A Macroeconomic Model for Romania's Flexible Exchange Rate System

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CONTENTS

EXECUTIVE SUMMARY

The comprehensive economic reform program instituted by the Government of Romania has generated a need for an analytical framework to coordinate a broad set of macroeconomic policies and structural adjustments required to sustain the country's transition to an open, market economy. To assist in the design and analysis of those macroeconomic policies and improve the sequencing of those initiatives, the US Agency for International Development (USAID) has provided technical assistance for the development of macroeconomic modeling capabilities of the Government of Romania. The design and implementation of the macroeconomic model for Romania described in this report is an outcome of that project.

An earlier macroeconomic model, also developed as part of a USAID technical assistance program, was designed for an administered exchange rate system and focused on the real sectors of the economy. As part of the government's 1994 program that formed part of an IMF stand-by arrangement, the exchange rate became unified through the adoption of a floating exchange rate, and the anti-inflationary program shifted from one based on an exchange rate anchor to one based on a monetary anchor. The present macroeconomic model provides real and financial sector forecasting and policy simulation capabilities under a flexible exchange rate system that is targeted to the needs of the Reform Council. It provides multisectoral simulation capabilities for analyzing the interrelationships and feedback effects of policy-determined economic variables. The transition process of the economy has motivated the design of a model that provides for a parsimonious representation of the structure of the Romanian economy, exploits the increased availability of data for the system of national accounts, and recognizes time-variant parameters that can result from the transition process. The resulting model allows for considerable flexibility in its usage for forecasting, and in the selection of the policy mix and instruments for the targets of a program. In its present form, it provides a framework for making rational and consistent predictions about Romania's overall economic activity, and the standard components of the production and expenditure concepts of the national accounts. It also offers a means of quantitatively evaluating the impact of monetary and fiscal policies on the economy, and assessing the feedback effects that changes in key macroeconomic variables of the economy produce in other sectors.

The model was designed and constructed jointly with the National Commission for Economic Forecasting, in close consultation with the technical staff of the Council for Coordination, Strategy, and Economic Reform. Its present form allows for considerable flexibility in its usage for forecasting, selection of the policy mix and instruments for the targets of a program, and the determination of the appropriate sequencing of policies.

I. INTRODUCTION AND BACKGROUND

A.THE GRADUALIST TRANSITION

The Romanian economy is undergoing a comprehensive, albeit gradual, reform program aimed at transforming the economy from a centrally planned economic system to a market-oriented economy. Under communism, economic development was based on strict autarky, central planning and investment in industry. During the 1980s, while other communist countries experimented with partial liberalization, planning in Romania became more centralized under Nicolae Ceausescu. Resources were diverted from unfavored sectors such as agricultre towards heavy industry and large building projects, and in the face of lower exports, imports were severely cut in an effort to pay off all foreign debt.

After the December 1989 revolution, the structural distortions created by investments in projects that lacked sustainability in the international economy caused severe adjustment problems in the economy. After years of forced savings and repression, the Romanian population was unprepared for additional austerity measures and dislocations that the transition to a market-oriented economy necessitated. Moreover, unlike other communist countries where opposition movements with reform programs were prepared to lead the transition process, the absence of any such movement in Romania meant that the country emerged from the Ceausescu era with little, if any, coherent political base or policy program.[1] As a result, the transition to a market-oriented economy has occurred through gradual changes in the economic system.

Populist measures were introduced in the early years to help the Romanians recover from the years of suppressed living standards. During this period there emerged a persistent imbalance between aggregate demand and supply as a result of a severely inadequate productive capacity in the economy relative to expansionary domestic demand. The consumption expansion was fed by imports financed by large foreign exchange reserves, while investment and industrial production suffered severe declines. Real gross domestic product (GDP) declined by 6 percent in 1990, and by around 13 percent a year in both 1991 and 1992.[2] In large part, the output contraction was related to the energy dependence of the country's heavy industry, which needed to be imported from other centrally-planned economies at artificially low prices after Romania's large reserves of natural gas and oil were depleted.[3] After the revolution, the move to the much higher priced

[1]For a detailed analysis of the early years of the transition process, see OECD (1993).

[2]Official statistics indicate that GDP in 1992 was less than $600 a person. However, central bank estimates indicate that around $1 billion in hard currencies were circulating in the black market, an amount equal to between 25 and 30 percent of GDP.

[3]According to the OECD (1993), Romania's ratio of primary energy consumption to GDP was five times higher than

imports from the world market depleted the country's reserves and decreased the capacity of the economy to sustain its domestic production. Moreover, it has been argued that the allocation of scarce energy supplies on the basis of historical usage rather than productive capacity resulted in an enormous build-up of inventories and the consequent cutbacks in productive output (OECD, 1993, pp. 32-33). It was not until 1993 that the contraction in real GDP ceased as a result of an output recovery in agriculture and an expansion in exports (see Figure 1).

The decline or stagnation of output was accompanied by inflation of around 200 percent a year in 1991-92, and it accelerated to 250 percent in 1993. Price controls were gradually liberalized, and not until mid-1993 were the last consumer subsidies and most remaining price controls eliminated. Much of the price rise was perpetuated by soft credit constraints on state enterprises, the indexation of wages to inflation in lieu of reforming the social-security system, and the lack of currency convertibility, as both current and capital account transactions became subject to restrictions. The lack of convertibility gave rise to an exchange rate gap between both the black market and the legal foreign exchange bureau market and the official auction exchange rate, which was set on an administered basis.[4] The exchange rate system tended to favor cheap imports at the expense of the country's export competitiveness since access to the foreign exchange bureau market was limited to household transactions. Inflation was fueled by delays in launching a comprehensive privatization program. As the money supply was tightened to dampen inflation, state enterprises circumvented their liquidity constraints by not paying taxes and running up large debts with one another.[5] The resulting growth of inter-enterprise arrears weakened the central bank's capacity to control inflation. As confidence in the leu weakened, the exchange rate gap widened and the rising pressure on prices of tradeable goods further fueled inflation.

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in Western Europe, and at least twice as high as other centrally-planned economies.

[4]There were four parallel markets in existence until the beginning of 1994: (1) the official auction exchange rate, which was set on an administered basis; (2) the "grey" market, which consisted of inter-enterprise foreign exchange transactions whose premia of between 10 and 30 percent caused the volume of transactions in this market to exceed that in the official auction; (3) the legal foreign exchange bureau market, which serviced household transactions, and whose rate tended to exceed those of the grey and official markets; and (4) the black market, for which data on transactions levels are unavailable.

[5]Inter-enterprise debt in the latter part of 1993 reached 1,900 billion lei ($2.3 billion), equivalent to about 20 percent of GDP.

At the end of 1993, the government agreed to liberalize the exchange rate, restructure state enterprises, eliminate preferential credits, and fast-track the privatization program. These measures were adopted as part of a program supported by a stand-by arrangement with the International Monetary Fund.[6] In its macroeconomic stabilization policies, the government has now begun to establish a realistic price structure based on currency convertibility. In early 1994 the unification of the exchange rate through the adoption of a floating exchange rate shifted the anti-inflationary program from one based on an exchange rate anchor to one based on a monetary anchor. As a first step, the foreign exchange auction began to determine the exchange rate on the basis of a market clearing mechanism. Concurrent with this action, interbank foreign exchange transactions were liberalized, foreign exchange bureaus were allowed to purchase foreign exchange from commercial banks, and commercial banks and enterprises were permitted to purchase foreign exchange in the auction. As a result, the auction rate converged to that of the foreign exchange bureaus, and the amount of transactions channeled through the auction began to grow. The second step in the liberalization process consisted of the establishment in June 1994 of an interbank foreign exchange market to replace the auction market. The interbank market allows all commercial banks and foreign exchange bureaus to buy or sell foreign exchange from each other at negotiated market rates. After its establishment the interbank market rate is being used for all official transactions.

The new program also introduced positive but low interest rates, applied fiscal restraints to reduce the fiscal deficit to sustainable levels, and introduced structural reforms in the form of financial sector reforms, producer pricing policies, trade liberalization, and tax reforms that would allow the economy to more readily respond to the market mechanism. In May 1994 the Romanian parliament approved an austerity budget for 1994 which is to keep the budget deficit to below 3.5 percent of GDP. Indirect taxes will be increase to provide additional fiscal revenue. For its part, the IMF approved credits for Romania totaling about $454 million in May 1994. A second disbursement of $267 million will be made if Romania shows progress in its stabilization and reform efforts. The performance criteria include the reduction of inflation from over 250 percent in 1993 to the two-digit level by the end of 1994, speeding up privatization and restructuring state enterprises, which account for about 90 percent of industrial output, and ensuring internal convertibility of the leu. The central issues now facing the government remains the question of how fast and in what sequence to open the external sector for trade and capital movements, create a domestic financial market, reduce the government deficit, and impose budget constraints both on state enterprises and on wages of the workers in those enterprises.

[6]The previous stand-by arrangement operated from May 1992 to March 1993. However, the final purchase under that arrangement was not made because of Romania's failure to meet performance criteria by December 1992.

B.POLICY COORDINATION

The determination of the speed of sequencing of these and other economic reform policies and the structural adjustment program is being carried out by the Council for Coordination, Strategy, and Economic Reform (hereafter Reform Council). As a super-ministerial Government body, the Reform Council provides economic policy advice to both the Prime Minister and an inter-ministerial policy reform committee on all matters related to macroeconomic policies and structural reforms. In formulating economic policy recommendations and providing advice to senior Government policy-makers, the Council's economic policy activities focus on the direct and indirect impact of current and proposed economic policies on production, trade, consumption, employment, and price and wage movements.

Technical support for the Council's activities comes from the National Commission for Economic Forecasting (hereafter Forecasting Commission), a branch of the Reform Council with broad-based capabilities in macroeconomic modeling, monetary and fiscal policy analyses, studies on trade and the balance of payments, sectoral research, and social sector studies. In those areas related to macroeconomics, the Forecasting Commission has sought to enhance its capacity to analyze sectoral interrelationships and feedback effects likely to arise from a broad set of Government initiatives related to economic stabilization efforts and attempts to reverse output declines in order to achieve self-sustained economic growth.

Since mid-1993 the US Agency for International Development (USAID) has provided technical assistance for the development of macroeconomic modeling capabilities in the Forecasting Commission to support and strengthen the government's economic policy reforms and structural adjustment program. The initial technical support consisted of the design and implementation of a macroeconomic model of Romania's fixed exchange rate system which principally focused on the real sectors of the economy (Lord, 1993a); it also included a component to identify the Commission's technical capabilities and training needs (Lord, 1993b). The next technical support was in the form of staff training in the Commission, and it provided for seminars and workshops on statistical methods, national income accounting and balance of payments methodologies, macroeconomic analysis of open economies under fixed and flexible exchange rate systems, econometric modeling, and economic forecasting and simulation techniques (Lord, 1993c).

C.POLICY ANALYSIS AND FORECASTING

The present macroeconomic model provides real and financial sector forecasting and policy simulation capabilities targeted to the needs of the Reform Council. As such, it serves a dual purpose. First, it provides a framework for making rational and consistent predictions about Romania's overall economic activity, the standard components of the balance of payments, and the production and expenditure concepts of the national accounts. Secondly, it offers a means of quantitatively evaluating the impact of monetary and fiscal policies on the economy, and assessing the feedback effects that changes in key macroeconomic variables of the economy produce in other sectors. These two objectives are, of course, closely related since the capacity to

make successful predictions depends on the model's ability to capture the interrelationships of the real and financial sectors of the economy.

The modeling procedure has sought to account for the structure of the Romanian economy, the availability of data, and the degree of stability of time-series estimates of parameters during the country's transition process. The nature of the transition process of the Romanian economy has motivated the design of a model that can grow and evolve with the economy. While the model described in Lord (1993a) was designed for an administered exchange rate system and focused on the real sectors of the economy, the present one incorporates both the real and financial sectors of the economy within the flexible exchange rate system that now characterizes the Romanian economy. The objective is to provide a mechanism to link policies and targets while, at the same time, providing an easy and adaptable means of both forecasting key macroeconomic variables and simulating the interrelationships between economic policy initiatives. The present form of the model therefore provides a relatively parsimonious representation of the Romanian economy that allows for considerable flexibility in its usage for forecasting, selection of the policy mix and instruments for the targets of a program, and determination of the appropriate sequencing of policy changes.

The model was developed in close consultation with the technical staff of the Forecasting Commission. This process ensured that the model would be used by both the Commission and the Reform Council, and it offered an opportunity for the staff to consider areas of future expansion and disaggregation of the model. Areas identified include (a) the disaggregation of the public sector and its integration into the work of the Ministry of Finance, (b) the expansion of the external sector to analyze Romania's export competitiveness in selected products and markets, (c) the inclusion of wage determination within the model, and (d) the further disaggregation of the real and financial sectors.

The model was developed between May and November 1994 at the request of the Reform Council. It was designed and constructed at the Forecasting Commission with the close collaboration of the Department of Macroeconomic Models for Gross Domestic Product and the Department of Financial, Monetary, and Valuable Balances. Ms. Vlásceanu, Director of the Division of Macroeconomic Model, Formation and GDP Use, collaborated in all aspects of the design, estimation, and simulation of the model. As with the development of the earlier fixed exchange rate model, her collaboration and that of her colleagues greatly contributed to the successful development of the model.

D.MODELING HISTORY

Up to now the Forecasting Commission has used two separate, though closely related, models for much of their forecasting and economic policy simulations. The first is an accounting framework model which is used to verify the consistency of economic activity projections. The other is somewhat more sophisticated insofar as it includes behavioral relationships; however, its utilization has been hampered by the software used to operate it. Both models are supply-driven. Gross domestic product (GDP) is determined by the activities of eight sectors in the economy. Once total output is determined, it is allocated among consumption, investment, and foreign

resource transfers.

The first model was constructed by the Forecasting Commission in its Macroeconomic Model, Formation, and GDP Use Division. The accounting framework it uses links the various real sectors in the economy. The model initially solves for the nominal values of the variables; the nominal values are then converted to real values by applying the GDP deflator based on the consumer price index (CPI) and the wholesale price index (WPI), both of which are obtained from the Department of Prices in the Ministry of Finance.[7]

The system of equations can be altered to provide different types of information such as projected growth rates with or without additional external financing. In its basic form, the model calculates the additional external financing required to achieve the GDP growth rate determined by the potential output of the Romanian economy. It has also been used to obtain solutions for the following: The projected economic growth of Romania given no additional external financing beyond that which has already been committed, and the effect of additional value added in particular sectors on expenditure levels in the economy.

The second model used by the Forecasting Commission was developed jointly with the National Institute for Economic Research (1993), and is know as the Dobrescu Model. The model runs on the GAMS program, with the equations having been estimated on spreadsheet software (LOTUS) using programmed least squares estimates of the equations. As a result, the model is relatively cumbersome to operate.

Both models project in some detail the production and expenditure concepts of the system of national accounts. Supply projections are based on resource constraints, particularly energy supplies, and there is a detailed breakdown of economic activity by sector of origin (industry, agriculture, forestry, construction, transportation, telecommunication, trade, and financial services); basic information on the balance of payments is also provided.

The major modifications and extensions of these two models that were introduced into the present macroeconomic model for Romania are the following:

•Estimation of the behavioral equation in real terms.

•Disaggregation of the balance of payments into standard components.

•Determination of the level of exports and imports within the system of equations.

•Separation of Government into its three major components: State, Local, and Social Security Budget.

[7]Estimates of the GDP deflator for the forecast period are obtained from the historical correlation between the GDP deflators and the CPI and WPI, and applied to the projected CPI and WPI of the Department of Prices of the Ministry of Finance.

•Introduction of monetary, fiscal, and exchange rate policy-determined variables.

