevertheless, the economy performed fairly well, with real GDP growth rate averaging 5.2 percent during the period.

1983-1987: Growth in agriculture was hampered by a severe regional drought in 1984 (which also devasted neighbouring countries). There was some economic recovery, as Kenya experienced a mini-coffee boom in 1986, following a considerable international price increase of coffee, leading to a real GDP of 5.7 percent. However, this was short-lived. With other problems such as unfavourable weather, real GDP growth rate dropped to an average of 3.8 percent during the period. The government produced Sessional Paper No.1 of 1986 on *Economic Management for Renewed Growth*, which marked a major policy shift towards liberalizing the economy, and was later used as the basis for sectoral reforms (Were *et al.*, 2005).

1988-1992: There was a donor aid freeze on BOP support in November 1991, following clamor for multi-party democracy, stifling most of the government's expenditure and reform programmes. The economy was also distracted following a crisis in the banking sector. There was build up in growth of monetary variables such as inflation and money supply

[2] Kenya received the first Structural Adjustment Loan from the World Bank in 1980.

in the run up to the first multi-party general elections[3] held in December 1992.[4] Broad money grew by 34 percent in 1992, way above a target of 9 percent. Real interest rate became negative as inflation rose to 29 percent. With no quick resumption in foreign aid, there was a build up in domestic debt, exacerbated by increased borrowing from the domestic market. During 1991, the public sector deficit remained above 11 percent of GDP. The economy was pushed into a recession, growing at only 0.5 percent in 1992 from a growth rate of 2.1 percent in 1991. Real GDP growth rate averaged 3.4 percent for the period. In a nutshell, the economy continued to experience a downward trend (Figure 1). Externally, the world recession coupled with the Gulf war in the early 1990s did not help the situation.

1993-1997: This period could be viewed as a critical period in Kenya's economic history, as there was a significant turn around of events ranging from deterioration in economic performance to dwindling donor support. By 1993, it was clear that the economy was in a crisis and drastic steps were needed to resuscitate the economy. The period witnessed the highest instability in most of the nominal macroeconomic variables particularly around 1993. Inflation shot from around 27 percent in 1992 to over 40 percent, while exchange rate (Kenya shillings per US$) doubled (depreciated) from previous year to about Ksh 60 per US$ in 1993. Money supply and interest rates also overshot their trend values. At one point, the Treasury bill rate – which often acts an anchor for other forms of interest rates – was over 70 percent. Real GDP growth rate had deteriorated to a mere 0.2 percent in 1993. Implementation of tight fiscal and monetary policies had proved difficult.

[3] Presidential, parliamentary and local authorities.

[4] The elections coincided with financial scams, which involved some politically-connected banks that later collapsed.

However, speedy implementation of reforms towards liberalisation of trade and foreign exchange markets, coupled with resumption of donor funding in December 1993 seem to have eased the economic crisis. By 1994, there were signs of movement towards internal economic stability. The exchange rate and interest rates stabilized, though the fiscal deficit still remained high. There was a positive growth in investment for the first time since 1990. High prices in world coffee market and producer incentives led to a surplus in current and overall BOP, and real GDP grew by average of 4.7 percent for 1994-1995 period. However, this was short-lived since foreign aid was again suspended in August 1997 by the multilateral institutions due to poor governance, especially in public sector institutions. The unprecedented volatility of variables witnessed during the period, particularly in 1993 and 1994, is likely to show up in the simulation analyis since it implies a significant deviation from the long run path.

1998-2003: By this period, real GDP growth had deteriorated to an average of 1.1 percent. The El Nino effects of 1997 impaired major infrastructure networks (roads, bridges, etc) and significantly affected the economy. Financial constraints exacerbated by suspension of Enhanced Structural Adjustment Facility in August 1997 only made the situation worse. There was also a drought in 2000, disrupting socio-economic activities. However, the monetary variables such as exchange rate and interest rates remained stable.

4. An Overview of the KTMM

KTMM has basically been developed for short- and medium-term forecasts, ranging from about 4 to 6 years[5]. KTMM plays a critical role in the budget process under the Medium Term Expenditure Framework (MTEF) by providing projections of macroeconomic aggregates in a consistent framework. The model is also used for analyzing the effects of economic developments on the budget framework, evaluating policies and building different scenarios based on different assumptions and unforeseen events such as drought, deficits in budget financing, among others.

KTMM is an empirical macro model of a market economy, and it describes the behaviour of market actors. It is built along the fairly familiar aggregate demand-aggregate supply framework. The real side of the economy in the model contains four types of agents: domestic production (private firms, parastatals and public service sector); households; government; and the rest of the world. The model contains three types of markets: labour, product and financial markets. Total demand equals the sum of investment, consumption, government expenditure and exports. Total demand minus imports equals GDP at market prices.

Basic prices are determined endogenously in the model; that is, price of goods and services, nominal and real wage, nominal and real exchange rate, and domestic nominal interest rate. Wages and prices are determined in the labour market and product markets, respectively. The exchange rate and interest rates are determined in the financial market. It is assumed that the exchange rate is floating so that money supply is

[5] However, the model can also be used to project over a long a period of 10 years and more, only that the further the future, the less accurate the projections.

