Macro Models of the Kenyan Economy: A Review

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Abstract

This paper critically reviews the existing Kenyan macroeconomic models, identifying their strengths and weaknesses. It argues that there are major weaknesses in the two existing models, MEPM and MELT3, particularly their failure to recognize the importance of the supply-side factors in the economy. The rudimentary treatment given to the supply side by the two models inevitably means that forecasts generated by the models downplay the significance of structural rigidities in the economy in determining the final outcome of policy measures. The paper also reviews two key models, used by the World Bank and the International Monetary Fund, for analysing the economies of developing countries including Kenya. Like the existing Kenyan models, the World Bank and the IMF models are also useful for short-term policy analysis, but their use for medium- to long-term forecasting is limited as they are weak in representing production in the real sector. The paper therefore justifies the case for a new macro model of the Kenyan economy. It discusses the key macroeconomic sectors that should go into the new model and provides initial thoughts on the specification of the equations in each of these blocks.

Abbreviations

GDP	gross domestic product
IMF	International Monetary Fund
KIPPRA	Kenya Institute for Public Policy Research and Analysis
MELT3	medium- to long-term model
MEPM	macroeconomic policy model (Chakrabarti model)
NAIRU	non-accelerating inflation rate of unemployment
PIM	perpetual inventory method
PPP	purchasing power parity
PSBR	public sector borrowing requirement
RMSM	reduced minimum standard model (World Bank)
RMSM-X	combines the Polak model of the IMF with original RMSM model

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Executive Summary

Objective

This paper starts by briefly answering the question, what are macro models? It then reviews the existing Kenyan macro models, the Macroeconomic Policy Model (MEPM) or the Chakrabarti model and the Medium- to Long-Term Model (MELT3). After identifying the shortcomings in these models, the paper reviews macro models of the Bretton Woods institutions: the Polak model of the International Monetary Fund (IMF); the Reduced Minimum Standard Model (RMSM) of the World Bank; and the RMSM-X model, which combines the extended Polak model of the IMF with the original RMSM. The paper justifies a new macroeconomic model of the Kenyan economy and suggests the requirements that are needed for a KIPPRA macroeconometric model.

What are macro models and what are their uses?

A macro model is a representation of the quantitative relationships among macroeconomic variables such as employment, output, prices, government expenditure, taxes, interest rates and exchange rates. The equations of the model comprise technical (institutional) relationships, accounting identities and behavioural equations. Macro models are useful in explaining the empirical behaviour of an economic system. The system may include growth; cyclical, seasonal and erratic patterns; changing rates of inflation; levels of output and unemployment; and so on. Macro models are also useful in forecasting and in analysing policy.

Shortcomings of the existing Kenyan models, MEPM and MELT3

Of the two Kenyan models that have been documented, MEPM has been used in Kenya as a basic short-term planning tool. However, its use was discontinued because there was inadequate capacity to update it and because most of its relationships were specified for a controlled economy. MELT3 was never used despite its comprehensive documentation. MEPM and MELT3 have the following key components: sectoral and total GDP (gross domestic product); investment; private and public consumption; balance of payments; government budget; money, credit and prices; and wages and employment. In MEPM and MELT3, demand components are determined without recourse to theory. For example, in MEPM income is the main determinant of private consumption while MELT3 includes money supply as well. There is no role for interest rates or wealth in either model.

A major weakness of these models is that they are ad hoc in modelling the supply side of the economy. They do not introduce the production function explicitly to derive factor demands. And so they fail to recognize that developing economies like Kenya are driven by the supply side. The Kenyan models have other shortcomings as well:

- They fail to incorporate stock building in modelling investment demand.
- Neither model has a role for the real exchange rate in either the import or the export equation. The impact of monetary and fiscal policy on the real exchange rate, hence on the balance of payments, is not captured.
- The nominal exchange rate is mainly exogenous whereas in floating regimes this should be endogenized.
- Neither model can project employment levels; thus they are inadequate in assessing the effect of policy on unemployment.

- MEPM assumes unlimited availability of sources of finance in the public sector rather than imposing a government budget constraint.
- There is no role for interest rates either in consumption or in real money balances.

The Polak, original RMSM and RMSM-X models

The Polak model provides the core framework that IMF applies in its stabilization programme for developing countries. The model has four equations: two identities, one behavioural and one equilibrium condition. The first identity is that of money supply as a function of domestic credit and official foreign exchange reserves. The second identity relates official reserves to the current account and capital inflows. The behavioural equation is nominal demand for money as a function of changes in nominal income. The equilibrium condition equates changes in nominal money supply to changes in nominal demand for money. The Polak model is used mainly to assess the effect of changes in domestic credit on the balance of payments.

The model has several limitations. The behavioural equation ignores other determinants of money balances such as interest rates, inflation and wealth. It assumes that changes in domestic credit have no effect on the determinants of money demand. The model largely ignores the real side of the economy. It also assumes that the economy has a fixed exchange rate regime and that a government cannot borrow from the domestic private sector. It assumes that the country produces one good.

The World Bank's RMSM on the other hand is a real economy model that makes an explicit link between medium-term growth and its financing. The model has five key relationships: an equation relating desired level of investment to the change in real output, making it driven by the incremental capital–output ratio; an imports equation; a private consumption equation; the

balance of payments identity; and the national income identity. The two target variables in the model are change in official foreign reserves and output. In the macroeconomic closure, exports are treated as exogenous. Key policy instruments are government expenditure, tax revenues and change in net foreign borrowing. It is a trade gap model. Treating real output as a target variable fixes imports and, with exogenous exports, fixes the trade balance. The trade gap framework works well if policy-makers have sufficient control over capital inflows. Due to foreign borrowing limits, RMSM is also used as a savings-gap model.

Limitations of RMSM include that it lacks the substitution effects of relative price changes; capacity utilization and labour are absent; and although the emphasis is on real variables, it does not specify the monetary or financial side of the economy. The government sector in the original model is minimal. Prices are exogenous, and in countries where the capital account is open, control on capital flows is not feasible.

The RMSM-X combines an extended Polak model with RMSM. The improvement is that the financial sector, ignored in the original RMSM, is incorporated through the extended IMF model. Prices in RMSM-X are endogenous. Different rules for public, private and policy closures make it versatile. However, RMSM-X still has some limitations: the rudimentary nature of the financial programming model and its failure to include many important features, such as bond financing of fiscal deficits. The model still fails to incorporate a labour market and uses an inflexible production function on the supply side. A general weakness of the model is that its recursive solution ignores simultaneity in macro variables.

Requirements for a macroeconometric model

From the review of Kenyan models and those of the Bretton Woods institutions, the paper concludes that KIPPRA should

develop a new macro model. One important use would be to obtain medium-term projections of major macroeconomic variables such as sectoral and total GDP; exports, imports and balance of payments; government revenue, expenditure, deficit and its financing; private and public consumption and investment; money, credit, prices and employment. The KIPPRA model would need to be detailed enough to generate consistent forecasts of the key variables: output, expenditure, income, trade, price, employment and finance. The need to make especially detailed forecasts of public sector accounts means that the public sector of the model would have to be unusually large.