•Disaggregation of the State Government's revenue and expenditures to include as policy-determined variables the direct and indirect taxes on specific sectors and activities, and those of subsidies on specific sectors.

•Development of income concepts by sector.

•Determination of wages and prices in each sector.

•Determination of value added for the primary and secondary sector within the system of equations.

•The simultaneous determination of the overall production and expenditures of Romania, in both real and nominal terms.

Most models provide flexibility in the determination of different variables in the system of equations that make up the model. For example, the World Bank's (1992) Revised Minimum Standard Model, Extended (RMSM-X) estimates the external financial requirements of a country as the gap between the estimated debits and credits to the balance of payments required to achieve a given growth rate. The present modeling framework provides a similar level of flexibility for the Romanian economy. It offers a system of equations that describe the interaction of the economy, and it provides for additional extensions to more disaggregated relationships without loss of flexibility. Extensions to the model are described in Part VI.

E.SCOPE OF THE STUDY

This report is organized as follows:

•Part I provides a general introduction to the transition process in Romania, the coordination of policies, and the motivation for the construction of the model. It also discusses issues related to modeling the Romanian economy, including the characterization of economies in transition and data considerations.

•Part II describes the theoretical structure of the model and its major components, and it specifies the system of equations that make up the basic model. It shows how the dynamics underlying the data generating process in the system of equations provide a theory-consistent representation of the Romanian economy.

•Part IIII describes economic policies under a flexible exchange rate system, and their representation in the model.

•Part IV presents the behavioral relationships which are key components of the macroeconomic model and presents the empirical results for Romania. It also examines possible effects of changes in the structure of the economy on the coefficient estimates in the model.

•Part V sets out the system of equations as a whole, and describes the interrelationship between the equations that make up the model.

•Part VI describes the solution of the system of equations as a whole, and presents the effects of changes in policy variables on the economy.

•Part VII provides a summary and sets forth some of the major conclusions.

•Annex A contains a list of documents and studies used in the preparation of this report.

•Annex B discusses econometric issues related to the specification and estimation procedures of the macroeconomic model.

•Annex C examines practical issues of the model as they related to the generation of fforecasts and policy simulations during a forecast period.

•Annex D contains the data used in the construction of the model.

II. THE MACROECONOMIC FRAMEWORK

The present model applies a conventional IS-LM framework to a transition economy under both fixed and flexible exchange rate systems and, as a policy-oriented system, it incorporates key parameters for policy formulation. At the onset, the model is designed as a parsimonious representation of the underlying data generating system for key behavior relationships. A similar approach is adopted by the IMF staff's macro model-building applications and used in IMF-sponsored adjustment programs, except that the underlying structure of those models are related to the monetary approach to the balance of payments (Frenkel and Johnson, 1976).[1] The conceptual approach to the present model is instead based on conventional economic theory as described in Sachs and Larrain (1993). The empirical specification of the conventional theory is, nevertheless, not well established since there are numerous approaches to the specification, estimation and testing procedures in standard macro models.

A.MODELING THE TRANSITION PROCESS

The major characteristics that need to be considered in the design and implementation of a macroeconomic model for Romania concern the transformation of the economic and statistical systems in the country. The transition process accompanying such a transformation refers to the introduction of fundamental reforms in the socio-economic system which are changing the role of prices in the economy, altering institutional structures, developing the private sector, restructuring industries, creating an autonomous banking system, and establishing other financial markets. After 42 years of operating under a centrally planned economy where the institutions and a system of incentives were far removed from those in market economies, the Romanian socio-economic system has had to undergo extraordinary adjustments.

The reduction in price controls has brought with it large cost and price rises, an acceleration in the rate of increase of prices, and large output declines. Substantial dislocations have arisen because pre-reform prices were not established at market-clearing levels. The initial conditions for the transition were therefore characterized by large internal and external macroeconomic imbalances. According to a study by the National Commission for Economic Forecasting (1993b), inflation has also reflected the reduction in controls over wages and the increase in labor mobility. The movement of workers, particularly those with scarce skills, from the public to the private sector has driven up labor costs in both sectors. Moreover, higher prices for consumer goods and services resulting from reduced subsidies have amplified the pressure for

[1] A description of the monetary approach to the balance of payments can be found in Frenkel and Mussa, 1985; and Krugman and Obstfeld, 1991. For a prototype IMF monetary model of the IMF, see Khan and Montiel (1989); for a sampling of IMF macro models, see Khan, Montiel, and Haque (1991).

compensating wage increases.

Modeling these processes requires the explicit recognition of how the transmission mechanism for inflation adversely affects development on the real side of the economy. One approach is to incorporate uncertainty in the model and measure its effects on consumption and investment patterns. Another way is to include the propagation mechanism for inflation on the cost side of the model, and use it to determine possible effects of incomes policies on price level increases and the rate of inflation. The inclusion of these transmission mechanisms is particularly important since there is general consensus that macroeconomic stabilization needs to be addressed early on in the reform process (see, for example, Commander (1992), Corbo (1991), Fischer and Gelf (1990, 1991), and Roe (1991, 1992)).

The move from a fixed to a flexible exchange rate system, while still controlling capital movements, have important implications for the policy instruments that are available to the government and the Central Bank of Romanis. Although capital controls are common to developing countries, they are usually combined with fixed exchange rate systems, while the industrial countries are more likely to have adopted a floating exchange rate system without restrictions on capital movements. While macroeconomic systems often avoid explicitly modeling capital controls, the explicit introduction of those controls in the present model changes the mechanism through which interest rate variations affect the economy. Modeling the mechanism through which monetary and fiscal policies affect consumption, investment, and the trade balance can help to ensure that policy instruments are correctly combined to achieve stability and growth targets for the Romanian economy.

Similar model applications can determine the role of interest rate policies in reversing stagflation in the economy. Romania has succeeded in restraining the growth of credit to the non-government sector. In 1991-92 broad money increased by under 250 percent, while prices rose by more than 850 percent, thereby eliminating the inherited monetary overhand (World Bank, 1993). However, as Calvo (1991) points out, the legacy of inefficient credit allocations left by the socialist system has given rise to a complex financial reform challenge for countries like Romania. Tight monetary policies designed to slow inflation can create a more protracted recession. Instead, financial policy reforms are more likely to involve increased support of profitable activities through the extension of credit facilities from the banking system. The interrelationship between these financial issues, which are generally of an institutional nature, and the macroeconomic issues raises fundamental questions about the design and implementation of reform programs and how to provide a modeling framework to facilitate their coordination and determine their appropriate sequence.

The movement from administered prices to more flexible market-determined prices has also brought about fundamental changes in the way that businesses and households respond to economic conditions. Under the central planning system that prevailed before 1990, prices had no allocative function. The liberalization of prices has helped to eliminate imbalances in the goods market and, at the same time, it has contributed to the improved allocation of resources. In modeling economic behavior, these changes imply a greater responsiveness of economic agents to changes in relative prices, and therefore possible parameter changes during both the historical period and the period of the forecast. If parameter changes occur, then the use of time-invariant

parameters can make the system of equations unstable. The alternative approach consists of the introduction of time-varying parameters that capture the transition process in the structure of the economic system. These types of parameters can introduce an element of subjectivity in the operation of the model, and a decision to adopt time-varying parameters therefore should be approached with caution.

Another manifestation of the transition process that needs to be considered in the model for Romania concerns household and business adjustments to fundamental changes in operating procedures. A recent example of these adjustments occurred with the introduction of a value added tax on July 1, 1993. Its introduction created assimilation difficulties for many enterprises, particularly in terms of product and service pricing, with the result that many businesses either remained temporarily closed after the introduction of the tax, or did not sell merchandise for several weeks because of their inability to determine their new pricing policies. As Corbo, Coricelli and Bossak (1991) point out, these adjustment difficulties reflect the decades of operation under institutions and incentives systems that were different from those found in market economies. It is therefore important that the analytical framework be developed in such a way as to support fiscal policies associated with adjustment programs. In addition to the development of basic fiscal institutions such as tax and budgetary systems, the introduction of new taxes, including value added taxes and personal income taxes, to replace the discretionary turnover taxes of the previous system are impacting the dynamic underlying the adjustment process of different components in the economy. The consequence of such adjustment difficulties, and their associated short-term costs, can be modeled through both the introduction of appropriate lag structures, and the inclusion of possible transient disturbance terms in particular sectors of the economy the account for obstructions to business activities resulting from the economic reform process.

The balance of payments position of Romania makes the situation all the more precarious. Without adequate external credit, the growth of exports has failed to provide scope for a reasonable expansion of imports. There is a minimal amount of service and transfer receipts, and the tourism industry is inhibited by inadequate infrastructure. Foreign direct investment, access to foreign capital markets, and commercial lending have all been limited. Yet the opening up of the economy and the ability to attract capital inflows, including foreign direct investment, remain critical to Romania's economic recovery. Indeed, the reform process in Romania requires not only the removal of distortions in the economy, but the creation of markets and institutions. Consequently, the balance of payments component of the model must be sufficiently disaggregated to permit the consideration of trade and exchange rate policies at a fairly detailed level. Moreover, as the economic reforms take hold, cost and price competitiveness will become more strongly related to trade and investment flows, and the ability to measure the transmission effects of relative price changes on the domestic and external sectors will become increasingly important.

B.PRELIMINARIES

1.National Accounting Concepts

In a sense the problems and issues of modeling the transition process in the Romanian

economy are reflected in the conversion of Romania's statistical system to comparable terms in market economies. The central planning system which prevailed until 1989 used the material product system (MPS) for the national accounts. The MPS was abandoned in 1991 and national accounts based on the United Nations (UN) system were developed for 1989 and 1990 by the National Commission for Statistics (undated publication). Essentially, the implementation of the UN system of national accounts used by market economies has had to address all the issues of the transition process in Romania, ranging from price reforms to open inflation, market breakdowns, and new arrangements for foreign trade. For purposes of time-series analysis of behavioral relationships, there has fortunately been a considerable amount of work already undertaken on the conversion of the accounting systems. These conversion are described in Marer et al. (1992) for Eastern Europe and elsewhere; for Romania they are detailed in Vlásceanu (1993). Issues related to the transition from the trade and payments system of the Council for Mutual Economic Assistance (CMEA) after its demise in 1990 are discussed in Schrenk (1991).

In the UN national accounts system, the main aggregate, GDP, is calculated by sector of production origin and use, or by type of expenditures, utilizing the following accounting identity:

Production*=*Expenditures

Value added in:Investment

Primary sector+Private consumption

+Secondary sector+Government consumption
+Tertiary sector+Balance of goods
and nonfactor services

=GDP=GDP

To arrive at overall GDP, the present model derives solutions for both the production and expenditure concepts. There are three major blocks: the national income accounts block, the monetary sector block, and the balance of payments block. The national income accounts block contains a considerable amount of interrelationships between the endogenous variables in the system in order to capture feedback effects in the economy. The monetary sector block provides information about the interrelationships between the real and financial sectors and shows how the monetarization of the fiscal deficit affects both sectors. The balance of payments block generates information about the major balance of payments components, and it yields a solution to the balance of goods and non-factor services, which is then used in the national income accounts block.

It should be emphasized that no one theory or dynamic specification can provide a complete description of the Romanian economy. What is essential is that key features of the process be represented in the system used to characterize the economy. The resulting system can therefore be viewed as an interpretation of the process by which real and financial transaction in the economy take place, and the way in which economic policies operate to affect those transactions.

2.Notations

To simplify the exposition that follows, the notations are summarized here as follows:

A=real domestic absorption
B=real trade balance
C=real private consumption expenditure
D=domestic credit from the monetary sector
D^p=domestic credit from the monetary sector to the private sector
D^g=domestic credit from the monetary sector to the public sector
D^{gs}=domestic credit from the monetary sector to the state government
D^{gr}=domestic credit from the monetary sector to the rest of the government
e^n=nominal exchange rate
e^r=real exchange rate
F=external debt of public sector, denominated in foreign currencies
G=real government expenditure
G^s=real state government expenditures
G^r=real rest of government expenditures
H=nominal debt of State Government
I=real gross domestic investment expenditure
i=nominal interest rate
i^f=nominal interest rate prevailing in world market
K=stocks
M=broad money
N=real non-tax revenue of public sector
P=domestic price level
P^f=foreign currency price of goods purchased abroad
r=real interest rate
R=international reserves (foreign currency denominated)
T=real taxes
V=velocity of money
X=real exports
Y=real aggregate demand
Y^a=real output of primary sector
Y^b=real output of secondary sector
Y^c=real output of tertiary sector
Y^d=real net household income
Y^f=real foreign market income
Z=real imports

C.OUTPUT DETERMINATION

1.Aggregate Demand

In an open economy, aggregate demand, *Y*, is the sum of domestic absorption, *A*, and the trade balance, *B*:

$$Y_t = A_t + B_t \tag{2.1}$$

Domestic absorption measures total spending by domestic residents and public and private entities. It is composed of total private consumption, investment, and government expenditures:

$$A_t = C_t + I_t + G_t \tag{2.2}$$

where *C* is real private consumption expenditure, *I* represents real gross domestic investment expenditures, and *G* is real government expenditures.

The trade balance measures the net spending by foreigners on domestic goods. It is defined as:

$$B_t = X_t - Z_t \tag{2.3}$$

where *X* denotes real exports, and *Z* represents real imports. As with domestic absorption, the trade balance is defined in real terms.

a.Behavioral Components of Domestic Absorption

To facilitate the demonstration of the IS-LM framework used for policy analysis in Romania, the behavior equations are presented in the levels form of the variables. Empirical estimates in the levels form of the behavior equations would yield parameter estimates whose implied elasticities would vary over the historical and forecast period. In contrast, behavioral equations estimated in their log-linear form yield direct elasticity estimates whose values remain constant over both the historical and forecast periods. Empirical estimates of the Romanian model are therefore based on log-linear relationships in both the earlier fixed exchange rate system (Lord, 1993, and National Commission of Economic Forecasting, 1994), and the new flexible exchange rate system described in the next section.

The dynamic processes underlying Romania's consumption and investment adjustments to changes in key determinants are described by stochastic difference equations. The general form of the equation for any dependent variable *Y* and the explanatory variables X_i is:

$$Y_t = Y_{t-1} + \Sigma^{k}_{i=1}\ \beta_i X_{it} + \varepsilon_t \tag{2.4}$$

Like all dynamic equations, the stochastic difference equation imposes an *a priori* structure on the form of the lag to reduce the number of parameters that need to be estimated. Since Romania's national income accounts data are limited in terms of their range and annual periodicity, the parsimonious representation of the data generating process afforded by the

stochastic difference equation is advantageous to the modeling process.

This class of equations has three other important advantages. First, as pointed out by Harvey (1991: ch. 8), the stochastic difference equation lends itself to a specification procedure that moves from a general unrestricted dynamic model to a specific restricted model. At the outset all the explanatory variables postulated by economic theory and lags of a relatively higher order are deliberately included. Whether or not a particular explanatory variable should be retained and which lags are important are decided by the results obtained. The approach is appropriate for an economy like that of Romania where there is uncertainty about the explanatory variables to be included in the behavioral equation.

The second advantage of the use of the stochastic difference equation lies in the estimation procedure. Mizon (1983) has noted that, given sufficient lags in the dependent and explanatory variables, the stochastic difference equation can be so defined as to have a white noise process in the disturbance term. As a result, the ordinary least squares estimator for the coefficients will be fully efficient.

Finally, stochastic difference equations lend themselves to long-run solutions that are consistent with economic theory. This characteristic is useful for the present Romanian modeling, which builds from theory to dynamic specification, and finally to estimation and testing of the theory. When restrictions are imposed by economic theory, the relationships between variables are determined by *co-integration analysis*, and equations known as *error correction models* are used to yield long-run solutions that are consonant with economic theory.