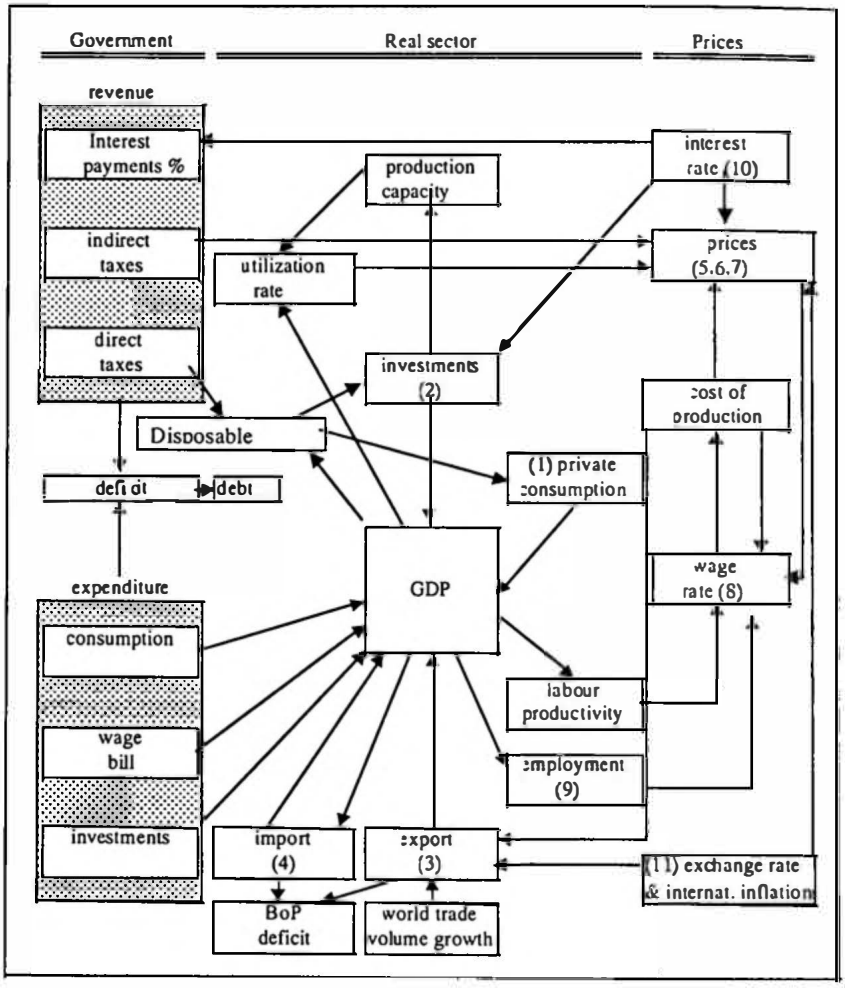
available as an exogeneous policy instrument. The interest rate moves to clear the money market while the exchange rate clears the market for foreign assets (Huizinga *et al.*, 2001).

The model is demand-driven in the short run, with multiplier effects through consumption and investment. It is assumed that the price system ensures that there is excess capacity so that any demand is actually met. This is justified by the liberalised nature of the Kenyan economy. The main feedback mechanisms in the real economy works through wage-price spiral, interest rate and real exchange rate. For example, suppose there is a demand increase; the increased demand will lead to high capacity utilisation of capital and low unemployment rates, which results in wage and price increases. Assuming a non-accommodating monetary policy, the higher inflation leads to higher interest rates and a real appreciation, thus causing a reduction of investment and exports. The drop in exports and investment reduces demand, until equilibrium is restored. The model, therefore, has a tendency to return to equilibrium in the medium term and in the long run (Huizinga *et al.*, 2001).

A summary of the sectors, prices and inter-relationships between variables in KTMM is given in Figure 2. The numbers 1, 2... and so on refer to the behavioural equations in the model. Appendix 1 gives the list of behavioural equations including the estimated coefficients. For a detailed description of the basic theoretical underpinning of KTMM and the estimation procedure as well as estimated results, refer to Huizinga *et al.*, (2001) and Geda *et al.*, (2002), respectively.

The model is built on SNA 93 consistency framework and consists of 50 primary variables with 13 core behavioural equations from which hundreds of other variables (secondary variables) are calculated

Figure 2: Flow diagram of the structure of KTMM



Source: van Schaaijk (2002)

automatically and consistently by definitional relationships.[6] For example, given wage employment and wage bill, the wage rate is computed as the latter divided by the former. Volumes are computed from values and prices. There are three types of primary variables: exogeneous, behavioural and institutional (also called as semi-behavioural – mainly government sector variables). Exogenous variables are determined outside the model, for example world trade price and world trade volume. Endogenous variables, on the other hand, are determined within the model. They include behavioural and definitional equations. Behavioural equations predict the value of a variable on the basis of some explaining factors.

The distinction between primary and secondary variables is used because the approach used in KTMM combines a data-model with a forecast-model (van Schaaijk, 2002). This distinction is only relevant when values for the future are predicted. For the past, all these variables have exogenous values. Primary variables are, thus, given for the past and are obtained for the future on the basis of exogenous assumptions or behavioural and semi-behavioural equations.

[6] Definition equations are used when the relationship between different variables is exactly set by definition. For example, "total wage income" is by definition equal to the sum of wages paid by businesses and the government.

5. Historical Analysis

Before proceeding with the analysis, it is important to note that like other macroeconomic models, KTMM is not meant to accurately predict. This is especially because of the inherently complex nature of the economy and the fact that uncertainty is a fact of life. The strength and weaknesses of the model should not be, thus, based solely on how accurate the model can predict. Besides forecasting, KTMM is also a vital tool for economic analysis, policy making and monitoring of the economy. The historical simulation analysis gives us an impression of the robustness of the model.

Because KTMM was made to produce simulations for the future, it does not take into account special factors or events that happened in some period in the past.[7] In practise, the model is never used by itself, but jointly with additional information based on the events that have just happened and expert opinion. This is done by frequently updating the model and using add factors (correction factors).[8] There are no hard rules about the use of add factors, which are only used where necessary. The magnitude and sign of the add factors is determined by several factors, such as the prevailing or new government policies, unforeseen shocks such as impact of drought (e.g. on imports, prices, etc), updated information gathered by daily monitoring of variables and the prevailing economic situation, among others.[9]

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[7] In empirical estimations, such special events are usually captured by use of dummies. However, forecasting equations do not include dummy variables.

[8] Since the annual national accounts data is only published once annually, a major update of the model is done once a year (after the release of the Economic Survey), during which all the variables in the most recent forecast year are updated with the actual published data.

[9] Add factors are also based on expert opinion by specialists from institutions like the Kenya Revenue Authority (on potential revenue or revenue updates), CBS and Central Bank of Kenya (e.g. on money supply growth) and ministries of planning and finance on government expenditure and financing options. The add factors are, thus, not just fixed arbitrarily but vary depending on the circumstances and what is happening at that particular time.