In building the KIPPRA model, it will be important to note that macromodels tend to be classified by category, the three most notable being the Keynesian, the monetarist and the classical. For instance, a KIPPRA model could be Keynesian in the short term by recognizing that short-term fluctuations are primarily determined by changes in the components of aggregate demand. However, an interesting aspect that the model will have to contend with is how to treat the supply side of the economy, which shapes the medium- to long-term response of the model. So the KIPPRA model could let supply-side factors influence output in the short run through pricing, employment and investment decisions but largely determine output in the medium term through such factors as technical progress, population growth and weather conditions. The long-term properties of the model would thus end up more accurately reflecting those of a neoclassical growth model. Hence, the model would be identified as having Keynesian short-run properties and classical properties for the long run.

1 Introduction

This paper reviews the macroeconomic models that have been developed and used in the macroeconomic management of the Kenyan economy. The survey has the following objectives:

- Define what macro models are, showing how macro-econometric model building is crucial for economic projections and forecasts.
- Review the macro models that have been used in Kenya and those used by the Bretton Woods institutions.
- Serve as a starting point for model building for Kenya, showing how macroeconomic models are formulated and how different sectors of the economy relate to each other.

No specific equations are produced that encompass the models surveyed and proposed but discussed at length are several approaches to modelling specific aspects or sectors.

2 What Are Macro Models?

A macroeconometric model is a mathematical representation of the quantitative relationships among macroeconomic variables such as employment, output, prices, government expenditure, taxes, interest rates and exchange rates (Whitley 1994). The equations of the macroeconometric model comprise technical relationships, accounting identities and behavioural equations.

Technical relationships are those that do not explain the actions of economic agents, but they may approximate institutional arrangements. They are subject to error in that they are approximations. Parameters in technical relationships may be derived from prior information or estimated from data. *Accounting identities* are exact relationships that hold at all points. Examples of identities are national output and components of

final expenditure, and government borrowing requirement, taxes and government spending. *Behavioural equations* are relationships characterizing the actions of economic agents such as consumers and producers. They are based in theory and their parameters are empirically determined using data.

The objective of a macroeconometric model is to explain the empirical behaviour of an economic system including its growth, its cyclical, seasonal and erratic patterns, its changing rates of inflation and its levels of output and unemployment (Hendry 1995). Empirically estimated macroeconometric models help in forecasting future outcomes, evaluating economic theory and analysing economic policy as well as projecting for resource planning or reallocation, for example foreign aid requirements or debt management for future sustainability.

Given the major roles that macroeconometric models play, formulating a macroeconomic model for the Kenyan economy that can be used in forecasting economic trends is an important endeavour. The model will also be useful in investigating the long-run sustainability of policies, analysing trade-offs between economic and policy options, and evaluating alternative policy packages. Before embarking on the development of a new macroeconomic model for Kenya, it is important to review the existing models.

3 Review of Kenya Macro Models

3.1 Macroeconomic policy model for Kenya: the Chakrabarti model

A good starting point for a review of Kenyan macro models is by looking at the structure and theory of the Chakrabarti model (Kenya 1994), which is the main model that the Government of Kenya has been using for some time, both for short-term

planning and as a basic planning tool. The initial model was developed in 1982, and through continuous respecification and re-estimation it continued to be used for policy simulations up to 1994. The model was used to project macro aggregates such as balance of payments, government budget out-turns, inflation rates and terms of trade. Simulations from the model were also used to give projections for evaluating policy proposals by comparing scenarios corresponding to alternative policies including alternative values of a policy instrument. Finally, the model was used to test preferred scenarios for development plans.

Sectoral and total GDP

The sectoral GDP for the five sectors in MEPM—traditional, agriculture, manufacturing, services, government—is determined through equations that are distinct for each sector. Supply- and demand-side factors are used to explain the sectoral GDP. For example, capital stock, fertilizer input and terms of trade determine agricultural output. Capital stock, real imports and agricultural output determine industry GDP. Service and government sectors GDP are explained by similar relationships, except that recurrent expenditure and average wage earnings are the key explanatory variables in the government sector. Agricultural output and real exchange rate are the key variables in the service sector in addition to the capital stock. Labour does not determine output in any of the equations, a development that is surprising since no assumptions about labour productivity are made. The explanation that labour does not determine output but is determined by output is not adequate reason to leave it out. A causality test has not been provided in the model to justify the idea that output determines labour, not the other way round. Essentially the model assumes that factor productivity is not important for output. The inclusion of a labour demand equation in the model might have made labour an important

determinant of output in the different sectors, for example, the service sector, the agricultural sector and manufacturing.

This block of equations of MEPM is actually its main weakness. Its theoretical foundation fails to recognize the underpinnings of the supply side of the economy. The model estimates simple behavioural relationships in which explanatory variables are chosen in an ad hoc manner. Probably it would be better to have output equations for each of the sectors through a specific production technology and then derive each sector's GDP through identities. This has the advantage of allowing the derivation of the labour and capital stock demand equations for a given level of output. Moreover, productivity of available technology can be endogenized with a link to specified production function.

Investment

The investment equations in MEPM are specified using the same search procedure as for sectoral GDP. Investment in the private sector is determined by profitability and the cost and availability of finance. Hence, the equation used in simulations identifies export earnings, real exchange rate, foreign reserves and GDP growth as the main determinants of investment in the private sector. However, it is not clear whether foreign reserves can be important in a floating exchange rate regime. Public investment is determined by development expenditure through a technical relationship. Why the modified or flexible accelerator models or the neoclassical approach to investment modelling were not used to determine investment and other variables added subsequently is not clear. The formulation as used in the MEPM can be modified to show that investment will respond to investment price and basic price in the economy plus other macro fundamentals in a liberalized economy. Theory, especially concerning behavioural equations, should always be given precedence, and it is when a model fails that it

should resort to other variables in attempts to explain variations in the dependent variable like investment. This means starting from some theoretical constructs using some micro-foundations in modelling investment.

The above observation notwithstanding, MEPM innovatively includes separately investment in other public institutions, mainly parastatals. Given the large share of capital stock held through parastatals, it is important that their investment demand be modelled separately. Government lending, external borrowing and GDP growth rate are the variables explaining other public investment in state enterprises.

An important equation in investment demand analysis is that of inventory. In MEPM, inventory investment is modelled as being determined by real GDP and real imports. An important variable left out in this formulation is the cost of stock building, which determines the ability of firms to hold stocks. In this case, the model would need to include short-run (or long-run) expectations of future demand conditions so that inventories work as shock absorbers or a disequilibrium component.

The last important equation in this block is that of capital stock. MEPM adopts the standard equation for updating capital stock with constant depreciation rates across the board over the sample period. The capital stock series used in the updating equation were calculated using the perpetual inventory method (PIM). There is the question, however, of how accurately data computed through PIM would reflect the true stock of capital.

Private and public consumption

Despite the large amount of literature giving empirical findings regarding the various consumption hypotheses, MEPM uses a simple Keynesian formulation with disposable income as the main determinant of consumption. Other variables are then introduced in an ad hoc manner for additional explanatory

significance. It might have been more appropriate to model private consumption following a given consumption theory. For instance, the consumption equation could have introduced wealth and income as explanatory variables using the appropriate proxies if necessary. Wealth in this case may be measured as the sum of financial and physical assets. And given the importance of monetary policy in determining consumer spending, the role of either real or nominal interest rates could be incorporated in the equation. This approach is the life-cycle hypothesis modified by liquidity constraints. An alternative approach would be to start from micro-foundations and then test some practical cases (see Agenor forthcoming; Agenor and Montiel 1998).