Private Consumption: The level of private consumption, *C*, is positively related to deposable personal income, *Y*, and negatively related to the domestic real rate of interest, *r*.[2] For data with annual periodicity, the relationship is described by a first-order stochastic difference equation in its linear form:

$$C_t = \alpha_{10} + \alpha_{11}C_{t-1} + \alpha_{12}Y^d_t + \alpha_{13}Y^d_{t-1} + \alpha_{14}r_t + \mu_1 \qquad (2.5)$$

The expected signs are $0 < \alpha_{11} < 1$, $\alpha_{12} + \alpha_{13} > 0$, $\alpha_{14} < 0$. Empirically the effect of real interest rate changes on consumption, or dis-savings, is ambiguous, and it is therefore not always clear whether real interest rate changes are negatively related to consumption (for a theoretical discussion, see Sachs and Larrain, 1992: 106-109; for empirical evidence, or lack thereof, in developing countries, see Giovannini, 1983).

In equation (2.5), disposable personal income is defined as the difference between real GDP and taxes, *T*:[3]

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[2]The real interest rate is measured by subtracting the inflation rate from nominal interest rate.

[3]Formally, disposable income is output plus interest earnings minus taxes. However, Romania's interest earnings on its stock of wealth relatively small and have been omitted here for simplicity. In the expanded model of Lord (1993), disposable income is composed of wages and salaries of households plus other household income. In the formation of household wages and salaries in that model, the wage rate is related to value added, which itself depends on the overall level of economic activity.

$$Y^d_t = Y_t - T_t \tag{2.6}$$

***Investment*:** Total investment is separated into gross fixed investment, I^g, and changes in stocks, ΔK_t.

$$I_t = I^g_t + \Delta K_t \tag{2.7}$$

As with all other activity variables in the model, the behavioral relationships of both of these concepts are estimated in real terms.

Gross fixed investment, I^g, is positively related to the general level of economic activity and negatively related to the real interest rate.[4] The relationship described by a first-order stochastic difference equation is:

$$I^g_t = \alpha_{20} + \alpha_{21} I^g_{t-1} + \alpha_{22} Y_t + \alpha_{23} Y_{t-1} + \alpha_{24} r_t + \mu_2 \tag{2.8}$$

The expected signs are $0 < \alpha_{21} < 1$, $\alpha_{22} + \alpha_{23} > 0$, $\alpha_{24} < 0$.

Stocks are held by companies to ensure that they are able to meet future orders. The amount of stock actually held is determined by medium and long-term demand estimates of the companies. In the short run, stock changes reflect company decisions to maintain stable production levels. Since stable production is more cost-efficient than production targeted to current market conditions, stocks tend to build up during downswings in the business cycle, and are drawndown during upswings. Thus changes in stocks, *K*, at any period *t* are determined by change in economic activity, as measured by real GDP, *Y*:

$$\Delta K_t = \alpha_{31} \Delta Y_{t-1} + \mu_3 \tag{2.9}$$

where $\alpha_{31} < 0$.[5] In general, stock levels would be expected to be drawn down as aggregate expenditures increased, and they would tend to accumulate as expenditures declined. In Romania, the large accumulation of stocks during the downturn in economic activity was not the result of the aforementioned stable production rationale, but rather the lack of an adequate market price system that would provide an effective signal for the efficient allocation of resources. Instead of allocating scarce energy resources on the basis of market demand, the authorities allocated them on the basis of historical usage. Consequently, stock levels of unproductive industries rose in the face of declining demand for their products. A more appropriate response of industries to their output utilization is expected to occur as they become more responsive to

[4]The earlier Lord (1993) model includes gross operating surplus as an explanatory variable. Since gross operating surplus is the difference between GDP and net household income plus government tax revenue, both of which are indirectly dependent on the formation of GDP, investment is also closely related to private and public sector activities in that model.

[5]Note that first differencing the levels form of the stock equation eliminates the intercept. [Include derivation of first-differed equation without intercept once constant has been removed in the final estimated equation]

market signals with the removal of price controls, and once subsidies to state enterprises are eliminated.

b.Behavioral Components of Trade Balance

The key assumption about trade in the two-goods model is that the home country produces output that is differentiated from that of the rest of the world. The relative price of goods produced in the home country and foreign countries vary according to quality, reliability of supply sources, differences in marketing and customs regulations, and historical and political ties with supply sources. As those prices vary to reflect changing differences, consumers will alter their demand for domestic and foreign goods. Indeed, suppliers often seek to increase product differentiation between their goods and those of other suppliers producing the same type of good to have greater control over the domestic or foreign markets through their pricing policies.[6] As a result, the trade balance depends not only on the level of output and consumption in the domestic and foreign economies, but on the relative price of domestic and foreign goods.

In general, the relative price of a country like Romania can be measured by the real exchange rate, which takes into account both the relative prices of domestic and foreign goods, and the nominal exchange rate. The real exchange rate is defined as:

$$e^r_t = e^n_t P^f_t / P_t \qquad (2.10)$$

where e^n is the nominal exchange rate, P^f is the foreign currency price of goods purchased abroad, and P is the domestic price level. A rise in e^r represents a real *devaluation* in a fixed exchange rate system, and a *depreciation* in a flexible exchange rate system, which can be brought about by either a rise in the nominal exchange rate e^n, or a rise in the relative price of foreign goods (equivalent to a relative fall in the price of domestic goods). Conversely, a fall in e^r represents a real *revaluation* of the leu under a fixed exchange rate system, and an *appreciation* of the leu under a flexible exchange rate system. The fall is associated with either a drop in the nominal exchange rate e^n or a fall in relative prices of foreign goods (equivalent to a rise in relative prices of domestic goods).[7] The real exchange rate therefore measures Romania's

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[6]Product differentiation underlies much of the new theory of international trade related to imperfect competition and economies of scale. Products are said to be *vertically differentiated* when differences between suppliers of the same good arise from variations in the quality of a commodity. Products are said to be *horizontally differentiated* when importers differ in their choice of the geographic origin of the good even though its quality does not vary from country to country. Importer distinctions of homogeneous products from different exporting countries arise because of attributes related to the export of the product. Among these attributes are adjustment costs involved in switching from one supplier to another, the reliability of supply sources, differences in marketing and customs regulations, the desire for diversification of supply sources, and historical and political ties with countries. For a format treatment of product differentiation in the context of the new theory of international trade, and the resulting import and export demand functions, see Lord, 1991, chapters 1 and 3.

[7]A rise in either e^r or e^n represents a real or nominal *devaluation* in a fixed exchange rate system, and a *depreciation* in a flexible exchange rate system. A fall in e^r or e^n represents a *revaluation* under a fixed exchange rate system, and an *appreciation* in a flexible exchange rate systems.

export competitiveness. Variations in e^r influence the quantity of Romanian goods demanded by foreign markets relative to competing foreign and domestic suppliers to those markets.

Exports: The volume of exports, *X*, is a positive function of economic activity in foreign markets, Y^f, and a positive function of the real exchange rate, e^r:

$$X_t = \alpha_{40} + \alpha_{41}X_{t-1} + \alpha_{42}Y^f_t + \alpha_{43}Y^f_{t-1} + \alpha_{44}e^r_t + \mu_4 \quad (2.11)$$

The expected signs are $0 < \alpha_{41} < 1$, $\alpha_{42} + \alpha_{43} > 0$, $\alpha_{44} > 0$. Equation (2.11) is a reduced form equation that incorporates the a two-stage process in the importers' determination of its demand for exports. In the first stage, a decision is made about how much to consume of a set of products, based on income and prices. In the next stage a choice is made about how much to consume from different suppliers, both foreign and domestic. Separability in the preference ordering means that the amount to consume of a set of products and all other products, whose composite forms a numeraire, is independent of how the amount spent on the set of products is allocated among different exporters.[8]

***Imports*:** The volume of imports, *Z*, is positively related to domestic economic activity, and it is negatively related to the real exchange rate:[9]

$$Z_t = \alpha_{50} + \alpha_{51}Z_{t-1} + \alpha_{52}Y_t + \alpha_{53}Y_{t-1} + \alpha_{54}e^r_t + \mu_5 \quad (2.12)$$

The expected signs are $0 < \alpha_{51} < 1$, $\alpha_{52} + \alpha_{53} > 0$, $\alpha_{54} < 0$. Separability in the preference ordering of importers means that the amount spent on imported goods is independent of how much is spent on consumption of domestic goods.[10]

2.Aggregate Supply

Having determined aggregate demand, we need to find aggregate supply to determine the output of the economy. Aggregate supply is given by the value added by each sector. The value added of all industries in a sector is the sum of the difference between their total revenue and the cost of their purchases from other industries or firms. In the present model, the output levels of

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[8]For a formal derivation of export demand function in the new theory of international trade, see Lord, 1991, chapter 3.

[9]In the expanded model, merchandise imports are separated into energy-related goods and other goods. Imports of fuels have represented between 30 and 44 percent of imports in the last ten years; they therefore figure prominently in trade. Lack of available data on unit prices or volume indices did not permit the separation of imports into capital goods, intermediate goods, consumer goods, fuels, and others. Indeed, data on trade prices were not readily available. It was therefore necessary to construct them on the basis of disaggregated trade data. The export price index was constructed for the aggregate, and import price indices were constructed for fuel and other imports.

[10]For a derivation of the import demand function and the dynamics underlying trade, see Lord (1991: Chapters 3 and 8).

both the primary and secondary sectors are endogenous, while the tertiary sector is predetermined.

The secondary sector accounts for nearly half of the total value added of the economy. Its output level is a positive function of aggregate demand, *Y*, and the real price level:

$$Y^b_t = \alpha_{60} + \alpha_{61} Y_t + \alpha_{62} P_t + \mu_6 \qquad (2.13)$$

The expected signs are $\alpha_{61} > 0$ and $\alpha_{62} > 0$.

The output level of primary sector is determined by the economy's overall expenditure level and the activity of the other two sectors. The simultaneous determination of the level of output in the economy also determines a unique price level. Hence, the equilibrium output is associated with a unique level of prices and interest rates.

D.THE OUTPUT MARKET

Up to now, aggregate demand, *Y*, and its components have been specified in terms of the dynamics underlying the consumption, investment, and trade adjustment processes. The results show the path over time of those components as they adjust from one long-run, or steady-state, equilibrium solution to another as a consequence of different policy initiatives or domestic or external shocks on the economy. A useful analytical tool for examining the effects of policy initiatives or shocks on the economy is the IS-LM curves. These curves provide a framework within which to show the equilibrium output solution of the Romanian economy under different predetermined variables, including those that represent policy instruments. So far we have derived the dynamic components underlying the IS curve.

There are four steps to the derivation of the IS curve. The first consists of the determination of the long-run, or steady-state, equilibrium solutions of the individual behavior relationships. The second involves the addition of the government's budget constraint to the system of equations. The third consists of the derivation of the reduced-form equation relating output to the predetermined variables in the economy. The final step consists of the determination of the relationship between interest rates and output to find the slope of the IS curve.

1.Steady-State Solution

The steady state solution of a variable is a timeless concept. Thus for any variable $Y_t = Y = Y_{t-1}$. Similarly, $\Delta Y_t = \Delta Y = \Delta Y_{t-1}$ is the rate of growth.[11] It is therefore fairly straight-forward

[11]Care must be taken in the interpretation of the steady-state solution of variables. For instance, the rate of growth of real GDP, approximated by $\Delta \ln(Y)$, is expected to have a positive or negative long-term growth path. In contrast, that of

to find the steady-state solution for the behavioral equations:

Private Consumption is positively related to income and negatively related to interest rates. The coefficients measure the *marginal propensity to consume*.

$$C = k_1 + \beta_{11}Y^d + \beta_{12}r \tag{2.14}$$

where $\beta_{11} = (\alpha_{12} + \alpha_{13}) / (1 - \alpha_{11}) > 0$, and $\beta_{12} = \alpha_{14} / (1 - \alpha_{11}) < 0$ in equations (2.5). The coefficient β_{11} is the *marginal propensity to consume out of current income (MPC).*

Investment is positively related to income and negatively related to interest rates. The coefficients measure the *marginal propensity to invest*.

$$I = k_2 + \beta_{21}Y + \beta_{22}r \tag{2.15}$$

where $\beta_{21} = (\alpha_{22} + \alpha_{23}) / (1 - \alpha_{21}) > 0$, and $\beta_{22} = \alpha_{24} / (1 - \alpha_{21}) < 0$ in equations (2.8). The coefficient β_{21} is the *marginal propensity to invest out of current income (MPI).*

Exports are positively related to foreign market income and negatively related to the real exchange rate. The coefficients measure the *marginal propensity to export*.

$$X = k_4 + \beta_{41}Y^f + \beta_{42}e^r \tag{2.16}$$

where $\beta_{41} = (\alpha_{42} + \alpha_{43}) / (1 - \alpha_{41}) > 0$, and $\beta_{42} = \alpha_{44} / (1 - \alpha_{41}) < 0$ in equations (2.11). The coefficient β_{41} is the *marginal propensity to export out of foreign market income (MPX).*

Imports are positively related to domestic income and negatively related to the real exchange rate. The coefficients measure the *marginal propensity to import*.

$$Z_t = k_5 + \beta_{51}Y + \beta_{52}e^r \tag{2.17}$$

where $\beta_{51} = (\alpha_{52} + \alpha_{53}) / (1 - \alpha_{51}) > 0$, and $\beta_{52} = \alpha_{54} / (1 - \alpha_{51}) < 0$ in equations (2.12). The coefficient β_{51} is the *marginal propensity to import out of domestic income (MPM).*

2.Aggregate Demand and the IS Curve

The total demand for a country's output, expressed in terms of its individual components, is derived from the aggregate demand identity in equation (2.1) and the domestic absorption and trade balance identities in equations (2.2) and (2.3):

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relative prices, approximated by $\Delta\ln(P^f/P)$, is likely to have a mean of zero since otherwise the terms of trade would diverge and the divergence between prices would increase over time. Where that to occur, eventually, all consumers would switch to the relatively cheaper market. That this situation appears to have occurred in the overall terms of trade between primary commodities and manufactures during the last 100 years suggests the possibility of exceptions to some relative price movements.

$$Y = C + I + G + X - Z \tag{2.18}$$

Substitution of the steady-state solutions of the individual relationships in equations (2.14) through (2.15) into the absorption and trade balance components yields the aggregate demand relationship in its explicit function form:[12]

$$Y = \theta_o + \theta_1 r + \theta_2 e^r + \theta_3 G + \theta_4 T + \theta_5 Y^f \tag{2.19}$$

where $\theta_1 < 0$, $\theta_2 > 0$, $\theta_3 > 0$, $\theta_4 < 0$, and $\theta_5 > 0$. Aggregate demand is therefore negatively related to the real interest rate and taxes, and positively related to the real exchange rate, government expenditures, and foreign market income.

The total effects of a change in interest rates, government expenditures, taxes, the real exchange rate, and foreign income are given by the corresponding coefficients of these variables in equation (2.19). An increase in taxes, *T*, for example, causes aggregate income, *Y*, to decrease by an amount that is always greater than the original tax. The multiplier effect of a unit increase in taxes is given by θ_2, whose value is greater than unity.[13] The tax increase initially reduces consumption, which reduces aggregate income. The reduction in aggregate income then reduces investment, government expenditures, and imports, which in turn further reduces aggregate income. That reduction leads to a further reduction in consumption, thereby leading to a new round of investment, government expenditure, and import reductions, until the full impact of the tax increase has been completed. Hence, a one unit increase in taxes always leads to a more than proportional decrease in income. Similar multiplier effects occur with change in interest rates, government expenditures, and foreign market income. In each case, the final effect on aggregate demand is more than proportional to the change in these variables.