Because of these frequent updates, changes that might not be purely captured by the equations are usually incorporated, and thus the discrepancy between the estimated and the actual, at least for the last two recent years after the model has been entirely updated has not been overly significant as may be reflected in the analysis in some cases. Thus, the differences generated on the basis of the equations even if larger, can help us to understand the economy better and give an indication of how future forecasts can be improved, for example using add factors. In the long run, even if the equations are re-estimated, unforeseen events and shocks will always be there and use of add factors may still remain handy.

Simulations for the past consecutive years (using the model equations) are used to produce (variable) estimates, which are compared with the realised values. Changes emanating from the historical simulations are analysed period by period, as well as cumulatively—averages for 5, then 10, 15, 20 years and entire period (29 years). Since simulations are based on actual data, the differences are largely driven by the coefficients of the equations for the respective variables (without any add factors). The coefficients for most of the behavioural equations in the model were estimated using time series data ranging from 1972 to 1998/99. The 1998-2003 period, which is also the most recent period in the analysis is, therefore, of significant interest in gauging the performance of the model based on the coefficients. Historical analysis of the economy is undertaken in the process of evaluating the predictive robustness of the model.

The average deviations or discrepancies between the actual data series and simulated values (backward projections—what the various equations in the model would predict based on actual explanatory variables) are summarized in Table 1 for specific period averages and Table 2 for cumulative averages. The focus is on behavioural variables

Table 1: Period specific average differences between actual and simulated values

Variable	1998-2003	1993-1997	1988-1992	1983-1987	1978-1982	1974-1977
Levels: Deviations in Ksh million (absolute deviations as a percent of actual values)						
Investment business value	-5687(5.3)	11422(14.9)	-11014(30.7)	-3542(17.6)	-1213(10.2)	-295(5.7)
Exports of goods and services	226(0.1)	19407(12.4)	-1632(3.2)	-2085(8.2)	-2412(16.6)	3807(41.5)
Imports of goods and services	-5320(1.9)	5069(3.0)	-162(0.3)	-52(0.2)	-862(4.6)	-8(0.1)
Wages (Business sector)	14550(5.8)	-85(0.1)	-3301(7.2)	-1243(5.4)	1570(12.4)	-
Private consumption	-3639(0.6)	9644(3.0)	1781(1.4)	-286(0.4)	336(1.0)	-298(1.7)
Price changes (%): Deviations as percentage points						
Export price	-4.8	1.0	3.0	-2.0	-2.2	-
Import price	2.2	-6.7	-7.6	-2.4	4.5	-
Investment price	-3.9	-4.2	-1.0	4.9	-2.4	-
Consumer price	-4.7	2.4	8.9	4.9	-3.5	-
Monetary variables						
Exchange rate (Ksh/US $)	-4.7	2.3	0.0	0.2	-0.9	-1.1
Short-term interest rate (TBR)	-4.3	-0.2	-0.5	-0.7	0.9	-1.2
Employment						
Wage employment business (thousands)	12.1	10.7	16.1	11.1	-11.5	-

Note: The numbers in brackets are (absolute) deviations expressed as a percentage of the actual values for the respective periods

Table 2: Cumulative average differences between actual and simulated values

Variable	1998-2002(5 years)	1993-2002(10 years)	1988-2002(15 years)	1983-2002(20 years)	1979-2002(29 years)
Levels: Deviations in million Ksh (Deviations as a percent of actual values in brackets)					
Investment business value	-4872(4.7)	3275(3.6)	-1488(2.0)	-2002(3.4)	-1938(3.8)
Exports of goods and services	-3653(1.7)	7877(4.3)	4707(3.4)	3009(2.7)	2168(2.2)
Imports of goods and services	-5021(1.8)	24(0.01)	-38(0.02)	-42(0.03)	-284(0.3)
Wages (business sector)	12805(5.5)	6360(3.7)	3140(2.4)	2044(2.0)	1645(1.9)
Private consumption	-5688(0.9)	1978(0.4)	1912(0.5)	1363(0.5)	1136(0.5)
Price changes (%): Deviations as percentage points					
Export price	-4.7	-1.8	-0.2	-0.7	-0.9
Import price	2.5	-2.2	-4.0	-3.6	-2.1
Investment price	-6.4	-5.3	-3.9	-1.7	-1.8
Consumer price	-5.8	-1.7	1.8	2.6	1.6
Monetary variables					
Exchange rate (Ksh/US $)	-3.5	-0.6	-0.4	-0.2	-0.4
Short-term interest rate TBR)	-3.9	-2.1	-1.5	-1.3	-1.0
Employment					
Wage employment business (thousands)	10	10	12.1	11.9	8.0

Note: The numbers in brackets are (absolute) deviations expressed as a percentage of the actual values for the respective periods

since these are the ones that may require econometric re-estimations[10]. For variables in levels, the average deviations are presented in two forms: simply as differences between the two series and, deviations expressed as a percentage of the realized values (the numbers in brackets). The deviations for percentage price changes are expressed in percentage points.

Gross private investment

The investment equation in KTMM is a combination of flexible accelerator, profitability, investment price, public investments and domestic credit to the private sector (see Appendix 1 for the coefficients). The simulation shows that actual value of total private investment value for the last 6 years spanning 1998-2003 was, on average, lower by about Ksh 5.7 billion than what the model would predict using the investment equation (based on realized or actual explanatory variables such as interest rate, public investment etc) (Table 1). On average, this value represents 5.3 percent of the realized investment value during the period. In the recent past, there has been a significant decline in both private and public investments, consistent with the declining economic performance during the period, and this might explain the discrepancy. If the equation is correctly specified, it also implies that private investments have been operating below their expected long-run potential, especially for the most recent period. This is illustrated in Figure 3, which shows that since around 1999, actual value of investments has been below what the investment equation predicts.