Public consumption is explained in MEPM by recurrent expenditure. The model fails to recognize that most public consumption habits are predetermined and at times residual based. Whether there is any advantage gained by having an equation for this variable in MEPM is debatable. This is because there is no problem with having public consumption as a policy instrument that is exogenous in the model through an equation for government budget deficit. In such a case, a macro variable would have to be specified that would be controlled by the policy instrument of public consumption.

Balance of payments

The MEPM equations dealing with the balance of payments are detailed. A high level of disaggregation, especially in treating coffee and tea separately, is important as it reflects the importance of these commodities in the current account. But important questions can be raised about the theoretical foundation of some of the equations used, because properties of the trade equations are key elements in determining the nature of any balance of payment constraint.

In the demand equation for imports, imports are modelled as a function of income, price, official control on imports and a dummy variable. While this formulation is plausible to some extent, it does raise the question of why the available theory in the treatment of imports was not used. For example, although the real exchange rate is an important determinant of import demand, it does not appear in the MEPM formulation. In addition, MEPM adjusts the import price index for tariff changes, but while this is a plausible treatment, it does not give the model the capacity to simulate varying tariff rates for analysing trade policy. It would have been more appropriate to include the import prices in the import demand equation inclusive of tariffs as these are what businesses face. Then a separate import price equation with a coefficient or parameter for tariffs could be included to cater for elements of trade policy. This formulation would recognize that import prices are an important link in transmitting inflation. The support for changing the formulation in MEPM is also based on findings by Mwega (1993), who shows that once foreign exchange is liberalized, fundamentals take effect and so the official control variable is no longer important in an import demand equation.

The export equations are modelled in the same way as those of imports. The real exchange rate, which is a key determinant of exports, is not part of the export equation. Moreover, failure to include an equation explicitly for export prices is a shortcoming. While such an equation may not be as limiting as in the case of imports, given that trade taxes targeting exports are insignificant, it is still necessary to link price of exports to international prices through the exchange rate. Also, it is in such an equation that policy instruments like export compensation and subsidy can be modelled.

Apart from the trade balance, MEPM uses equations for explaining the movement of flows such as interest payments and profit repatriation. The capital account component of the balance of payments is captured through an aggregate equation

explaining capital flows (mainly the official flows consisting of loans and grants) as a function of the development budget of the government. The module for the balance of payments is concluded in the standard format in which various balances are defined appropriately.

Government budget

The government budget module of MEPM uses the recurrent and development classification followed by the Ministry of Finance. The model treats government expenditure as an exogenous policy variable whereas public consumption on the demand side is treated as an endogenous variable through a technical equation. The implication is that the equation for public consumption is actually redundant as the difference between public expenditure and public consumption should not be significant in principle.

However, MEPM treatment of the government budget is comprehensive. All the sources of ordinary revenue are explained using technical equations that are subdivided to match all the categories as they appear in the budget statements. This makes the model very informative in providing forecasting values during the preparation of the budget. It is not clear whether the data used in these equations have been adjusted for variations in tax rates and therefore whether the equations can be used to analyse the effects of different tax rates. A model such as MEPM ought not only forecast future revenue growth paths, in which case specific parameters for tax rates are not required, but should also analyse explicitly the likely impact of different tax rates.

MEPM treats government expenditure as exogenous. However, the suitability of this assumption for planning purposes needs to be explored further. The model uses the revenue and expenditure totals to derive the government deficit, which is financed from domestic and external sources. The implicit

assumption in the model in its current form is that the sources of finance are unlimited or that the deficit can be allowed to grow without limit. This assumption needs to be reviewed both because government faces internal and external borrowing constraints and because of the negative effects of accumulated debt. An alternative assumption would be one of zero deficit, or if this is not achievable, a given proportion of deficit could be targeted. Lack of this constraint is a major weakness of a model about fiscal policy.

Money, credit and prices

The model also projects quantities of money and bank credit in addition to the general price level. Demand for real money balances is explained by income and interest rates—fairly standard for a macroeconomic model—but it should include the inflation rate. Interest rates do not play any significant part in the model because the data used were obtained before interest rates were liberalized in 1991. However, even though they were under control, interest rates could still be seen as the opportunity cost of holding money. A new model should make interest rates endogenous. In this regard, it is important to determine whether short-term interest rates can be an exogenous policy variable while long-term interest rates are part of the model. This would allow long-term rather than short-term interest rates to be part of investment equations.

The standard approach of the arbitrage process, in which long-term rates are the average of future expected short-term rates, might be adopted. It must be recognized that determining the term structure of interest rates can be helpful in introducing an element of forward-looking behaviour in the model. MEPM also fails to add the exchange rate as an indirect tool of monetary policy, which would enable the model to take care of currency substitutions.

The supply of money in the model is projected by multiplier analysis, with the base money and money multiplier being the explanatory factors. This approach is advantageous as the money multiplier is allowed to change, a phenomenon ignored when the money multiplier is assumed not to vary over time. The multiplier needs to be stable and predictable. The performance of the model using this approach ought to be evaluated vis-à-vis money supply that is endogenous by identity rather than through a technical equation, which will ensure that there are no residuals, as the identity has to be satisfied. However, money supply in the simulation version of MEPM is actually treated as an exogenous variable. Alternatives to the current formulation of money supply in MEPM are specification of a Central Bank reaction function or giving money supply an endogenous identity. Exploration of these alternatives is worthwhile given the importance of money in the economy. For instance, the interest rate for the monetary authority implied by the reaction function can be attained through open market operations. In this case, the amount of government securities outstanding would be endogenous, that is, the amount would be whatever is needed to meet the interest rate value from the reaction function.

The consumer price index is the main price projected in the model. Deflators for specific sectors are modelled in the sectoral and total GDP modules. The consumer price index is modelled to capture factors of both demand–pull (money supply) and cost–push (nominal exchange rate, unit labour cost, capacity utilization). The alternative to the current MEPM structure would be to specify a long-run inflation equation and show the contribution from other variables.

Wages and employment

Wage formation in MEPM is simple. Both average nominal wages in the formal sector and average real wages in

government are projected through the preceding year's inflation rate. Wages are at the heart of macroeconometric models and their formation has implications for what a given model forecasts. Hence, the simple nature of wage formation limits the ability of the model in forecasting and policy analysis. This equation should be able to capture the effects of unemployment if it follows the Phillips curve approach or the effects of, for example, taxes, productivity, real exchange rate, if it follows the Layard-Nickell approach. In fact, with the liberalization of wage guidelines allowing workers and employers more freedom in negotiations, a bargaining approach to wage determination following the work of Layard and Nickell (1985) would be more appropriate. However, considering the approaches to choose from, it must be recognized that minimum wages still apply and excess labour supply in the lower cadres might cause wage bargaining to be lopsided. So the alternative of having a disequilibrium queuing model akin to the Harris-Todaro formulation may also need to be considered.

Employment in MEPM is disaggregated to five categories. Modern sector employment is the main one and the data series are quite satisfactory. The model explains variation in modern sector employment through real GDP and real average wage. This equation could be extended to capture the capital cost, since capital substitutes for labour in some operations. A time trend to capture growth of the population might also be a useful explanatory variable in the employment equation. To avoid misspecification, population growth can be modelled directly.

Since reducing the level of unemployment will go a long way towards reducing poverty, any macroeconomic model should be able to forecast employment levels in the future as accurately as is practical. Hence, the block of equations capturing employment needs to be elaborate with a view to enhancing the model's ability to address the unemployment problem. This

means targeting growth of the economy and labour requirements in all sectors like in an input–output framework.