The effect of a change in the real exchange rate on aggregate demand is less clearly defined. For a relatively small country like Romania, the law of one price will ensure that the demand curve for traded goods is perfectly elastic, so that a devaluation will shift the export demand curve in proportion to the devaluation if there is underutilization of capacity. There is a

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[12] From equations (2.4) to (2.11), the coefficients of the reduced form equation are:

$\theta_1 = [\alpha_{14}/(1-\alpha_{11}) + \alpha_{24}/(1-\alpha_{21})]/B$

$\theta_2 = [\alpha_{44}/(1-\alpha_{41}) + \alpha_{54}/(1-\alpha_{51})]/B$

$\theta_4 = [(\alpha_{12}+\alpha_{13})/(1-\alpha_{11})]/B$

$\theta_5 = [(\alpha_{42}+\alpha_{43})/(1-\alpha_{41})]/B$

where $B = 1 - [(\alpha_{12}+\alpha_{13})/(1-\alpha_{11})] + [(\alpha_{22}+\alpha_{23})/(1-\alpha_{21})] + [(\alpha_{52}+\alpha_{53})/(1-\alpha_{51})]$.

[13] In terms of the original steady-state relationships, the multiplier is:

$\theta_2 = [(\alpha_{12}+\alpha_{13})/(1-\alpha_{11})] / \{1 - [(\alpha_{12}+\alpha_{13})/(1-\alpha_{11})] + [(\alpha_{22}+\alpha_{23})/(1-\alpha_{21})] + [(\alpha_{52}+\alpha_{53})/(1-\alpha_{51})]\}$.

Since α_{11}, α_{12} and α_{51} are positive and less than unity, a change in taxes leads to a more than promotional change in the combined amount of consumption, investment and imports.

large literature on possible contractionary effects of a devaluation of output (for a survey, see Lizondo and Montiel, 1989). The theoretical reasons for contractionary devaluations have been summarized by Edwards (1991: 311-330). They arise from the effects that a devaluation can have through either price rises that cause a negative real balance effect, the redistribution of demand from a sector having a low marginal propensity to save to one with a high one, a low price elasticities of demand for exports and imports, or supply-side rigidities.

The IS (investment-savings) curve relates the level of output of a country like Romania to its real interest rate. The IS curve is obtained from the relationship between the level of aggregate demand and the level of the interest rate in equation (2.19):

$$\Delta r/\Delta Y = 1/\theta_1 < 0 \qquad (2.20)$$

Thus the curve relating the level of aggregate demand to the level of interest rates is therefore downward sloping.

Shifts in the IS curve result from changes in taxes, the real exchange rate, government expenditures, and foreign income. An increase in taxes reduces disposable income, which thereby lowers consumption and shifting the IS curve to the left for the given level of interest rates. The amount of the shift is given by $\Delta Y/\Delta T = \theta_4 < 0$. An increase in the real exchange rate causes both foreign and domestic residents to shift their consumption to relatively less expensive Romanian goods, causing aggregate demand to rise and the IS curve shifts to the right for the given level of interest rates. The amount by which the curve shifts is $\Delta Y/\Delta e^r = \theta_3 > 0$. A similar rightward shift in the IS curve occurs when there is an increase in foreign market income, and the amount by which aggregate demand increases equals $\Delta Y/\Delta Y^f = \theta_5 > 0$. For government expenditures, the increase in aggregate demand equals $\Delta Y/\Delta G = \theta_3 > 0$. These shifts are demonstrated in the upper half of Figure 2.

E.THE MONEY MARKET

1.The Supply of Money

The National Bank of Romania controls the monetary base, or supply of currency in circulation and commercial bank reserves, through a set of policy instruments which have gradually evolved in importance over the last four years. Initially, the monetary authorities relied on the control of domestic credit, particularly through rediscounting operations with enterprises because of the lack of other policy instruments and the absence of any regulation over government financing and net foreign asset flows. Control over foreign currency movements remained outside the control of the NBR because banks were not required to remit deposits to the NBR. The discount rate was also largely ineffective since financial intermediaries were able to borrow directly from the State Savings Bank (CEC), which effectively controlled deposits. When in 1992 the CEC and other financial institutions were made to pay rates that were related to the NBR's refinancing rate, monetary policy became more effective. Minimum reserve

requirements were introduced in that year and replaced individual bank credit ceilings.[14] Thus by 1993 the NBR's available policy instruments included minimum reserve requirements, discounting operations and open market operations,

[14]For details of the evolution of Romania's monetary sector, see OECD, 1993: 54-59, and World Bank, 1993: 29-34.

but there was no recourse to foreign-exchange operations, and inter-enterprise arrears remained an intractable problem for monetary policy.

Recent reforms have greatly improved the ability of the NBR to control the money supply. In 1994 three additional measures were introduced to support earlier initiatives that lifted credit ceilings, introduced cash reserve requirements, and widened the base of the reserve requirements system to include household deposits. First, greater financial discipline on state-owned enterprises was introduced to limit the growth of inter-enterprise arrears, which thereby halted the expansion of informal credit outside the banking system. Secondly, subsidized refinancing credits were virtually eliminated. Thirdly, the monetarization of the deficit was limited, first, by requiring that government authorities shift a substantial amount of fiscal borrowing from the NBR to the CEC and, second, by requiring that the bulk of government deposits held by financial intermediaries be transferred to the NBR.

In addition to the improved control over the stock of money that these reforms have brought on, the current limitations on international movements of capital means that the growth of the money supply is closely related to the domestic component of the stock of money. In general, the domestic money stock is made up of net foreign assets of the consolidated banking system, plus bank credit to the public and private sector. Thus, control over capital movements has allowed the NBR to focus on the domestic stock of money component.

The supply of broad money[15], *M*, which is made up of currency, demand deposits, and time and savings deposits, is equal to the net stock of international reserves, *R* (in domestic currency terms) and the level of net domestic credit extended by the banking system to the private sector, D^p, and to the public sector, D^g :

$$M_t = e^n_t R_t + D^p_t + D^g_t \tag{2.21}$$

where total domestic credit is given by:

$$D_t = D^p_t + D^g_t \tag{2.22}$$

domestic credit to the government is separated into credit to finance the state deficit, D^{gs}, and other credit to the public sector, D^{gr}:

$$D^g = D^{gs} + D^{gr} \tag{2.23}$$

The *velocity of money* defines the number of times that the each unit of money circulates in the economy each year. For M1 money, denoted M_1, the velocity of money, denoted V_1, is defined as:

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[15]Money is classified into the following broad categories:

•*High-powered money* is made up of currency in circulation plus cash reserves of commercial banks in the centra bank.

•*M1 money* consists of liquid assets that include currency, demand deposits, traveler's checks, and other types of deposits against which checks can be drawn.

•*M2 money*, or *broad money*, is composed of M1 plus *quasi money* such as savings deposits and money market deposits.

$$V_1 = YP / M_1 \quad (2.24)$$

For M2 money, denoted M_2, the velocity of money, denoted V_2, is defined as:

$$V_2 = YP / M_2 \quad (2.25)$$

If V_i is relatively constant and real output, Y, is determined by other factors, then the supply of money, M, should grow in a fixed proportion to Y to keep prices, P, stable, since equations (2.24) and (2.25) imply that P = MV/Y. Under these circumstances which generally describe the monetarist doctrine, a stable growth of M would preclude the use of a proactive monetary policy. In Romania, however, neither V_1 nor V_2 have remained constant. The velocity of broad money, for example, rose sharply in the years preceding the revolution in response to an excess demand for consumer goods, then it fell sharply in the subsequent three years (OECD, 1993: 54-55). Thus under appropriate conditions described in the next chapter, monetary policy can play an important role in the Romanian economy.

2.The Demand for Money

The conventional approach to the demand for money derives from the Baumol-Tobin model (for details, see Sachs and Larrain, 1993, pp. 231-236). It defines the demand for money in an analogous was as the demand for stocks by companies. Money, like stocks, are held by individuals and firms to ensure that they have the necessary liquidity to pay for goods and services. Thus as income expands, the demand for money increases; as income contracts, money demand decreases. There is, however, an opportunity cost associated with holding money, associated with foregone earnings from holding interest-bearing financial asset such as bonds. The desire to hold money is therefore negatively related to the interest rate. As interest rates rise, the opportunity cost of holding money increases and the demand for money expands; as interest rates fall, the demand for money contracts due to the lower opportunity cost incurred from holding money. The aforementioned relationships between the demand for money and both income and interest rate are specified in real terms, since the demand for money is generally considered to be absent of any money illusion. Variations in prices therefore lead to proportional changes in nominal income, interest rates, and money demand.

The demand for money, *M,* is therefore defined in terms of real balances, *M/P*, and it relates the demand for those balances to the real rate of interest, *r*, and the level of income, *Y*:

$$(M/P)_t = \alpha_{70} + \alpha_{71}(M/P)_{t-1} + \alpha_{72}r_t + \alpha_{73}Y_t + \alpha_{74}Y_{t-1} + \mu_7 \quad (2.26)$$

The expected signs are $0 < \alpha_{71} < 1$, $\alpha_{72} < 0$, $\alpha_{73} > 0$, $\alpha_{74} > 0$.

The long-run, or steady-state, equilibrium solution for the demand for money equation is found by setting $M_t = M = M_{t-1}$, and the like for all other variables. The steady-state equilibrium solution for the demand for money is therefore given by:

$$M/P = k_7 + \beta_{71}r + \beta_{72}Y \quad (2.27)$$

where $\beta_{71} = \alpha_{72}/(1-\alpha_{71}) < 0$ and $\beta_{72} = (\alpha_{73}+\alpha_{74})/(1-\alpha_{71}) > 0$ in equation (2.26). The coefficient β_{71} is used to measure the real-income elasticity of money demand, and the coefficient β_{72} serves to measure the interest elasticity of money demand.

3.Derivation of the LM Curve

The LM curve relates the level of aggregate demand to the interest rate for a given level of real money balances. Thus, at each point in the curve, the aggregate demand associated with a given interest rate is consistent with money market equilibrium.

The LM curve is found from the steady-state equilibrium solution of equation (2.27) for the interest rate:

$$r = \kappa_0 - \kappa_1 Y + \kappa_2(M/P) \quad (2.28)$$

where $\kappa_0 = k'_7$, $\kappa_1 = (\beta_{72}/\beta_{71})$, and $\kappa_2 = (1/\beta_{71})$.

The slope of the LM curve is given by:

$$\Delta r/\Delta Y = - \kappa_1 \quad (2.29)$$

Since $\kappa_1 = \beta_{72}/\beta_{71}$, and $\beta_{71} < 0$ and $\beta_{72} > 0$, the slope of the LM curve is positive. A higher interest rate lowers the demand for money and a higher aggregate demand increases the demand for money. Hence, for a given real money balance, *M/P*, money demand can only be equal to the given money supply if an increase in interest rates is matched by an increase in aggregate demand.

An increase in the money supply shifts the LM curve to the right. When the money supply expands, it creates an excess supply of money at the prevailing interest rate and level of output. The excess supply causes households to convert their money to bonds and other securities, which drives down the interest rate. The lower interest rate, in turn, increases investment and leads to an overall expansion in aggregate demand. This effect is shown in the lower half of Figure 2.

4.Monetization of the Fiscal Deficit

The fiscal deficit associated with the government's current revenue and expenditures is critical to the level of inflation in Romania since deficit financing generally leads to an increase in the supply of money. Since 1990 the sources of deficit financing have varied. The law constrained the amount that the State Government could finance through the NBR to a maximum of 10 percent of the deficit. However, this law was not upheld until 1993. The other domestic sources of funds to cover the deficit have been commercial bank loans, CEC borrowing, bonds

issued to the public, and transfers from extra-budgetary funds. Foreign sources of funds include those of international lending organization, which are usually channeled through the NBR, and direct credits granted for imports of goods and services by individual government organizations.

The government deficit refers to the deficit of the state budget. To separate the State budget from other pubic sector budgets, define total government expenditures, G, as consisting of state government expenditures, G^s, and other government expenditures, G^r:

$$G = G^s + G^r \tag{2.30}$$

The fiscal deficit, or the change in the government's debt, is the difference between the state government's current expenditures and revenue. State government expenditures consist of nominal expenditures on domestic goods, PG^s, interest payments on domestic debt, $i_t D^{gs}_{t-1}$, and interest payments on foreign debt, $i_t F_{t-1}$. The state government revenues derive from tax receipts (in nominal terms), PT, and income from capital and other sources (in nominal terms), PN. The difference between revenue and expenditures represents the change in state government debt:

$$\Delta D^{gs}_t = PG^s + i_t D^{gs}_{t-1} + i_t F_{t-1} - PT - PN \tag{2.31}$$

The change in the government debt can be financed through an increase in the money supply, ΔM_t, a decrease in foreign exchange reserves, $e^n_t \Delta R_t$, an increase in the amount borrowed from the private sector, ΔD^p_t, or an increase in the amount transferred from extra-budgetary funds, ΔD^{gr}_t. These sources of deficit financing can be derived from the money supply equation (2.25) and equations(2.26) and (2.27):

$$\Delta D^{gs}_t = \Delta M_t - e^n_t \Delta R_t - \Delta D^p_t - \Delta D^{gr}_t \tag{2.32}$$

The State Government budget relates the sources of the deficit in equation (2.30) to the financing of the deficit in equation (2.31):

$$PG^s + i_t D^{gs}_{t-1} + i_t F^g_{t-1} - PT - PN = \Delta M_t - e^n_t \Delta R_t - \Delta D^p_t - \Delta D^{gr}_t \tag{2.33}$$

The budget constraint states that the government can finance its deficit by increasing the money supply, borrowing from the public sector, or reducing its foreign exchange holdings.

F.AGGREGATE DEMAND AND OVERALL EQUILIBRIUM

The equilibrium values for the interest rates and aggregate demand are determined by the intersection of the IS and LM curves. At that point, the real output demand and the money market are in equilibrium for a given levels of domestic prices, P, for a given level of foreign income, Y^f, and for given levels of the policy instruments (taxes, T, government expenditures, G,, and the real exchange rate, e^r).[16] To derive aggregate demand, substitute equation (2.28) of the

[16]To find the equilibrium value of Y and i from the IS curve in equation (2.19) and the LM curve in equation (2.28),

LM-curve into equation (2.19) for the IS-curve, and solve for aggregate demand:

$$Y = \lambda_0 + \lambda_1(M/P) + \lambda_2 e^r + \lambda_3 G + \lambda_4 T + \lambda_5 Y^f \quad (2.34)$$

where $\lambda_1 = \theta_1\kappa_2/(1+\theta_1\kappa_1)$, $\lambda_2 = \theta_2/(1+\theta_1\kappa_1)$, $\lambda_3 = \theta_3/(1+\theta_1\kappa_1)$, $\lambda_4 = \theta_4/(1+\theta_1\kappa_1)$, and $\lambda_5 = \theta_5/(1+\theta_1\kappa_1)$. Thus aggregate demand, *Y*, is positively related to the real money balance, *M/P*, since λ_1 is positive. However, since $0 < \lambda_1 < 1$, a change in real money balances always leads to a less than proportional change in aggregate demand, since the resulting change in interest rates also affects aggregate demand. An increase in real money balances, for example, leads to an excess supply and a shift from money to bond purchases. The resulting increase in bond prices, lowers their interest rate, which in turn stimulates investment and consumption, and leads to an overall increase in aggregate demand.

The effect on aggregate demand from changes in fiscal and exchange rate policy instruments, as well as exogenous foreign market demand are also shown in the final aggregate demand equation. Aggregate demand is negatively related to taxes since $\lambda_4 < 0$; it is positively related to the real exchange rate, e^r, since $\lambda_2 > 0$; it is positively related to government expenditures, *G*, since $\lambda_3 > 0$; and it is positively related to aggregate demand in foreign markets, Y^f, since $\lambda_4 > 0$.