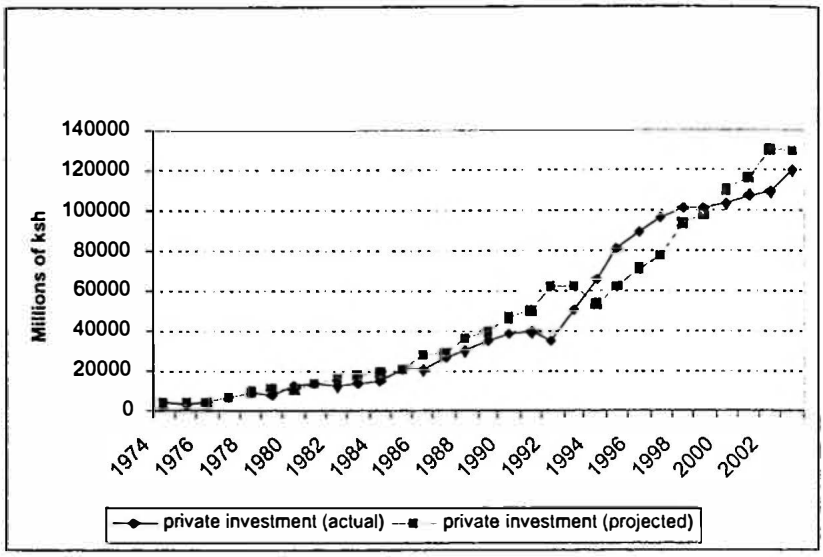
[10] Most of the government variables are semi-behavioural and largely driven by government policies.

A decomposition of the investment value for the period 1998-2003 based on the explanatory variables shows that on average, public investment accounts for 12 percent of the value of private investments; profitability accounts for 48 percent, while acceleration in economic growth accounts for 39 percent. Domestic credit to the private sector has been minimal and hence its minimal contribution of 1 percent. If these variables do not grow or increase as expected, the realized investment will be lower. We can illustrate this point further by showing what would have been the realised value had one of the determinants, say public investments, been higher. A simple simulation shows that if expenditure on public investments was more than the actual for 1999 by an extra Ksh 5 billion, private investments would have increased by an extra Ksh 1.5 billion in 1999 (and an extra Ksh 2 billion in 2003) due to crowding-in and lagged effects of public investments.[11]

Figure 3 shows that the simulated values based on the private investment equation tracks the actual investment fairly closely, particularly for 1970s and 1980s, but starts drifting from early 1990s. The latter also represents the period during which the economy was intensively liberalized. Further analysis shows that the simulated values are higher than actual private investments for the other periods further in the past except for 1993-1997 period, during which private investments performed better than would have been expected (Table 1, 2 and Figure 3). The difference between estimated and the realized values for the period 1993-1997 is about Ksh 11.4 billion on average, which is about 15 percent of the realised value for the period (or 2.4% of GDP). As earlier observed, the economy experienced economic turbulence in most of the variables during the period. However, the temporary pick up in economic growth in 1994 upto 1996 coupled with the increased profitability following the

[11] High quality investments are implicitly assumed.

Figure 3: Realised versus simulated value of private investment



comprehensive liberalization of trade and foreign exchange market were a major boost to private investments.

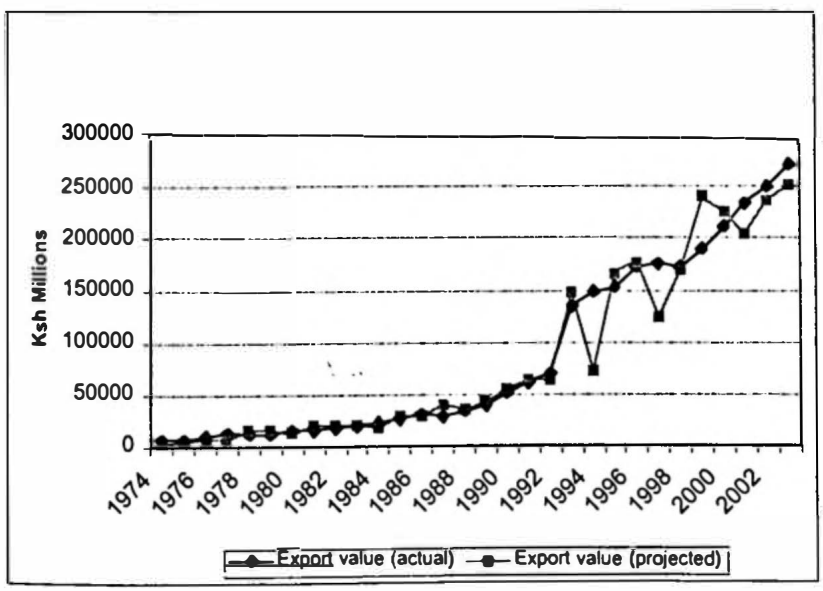
Cumulative averages in Table 2 depict the same pattern; as one moves further into the past, the discrepancy is negative but small, reducing to Ksh 2 billion for the entire period 1979-2002. Usually, in the long run, we expect deviations from the long run path to cancel out or get minimized and hence, the overall over-estimation represents only 4 percent of the actual values, on average.

A quick observation from the analysis is the kind of accuracy witnessed in the backward projections during the pre-liberalisation era (controlled economy) compared to the liberalized, market-oriented era in the 1990s and 2000s. If the trend in actual investment is expected to continue, the forecast for the future years could be improved based on the discrepancy, for example by using negative add factors of more or else equivalent amount in the short run. However, the equation can also be re-estimated using new data, additional variables or new techniques in a bid to generate new coefficients.

Export of goods and services

In KTMM, export of goods and services is a function of export price, income of trading partners, relative prices and private investment-GDP ratio (Appendix 1). Like in the case of investments, Figure 4 shows that the simulated values capture actual value of exports quite well in the 1970s and 1980s but that precise consistence is lost in the 1990s and beyond. There are a number of spikes in the 1990s (1994, 1997 and 1999). The simulated values are higher than actual for some periods and lower for others, particularly 1993-1997, which shows an underestimation of about Ksh 19 billion, on average (12% of actual value for the period). On close scrutiny, the overly huge discrepancy occurred in 1994, with an excess export value of goods and services of Ksh 75 billion (50% of actual value or 18% of GDP). Following the liberalization of foreign exchange market in 1993, the exchange rate depreciated tremendously, leading to an extraordinary increase in export of goods and services. The total export

Figure 4: Realised versus simulated value of export of goods and services



value to GDP increased from 26 percent in 1992 to 40 percent in 1993, the highest ever for the entire period considered. On average, the actual data shows that exports were higher than what the model depicts for the most recent period considered (1998-2003). This implies that exports of goods and services have performed better than would be predicted by the export equation. The export sector holds a lot of potential for growth, particularly with the boost in the tourism sector.