3.2 A medium- to long-term model: a macro model for Kenya

Keyfitz (1994) provides documentation for the second main macro model for Kenya, the medium- to long-term model, or MELT3. This review of the theoretical structure of MELT3 looks at the way the equations in the model are motivated and specified.

The model is disaggregated into five sectors in the production side, similar to MEPM—traditional, agriculture, manufacturing, services and government. Finance, banking and insurance can be separated if data are available.

Demand side of MELT3

Consumption is specified as depending on income and money supply. Hence, real balances are specified to have a direct effect on consumption. A lot of empirical studies have concentrated on consumer behaviour, recognizing that the consumption equation is at the heart of macroeconometric models based on the national income accounting tradition. Therefore, the empirical support for the consumption equation as given in MELT3 may need to be reconsidered, in the face of the changes that have taken place in the economy since 1994. It would be important to consider modelling consumer behaviour as a function of income, wealth and interest rates.

Income, capital stock and credit from the banking sector determine investment demand in MELT3. Capital stock is determined through a simple neoclassical model assumption that capital can be adjusted instantaneously with a predetermined depreciation rate and past levels of investment. Given the financial liberalization that has taken place in this

sector, the role of market-determined interest rates is important. Hence, it is necessary to investigate whether introducing interest rates in the investment equation would be more representative of the current situation in the economy. MELT3 specifies inventory investment as being determined by income and the trade balance. This raises a theoretical question since stocks should also be a function of the cost of stock building in addition to output and expectations, which are important aspects in theory (see Blanchard and Fischer 1989).

In modelling trade, MELT3 uses the key small-country assumption of the price-taking nature of Kenyan traders. Exports are a function of domestic production costs relative to export prices, whereas imports are a function of relative prices and domestic income. The major weakness with this formulation is that the role of the real exchange rate is ignored. If the Mundell-Fleming analysis of fiscal and monetary policy framework were to be adopted, exports would be a function of foreign income, capacity utilization and the real exchange rate. Imports would be the same, with foreign income replaced by domestic income. With this kind of formulation, the impacts of monetary and fiscal policies and their influence on real exchange rate, hence on balance of payments, would be captured.

Government spending is determined through an identity that is formed from the various categories of government spending. The advantage with this formulation is that the components of government spending are largely exogenous and can therefore be useful in simulation analysis of the effects of different components of government spending on the rest of the economy.

In concluding the demand side of MELT3, several sectoral GDP regressions are estimated, although their role in the model is not clear. Reference to the sectoral GDP equations as demand functions, relating output to various expenditure

categories and relative prices, discounts the possibility that they were meant to be production functions. The importance of these equations is not obvious nor is their rationale explained. The vagueness is further exacerbated by the argument that the GDP equation for the subsistence agriculture sector is a supply rather than a demand equation. The use of a Cobb-Douglas production function implies that what are called demand equations may in fact have been meant to be equations for the production technology for each sector. Surprisingly, the a priori restriction of constant returns to scale for Cobb-Douglas functions is not imposed in the GDP equations estimated.

Labour market in MELT3

Modelling the labour market in MELT3 is another section without a theoretical foundation. The labour demand, or employment, is modelled as a function of output and real wages. A better approach would be to model the labour market by defining a labour demand schedule, a labour supply schedule and a wage adjustment equation. Alternatively, the labour demand can be derived through an optimization process from the production technology defined. The model as it is cannot measure unemployment, yet government policy is to devise a strategy that lowers unemployment. Consequently, a clear modelling of the labour market requires that unemployment be explicitly recognized as an important model output in forecasting. If the labour market is modelled, it should be easy to derive the model's non-accelerating inflation rate of unemployment (NAIRU), which can be introduced by means of a disequilibrium mechanism in the labour market.

The wage–price block

Wages and prices are a key part of macroeconometric models, largely responsible for generating inflation. Historically, the Phillips curve is the standard mechanism for explaining wage

inflation, notwithstanding its poor empirical performance (Whitley 1994). In MELT3 the Phillips curve is the approach for modelling wages although the model acknowledges the dual[1] nature of Kenya's labour market. The Phillips curve has been criticized in that it does not explicitly consider the role of taxes in wage formation. The Phillips curve as used in MELT3 does not include the standard price expectations, which are given by past inflation. With these two observations in mind, an imperfect market approach of modelling the wages is suggested. This approach concentrates on labour market and goods market interactions, and it can be used to derive the NAIRU for the model, thereby making the role of taxes more explicit.

The price equation in MELT3 can be summarized as follows: for the traditional sector, the price deflator is a weighted average of current and lagged non-coffee and tea deflators with the weights restricted to one; for the other sectors, prices depend on unit labour costs with a unit elastic price imposed. While it is an advantage to model the price equations distinctly for the traditional sector compared with the other sectors, the MELT3 price equations fail to capture the influence of import prices. Incorporating import prices in the price equation gives the model ability to determine empirically how shocks in the international economy affect domestic prices, which is important for an open economy. Therefore, the Phillips curve approach used in MELT3 needs to be supported with a well-specified price equation that could be a function of unit labour costs and the price of imports. The consumer price index in MELT3 is defined to be the weighted average function of domestic production and import deflator and the share of imports in GDP, a formulation that might be the proxy for import prices.

[1] Even a dual labour market may be too simplistic. Further discussion is needed to define the other labour markets.

Public accounts

The importance of modelling the public accounts module of a macroeconometric model for a developing country like Kenya, where government spending is so important, cannot be overemphasized. A model to be used for public policy analysis needs to model the public sector in detail to assist the Ministry of Finance and Planning.

The expenditure component of public accounts in MELT3 is modelled by tracking the major spending categories as given in the economic analysis of government expenditure. This formulation leads to endogenized government expenditure. Given that the public debt is also endogenous, this leaves only revenue as a candidate for exogenizing fiscal policy. But apparently revenue is also endogenous in the model. A proper way to handle this would be to determine expenditures and revenues as identities rather than having them as technical equations. The public debt would also be an identity, which is how MELT3 treats it. This formulation may still not change much if fiscal deficit or balance was made an explicit target.

A critical weakness of MELT3 in modelling government spending is that it fails to link domestic and foreign debt to the fiscal and monetary policy. It would be expected in theory that the stance of fiscal policy would affect domestic debt. Also, monetary policy affects foreign debt through its effect on the current account, which influences how much needs to be borrowed. This amount eventually shifts the capital account, hence the balance of payments. In other words, it is possible to extend the model through a fully defined public sector linking monetary and fiscal policy. In this context, the fiscal deficit would be related to the stock of government debt, money and bonds, and the debt by the overseas sector. Fiscal policy would determine the size of the government deficit while monetary policy would have implications for financing the deficit.

Balance of payments

In MELT3 the current account balance on investment income and the current account balance on other goods and services are modelled as technical equations. The advantage gained from this attempt to explain these components is not obvious and may not be necessary. Determining the current account balance through an identity that captures all components of this account might have been sufficient. The same can be said for the capital account components. It is counterproductive to explain long-term private and parastatal capital inflows through technical equations. These variables are best treated as exogenous. An identity equation for the capital account is adequate in a macroeconometric model such as MELT3.