As Figure 3 shows, the equilibrium level of output and prices is determined by the intersection of aggregate demand and aggregate supply. From equation (2.13) for supply of the secondary sector, the steady-state solution for the total aggregate supply is given by:

$$Y = Y^a + \varphi_0 + \varphi_1 I + \varphi_2 P^b + Y^c \quad (2.35)$$

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set the right-hand-side of one equation equal to the right-hand-side of the other, and solve for *Y*. The solution yields the value of *Y* in terms of exogenous variables, including policy-determined variables. Next, substitute the solved value of *Y* into either LM curve in equation (2.28), or the IS curve in equation (2.19) to yield the equilibrium value of the interest rate in terms of only exogenous variables, including policy-determined variables.

The price index of the secondary sector, P^b, is related to the general price level, P, according to the following relationship:

$$P^b = \gamma_0 + \gamma_1 P + \mu_7 \tag{2.36}$$

Overall equilibrium of the Romanian economy is achieved when aggregate demand in equation (2.34) is equal to aggregate supply in equation (2.35). The solution for the general price level is given by:[17]

$$P = \zeta_0 + \zeta_1 M + \zeta_2 e^r + \zeta_3 G + \zeta_4 T + \zeta_5 Y^f + \zeta_6 (Y^a + Y^b) \tag{2.37}$$

where $\zeta_1 = \lambda_1/(\tau_1+\theta_2) > 0$, $\zeta_2 = \lambda_2/(\tau_1+\theta_2) > 0$, $\zeta_3 = \lambda_3/(\tau_1+\theta_2) > 0$, $\zeta_4 = \lambda_4/(\tau_1+\theta_2) < 0$, $\zeta_5 = \lambda_5/(\tau_1+\theta_2) > 0$, and $\zeta_6 = -1/(\tau_1+\theta_2) < 0$. Prices are positively related to the monetary, fiscal, and exchange rate policy instruments, *M*, *G*, and e^r, and they are negatively related to the fiscal policy instrument, *T*. However, since $0 < \zeta_1 < 1$, the price rise associated with a monetary expansion is always less than proportional to the increase in the supply of money. Prices are positively related to foreign market demand, since an increase in demand with capacity unchanged leads to a price rise. In contrast, prices are negatively related to a real output expansion in the primary and tertiary sectors since the increase in productive capacity, with demand unchanged, drives down prices.

Equilibrium output is found from the substitution of the price equation (2.37) into the aggregate demand equation (2.34):[18]

$$Y = \omega_0 + \omega_1 M + \omega_2 e^r + \omega_3 G + \omega_4 T + \omega_5 Y^f + \omega_6 (Y^a + Y^b) \tag{2.38}$$

where $\omega_1 = \lambda_1 - \lambda_1 \zeta_1 > 0$, $\omega_2 = \lambda_2 - \lambda_1 \zeta_2 > 0$, $\omega_3 = \lambda_3 - \lambda_1 \zeta_3 > 0$, $\omega_4 = \lambda_4 - \lambda_1 \zeta_4 < 0$, $\omega_5 = \lambda_5 - \lambda_1 \zeta_5 > 0$, and $\omega_6 = -\lambda_1 \zeta_6 > 0$. Output is positively related to the monetary, fiscal, and exchange rate policy instruments, *M*, *G*, and e^r, and it is negatively related to the fiscal policy instrument, *T*. However, since $0 < \omega_1 < 1$, the final effect on output is always smaller than the initial rise in aggregate demand associated with the policy change, the reason being that the associated price change dampens the initial shift in the demand schedule. A similar situation occurs with a change in foreign market income. The resulting rise in prices dampens the initial increase and causes a lower expansion in output. Finally, as expected, output is positively associated with a change in output from the primary and tertiary sectors.

[17] For ease of computation, it is useful to approximate M/P by M-P.

[18] Again, for ease of computation, it is useful to approximate M/P by M-P.

III. ECONOMIC POLICY ANALYSIS

A.INTRODUCTION

The effectiveness of economic policy instruments can vary considerably under fixed and flexible exchange rate regimes, depending on the extent to which prices, wages, and capital are free to move in response to changes in market conditions. When capital is allowed to move freely, international investors arbitrage differences in interest rates across countries. Differences in real interest rates, adjusted for expectations about exchange rate movements, generate large capital movements that tend to eliminate those differences. Consequently, interest rate tend to equalize among countries without controls over capital movements.

When controls over capital movements exits, domestic interest rates do not adjust to international interest rates, with the result that the mechanism by which monetary policy operates differs from that under a system without capital controls. In Romania, international capital movements have been controlled in an effort to prevent households from either purchasing foreign bonds or investing in stock markets abroad. Despite the liberalization of the exchange rate under the 1994 standby agreement with the IMF, Romania's capital movements remain highly restricted, as are some transactions in the current account. The principal changes affecting transactions in the current and capital accounts relate to foreign direct investment and foreign currency purchases for tourism. Foreign direct investment is now permitted in most activities, the major exclusions being land purchases and the ownership of buildings (Parliament Regulation No. 35, February 8, 1994). Nationals can purchase foreign exchange currency for travel abroad up to an amount equivalent to $500 a person each year (Parliament Regulation No. 21, August 6, 1993). The restriction on foreign currency purchases aims to prevent speculation in exchange rate movements.

B.MONETARY POLICY

Monetary policy under a fixed exchange rate system is generally ineffective in changing aggregate demand, whether or not capital controls exists. However, the mechanism through which monetary policy becomes ineffective differs. With capital controls, a monetary expansion shifts the LM-curve in Figure 4 to the right, and the increase in the money supply induces a fall in the interest rate. Domestic absorption, A, in equation (2.1) increases as domestic consumption and investment both expand. Thus the monetary expansion initially causes interest rates to fall and aggregate demand to increase. The increase in the domestic demand, however, induces an expansion in imports, and since exports remain unchanged with the exchange rate fixed, the trade balance, B, in equation (2.1) will decrease. As aggregate

demand decreases, interest rates rise, and the process continues until the interest rate and aggregate demand return to the level prior to the monetary expansion. Although monetary policy is effective in the short run, it is otherwise ineffective. Indeed, the monetary expansion causes a loss in foreign exchange reserves equal to the expansion in the money supply.

Under a fixed exchange rate system with complete capital mobility, Romania's real interest rate, r, will adjust to the average interest rate in international capital markets, r^f. A monetary expansion would initially shift the LM-curve in Figure 4 to the right. However, the resulting lower domestic interest rate would drive domestic investors to sell domestic assets in order to purchase foreign assets. As domestic investors exchanged lei for foreign exchange to purchased the foreign bonds, the NBR would have to sell foreign exchange in exchange for lei. The initial monetary expansion would eventually be offset by NBR absorption of lei until international arbitrage again equalized domestic and foreign interest rates at the original position of the LM-curve. Thus under a fixed exchange rate system, monetary policy is ineffective with both capital mobility and capital controls, but the mechanism differs.

Under a flexible exchange rate regime with capital mobility, monetary policy operates through changes in the exchange rate instead of through interest rate variations. Thus it affects aggregate demand via the trade balance rather that domestic absorption. A monetary expansion, for example, shifts the LM-curve in Figure 4 to the right and drives down interest rates. The capital outflow resulting from the domestic and foreign interest rate differential causes the exchange rate to depreciate, which in turn improves the trade balance through the effects on the export demand equation (2.10) and import demand equation (2.11). The expansion in aggregate demand shifts the IS-curve to the right. The rightward shifts in both the LM-curve and the IS-curve result in a new equilibrium at a larger aggregate demand but at the original interest rate.[1]

With capital controls, a flexible exchange rate regime a monetary expansion operate through a change in domestic absorption rather than the trade balance. A monetary expansion that shifts the LM-curve in Figure 4 to the right, lowers interest rates. Since capital movements are restricted, the domestic and foreign interest rate differential remain. The lower domestic interest rate stimulates investment and consumption, and thereby causes an increase in aggregate demand.

C.FISCAL POLICY

Under a fixed exchange rate system with capital controls, fiscal policy tends to shift expenditures from the private to the public sector. An increase in government expenditures, for example, shifts the IS curve in equation (2.18) to the right. Absorption, A, in equation (2.1) increases and, as aggregate demand expands, interest rates rise. The expansion in aggregate demand leads to an expansion in imports, and since exports remain unchanged with the exchange rate fixed, the trade balance, B, in equation (2.1) decreases. The increase in imports causes a reduction in foreign exchange holdings of the monetary sector, and the total money supply in

[1]For a diagrammatic representation, see Sachs and Larrain, 1993: 419-421.

equation (2.21) decreases.

The decrease in the money supply shifts the LM curve to the left and causes interest rates to rise in equation (2.27). The process will continue until the trade deficit is eliminated and aggregate demand returns to its level prior to the fiscal expansion. The final result is a higher interest rate that drive down private consumption and investment by the amount of the government expenditure increase.[2] The outcome is an unchanged aggregate demand. What changes is the composition of demand, as government expenditures have increased while private consumption and investment has decreased. Thus with a fixed exchange rate and the absence of capital mobility, fiscal policy is ineffective.

With capital mobility, fiscal policy would be fully effective. An increase in government expenditures would shift the IS-curve to the right and result in a short-term equilibrium along the original LM-curve at a higher interest rate. The differential between the domestic and foreign interest rates would induce purchases of domestic bonds, which in turn would lead the NBR to purchase foreign exchange and sell lie to satisfy the great demand for domestic currency. The resulting rightward shift in the LM-curve would eventually lead interest rates to return to their original level, but aggregate demand would have expanded.

Under a flexible exchange rate, an expansionary fiscal policy has a crowding out effect under both capital mobility and capital controls. However, the channels through which fiscal policy impacts on the economy differ. With capital mobility, an increase in government expenditures would shift the IS-curve to the right and initially increase aggregate demand and raise the interest rate. However, the interest rate differential will attract capital inflows and lead to an appreciation of the currency. As exports decrease in equation (2.10) and imports increase in equation (2.11), the trade balance in equation (2.1) worsens. The contraction in aggregate demand continues until the interest rate differential disappears.

With capital controls, an increase in government expenditures would also shift the IS-curve to the right and initially increase aggregate demand and raise the interest rate. In this case, however, interest rate differentials are not eliminated by capital movements. Instead, the higher interest rates induce a reduction in investment and consumption, which drives aggregate demand back towards its original level.

D.EXCHANGE RATE POLICY

Under a fixed exchange rate regime, the NBR had control of the official exchange rate. A devaluation by the NBR, for example, would have raised the real exchange rate in equation (2.9), and improved the trade balance in equation (2.1) through its effect on exports in equation (2.10) and imports in equation (2.11). The resulting shift to the right of the IS-curve initially increased both aggregate demand and the interest rate. The interest rate differential would have induced a

[2]For a diagrammatic illustration, see Sachs and Larrain, 1993: 406-407.

capital inflow. The NBR purchases of foreign exchange and sales of lei would have increased the money supply and shifted the LM-curve to the right. Capital inflows would have continued until interest rate differentials were eliminated by capital movements. Final aggregate demand would increased, while interest rate returned to their original level. With capital controls, the devaluation would improve the trade balance in equation (2.1) and interest rate differentials would not be eliminated.

Under the 1994 standby agreement with the IMF, intervention on the part of the monetary authorities in the exchange market is limited to purchases by the NBR to accumulate reserves and for occasional smoothing operations (IMF, 1994: 14). Those smoothing operations are normally performed by monetary authorities in countries having a floating exchange rate system.[3] In Romania, the ability of the NBR to engage in foreign exchange operations allows it to exercise some control over the money supply.

[3] A floating exchange rate system that allows the central bank to engage in foreign exchange operations is called a *dirty float* to distinguish it from a *clean float*, in which the central bank does not engage in foreign exchange transactions.

IV. MODELING THE FLEXIBLE EXCHANGE RATE SYSTEM

The introduction of a flexible exchange rate system in the Romanian economy has altered the channels through which economic policies operate, and in so doing, it has altered the effectiveness of those policies. As indicated in the previous chapter, under the fixed exchange rate system that previously operated in Romanis the stock of money adjusted to the exchange rate selected by the NBR. In the presence of capital controls, an expansionary monetary policy augmented the current account deficit, which reduced foreign exchange reserves and counters the initial expansion in the money supply. In contrast, under the present flexible exchange rate system, output, prices, and the exchange rate adjust to the level of money established by the NBR, as well as the government's level of fiscal revenue and expenditures. With controls over capital movements still in place, an expansionary monetary policy now leads to an exchange rate depreciation and a rise in domestic prices, which tends to offset the initially fall in interest rates albeit at a higher output level. Thus, the move to a flexible exchange rate system has important implications for the economic policy mechanisms of Romania, and the system of equations used to characterize the data-generating process of the economy. In this chapter, the channels through which economic policies operate are explicitly introduced into the system of equations developed in Chapter 2. The parsimonious nature of the model makes it tractable from an operational point of view, and it provides the basis for subsequent extensions of the public and financial sectors, as well as the private domestic and external sectors of the economy.

An important modification to the system of equations presented in Chapter 2 is the specification of the behavioral equations in their logarithmic form, rather than in the levels form of the variables used to facilitate the earlier exposition of the properties of the model. Use of the logarithmic form of the behavioral equations yield direct elasticity estimates whose values remain constant over both the historical and forecast periods.

A.SPECIFICATION

Notations:

A=real domestic absorption
B=real trade balance
C=real private consumption expenditure
D=domestic credit from the monetary sector
D^p=domestic credit from the monetary sector to the private sector
D^g=domestic credit from the monetary sector to the public sector
D^{gs}=domestic credit from the monetary sector to the state government
D^{gr}=domestic credit from the monetary sector to the rest of the government
e^n=nominal exchange rate
e^r=real exchange rate
F=external debt of public sector, denominated in foreign currencies
G=real government expenditure
G^s=real state government expenditures
G^r=real rest of government expenditures
H=nominal debt of State Government
I=real gross domestic investment expenditure
I^g=gross capital formation

i=nominal interest rate
i^f=nominal interest rate prevailing in world market
K=stocks
M=broad money
N=real non-tax revenue of public sector
P=domestic price level
P^f=foreign currency price of goods purchased abroad
r=real interest rate
R=international reserves (foreign currency denominated)
T=real taxes
V=velocity of money
X=real exports
Y=real aggregate demand
Y^a=real output of primary sector
Y^b=real output of secondary sector
Y^c=real output of tertiary sector
Y^d=real net household income
Y^f=real foreign market income
Z=real imports

1.Aggregate Demand

Private Consumption: The amount of private consumption, *C*, is related to disposable income, *Y*, and the real interest rate, *r*:

$$\ln C_t = \beta_{10} + \beta_{11}\ln C_{t-1} + \beta_{12}\ln Y^d_t + \beta_{13}\ln Y^d_{t-1} + \beta_{14}\ln r_t + \mu_1 \quad (4.1)$$

where the expected signs are $0 < \beta_{11} < 1$, $\beta_{12} + \beta_{13} > 0$, $\beta_{14} < 0$, and where net household income is itself defined as the difference between real income, *Y*, and taxes, *T*:

$$Y^d_t = Y_t - T_t \quad (4.2)$$

***Investment*:** Gross fixed investment, I^g, is related to the general level of economic activity, *Y*, and the real interest rate, *r*:

$$\ln I^g_t = \beta_{20} + \beta_{21}\ln I^g_{t-1} + \beta_{22}\ln Y_t + \beta_{23}\ln Y_{t-1} + \beta_{24}\ln r_t + \mu_2 \quad (4.3)$$

where the expected signs are $0 < \beta_{21} < 1$, $\beta_{22} + \beta_{23} > 0$, $\beta_{24} < 0$.