As the time period is increased backwards in the past, the discrepancy declines consistently to about Ksh 2.2 billion (2.2% of the actual values) over a period of 24 years (1979-2002). For enhanced precision and sectoral analyses, the export equation needs to be disaggregated into key export components which can then be projected separately. This is important because factors that explain movements in commodity exports may not necessarily be the same as those for other sectors such as tourism.

Import of goods and services

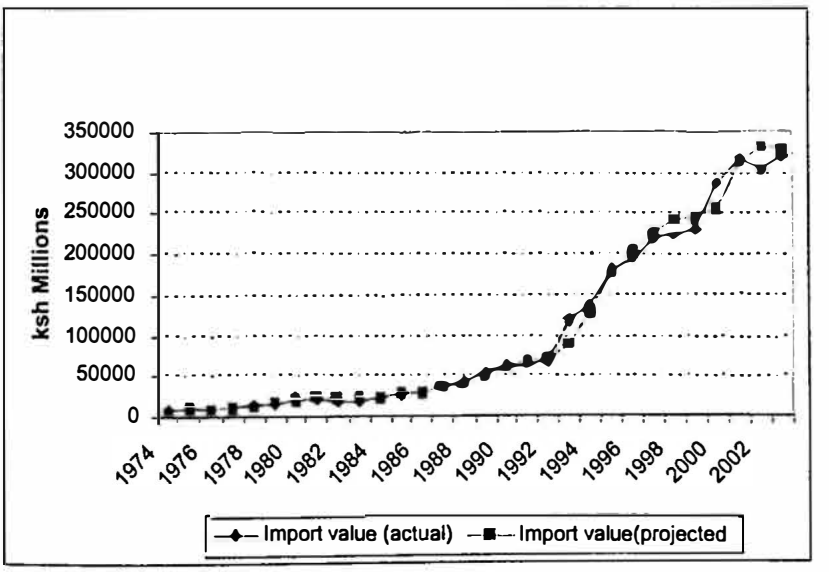
The import equation in KTMM is a function of real final demand (re-weighted by import intensity, based on Cumulative Production Structure (CPS) matrix)[12] and relative prices (import price less domestic consumer price). Changes in relative prices or any additional demand for imports by the various sectors affect the value of imports. Figure 5 shows that this equation tracks the actual value of imports closely. This is also exemplified by relatively small deviations, particularly for the earlier periods of 1970s and 1980s (Table 1 and Figure 5). The average value of imports of goods and services for 1998-2003 is less than the simulated value by about Ksh 5 billion—a deviation of 2 percent of the realised values. However, there is a huge positive discrepancy in the year 2000

[12] The CPS matrix is derived from Kenya's Input-Output tables. The matrix allows computation of the import intensity among other components of the aggregate demand.

of about Ksh 32 billion (11% of actual value or 4% of GDP in 2000), which can largely be attributed to extraordinarily high demand for imports following the drought effects in that year. The simulated values for 1993-1997 period are lower than actual values (by a magnitude of about Ksh 5 billion). Like in the case of exports, there was a huge increase in import demand following liberalization of the foreign exchange market in 1993, as foreign exchange became available to the constrained importers. This largely explains the excess import demand of about Ksh 27.8 billion in 1993 (about 8% of GDP in 1993). On average, the deviation for the entire period (1979-2002) represents only 0.3 percent of average actual import value for the period (Table 2).

The equation performs quite well, on average. However, updated input-output tables can provide an easier way of further improving the equation and hence, the forecast. There is also need to disaggregate imports into final goods and intermediate goods for comprehensive analysis.

Figure 5: Realised versus simulated value of imports of goods and services



Wages (business sector)

In KTMM, wages in formal business sector are a function of growth in wage employment, inflation, labour productivity and informal sector rate (Appendix 1). A comparison of actual and simulated wages points to the fact that (actual) total wages in the private sector increased significantly in the recent past (1998-2003) way above their expected long-run path. On average, total wages are estimated to have been about Ksh 12.8 billion above what the wage equation would predict for the period (Table 1). In other words, actual total wages in the formal private sector were more by about 5.8 percent, based on simulated results using the wage equation. The huge increase seems to have occurred in 2000 and 2001. This is likely a reflection of the rise in wages for skilled labour. There has been concern that wages in Kenya have risen steadily in the private sector without corresponding productivity improvements, resulting into Kenyan enterprises becoming less competitive compared to South East Asian countries (KEPSA, 2005). However, since the formal private sector constitutes only a small proportion of the economy, this should not be interpreted to mean that general wages in the entire economy have increased.

If this trend is expected to continue, the equation might continue to underestimate the wages, and hence, there should be room for adjustments in the forecast (e.g via add factors). However, this equation can be re-estimated or calibrated on the basis of the past few years. The cumulative averages over longer periods in Table 2 show a consistent underestimate. The average for the overall period is about Ksh 1.6 billion (1.9%).

Private consumption[13]

Private consumption changes with (weighted) disposable income (98% wage income and 95% profit income). The simulated values closely match the actual values over time, with the highest deviation recorded in the 1993-1997 period. For the most recent period considered (1998-2003), the backward projections are more than actual values by about 0.6% (or Ksh 3.6 billion) on average (Table 1). This implies that (actual) private consumption for the period declined relative to its expected long run values. There was a particularly huge drop in consumption spending in 2002 of about Ksh 40 billion (4% of GDP). On the contrary, the actual consumption for a slightly earlier period (1993-1997) was higher by about Ksh 9.6 billion (3% of the realised values) than what the model would predict (Table 1). The bulk of this occurred in 1995 and 1997. The huge consumption in 1997 can be explained by the increased spending associated with the general elections held that year.