Financial sector

The Central Bank of Kenya needs detailed modelling of the monetary sector for forecasting. However, the rudimentary nature of the financial sector in MELT3, while acceptable for an economy without a liberalized financial sector, is simplistic for the current environment and would need to be respecified. Particular issues can be raised with the current specification. First, the money demand equation is completely left out from the model. Consequently, forecasting money demand may not be possible. Second, while interest rates are related to money supply, their relationship to the domestic debt is not included. Third, the link between interest rates and balance of payments is lacking and needs to be introduced. An important point that needs exploration is whether the velocity of money can be targeted using an equation of exchange and the exchange rate added to capture currency substitution.

The real exchange rate is modelled as a function of lagged real exchange rate and ratio of reserves to imports. While this formulation might have been useful under the regime in which MELT3 was to operate, it is no longer the case. The exchange

rate plays a key role in the transmission of shocks in macroeconometric models. The increased liberalization of financial markets has made capital more mobile so that capital flow considerations, rather than those of current account, dominate exchange rate movements. There are models of the real exchange rate that can be used as a behavioural equation if this framework was to be favoured (see Mwega 1993; Mwega and Ndung'u 1999; Ndung'u forthcoming).

This raises the question of whether the purchasing power parity (PPP) approach is the ideal framework for exchange rate modelling for Kenya. The empirical evidence in favour of a PPP hypothesis for Kenya would have to be strong, since the hypothesis as embodied in the monetary theory of the balance of payments has been found to be weak unless considerations are long run (Whitley 1994). The alternative to the PPP hypothesis is to model the exchange rate through the uncovered interest parity approach, which has become more widespread. Having the exchange rate as a function of relative money supplies is ideally the law of one price. Since the relevance of interest rates to movements in the Kenya shilling has been evident in the events of 1999, it would be worthwhile to directly model the exchange rate with emphasis on uncovered interest parity or through an equation where PPP does not hold unless real interest rate differentials are added to the equation. This could be done by making use of the expectation that higher interest rates are associated with an appreciating currency, meaning that exchange rates can be modelled directly or indirectly as the result of capital flows (see Ndung'u forthcoming).

4 Review of IMF and World Bank Macro Models

4.1 The IMF model: the Polak model

The Polak model has been the main framework the IMF has applied in its stabilization program for developing countries. The model essentially consists of four equations: two identities, one for nominal money supply as a function of domestic credit and official foreign exchange reserves, the other for the relation of official reserves to current account and capital inflows; a behavioural equation for nominal demand for money as a function of changes in nominal income (ignoring other determinants of money balances such as interest rates and wealth); and an equilibrium condition, which assumes that the money market is in flow equilibrium and equates changes in nominal money supply to changes in the nominal demand for money.

The main use of the Polak model is to assess the effects of changes in domestic credit on the balance of payments. If this were the only model to be applied for forecasting and policy analysis to the Kenyan economy today, it would have a number of limitations. These include the assumption that changes in domestic credit have no effect on the determinants of money demand such as real income or domestic interest rates and the fact that it largely ignores the real side of the economy, concentrating on the external sector through its focus on balance of payments. The model is also limited in its application to economies with regimes of fixed exchange rate and from the inherent closure where exports and capital flows are treated as exogenous. The exogeneity of exports is realistic if the exchange rate is fixed, but where the exchange rate is flexible, exports have to be endogenous. Of course, the current account would be endogenous if exports were exogenous and imports endogenous.

The Polak model has been extended to address some of the limitations inherent in the original formulation. One such extension is that by Khan et al. (1990), which distinguishes explicitly between changes in real and nominal output and the sources of credit growth. Domestic credit consists of credit to the private sector and the government. Capital inflows are both private and public. Foreign direct investment intended for private sector is distinguished from foreign borrowing mainly by the government.

A significant extension to the original Polak model is the introduction of the government sector through a government budget constraint. This extension is appropriate in the sense that the balance of payments problems addressed by the original Polak model arise as a result of the difficulties encountered in financing the fiscal budget balance. The government budget constraint relates the budget deficit to foreign borrowing and changes in Central Bank credit. A limiting assumption in this extension is that the government cannot borrow directly from the domestic private sector through bonds. This is restrictive for Kenya where government borrowing through short-term instruments, mainly Treasury bills, has become a problem.

Despite the various extensions, the model has the acknowledged limitation of assuming that the economy produces one domestic good, which is used for both domestic consumption and exports. A more appropriate framework for developing economies would distinguish between exportables, non-tradables and importables.

4.2 The World Bank revised minimum standard model

The World Bank's revised minimum standard model, RMSM, is a real economy model whose objective is to make explicit the link between medium-term growth and its financing. The model

has five relationships: an equation relating the desired level of investment to the change in real output; an imports equation; a private consumption equation; the balance of payments identity; and the national income identity. The target variables in the model are change in official foreign reserves and change in output. In the macroeconomic closure, exports are treated as exogenous. Key policy instruments are government expenditure, tax revenues and change in net foreign borrowing.

This model is described as a trade gap model since the treatment of real output as a target variable essentially fixes imports and, given exogenous exports, the trade balance is fixed. The trade gap framework works well if policy-makers have sufficient control over capital inflows. Because of the foreign borrowing limits that economies invariably face, a savings gap framework of the same model is used. Where both the trade gap and the savings gap are binding constraints, RMSM becomes a two-gap model, and the solution depends on which constraint is more binding.

A main criticism of the two-gap RMSM is that in determining the financing requirements for alternative target rates of output growth, one cannot tell a priori whether the savings or the trade constraint will be binding. A second criticism, and one that is more serious in applying RMSM to Kenya, is that it fails to incorporate the financial sector of the economy. The government sector is also minimal in the model while the exogeneity of prices is a major limitation.

The original RMSM has been revised further to what is now called RMSM-X. It combines the extended Polak model with the Bank's RMSM model.[2] The improvement in RMSM-X is that the financial sector component is incorporated through the extended IMF model. Endogenizing the prices in RMSM-X is a positive attribute. Nevertheless, RMSM-X still suffers from the

[2] An example of the application of RMSM-X is Serven (1990) to the Chilean economy.

limitations of the two models underlying it: the rudimentary nature of the financial programming model and its failure to include many important features such as bond financing of fiscal deficits, which is important in the Kenyan economy; its failure to incorporate a labour market; and the use of an inflexible production function on the supply side.

Different closure rules normally solve RMSM-X: normative, positive and policy closures. Whereas this makes the model versatile, it has a general weakness in that it is usually solved recursively, ignoring the simultaneous nature of key macroeconomic variables. The recursive solution to the model does not allow for explicit consideration of the relationships among variables.

5 Justification and Proposal for a Macroeconometric Model for KIPPRA

5.1 Main uses and features of a macroeconometric model

From the above review of Kenyan models and those of the Bretton Woods institutions, an important question is whether a new macro model should be developed at KIPPRA. The answer must be based on what uses KIPPRA will make of the model. One important use would be to obtain medium-term projections of major macroeconomic variables such as sectoral and total GDP; exports, imports and balance of payments; government revenue, expenditure, deficit and its financing;[3]

[3] It is important to recognize that there are different deficit concepts. Financing is not actually based on the deficit but on the public sector borrowing requirement (PSBR), which includes funding required for repayment of principal. Therefore, KIPPRA's macro model will need to have an explicit way to derive the PSBR.

private and public consumption and investment; money, credit, prices and employment. Like the model of Her Majesty's Treasury in the UK (Chan et al. 1995), the KIPPRA model will need to be detailed enough to generate consistent forecasts of the set of output, expenditure, income, trade, price, employment and financial variables. The need to make especially detailed forecasts of public sector accounts means that the public sector of the model has to be unusually large. There has to be sufficient detail elsewhere in the model (on expenditures, incomes, debt stocks, interest rates, and so on) to generate forecasts of individual taxes and of debt interest.