Changes in stocks, *K*, are determined by change in economic activity, *Y*:

$$\ln \Delta K_t = \beta_{31}\ln \Delta Y_t + \mu_3 \quad (4.4)$$

where $\beta_{31} > 0$.

Total investment is therefore composed of gross fixed investment and the change in stocks:

$$I_t = I^g_t + \Delta Y_t \quad (4.5)$$

Exports: The volume of exports, *X*, depends on the economic activity of foreign markets, Y^f, and the real exchange rate, e^r:

$$\ln X_t = \beta_{40} + \beta_{41}\ln X_{t-1} + \beta_{42}\ln Y^f_t + \beta_{43}\ln Y^f_{t-1} + \beta_{44}\ln e^r_t + \mu_4 \quad (4.6)$$

where the expected signs are $0 < \beta_{41} < 1$, $\beta_{42} + \beta_{43} > 0$, $\beta_{44} > 0$.

***Imports*:** The volume of imports, *Z*, depends on domestic economic activity and the real exchange rate:

$$\ln Z_t = \beta_{50} + \beta_{51}\ln Z_{t-1} + \beta_{52}\ln Y_t + \beta_{53}\ln Y_{t-1} + \beta_{54}\ln e^r_t + \mu_5 \quad (4.7)$$

where the expected signs are $0 < \beta_{51} < 1$, $\beta_{52} + \beta_{53} > 0$, $\beta_{54} < 0$.

Aggregate Demand: Total demand is derived from the domestic absorption and trade balance components:

$$Y_t = C_t + I_t + G_t + X_t - Z_t \quad (4.8)$$

where government expenditures, *G*, depend on the government budget constraint.

2.Aggregate Supply

Secondary Sector: Output of the secondary sector depends on investment, consumption, and exports of goods and nonfactor services:

$$\ln Y^b_t = \beta_{60} + \beta_{61}\ln Y_t + \beta_{62}\ln P_t + \mu_6 \quad (4.9)$$

where the expected signs are $\beta_{61} > 0$ and $\beta_{62} > 0$.

Tertiary Sector: Output of the tertiary sector is calculated as a residual from the equilibrium condition for aggregate supply and demand:

$$Y^a_t = Y_t - Y^b_t - Y^c_t \quad (4.10)$$

where Y^c is predetermined. Hence total output is given by:

$$Y_t = Y^a_t + Y^b_t + Y^c_t \quad (4.11)$$

3.Prices and the Exchange Rate

The price level and the exchange rate depend on the equilibrium output of the economy. In Chapter 2 the system of equations was used to find the equilibrium level of output and prices for the Romanian economy. Under a flexible exchange rate system, the same system of equations can be used to determine the equilibrium exchange rate. The first step consists of the determination of the price level from the relationships for the aggregate supply of output and the money marker equilibrium (the LM-curve). The next step consists of the determination of the exchange rate from the relationships for the money market equilibrium (the LM-curve) and the aggregate demand for output. Having obtained solutions for prices and the nominal exchange

rate, we are then able to calculate the real exchange rate and measure the effects of monetary and fiscal policies on the trade balance and aggregate output.

The Price Level: The relationship for the price level is derived from the aggregate supply of output in equation (4.11) and the dynamic specification of the LM-curve in equation (2.26). From equations (4.9) and (4.11), the supply of output is given in its levels form by:

$$Y_t = \beta_{60}/(1-\beta_{61}) + \beta_{62}/(1-\beta_{61})P_t + 1/(1-\beta_{61})(Y^a+Y^a) \tag{4.12}$$

The demand for output is derived from the dynamics specification in equation (2.26) for the LM-curve:

$$Y_t = -\alpha_{70}/\alpha_{73} + 1/\alpha_{73}(M/P)_t - \alpha_{71}/\alpha_{73}(M/P)_{t-1} - \alpha_{72}/\alpha_{73}r_t - \alpha_{74}/\alpha_{73}Y_{t-1} \tag{4.13}$$

Hence the equilibrium solution for the price level, *P*, equals:[1]

$$P_t = \beta_{70} + \beta_{71}P_{t-1} + \beta_{72}M_t + \beta_{73}r_t + \beta_{74}(Y^a+Y^c)_t + \mu_7 \tag{4.14}$$

where $\beta_{71} = \alpha_{71}/\alpha_{73}\Theta$, $\beta_{72} = 1/\alpha_{73}\Theta$, $\beta_{73} = \alpha_{72}/\alpha_{73}\Theta$, $\beta_{74} = \alpha_{74}/\alpha_{73}\Theta$, and where $\Theta = \beta_{62}/(1-\beta_{61}) + 1/\alpha_{73}$.[2]

In its log-linear form, expression (4.14) becomes:

$$\ln P_t = \beta_{80} + \beta_{81}\ln P_{t-1} + \beta_{82}\ln M_t + \beta_{83}\ln(r)_t + \beta_{84}\ln(Y^a+Y^c)_t + \mu_8 \tag{4.15}$$

with expected signs $0 < \beta_{81} < 0$, $\beta_{82} > 0$, $\beta_{83} < 0$, and $\beta_{84} > 0$. Thus, as expected, the price level is positively related to the money supply and output, and negatively related to the interest rate.

The Exchange Rate: The relationship for the exchange rate is derived from the relationships for the money market equilibrium (the LM-curve) in equation (2.26) and the reduced form of the aggregate demand for output described by equation (4.8) and specified in equation (2.37). From equation (2.26) for the dynamics underlying the LM-curve, the supply of output is given by:

$$Y_t = -\alpha_{70}/\alpha_{73} + 1/\alpha_{73}(M/P)_t - \alpha_{71}/\alpha_{73}(M/P)_{t-1} - \alpha_{72}/\alpha_{73}r_t - \alpha_{74}/\alpha_{73}Y_{t-1} \tag{4.16}$$

The demand for output is obtained directly from the reduced form equation (2.38)

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[1]For ease of computation, it is usefult to approximate M/P by M-P. Also, for puposes of simplification, the lagged exogenous variables have been left out since their effect can be captured by the specification of the equation as a first-order difference equation.

[2]Note that in the linear form of the expression for output of the secondary sectory, the coefficient for β_{61} must lie between zero and one (ie, $0 < \beta_{61} < 0$) since the output expansion from the secondary sector can never exceed the total output expansion.

$$Y_t = \omega_0 + \omega_1 M_t + \omega_2 e^r_t + \omega_3 G_t + \omega_4 T_t + \omega_5 Y^f_t - \omega_6 (Y^a + Y^b)_t \quad (4.17)$$

Hence the equilibrium solution for the real exchange rate is:[3]

$$e^r = \sigma_0 + \sigma_1 P_t + \sigma_2 M_t + \sigma_3 r_t + \sigma_4 G_t + \sigma_5 T_t + \sigma_6 Y^f_t + \sigma_7 (Y^a + Y^b)_t + \mu_9 \quad (4.18)$$

where $\sigma_1 = -1/\alpha_{73}\omega_2$, $\sigma_2 = (1/\alpha_{73} - \omega_1)/\omega_2$, $\sigma_3 = -\alpha_{72}/\alpha_{73}\omega_2$, $\sigma_4 = -\omega_3/\omega_2$, $\sigma_5 = -\omega_4/\omega_2$, $\sigma_6 = -\omega_5/\omega_2$, $\sigma_7 = -\omega_6/\omega_2$.

In its log-linear form, expression (4.18) becomes:

$$\ln(e^r)_t = \sigma_0 + \sigma_1 \ln P_t + \sigma_2 \ln M_t + \sigma_3 \ln(r)_t + \sigma_4 \ln G_t + \sigma_5 \ln T_t + \sigma_6 \ln Y^f_t + \sigma_7 \ln(Y^a + Y^b)_t + \mu_{10} \quad (4.19)$$

with expected signs $\sigma_1 < 0$, $\sigma_2 > 0$, $\sigma_3 < 0$, $\sigma_4 > 0$, $\sigma_5 < 0$, $\sigma_6 < 0$, and $\sigma_7 < 0$.

Equation (4.19) shows that the exchange rate appreciates when domestic prices rise, interest rates rise, taxes increase, foreign income expands, and domestic output increases. In contrast, the exchange rate depreciates when the money supply expands and, when there are controls over capital movements, when government expenditures increase.

Although equation (4.17) indicates that a devaluation would expand aggregate output through an improvement in the trade balance, in practice the effect for a relatively small country like Romania is not clearly defined. Normally, the law of one price would ensure a perfectly elastic demand curve for traded goods, so that a devaluation would shift the export demand curve in proportion to the devaluation if there were underutilization of capacity. However, contractionary devaluations can arise through either price changes that cause a negative real balance effect, the redistribution of demand from a sector having a low marginal propensity to save to one with a high one, a price inelastic demand for exports and imports, or supply-side rigidities. The extensive literature on possible contractionary effects of a devaluation of output therefore suggests that care must be taken in the interpretation of the coefficients of the present model of the Romanian economy.

B.ESTIMATION

The behavioral equation in the model were estimated using annual data for the period between 1980 and 1993. The equations were estimated using ordinary least squares after preliminary evidence for the earlier model (Lord, 1993) indicated that estimates using least squares and instrumental variables differed by only relatively trivial amounts. Due to the

[3]Again, for ease of computation, it is usefult to approximate M/P by M-P. Additionally, for puposes of simplification, the lagged exogenous variables have been left out since their effect can be captured by the specification of the equation as a first-order difference equation.

structural changes in the economy since 1990, tests of parameter constancy were carried out for all the equation estimates. The results, reported at the end of this section, show a remarkable degree of stability in the estimated parameters over the sample period. All data are from the National Commission for Economic Forecasting.

1.Private Consumption

Consumption by the private sector depends on disposable income, measured by total income less taxes, and real interest rates. As real interest rates have been negative since 1990, a scaler value was added to the series to make all values positive, thereby allowing the logarithm of all values in the series to be calculated. The final estimated relationship for consumption is:

$$\ln C_t = -0.14 + 0.43 Y_t - 0.025 r_{t-1} - 0.56 \ln C_{t-1} - 0.06 d85_t$$
(2.9)(0.9)(4.0)(1.4)

$R^2 = 0.90$ SEE $= 0.03$ DW $= 1.3$ Period: 1981-93

where
Cprivate consumption, real
Yincome, real
rinterest rate, real
d85binary variable, 1 in 1985; 0 elsewhere

Note: The t-statistics are given in parentheses.

The income and interest elasticities are reasonable in magnitude, and have the expected signs. A similar income elasticity was found by Lord (1993) in the earlier model of Romania, and Haque, Lahiri, and Montiel (1991) found similarly low interest elasticities for a cross section of developing countries. Consumption responds to current income, whereas it responds to changes in interest rates with a one period lag. Changes in both income and interest rates do not produce their full impact on consumption in the same period. The income elasticity is 0.43 in the short run and 0.98 in the long run. The interest elasticity is -0.02 in the short run and 0.045 in the long run.

Despite the relatively simple definition of disposable income, the variable provided a reasonably good explanation of consumption behavior in Romania. Future extensions of the model could incorporate as an explanatory variable the net household income, composed of wages and salaries of households plus other household income, and used in Lord (1993).

The tests of randomness of disturbances based on the Durbin-Watson statistic indicate the possibility of serial correlation. However, correction for serial correlation should not be undertaken before other tests related to left-out variables are performed. Given the parsimonious nature of the present model, such tests were left for future extensions and disaggregation of the model.

2.Investment

Investment is composed of fixed investment and changes in stocks. Fixed investment is related to the GDP and real interest rates. As with all other activity variables in the model, the concepts in the behavioral relationship are estimated in real terms. The final estimated relationship is:

$$\ln I^{g}_{t} = -4.4 + 1.56 \ln Y_{t-1} - 0.07 \ln r_{t-1} - 0.06\ T$$
$$(2.3)\quad (0.6)\quad (3.5)$$

$R^2 = 0.83$ SEE $= 0.17$ DW $= 1.2$ Period: 1981-93

where I^{g} gross capital formation, real
Y total output, real
r interest rate, real

The coefficient for the output and interest rate variables are of the correct sign. Investment responds to interest rate changes with a one period lag, and the magnitude of the response is relatively small. Changes in output also produce their full impact with a one period

lag. Normally, interest rates are excluded as an explanatory variable from macromodels of transition economies because of inadequate information,and there is therefore a lack of policy-related responsiveness in models. The inclusion of the interest rate in the present equation allows for that measure of policy response. The magnitude of the elasticity of investment with respect to output changes is relatively large. Figure 6 shows the estimated equation for gross capital formation.

Changes in stocks are normally inversely related to the general level of economic activity. An increase in economic activity leads to a drawdown of stocks, and conversely, a cutback in economic activity often results in an accumulation of stocks. In the case of Romania, inappropriate allocation of resources in the period since 1990 produced a perverse response in stockpiling behavior.[4] The response profile of stocks are expected to alter, and the estimated behavioral relationship was therefore excluded from the system of equations to avoid inconsistent results in forecasts and policy analyses.

[4]The estimated relationship for changes in stocks was:

$\ln\Delta K_t = 0.15\ln\Delta Y_t + 0.78\ln\Delta K_{t-1} - 1.86D88_t + 3.83D90_t$
(1.8)(7.6)(5.7)(7.3)

$R^2 = 0.93$ SEE = 1.24 DW = 2.5 Period: 1981-93

where ΔK Change in stocks, real
ΔY Change in output, real

3.Imports

The imports equation is estimated for the aggregate of all goods imported by Romania.[5] Imports are related to consumption, changes in reserves measured as the difference between exports and imports in the previous period, and the real exchange rate. A second-order (quadratic) polynomial distributed lag (PLD) specification for the exchange rate was used. The final estimated equation is:

$$\ln Z_t = -10.3 + 2.88 \ln C_t - 0.05 \ln(X-Z)_{t-1} + 0.17 \ln(e^r)_{t-n} - 0.68 \ln(e^r)^2_{t-n} + 0.13 d88_t$$
(3.4)(3.3)(1.9)(4.5)(1.1)

$R^2 = 0.92$ SEE = 0.07 DW = 2.5 Period: 1985-93

where
Z imports, real
C consumption, real
X-Z exports less imports, real
e^r real exchange rate
d88 binary variable, 1 in 1988; 0 elsewhere

and where subscript *n* refers to the number of periods in the polynomial.

The estimated coefficients are of the right signs and magnitudes. Since the real exchange rate includes relative prices, tariffs are implicitly included.[6] As a result, in future extensions of

[5] An effort was made to desegregate imports into the following components: Consumer goods (SITC 0 + 1 + 8), petroleum (SITC 3), intermediate goods (SITC 2 + 4 + 5 + 6), and capital goods (SITC 7). However, data limitations prevented such a disaggregation. As information becomes available for these categories, their inclusion in the model would permit policies to be examined in terms of their effects on consumer goods versus capital and intermediate goods. In the estimation of these functions, the activity variable used to explain Romanian imports would be determined by the purpose of the import. In the case of consumer goods, oil, and intermediate goods, real GDP would be used as the explanatory variable. In the case of capital goods, it would be preferable to use fixed investment and test for the significance of (a) total fixed investment, and (b) private and government fixed investment separately, since the level of the response of these two sectors might be significantly different from one another.

[6] The effective, or observed, import price includes tariffs. Consequently, expenditure-switch policies in the form of tariffs and non-tariff barriers to trade can easily be modeled by the explicit separation of the tariff rate from the price variable in the import demand equation. The tariff rate is the amount of tariff collected relative to the value of merchandise imports in each category. It is important to note that the tariff variables are defined differently in the linear and log-linear equations:

the model it would be possible to consider the effects of trade liberalization policies on the economic activity of particular sectors, as well as overall economic activity itself.