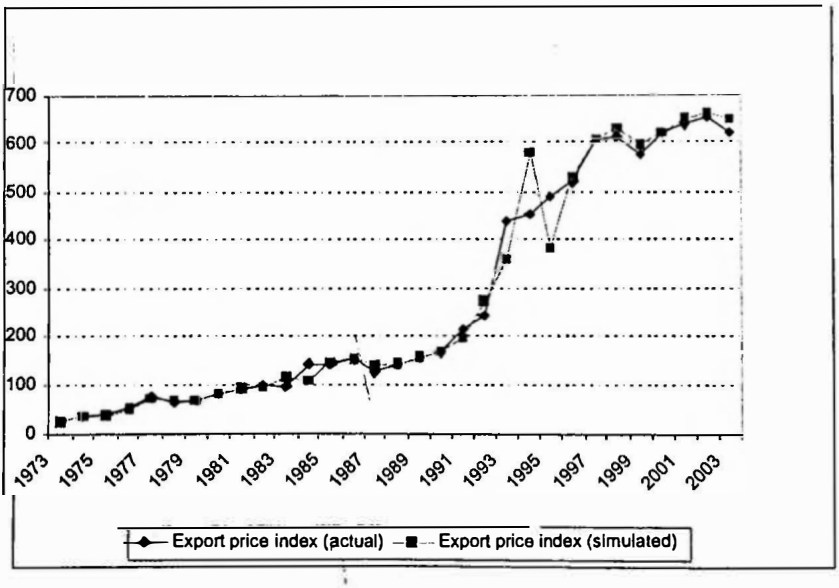
The cumulative averages show a consistent reduction in the discrepancy as one moves further in the past, stabilizing at about Ksh 1.1 billion (for the period 1979-2002. Holding other factors constant, the deviations are generally positive, implying that the equation seems to generally underestimate private consumption. However, given the slight change in the way private consumption is computed in the new SNA 1993, this may not necessarily be the case for future projections and thus, further analysis is needed in reference to forecasting future values.

[13] Before the recent adoption of the new SNA 1993, private consumption was normally computed in the national account statistics as a residual, and consequently contained all the errors that could not be accounted for. Therefore, the discrepancies between the model predicted values and the actuals ought to be interpreted cautiously.

Export price

The export price equation in KTMM is specified as a function of wage costs, import price, world trade price (competitors price) and real interest rate.[14] The exchange rate (Ksh/US $) enters the equation via world trade price, which is converted to Kenya shillings at the prevailing exchange rate. The equation suggests that on average, export prices have fallen in recent times, relative to what we would expect given the long-run relationship. For the period 1998-2003, Table 1 shows that the actual percentage change in export price was, on average, lower than what the export equation would show (based on actual data) by about 5 percentage points, but was higher for the period 1993-1997 and 1988-1992 by 1 and 3 percentage points, respectively. Except for a few years (1994 and 1995) there is a close matching between the simulated and actual price indices

Figure 6: Actual versus simulated export price indices



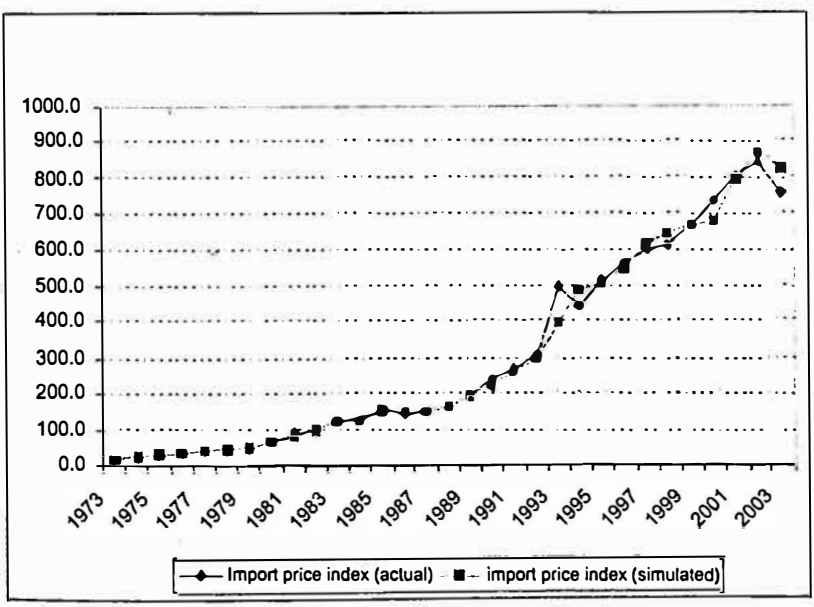
[14] See the coefficients in Appendix 1

(Figure 6). The slight deviation in 1986/87 is largely attributable to the mini-coffee boom, during which international coffee prices went up. However, the cumulative averages in Table 2 show that changes in export price based on the export price are generally just slightly higher. Just as there is need to disaggregate the value of exports into key export categories, there is need to also disaggregate the export price equation by the respective export categories in future.

Import price

Currently, changes in import price in the model are determined by changes in world trade price and indirect tax (VAT and import duty) pressure on imports. Like the export price, the exchange rate (Ksh/US$) enters the import price equation via world trade price, which is converted to Kenya shillings at the prevailing exchange rate. Figure 7 shows a good fit between the simulated and actual series except for some specific years. The positive deviation of 4.5 percentage points for the 1978-1982 period