It is important to consider how the model proposed for KIPPRA can be built and what can be borrowed from the models reviewed. This section presents the case for a new macroeconomic model for the Kenyan economy and suggests the structure for this model, to be developed in KIPPRA. The salient differences in structure between the proposed model and MEPM and MELT3 are highlighted.

A key weakness of both MEPM and MELT3 and one reason why there is need for a new model is lack of a sound theoretical foundation. Since a model at KIPPRA would be used for research, forecasting and policy analysis, it is imperative that the theory upon which the model is based be sound and evident. Models that are only empirical, such as MEPM and MELT3, do not provide avenues for other researchers to question the theory underlying the model, because the theory is not explicit.

Another consideration is the level of disaggregation of the models in existence. Disaggregation is used to capture empirical and economic differences within the economy. Where the macro policy is highly non-interventionist, macroeconometric models can be more aggregated because only knowledge or understanding of the basic features of the economy is necessary. But in situations where macro models are to be used in planning, disaggregation is important (Whitley 1994). Since

the KIPPRA model will be used in both forecasting and planning, a more disaggregated model will be required.[4] One important area that needs to be considered for disaggregation is the real sector of the economy, which is one of the four core macroeconomic accounts (real, fiscal, external and monetary) in any economy. The real sector reflects economic activities involving the production of goods and services with market prices as the equilibrating mechanism.

On the supply side, the components that need to be disaggregated with a focus on output and growth, employment and, indirectly, poverty issues can be identified along the format of the 1993 System of National Accounts; they include agriculture, industry, distribution and services, and other services. The level of disaggregation would depend on the importance of the various subsectors in the Kenyan economy. Under agriculture, the key subsectors are coffee, tea, horticulture, fisheries and forestry, other crops and livestock. For industry, one would consider disaggregating into manufacturing, mining and quarrying, construction, and energy and water. The importance of tourism in Kenya means that the sector of distributive and other services should be disaggregated into trade, tourism, transport and communications. Lastly, the need to focus on the sectors that contribute towards reducing poverty imply that the other-services sector can be disaggregated in the model into financial, health, education, and security and defence.

Both MEPM and MELT3 lack a formal incorporation of expectations in the economy. Expectations could be modelled

[4] Chan et al. (1995) argue that the level of disaggregation needs to be determined cautiously. It is easier to achieve theoretical consistency in a small model than in a highly disaggregated one. Moreover, practical considerations are important in determining model size. A large model can make forecasting unduly complex and laborious, and model maintenance can become a major chore.

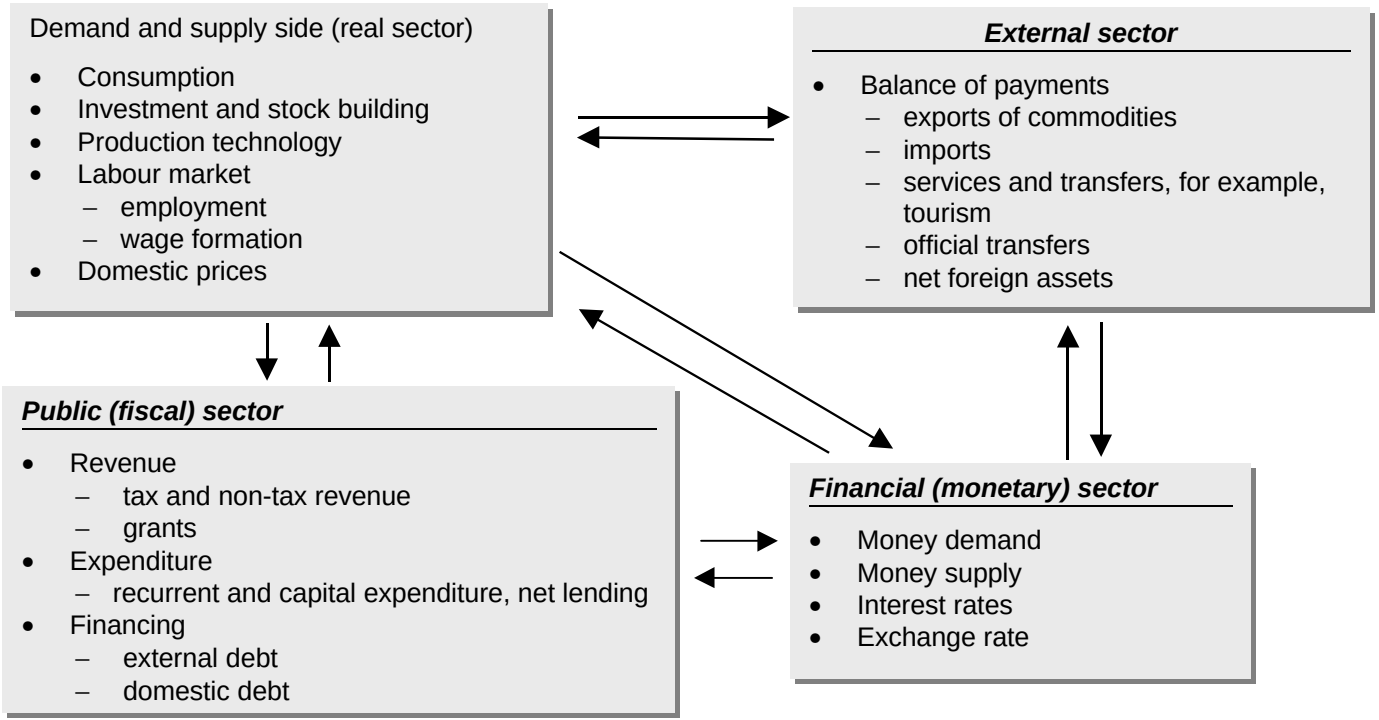
in two main ways: expectations in exchange rate, prices, wages and stock building could be rational; alternatively, they could be adaptive or implicit.

It should be noted that incorporating expectations is not a main feature of US models, except for the Fair model (Fair 1984), nor of models from the Nordic countries. Only a few of the UK models include explicit expectations. In fact, in the original macroeconomic models developed for forecasting and policy analysis, most of the behavioural relationships were expressed as reduced-form equations, which combined information on the decision rules of economic agents with implicit expectations of the variables affecting their behaviour (NIESR 1999). This made them vulnerable to the "Lucas critique", which showed that reduced-form equations would display parameter instability whenever the policy rules of other economic agents changed, most importantly when the objectives of the government changed. This is overcome by expressing behavioural equations as decision rules. Therefore, the KIPPRA model could contain equations containing explicit expectation variables and the model would be solved by assuming that these are formed rationally or consistently. Where this is not possible, a formal test of strong and super exogeneity of the variables in the model would be necessary to overcome the critique.

Figure 1 shows the proposed structure for a macroeconometric model to be developed at KIPPRA through the expected key equations blocks. The figure shows the four main macroeconomic accounts in the economy and a list of the key equations within each block. The equation blocks are guided by the expected model outputs that are considered the targets of both policy-makers and KIPPRA. Identified are the key relationships and the general theoretical background to those relationships, which will be incorporated in the KIPPRA model.