Again, changes in the explanatory variables produce their full impact on consumption in the same period, a phenomenon probably associated with the annual periodicity of the data. The primary activity variable, *Y*, was not found to be significant, but consumption was found to be significant in explaining import behavior. The high elasticity of 2.9 is consistent with the tendency of economies to become more open over time.

•Log-Linear Equations:

TARIFF = 1 + t, where *t* is the tariff rate of each import category.

•Linear Equation:

Let t = tariff rate. Then in the linear equation, the tariff variables are defined for consumer goods as follows:

$TARIFF_c = (t \times P_c \times Q_c) / P_d$

where Q_c is the volume of imports of consumer goods, and P_c and P_d are import prices of consumer goods and the general domestic price deflator, respectively.

A description on how to model trade policies, including tariffs and non-tariff barriers to trade, exchange rate policies, and export promotion policies, can be found in Lord (1991).

Since international reserves have been an important constraint on imports in recent years, the trade balance was included in the equation and found to be significant in explaining Romania's imports. The real exchange rate was also found to be significant. The sum of the coefficients of the lag distribution of the real exchange rate is the right sign and is equal to -0.67. Finally, a binary variable to account to the 1988 administered cutbacks in imports was included in the equation.

4.Exports

The volume of exports is related to the economic activity of Romania's foreign markets, the real exchange rate, as well as a trend variable. The estimated relationships is:

$\ln X_t = -5.7 + 2.15 \ln Y^f_t + 0.40 \ln(e^r)_t - 0.009 \ln T^2_t - 0.32 \ln d90_t$
(4.0)(3.3)(6.2)(5.2)

R^2 = 0.95SEE = 0.07DW = 1.5Period: 1981-93

whereXexports, real
Y^fforeign market income, real
e^rreal exchange rate
T^2trend variable (quadratic)
D90binary variable, 1 in 1990; 0 elsewhere

Romania's exports are generally responsive to changes in the economic activity of its foreign markets. The negative trend component indicates, however, that there have been concurrent negative influences on the country's export sector. The coefficient estimate for the real exchange rate is significant and has the correct sign. The relatively large magnitude of the coefficient shows that changes in the real exchange rate can have a large impact on exports via either nominal exchange rate changes or relative price movements.

5.Value Added by Secondary Sector

The value added by the secondary sector is related to real gross domestic expenditures, real prices measured by the ratio of the price index of the secondary sector to that of the GDP deflator, and a trend variable used to account for changes in productivity. The final estimated relationship is:

$\ln Y^b_t = 4.01 + 0.4 \ln I^g_t + 1.01 \ln P^b_t - 0.013 \ln T_t$
(7.1)(4.3)(2.6)

$R^2 = 0.98$ SEE = 0.04 DW = 2.1 Period: 1982-93

where Y^b value added by the secondary sector, real
I^g real gross domestic investment expenditures
P^b prices index of secondary sector relative to GDP deflator
T trend variable

The coefficient estimates of both the investment and price variables have the expected positive signs, and the elasticities are within their expected values.

6.The Price Level

The price level is related to the supply of money, the interest rate, and output. The final estimated relationship is:

$\ln P_t = -8.2 + 1.29 \ln M_t - 0.25 \ln r_{t-1} + 1.2 \ln Y^{ac}_t$
(6.2)(1.7)(1.1)

$R^2 = 0.99$ SEE = 0.17 DW = 1.2 Period: 1985-93

where
P general price level
M supply of money
r real interest rate
Y^{ac} output of primary and terciary sectors, real

The coefficient estimates of both the supply of money and output variables have the expected positive signs, and that of the real interest rate has the expected negative sign. All the elasticities are within their expected values.

7.The Exchange Rate

The exchange rate is related to domestic prices, the money supply, government

expenditures, and output. Additionally, it is related to the interest rate and taxes. The limited degrees of freedom available, however, prevented the interest rate and taxes from being included in the final estimate of the relationship for the exchange rate. Changes in the money supply incorporate changes that would result in the interest rate, and thus it is used as a proxy for that variable when the effects of monetary policies are considered. Similarly, changes in government expenditures have the opposite effect as changes in the level of taxes, and can therefore be used to assess fiscal policy changes. The final estimated equation is:

$$\ln E_t = 22.2 - 0.81 \ln P_t + 0.66 \ln M_t + 0.96 \ln G_t - 4.24 \ln Y^{ac}_t - 0.42 d89_t + 0.6 \ln E_{t-1}$$
$$(1.3)(0.9)(1.4)(3.6)(3.3)(0.9)$$

$R^2 = 0.99$ SEE $= 0.09$ DW $= 2.5$ Period: 1985-93

where
E real exchange rate
P general price level
M money supply
G government expenditures, real
Y^{ac} output of primary and tertiary sectors
d89 binary variable, 1 in 1989; 0 elsewhere

The real exchange rate is negatively related to the domestic price level since a rise in domestic prices, with foreign prices and the nominal exchange rate unchanged, leads to an appreciation of the lei. The estimated elasticity is -0.8 in the short run, and -2.0 in the long run.

The real exchange rate is positively related to the supply of money since an expansion in the money supply causes interest rates to fall. When there are unrestricted international capital movements, the lower interest rates cause an outflow of capital and an exchange rate depreciation. The estimated elasticity is 0.66 in the short-run, and 1.65 in the long run.

The real exchange rate is positively related to government expenditures. Here the effect under restricted movements of international capital differ from those under unrestricted capital movements. With restricted capital movements, an expansion of government expenditures causes interest rates to rise (as the IS curve shifts to the right), and private consumption and investment decrease and the exchange rate depreciates. With capital mobility the higher interest rates would have attracted foreign capital and caused a currency appreciation. The estimated elasticity is 0.96 in the short-run, and 2.4 in the long-run.

Finally, the real exchange rate is positively related to output since an output expansion causes a currency appreciation. The estimated elasticity is -4.2 in the short run, and 10.5 in the long run.

8.The Demand for Money

The demand for broad money is related to the rate of interest and the level of economic activity. The final estimated relationship is:

$\ln(M/P) = -19.9 - 0.13\ln r_t + 3.88\ln Y_{t-1} + 0.4D90$
(2.8)(12.7)(3.4)

$R^2 = 0.98$ SEE = 0.11 DW = 2.6 Period: 1985-94

where
M/P real money demand
r real interest rate
Y real GDP

The coefficient estimates of both the interest rate and activity varaibles have the expected signs. The demand for money is egatively related to the real rate of interest since a rise in the rate of interest reduces the demand for money. The estimated interest rate elasticity of demand for real money balances is -0.13.

The demand for real money balances is positively related to the level of economic activity. The income elasticity of demand for real money balances is 3.88.

C.STRUCTURAL CHANGES

Estimates of behavioral equations in the macroeconomic model are based on time series data from the early or mid-1980s to 1993. The economic and political reforms since 1989 shifted the economy from low or negligible inflation, full employment, stable relative prices and real incomes to an open market economy with stagflation, and are likely to have produced changes in the responsiveness of economic agents in the public, private, financial, and external sectors of the

economy to key economic variables. Moreover, the administered prices that prevailed prior to 1990 did not reflect market-clearing levels. Although they were intended to clear specific product markets by balancing financially effective demand and planned output, prices did not affect the allocation`process; the allocation of products was instead the function of central planning. Moreover, while prices of trade with market economies generally reflected international prices, those of trade with the Council for Mutual Economic Assistance (CMEA) used the "Bucharest pricing formula", by which international prices were based on a five-year moving average, and converted into transferable rubles at the CMEA's exchange rate between the transferable ruble and the international currency. However, international prices were not necessarily based on the domestic end use market, and consequently had little, if any, effect on the allocation process. The changes which have taken place since the December 1989 Revolution therefore translate into possibly unstable coefficients in the model which could invalidate policy simulations or predictions based on post-sample data.

If parameter changes have indeed occurred since 1989, then problems would arise in the use of conventional estimation techniques for building a time-invariant model. The alternative formulation would be to use time-varying parameters in the model. Essentially this involves an abandonment of key assumptions such as normality in the distribution of observations, and the stationarity of cointegrated variables.[7] The procedure for the re-estimation of the model would then involve the identification of structural changes which occur at each time period in the historical period, and the introduction of coefficient matrices that are endogenous in the model (for details, see Harvey, 1990: 341-44). The major drawback of utilizing this approach in the model for Romania is that information about how parameters might change in each projected time period is rarely available. As a result, additional subjectivity would be introduced into the forecasts.

In order to test for parameter constancy in the model, a Chow test was performed for a time period before and after the December 1989 Revolution. One of the difficulties in the evaluation of structural changes in the Romanian economy, and possible parameter instability resulting in the model, was the determination of possible change points in the transition process. In the first year following the Revolution, the government of Romania instituted wide-ranging reforms aimed at the alleviation of economic and social hardships throughout the country. As a consequence, structural changes were not immediately instituted, as little attention was given to the country's economic performance. There were, however, wide ranging liberalization policies instituted with respect to wages, retirement rules, working hours, import regulations, and export requirements, but they lacked policy cohesiveness.

In 1991 the government instituted a comprehensive economic reform program, under which prices and the exchange rate were liberalized. Although these policies, along with

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[7] Variables are said to be cointegrated when there exists a stationary linear combination of their series. Suppose that the first difference of two variables, x and y, grow over time in such a way that the linear combination of these two variables, given by $d_t = x_t - \alpha y_t$, is stationary. If α is unique, then x and y are said to be cointegrated (for details, see Engle and Granger, 1987). The existence of long-run relationships in the behavioral equations of the model suggests that future extensions of the model should test for cointegrating relationships and use an error-correction form to describe the behavioral relationships in the model.

growing imbalances in the economy, led to an acceleration of inflation, an increased differential between the official and curb exchange rates, and a drawing down of foreign exchange reserves to pay for the trade deficit, they did produce important changes in the economy. More recently, the economic policy component of the government's reform strategy has attempted to implement a coordinated set of macroeconomic and structural reforms to sustain the transition to an open, market economy. Under the economic program adopted in 1993, the major initiatives include continued stabilization efforts, greater privatization and enterprise restructuring, enforcement of enterprise financial discipline, financial sector reform, and the gradual elimination of the government's interventions in pricing, exchange rate determination, and credit policies. A number of those reforms, including that related to the liberalization of the exchange rate, were implemented in 1994.

Major changes in the economy were therefore considered as having taken place in 1991 and thereafter. Once the final equation was selected, the equation was re-estimated for the period between the start of the sample and 1990. The post-sample predictive test is then a test of parameter constancy. Since the number of observations in one of the two sub-periods in the sample period is less than or equal to the number of constraints plus one, the Chow test is based on the following *F*-test:

$$F = \frac{(RSS_o - RSS_1) / n_2}{RSS_1 / (n_1 - k)}$$

where
RSS_o Residual sum of squares of sample period that includes 1991-93 reforms.
RSS_1 Residual sum of squares of sample from 1980-90 period.
n_1 Number of observations in sample from pre-reform period.
n_2 Number of observations in sample from reform period (1991-93).
k Number of constraints.

Formally, the F-statistic tests the null hypothesis that the behavioral equations estimated by the sample including the period 1991-93 come from the sample for the period of the 1980s. The results of the calculations are as follows:

Equation	F-Statistic	Significance Level	F value at 5% Critical Value [8]
Private consumption	0.25	9.65	0.04
Fixed investment	1.19	4.12	0.25
Exports	0.22	4.49	0.05
Imports	2.20	5.85	0.26
Value added by secondary sector	0.92	5.17	0.19
General price level	2.85	4.50	0.55

[8] The critical value is calculated as the ratio of the *F*-test times 0.95 to the 5 percent *F*-value for n_1 and n_2 degrees of freedom. If the entry is greater than 0.95, then the null hypothesis of parameter constancy can be rejected with 95 percent confidence.

Real exchange rate2.333.460.35

The results for almost all the equations do not reject the hypothesis that the relationships are stable -- that is, we do not reject the hypothesis that the observations in the 1990s came from the same data-generating process as the observations in the 1980s. What is perhaps surprising is the otherwise stable coefficients in most equations. This phenomenon may be explained by two factors. First, the large relative price movements that have accompanied price liberalization and caused changes in the level of consumption and investment apparently reflect a similar level of consumption and investment responsiveness to small price changes prior to 1990. Second, the changes in consumption and investment responsiveness to changes in prices and economic activity may be gradual, with the result that year-to-year parameter variations are small. While the results support the use of invariant parameters for most equations in the model, the transition process nevertheless points to the need for additional research into the use of time-invariant versus time-varying parameters when modeling the Romanian economy.

Basic structural reforms are still incomplete in Romania, and their eventual implementation could produce parameter changes in the present model. In this context, structural changes can be viewed as part of the transition process, without a clear demarcation of change points. The recent work of Andrews (1993) suggests that, when change points are unknown, alternative tests consisting of Wald, Lagrange multiplier, and likelihood ratio-like tests for parameter instability be used for both unknown change points or within restricted intervals. Further work on the present macroeconomic model for Romania could adopt these test procedures to examine structural changes in the interval following the December 1989 Revolution.

V. STRUCTURE OF THE MODEL

The macroeconomic model for the Romanian economy consists of 98 equations, of which 15 are behavioral. Since the model aims to provide fairly detailed information on sector interrelationships, a relatively high degree of simultaneity has been introduced into the solution of the system of equations. The model solves for GDP in both real and nominal terms, and it can be inverted to solve for any of the other variables in the model. The set of solutions provided by the system of equations therefore depends on the policy application of interest. In the preparation of basic forecasts, however, since access to external financing is limited, the model should solve real GDP with constrained external financing.

A.OVERVIEW

To arrive at the overall and sector-specific levels of economic activity, the model derives solutions for four major blocks: the national income accounts block, the public sector block, the financial sector block, and the balance of payments block. The balance of payments block generates information about the major balance of payments components, and it yields a solution to the balance of goods and non-factor services, which is then used in the national income accounts block. The national income accounts block contains a considerable amount of interrelationships between the endogenous variables in the system in order to capture feedback effects in the economy, including those in the public sector block.

The financial sector block helps to determine the real and nominal variables in the economy. The resulting system allows for a broader-ranged analysis of monetary policy: the interest rate can be determined through the NBR's adjustment of reserve requirements or the currency in circulation; the financing of the State Government deficit is linked to the financial sector, and can therefore be used to determine the Government's level of net transfers, current expenditures, or public investment; monetary policy affecting the interest rate can influence the rate of inflation through the demand for money equation; the desired rate of increase of the money supply can be derived from the policy-determined target inflation and real GDP growth rates; and both credit availability and the interest rate will influence the level of investment originating from gross capital formation.

Figure 13 provides a visual representation of the equations of the system used to describe the underlying features of the Romanian economy. The variables are enclosed in a box if they are endogenous and in a circle if they are exogenous. The direction of dependence is shown by arrows.

1.Balance of Payments Block

The volume of exports depends on the economic activity of foreign markets, and the real exchange rate. In addition, relative export prices are important to the determination of Romania's exports insofar as they reflect the country's competitiveness; they therefore influence the quantity of Romanian goods demanded by foreign markets relative to competing foreign and domestic suppliers to those markets. Nonetheless, by the very nature of relative export prices, calculation of these prices must be undertaken on the basis of bilateral trade flows, and it is therefore outside of the scope of the present model. As the Romanian economy becomes more open, it will be important to incorporate these prices into the model.

Merchandise imports depend on the economic activity of the domestic market, and the real exchange rate. Lack of available data on unit prices or volume indices did not permit the separation of imports into capital goods, intermediate goods, consumer goods, fuels, and others. Indeed, data on trade prices were not readily available and it was necessary to construct them on the basis of disaggregated trade data.