Figure 7: Actual versus simulated import price indices

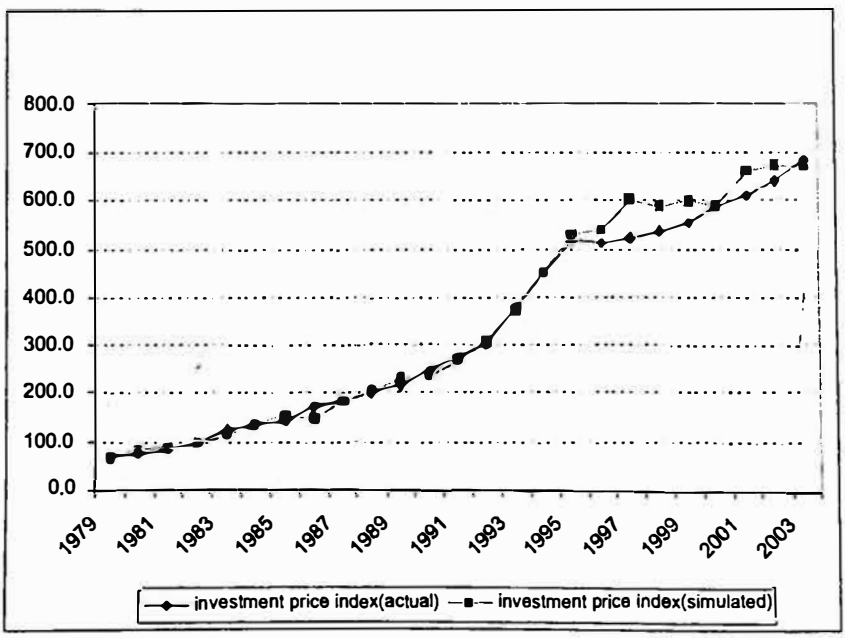


can be explained by overly high oil prices following the second oil price shock of 1979. Oil is a major import category in Kenya.

Investment price

In KTMM, changes in investment price are determined by changes in import price, wage rate, labour productivity, as well as real interest rate and capacity utilisation rate (see Appendix 1 for the coefficients). Figure 8 shows that the simulated investment price index matches the actual investment price index until around 1995. Going by the investment price equation, realized investment price changes are slightly lower, on average, than would be expected except in the period 1983-1987 when they were higher (Table 1). On average, the differences decline in the most recent period (1998-2003) by about 4 percentage points. The cumulative averages show a declining but consistently negative residual, implying some slight over-estimation.

Figure 8: Actual versus simulated investment price indices



Consumer price

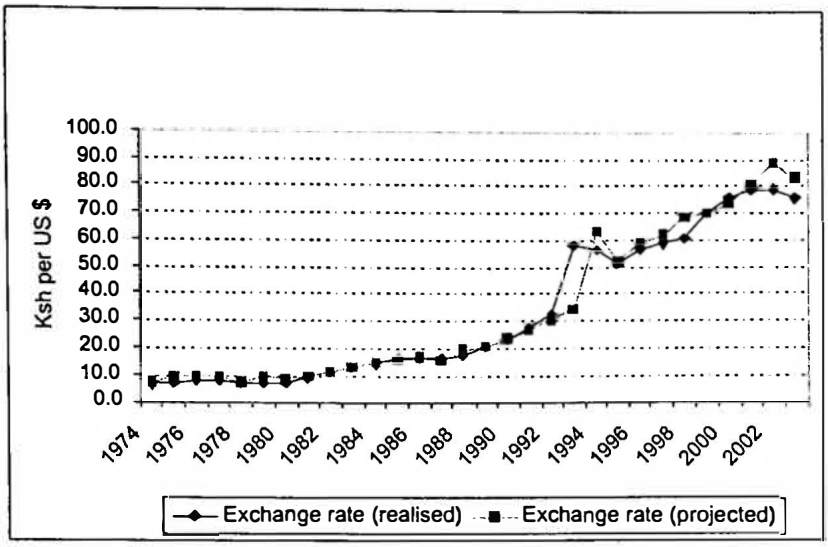
Changes in consumer price (inflation) are a function of wage costs, import price and indirect tax pressure (see Appendix 1)[15]. The numbers provided in Tables 1 and 2 are based on discrepancy from inflation rate as reported by the Central Bureau of Statistics (CBS). The average deviation for 1998-2003 is -4.0 percentage points, implying that in the last 6 years, the inflation rate was lower than would have been expected given the price equation (Table 1 and 2). For a period of ten years, 1992-2003, the average deviation is merely 0.7 percentage points. Given the weight of food in CPI, future re-estimation of this equation should attempt to capture the food component.

Exchange rate

The exchange rate (Ksh/US$) is determined by price differentials (between world trade price and domestic price), changes in interest rate differentials (domestic and foreign (US) short term interest rates), net foreign financing and current account balance as percentages of GDP (for details, see Were *et al.*, 2001 and Appendix 1). The exchange rate equation shows that for 1998-2003, the rate of change for Kenya shillings per US dollar was lower (appreciated) than would have been expected, with about Ksh 5 on average. There has been a general concern in the market about a persistently strong shilling (particularly against the dollar). The Kenyan shilling has been appreciating against the dollar since the early 2000s in a way that may be way above the expected long run equilibrium path.

[15] There has usually been a discrepancy between SNA-based consumer price change (using old SNA 1963) and the inflation as computed by the CBS based on different weights. The former is based on private consumption which, as earlier, indicated was computed in the national accounts as a residual.

Figure 9: Realised versus simulated exchange rate



The average difference of about Ksh 2 between the actual and the model estimates in the period 1993-1997 is largely due to a big discrepancy of about Ksh 24 in 1993, when the shilling depreciated against the dollar to unprecedented levels. This happened immediately after the liberalization of the foreign exchange market – perhaps as an indication of the unmet demand for foreign exchange. However, the exceptional depreciation cannot be analysed in isolation from other economic and political fundamentals at the time. For instance, liberalising the foreign exchange rate market at a time when financial crisis was looming and inflation soaring was wrong timing (Were et al., 2005).