In building the KIPPRA model, it is important to note that macro models tend to be classified as Keynesian, monetarist or classical. For instance, a KIPPRA model could be Keynesian in the short-term by recognizing that short-term fluctuations are primarily determined by changes in the components of aggregate demand. However, an interesting aspect of the model will be how it treats the supply side of the economy, which shapes the medium- to long-term response of the model. The KIPPRA model could let the supply-side factors influence output in the short run through pricing, employment and investment decisions but largely determine output in the medium term through such factors as technical progress, population growth and weather conditions. Thus, the long-term properties of the model would more accurately reflect those of a neoclassical growth model. Hence, the model would be identified as having Keynesian short run and classical long run properties.

Figure 1 Macroeconomic modelling framework



5.2 Demand

The demand side of the model captures the expenditure side of the economy. It captures the demand curve in the goods market, which includes the domestic expenditure and trade equations. Domestic expenditure (domestic demand) comprises consumption (public and private) and investment (in fixed capital and stocks). Both MEPM and MELT3 have attempted to model consumption, investment, exports and imports comprehensively. However, as noted earlier, both models suffer from the ad hoc manner in which they determine the explanatory variables to the demand components. Consequently, there is need to investigate whether these demand components could be based on established theory, as proposed here.

Consumption

The importance of having a well-specified consumption function cannot be overemphasized. Consumption accounts for between 60 and 70 per cent of the national output, meaning that the behaviour of private consumption as a result of policy change needs to be captured appropriately. The literature identified several variables that explain variations in private consumption. The KIPPRA model proposes to explain consumption in Kenya based on the life-cycle hypothesis, which seems to be the main hypothesis in other macro models.

However, unlike MEPM and MELT3 where the role of monetary policy in consumption spending is ignored, the importance of monetary policy will be recognized.[5] Variables

[5] Fiscal policy influences private consumption spending directly through taxation. To the extent that the government finances a deficit by issuing debt, interest rates may need to rise to encourage the private sector to hold the debt. Thus, monetary policy affects consumption through this path.

that will be included are real income, total wealth (housing and financial), and interest rates (a choice will be made between real and nominal interest rates). Hence, behaviour in the household sector will need to be described by a system of equations determining consumer spending and wealth accumulation.

Public consumption could be treated in the model as a policy instrument to control public sector borrowing. Alternatively, it could be made to vary to ensure that a target is met for the ratio of general government expenditure to GDP.

Investment and stock building

Investment in macro models has tended to follow the flexible accelerator models that are standard in macroeconomic textbooks. Neither MEPM nor MELT3 followed this approach, probably because of the insignificance of interest rates when these models were developed. In the proposed KIPPRA model, specification of the investment equation should begin by establishing whether investment in the economy can be explained through output, relative factor prices and real interest rates.

Stock building is an important aspect of the demand side of macro models. It takes place in manufacturing, distribution and similar sectors. It depends on output and the financial costs of holding stocks (which are a function of interest rates and inflation) and the profitability of the companies.

Exports and imports

Both MEPM and MELT3 were developed at a time when the exchange rate regime was just beginning to be liberalized. This meant that the exchange rate was not a significant variable in the trade equations in these models whereas the availability of foreign exchange was significant. But the exchange rate is now an important variable in determining the level of trade in an

open economy like Kenya's. Consequently, exports in the Kenyan economy need to be explained through the real exchange rate, foreign income and capacity utilization. Exports may also be determined by overseas demand functions for domestically produced goods that depend on world trade measures and relative prices appropriately defined for each category, as in the National Institute Domestic Econometric Model (NiDEM) (NIESR 1999). A formulation similar to that for exports will be used to explain imports. However, the foreign income variable will be replaced by domestic income and thereby will compute appropriate import elasticities.

5.3 Supply

One weakness in both MEPM and MELT3 is their ad hoc modelling of the supply side of the economy. The equations determining output in the economy are theoretically weak, with the variables explaining output changes or growth, being chosen arbitrarily or guided by the availability of data. Both models could be said to favour the Keynesian paradigm by emphasizing the demand side of the economy. The fluctuations in output in these models largely reflect fluctuations in aggregate demand. However, the importance of the supply side of the economy cannot be ignored. As pointed out in Chan et al. (1995), the supply side is relatively unimportant for determining output in the short run but is crucial for the longer-run properties of the model.

Production technology

Two approaches can be used to model output. One approach to the supply side is to emphasize wages and prices together with the real exchange rate. It considers that the production function is merely a technical relationship, the background to the economic decisions that firms make concerning pricing and factor demand.

The second approach focuses on the production function treatment of technology and the demand and supply of factors of production. In this approach, factor demands, price setting and decisions about the supply of output are derived jointly. This ensures that the equilibrium level of employment consistent with the NAIRU corresponds with that given by the labour demand function conditioned on equilibrium real wages (Whitley 1994). And so, unlike MEPM and MELT3, the KIPPRA model proposes to introduce the production function explicitly. Factor demands can then be derived using the profit maximization approach or the cost minimization technique. Underlying the factor demand relationships would be a Cobb-Douglas or constant elasticity of substitution production function. This would relate output to inputs of capital and labour, assuming that technical progress is labour augmenting.

Employment

A major problem facing Kenya today is how to deal with the high level of unemployment in the economy. This means that if positive effects are to be registered in reducing the unemployment level, there needs to be capacity to forecast employment levels. Such a mechanism will give policy-makers an idea of the impact on employment that their policies are likely to have. It is thus envisaged that unlike MEPM and MELT3, where employment has not been seriously modelled, the KIPPRA model will specify an equation system that should help in employment forecasts. The key explanatory variables that will be considered in the employment equation are real wages, output (or domestic and foreign demand), and capital stock (or real cost of capital).

The more standard approach of specifying the labour market is to define a labour demand schedule, a labour supply schedule and a wage adjustment equation (see Whitley 1994, pp. 98–99). The demand schedule would have real wage defined in terms of

the product price. Other exogenous factors that affect labour demand, such as real prices of other factors of production, capital cost and output, would be explanatory variables. The labour supply schedule would be affected by real wage defined in terms of consumption price and other exogenous factors determining labour supply such as the labour force and real interest rates. Assuming there is equilibrium in the labour market would mean that the real wage and employment could be obtained by setting demand equal to supply. However, if a disequilibrium framework were to be adopted, a different wage adjustment mechanism would need to be specified. The labour force would be treated as exogenous and so measurement of unemployment would be the difference between labour force and employment.

In light of the legislative changes in 1994 that give employers and unions more bargaining space instead of strict wage legislation, the KIPPRA model could adopt the Layard and Nickell (1985) bargaining approach to wages and employment. This framework would result in a wage equation that would include all the variables that are exogenous to the labour market.

Wage formation

It is already noted that the wage mechanism in both MEPM and MELT3 needs reformulation in recognition of the importance of wages and prices in a macro model. To incorporate wages seriously, a possible alternative to the Phillips curve framework used in MELT3 is one where imperfect competition with recognition of wage bargaining ability of trade unions is introduced, as suggested above. This alternative is preferred as it captures the role of taxes in wage formation. And so, unlike in the Phillips curve framework where wages depend on inflation and unemployment, the wage equation will include more variables. Thus real wages should be specified to depend

on productivity, unemployment, income taxes and terms of trade (or import prices and real exchange rate).