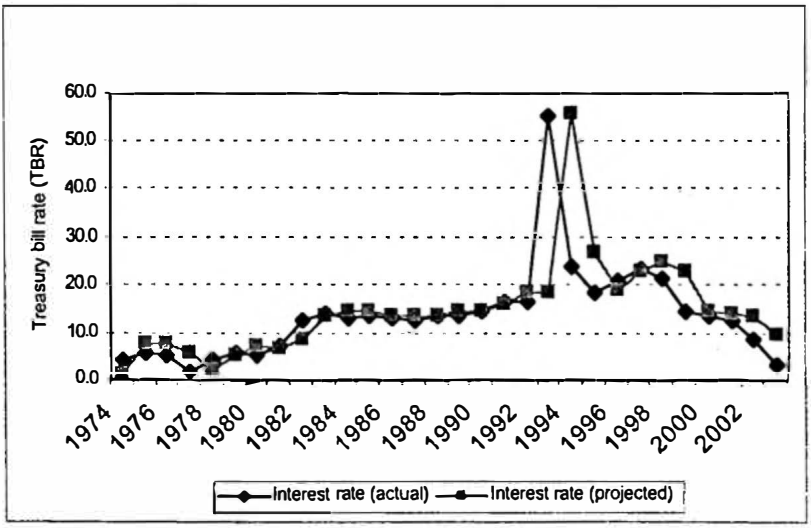
Figure 9 shows that, on average, the equation simulations trace the actual values except for the period after liberalization of the foreign exchange market in 1993. If the shilling continues to strengthen against the dollar, future projections should take that into account. There is also need to

incorporate and forecast other key exchange rates such as the rate of change between Kenya shillings and the Euro. That notwithstanding, in a liberalised market economy, exchange rate is perhaps one of the difficult variables to forecast, given the role of expectations (and speculation) in the market.[16]

Short term interest rates

The short term interest rate used is the Treasury Bill rate, which also forms a benchmark for other interest rates in Kenya. Like in the case of most of the variables, there is a sharp peak in 1993 and 1994 during which there was unprecedented rise in interest rates. For most of 1990s and early 2000s, the simulated or predicted interest rates are slightly higher than the realized rates (Figure 10, Tables 1 and 2). The interest

Figure 10: Actual versus simulated interest rates (TBR)



[16] For details, see Krugman and Obstfeld (1994).

rate link in the model is still weak and further empirical investigation is needed. At the moment, the short term interest rate changes with change in consumption price less inflation target (with a coefficient of 0.1).

6. Conclusion and Policy Implications

The analysis shows that most of the variables such as levels of private investment and private consumption have been operating below their potential values, based on the simulated trends depicted by the respective equations in the model, particularly in the 1998-2003 period. In the case of the exchange rate (Ksh/US$), a comparison of actual and simulated exchange rates using the exchange rate equation shows a marked appreciation since the early 2000s. This has implications for sectors like the export sector, which is key to spearheading economic growth. The analysis also shows that (total) wages in the formal private sector increased significantly in the most recent period considered (1998-2003). However, since the formal private sector is relatively small (compared to the vibrant informal sector), this trend should be interpreted cautiously, not to imply that general wages in the economy have risen. Such a conclusion would require further analysis.

In general, the period around 1993 remains unique in Kenya's economic history as a period with uncertainty and extreme volatility in nominal variables, as depicted by big discrepancies from the historical simulations.

In all, the results point to the fact that the economy has been operating below its expected potential, particularly for the most recent period considered (1998-2003). There is potential for the economy to perform better, and what is needed are measures aimed at resuscitating the economy.

On average, the behavioural equations in the model perform fairly well in terms of predictive power. Generally, there is a very close match between simulated and actual values in the 1970s and 1980s when the economy was controlled and less open than in the liberalized, market-oriented period of 1990s and 2000s, perhaps indicating the kind of

forecasting difficulty associated with a liberalized, free market economy. The analysis shows that on the basis of the coefficients alone (without add or correction factors), the equations have a tendency to over-project most of the variables in the recent past period considered (1998-2003), which is possibly due to the deterioration in growth of most variables and economic performance in general. For the purposes of improving future forecasts, there is need to re-estimate some of the behavioural equations such as investment, export, wages and private consumption and interest rate equations based on recent data. Additionally, frequent update of the model and incorporation of new information as is already the case often pays dividends. That notwithstanding, it should be stressed that it is inadvisable to judge policy models like KTMM purely by forecast accuracy since such models play a far much more important role in policy analysis and evaluation. Moreover, uncertainty is a fact of life, and in the modeling world, re-estimating the equation may improve the forecast but cannot wholly eliminate uncertainty effects. Regression analysis is only one of the instruments of improving the coefficients. Also important is judgement of results of simulations or variants and recalibration based on recent years[17]. Given the critical role of KTMM, continous model improvement is vital. With the introduction of SNA 1993 by CBS, more analysis and monitoring of variables and model outcomes is important.

[17] I owe this insight to Marein van Schaaijk.

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Appendix 1

List of main behavioural equations in KTMM

Components of GDP:	
1.	Private consumption: changes with (weighted) disposable income (98% wages, 95% profits) (lags)
2.	Private investments volume growth: 0.4*(1+2*GDP real growth) +0.33*(disposable profits income minus 0.01* long interest rate*invested wealth)+(0.3* public investment+0.4*public investment lagged five years) +0.06*change in domestic credits to private sector
3.	Export volume growth: 2* (world trade price minus export price change) + 1.3* world trade growth (growth in income of trading partners) + 0.2* change in investment/GDP
4.	Import volume growth: real final demand growth - 0.5* (import price minus consumption price changes)
Prices:	
5.	Consumption price % change: 0.7* wage costs + 0.3*import price + 100% change in indirect tax pressure.
6.	Export price % change: 0.4* wage costs + 0.3*import price + 0.3*competitors price + 0.2*real interest rate
7.	Investment price % change: 0.5* wage costs + 0.5*import price + 4*(capacity utilisation rate -1) + 0.1* real interest rate (t-1)
8.	Wages (businesses): 3 + 0.8*consumer price change (inflation)+0.7*labour productivity trend - 0.05*informal sector rate + increase in wage employment businesses
Employment	
9.	Employment businesses change with labour productivity trend -0.4* real wages + 0.8* gross value added real growth
Monetary variables:	
10.	Interest rate: changes with 0,1*(consumption price change minus inflation target (exogenous)
11.	Exchange rate changes with 0.22*(domestic minus foreign price changes) -0.19 (short term domestic (TBR) minus foreign interest ratea changes)-2.49*current account/GDP -2.21*net foreign financing/GDP
12.	Money supply: increases with 0,9*Real GDP growth and 100% inflation target

Notes: Lags not mentioned; a=USA short term interest rate