Prices

The theory behind the price equation in macro models tends to vary with specific economies. However, particular explanatory variables can be expected to have an influence, including unit labour costs, import prices and capacity utilization. Price in the goods market in the NIESR model, for example, depends on costs (essentially labour and import costs but also the costs of stock building), productivity, demand and, for wholesale prices in manufacturing, capacity utilization. Of course, if the model were to be new classical in nature, inflation would be modelled as a result of the difference between money demand and fixed money supply, but this formulation cannot be justified since an eclectic model is more practical for Kenya rather than one that subscribes to a particular paradigm. Trade prices in the model may be related to world prices or be a combination of world and Kenya prices (for example, in manufacturing) and the exchange rate. Alternatively, a flexible approach can be adopted in which the demand and the supply sides of the economy determine prices. On the demand side would be the money market, on the supply side would be the labour market and the external sector.

5.4 Public sector

In the proposed model for KIPPRA, the public sector module[6] is seen as an important component of the model. It is envisaged that the equations capturing the public sector will introduce a

[6] This module can be enriched by borrowing from the theory used in RMSM-X. The important aspect is to ensure that the various aggregates and their determinants are consistent with those of Kenya's public sector.

link between monetary and fiscal policy,[7] which should also show the links with wealth determination. The public sector can be introduced through a government budget constraint. On one hand, this will stem the government financial balance or deficit, defined as spending less taxes plus interest payments on outstanding government debt. By fully specifying how government spending and tax receipts in their different components are determined, several questions about the stance to be taken can be analysed. On the other hand, it shows how issuing money or bonds both domestically and abroad finances the deficit.

Just as the economy needs a nominal anchor in the case of monetary policy shocks (see below), so the various sectors in the economy have to be solvent. Thus borrowing and lending need to be constrained so that the balance sheet of each sector is controlled. In the public sector specifying a target for the financial surplus to GDP ratio imposes this constraint.[8] Because this ratio includes interest payments and receipts, controlling it by changes in the basic rate of income tax is sufficient to control the balance sheet. A consequence of the need for solvency is that any fiscal policy measures that change the budgetary position need to be financed. Thus an increase in spending will ultimately be offset by an increase in taxes or a fall in spending elsewhere, or both. The exception is when the target itself is changed. If the fiscal shocks under consideration assume no change in the target, then in the long run a change in the composition of the budget rather than a change in the fiscal stance has to be reflected.

[7] Fiscal policy here refers to determination of the size of the government deficit while monetary policy is the way in which the deficit is financed.

[8] Wealth effects in the consumers' expenditure equation and the excess debt effects in the expenditure and dividend equations in the company sector are used to achieve the fiscal solvency constraints for the private sector.

5.5 Financial sector

This module of KIPPRA's proposed model could borrow from macroeconomic models developed for specific aspects like exchange rate behaviour, inflation behaviour and money demand equations. In doing so, the currency of the theory used in the topical models will be an important determinant of whether they can be included.

Money demand

Interest rates and income determine money demand in MEPM. However, money demand is not modelled in MELT3. Whether the money demand equation was left out in MELT3 due to failure to get a stable function is not clear, and the stability of the equation in MEPM is not discussed either. Therefore, it is proposed that a money demand equation be introduced in KIPPRA's model as a function of output, price, interest rates and wealth. It could also include the nominal exchange rate to capture currency substitution. The stability of the function will be tested, as an unstable function may not augur well with a macro model.

Money supply

Money supply can be incorporated in the macro model in three ways: it could be endogenous with no explicit money demand equation; it could be endogenous accompanied by an explicit money demand equation; or it could simply be endogenous by identity, which is the more common way to model it. In a regime with a floating exchange rate, monetary policy is independent and this favours an identity.

Interest rates

The relevance of interest rates in a macro model for Kenya is stronger now than it was when MEPM and MELT3 were being developed. Changes in interest rates influence both effective demand and, through investment, the level of capacity utilization. The key dynamic path of the exchange rate may also be largely determined by interest rates, hence the importance of any feedback rule specified for interest rates in the monetary policy assumption.

Theory suggests that the economy needs a nominal anchor for it to be stable in the face of shocks (NIESR 1999). It is certainly true that a model is unstable unless a suitable monetary rule is specified. One possible rule may be to use nominal interest rates to target the rate of inflation. It is also possible to use other monetary policy targets such as one of the monetary aggregates or money GDP. Alternatively, nominal interest rates and the exchange rate may together be fixed (as in a fixed exchange rate regime), as it is not possible to solve a model with fixed nominal interest rates unless the exchange rate is also fixed. Therefore, modelling interest rates will need to take centre stage in any endeavour to develop a macro model for the Kenyan economy, and the appropriate monetary policy rule will need to be identified. In addition, the short-run effects of interest rates are driven by government domestic debt, which makes modelling interest rates quite complicated.

It is not possible at this stage to determine how interest rates ought to be incorporated in the model, but there are several options. At one end, the interest rates can be treated as exogenous (policy variable) with long-run rates being modelled to depend on past short-run rates. In other cases, interest rates are incorporated through reaction functions for the short rates with long rates being forward looking. Alternatively, interest rates can be explained through a reaction function where money growth differential, inflation differential, interest rate

differential, exchange rate and current account balance are key variables. At the other extreme, the efficient market hypothesis can be appealed to, in which case the equalization of real domestic and foreign interest rates is justified and hence uncovered interest rate parity could be exploited.

Exchange rate

Exchange rate in MEPM and MELT3 has been mainly exogenous. But where the regime is a floating one, it is important that an explicit mechanism of addressing exchange rate be formulated. The exchange rate plays a crucial role in the model, helping to determine output, inflation and the price level in both the short and the long term. It also determines the adjustment speed from shocks in the supply side of the economy. As discussed earlier, the exchange rate could be incorporated through the uncovered interest parity approach, which is now widely used. The alternative is to let the exchange rate adjust to an equilibrium rate, which depends on relative money, relative prices and interest differentials. The NIESR model determines exchange rate by the open arbitrage condition (short-term interest-rate differentials less the expected change in the exchange rate). This relationship is written as an equation in the current exchange rate, with the expected exchange rate and interest rate differential as independent variables. The relationship implies a long-run equilibrium in which the rate of change of the nominal exchange rate, and hence price inflation, is consistent with the interest rate differential.

5.6 Balance of payments

An important output of KIPPRA's macroeconomic model would be to indicate whether the balance of payments is a constraint upon economic policy. Therefore, modelling the balance of payments would be an integral part of the model,

capturing the determination of the current account and the capital account. Both these accounts need to be comprehensively modelled while realizing that the capital account consists of both long-term and short-term capital inflows and outflows. In this module, the question of foreign debt and its structure can be addressed by ensuring that all the components of the total debt are clear in the model.[9]

6 Concluding Remarks

The objective of this paper is to review the macroeconometric models for the Kenyan economy and to highlight the main shortcomings of these models. It argues that the two main models that have been developed for the Kenyan economy are not useful in forecasting and policy analysis as they have major weaknesses. The alternative of using the models of the IMF and the World Bank also has limitations, in that these models cannot be used for medium- to long-term projections due to their rudimentary incorporation of the real sector from a theoretical point of view. The conclusion is that a new macro model needs to be developed that addresses the shortcomings identified from previous models while borrowing where appropriate from them. The paper also suggests the structure of the new model, emphasizing the imperative of having a theoretically sound supply side.

[9] This module can adopt the framework used by the IMF and the World Bank in the extended Polak model and RMSM-X. Both these models are strong on modelling the external sector. However, it would be important to use aggregates as used in the rest of the model to ensure internal consistency. In addition, the public debt module could be analysed independently and then incorporated into the KIPPRA model. This would help in analysing sustainable issues.

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