Once exports and imports of goods and non-factor services are derived, the model calculates the balances for the merchandise account, non-factor services, goods and non-factor services, factor services, and the current account. Changes in foreign reserves are currently exogenous in the model since the Government does not establish target levels of reserves relative to imports or other activity variables. Once target levels of reserves are established, it will be important to introduce this policy-determined target into the model. In its present form, the model calculates total borrowing needs, total external debt, and the balance on the capital account.

The model can provide information on Romania's external financial requirements. At present, the solution provides the total amount of borrowing needed to finance the deficit in the current account. It is straightforward to include estimates of the borrowing needs beyond existing commitments. To calculate the additional borrowing needs, programmed disbursements and amortization payments would be subtracted from the total borrowing needs estimated by the model.

2.Government Consumption and Transfers

The Government is composed of the State Government, the Local Government, and the Social Security Budget.[1] Since the model aims to provide an opportunity to examine fiscal policies at the national level, the major area of disaggregation in the model occurs at the State Government level. On the revenue side, direct taxes are divided into corporate and household taxes. The tax rates for these two sectors are policy variables and, as such, they can be altered to

[1] Additionally, several special Government funds exist, the most important of which are the Fund for Payment of Unemployment Wages and the Supplementary Pension Fund. These funds are not explicitly considered in the model.

analyze feedthrough effects on the Romanian economy arising from fiscal initiatives. Indirect taxes are separated into value added, or sales, taxes and excises, and import taxes. The rates for these taxes are also policy variables in the model. Once data become available, import taxes should be further divided into the major categories of petroleum, intermediate goods, capital goods, and consumer goods. That level of disaggregation would permit an analysis of the effects of policy changes that, for example, raised the tax rate on imports of consumer goods, and lowered the rates on petroleum, capital or intermediate goods. The disaggregation of major Government revenue sources would allow more stable relationships to be derived between each of the tax collection flows and their more narrowly defined revenue bases, without the need to estimate new revenue base variables.

State Government expenditures consist of consumption and subsidies. Subsidies are separated into those given to the business sector and those given to the household sector. Since Government policies towards these two sectors are distinct from one another, separate policy variables were constructed for the corresponding subsidy rates. Long-term historical data were only available for Government expenditures (rather than Government consumption); consequently, a behavioral function has been estimated for overall expenditures. Consumption is therefore derived as a residual after subsidies, transfers, and interest on internal and external debt are subtracted from those expenditures.

3.Financial Sector

The earlier discussion of monetary policy in a flexible exchange rate system provides much of the motivation for the present design of the financial sector block in the model. There are a number of ways to model the financial sector, and the present formulation is intended to establish the basic relationships needed to characterize this sector in Romania.[2] The financial sector is divided into two components: the National Bank of Romania (NBR), which is the central bank, and the banking system, which is defined as the private and state-owned commercial banks, plus the State Savings Bank (CEC). The structure of the financial sector component reflects the balance sheets of NBR and the banking system[3]

It is important to note that the mechanics of Romania's inflation are more complex than that suggested by conventional theory. Since bank credit fell sharply during this period, the negative real interest rates that have prevailed since 1991 have produced little direct effect on investment. Instead, inter-enterprise arrears have represented a means for businesses to expand their nonbank credit, and the negative interest rates have reduced household saving deposits (World Bank, 1993). Rather than direct funds to household savings to support productive

[2]The motivation underlying the specification of the conventional financial sector components are well documented in the literature related to the World Bank's RMSM-X model and other macroeconomic models (see, for example, Easterly et al. (1990), De La Viña (1993), Everaert, Garcia-Pinto, and Ventura (1990), Everaert (1992), Serven (1990), and Serven and Solimano (1991).

[3]See National Bank of Romania (1992) for the balance sheets of the NBR and commercial banks, as well as other financial accounts.

investments, they have been used to increase demand for goods and services, and have thereby hindered stabilization efforts. It is therefore important to introduce a more disaggregated financial sector framework in the model that accounts for the institutional and administrative characteristics of the banking system in Romania.

4.Value Added

The system of equations simultaneously solves for total production and expenditures of the Romanian economy. The secondary sector, which accounts for nearly half of the total value added of the economy, is endogenous; its level depends on investment and consumption activities. Although the tertiary sector is predetermined in the model, the primary sector is endogenous, since its level is determined by the economy's overall expenditure level and the activity of the other two sectors. Given the growing importance of the primary sector in the coming years, it is particularly important to ensure that this sector is explicitly considered in the solution of the system of equations, particularly when policy simulations are performed to measure their impact on different sectors of the economy.

B.SPECIFICATION OF THE MODEL

Notations:

L=Leu currency
D=Dollar currency
R=Real value

NB Predetermined variables are underscored.

1.Balance of Payments Block

Exports

XGNFSR=f_1(FGDPR, REXCHR)Exports of goods and nfs, real value index
XMRCHR=XGNFSR - XNFSVRExport value of goods, real value index
XMRCHDP=f_2(TMUVPD)Export price of goods, index
XNFSVL=XNFSVR × GDPLPExport value of nfs, lei
XNFSVD=XNFSVL / REXCHLExport value of nfs, dollars
XMRCHD=(XMRCHR × XMRCHDP)$_{1990}$Export value, dollars
XGNFSD=XMRCHD + XNFSVDExport value of goods & nfs, dollars
XGNFSL=XGNFSD × REXCHLExport value of goods & nfs, lei
XMRCHL=XGNFSL - XNFSVLExport value of goods, lei

Imports

MGNFSR=f_3(NPCNR, TBTRDR)Imports of goods & nfs, real value index
MMRCHDP=f_4(GDPLP)Import price of goods, index
MGNFSD=(MGNFSR × MMRCHDP)$_{1990}$Import value of goods & nfs, dollars
MGNFSL=MGNFSD × MMRCHDPImport value of goods & nfs, lei

Balances in Current Account

TBTRDD=XGNFSD - MGNFSDBalance of goods & nfs, dollars
TBTRDR=XGNFSR - MGNFSRBalance of goods & nfs, real value index
TBTRDL=XGNFSL - MGNFSLBalance of goods & nfs, lei
TBFSRD=XGFSRD - MGFSRDBalance of factor services, dollars
TBCACD=TBTRDD + TBFSRD
+ TCAPID + TUNRTDCurrent account balance, dollars
TBCACL=TBCACD × REXCHLCurrent account balance, lei

Stock of International Reserves

TRESVD=TRESVD(-1) + TRESDDStocks of foreign reserves, dollars

External Financial Requirements

TEXTVD=- TBCACD + TRESDD - TFDIVD
- TEAODTotal borrowing needs, dollars

External Debt

TEXTDD=TEXTDD(-1) + TAEXTDTotal external debt, dollars

Balance on Captial Account

TCAPD=TEXTVD + TFDIVDBalance on capital account, dollars

2.National Income Accounts Block

Private Consumption

NPCNR=g_1[NGDPR, NINTER]Private consumption, real
NPCNL=NPCNR × NPCNPPrivate consumption, lei

Investment

NGFIVR=g_2[NGDPR, NINTER]Gross fixed investment, real
NDINVR=g_3[NDPR]Change in stocks
NTINVR=NGFIVR + NDINVRTotal investment, real
NTINVL=NTINVR × NINVLPTotal investment, lei

Government Consumption and Transfers

1.STATE GOVERNMENT:

(a)Revenue:
NGTCL=NYBSL × NCTXRCorporate direct taxes
NGTHL=NYHSL × NHTXRHousehold direct taxes
NGTDL=NGTCL + NGTHL + NGTOLTotal direct taxes
NGMTL=MGNFSL × NMTXRImport taxes
NGVTL=NCONL × NVATRValue added, or sales, taxes and excises
NGTIL=NGMTL + NGVTL + NGOILIndirect taxes
NGTXL=NGTDL + NGTILTax revenues
NGCRL=NGTXL + NGNTL + NGYCLTotal current revenue

(b)Expenditures:
NGSBL=NYBSL × SUBYBRSubsidies to business sector, lei
NGSHL=NYHSL × SUBYHRSubsidies to household sector, lei
NGSTL=NGSBL + NGSHLSubsidies, total, lei

NGCNL=NGCNR × NGCNPTotal current expenditures, lei
NGCEL=NGCNL - (NGSTL + NGIDL
+ NGEDL + NGTRL)Government consumption, lei
NGCER=NGCEL/NGCNPGovernment consumption, real
NGSVL=NGCRL - NGCELCurrent savings, lei
NGDFL=NGSVL - NGCCL - NGNLLState Government deficit, lei

2.LOCAL GOVERNMENT:

NLTDL=NLTCL + NLTHL + NLOTLTotal direct taxes, lei
NLCRL=NLTDL + NLTIL + NLNTL
+ NLYCL + NLTRLTotal current revenue, lei
NLDFL=NLCRL - NLCELLocal Government deficit, lei

3.CONSOLIDATED GOVERNMENT:

NCCRL=NGCRL + NLCRL +NSCRLTotal current revenue, lei
NCCEL=NGCEL + NLCEL +NSCELTotal current expenditures, lei
NCDFL=NCCRL - NCCELConsolidated Gov't deficit, lei

Total Consumption

NCONL=NPCNL + NGCNLTotal consumption, lei
NCONR=NPCNR + NGCNRTotal consumption, real

Income Concepts

NPWSL=NWAGEP × NWORKWages & salaries of households, lei
NYHSL =NPWSL + NYHOLNet household income, lei
NYHSR=NYHSL/GDPLPNet household income, real
NYBSL=NTINVL + NCONL + XGNFSLGross sales by business sector
NPRFTL=NGDPL - NYHSL - NGTRLGross operating surplus, lei
NPRFTR=NPRFTL/GDPLPGross operating surplus, real

Prices, Interest, Wages and Exchange Rates

GDPLP=g_4(FMNYSL, NINTER, VLADT)GDP deflator
NPCNP=g_5(NPCNP(-1), GDPLP)Private consumption deflator, lei
NINVLP=g_6(NINVLP(-1), GDPLP)Investment deflator, lei
NGCNP=g_7(NGCNP(-1), GDPLP)Government consumption deflator, lei
NWAGER=g_8(VLADT, GDPLP)Wage rate, average net, real
NWAGEP=NWAGER × GDPLPWage rate, average net, lei (nominal)
NINTER=NINTEL - GDPLPRInterest rate, real
REXCHR=g_9(FMNYSL, GDPLP)Real exchange rate

3.Financial Sector Block

Banking System

FBKNBL=FBKRVL + FBKOLLBanking system credit to NBR, lei
FBKDAL=FBKNBL + FBKGVL + FBKPRL
+ FBKOAL - FBKOLLBanking system domestic assets, lei
FBKDPL=FBKDAL + FBKFALDeposits in banking system, lei

National Bank of Romania

FNBBKL=FNBCML + FNBOLL - FNBRVL NBR credit to the banking system, lei
FNBDAL=FNBBKL + FNBGNL
+ FNBOAL - FNBELLNBR net domestic assets, lei
FNBCRL=FNBDAL + FNBFALCurrency in circulation, lei
FBSMNL=FNBCRL + FNBRVLBase money[4], lei

Money and Credit

FMNYSL=FNBCRL + FBKDLPBroad money supply[5]
FMNYDL=h_1(GDPLP × NGDPL, NINTEL)Demand for broad money
FMNYDL=FMNYSLEquilibrium condition in money market
FCURDL=FCURDL(-1) × GDPLP%
× NGDPRTransactions demand for money[6]
FDEPDL=FMNYDL - FCURDLDeposits in banking system
FCRRLL=FNBRVL - FNBRVL/FBKDPLCredit to non-financial sector
FCRGVL=NGDFL - FEXFGLCredit to (non-financial) Government, lei
FCRPRL=FCRRLL - FCRGVLCredit to (non-financial) private sector, lei

4.Output from Major Sectors and Aggregates

Value Added
VLAD1=NGDPR - VLAD2 - VLAD3Primary sector, value added
VLAD2=g_{10}(NGFIVR, VLAD2P, GDPLP)Secondary sector, value added

[4]Also known as the monetary base, or *high-power* money.

[5]The supply of money is also defined as $v \times$ FBSMNL, where $v = (1 + c)/(r + c)$ is the money multiplier, such that r = FNBRVL / FBKDPL is the reserve requirements ratio, and c = FNBCRL / FBKDPL is the currency to deposit ratio.

[6]Based on the quantity theory of money, whereby the money supply grows at the same rate as nominal GDP.

VLAD3=VLAD3(-1) × VLAD3RTerciary sector, value added
VLADT=VLAD1 + VLAD2 + VLAD3Value added, total

Aggregates

NGDPL=NCONL + NTINVL + XGNFSL - MGNFSLGDP, lei
NGDPR=NCONR + NTINVR + XGNFSR - MGNFSRGDP, real

INPUTS FOR THE BASIC FORM OF THE MODEL

FBKFALBanking system net foreign assets, lei
FBKGVLBanking system credits to (non-financial) Government, lei
FBKOALBanking system other assets, lei
FBKOLLBanking system's other libilities to NBR, lei
FBKPRLBanking system credits to private sector, lei
FBKRVLBanking system reserves in NBR, lei
FGDPRReal GDP of Romania's export markets, constant dollars
FNBCMLNBR credit to commercial banks, lei
FNBFALNBR net foreign assets, lei
FNBGNLNBR credits to (non-financial) Government, lei
FNBOALNBR other assets, lei
FNBELLNBR medium and long term external liabilities, lei
FNBOLLNBR other liabilities with banking system, lei
FNBRVLNBR reserve holdings, lei
MNFSVDImport value of non-factor services, dollars
MGFSRDExpenses for factor services, dollars
NCTXRCorporate tax rate, percent
NDISCLStatistical discrepancy in national income accounts, lie
NDISCRStatistical discrepancy in national income accounts, dollars
NGCELCapital expenditures by the Government, lei
NGCERTotal current Government expenditures, real
NGEDLInterest on external debt, lei
NGIDLInterest on internal debt of the Government, lei
NGNLLNet lending by the Government, lei
NGNTLNon-tax Governmnet income, lei
NGOILOther indirect taxes of State Government, lei
NGSBLGovernment subsidies to businesses, lei
NGSHLGovernment subsidies to households, lei
NGTOLOther direct taxes of State Government, lei
NGTRLGovernment transfers, lei
NGYCLState Government income from capital, lei
NHTXRHousehold tax rate, percent
NINTELInterest rate, nominal

NLCELTotal expenditures of Local Government, lei
NLNTL Non-Tax Income of Local Government, lei
NLTCLCorporate direct taxes of Local Government, lei
NLTHLHousehold direct taxes of Local Government, lei
NLTILIndirect taxes of Local Government, lei
NLOTLOther direct taxes of Local Government, lei
NLTRLTax revenue of Local Government, lei
NLYCLIncome from capital of Local Government, lei
NMTXRImport tax rate, percent
NSCELCurrent expenditures of Social Security Budget, lei
NSCRLCurrent revenue of Social Security Budget, lei
NVATRVAT rate, other sales tax rates, and excises, percent
NYHOLOther household income
NWORKNumber of workers
SUBYBRSubsidy rate for businesses, percent
SUBYHRSubsidy rate for households, percent
TCAPIDCapitalized interest (due-paid) on LT public external debt, dollars
TEAODErrors and omissions, dollars
TFDIVDForeign direct investment, dollars
TMUVPDManufactured unit value index of industrialized countries' imports, dollars
TRESDDChange in international reserves, dollars
TUNRTDUnrequited transfers, dollars
VLAD3RValue added of tertiary sector, growth rate (percent)
XGFSRDRevenue from factor services, dollars
XNFSVDExport value of non-factor services, dollars

VI. DYNAMIC POLICY RESPONSES

VII. SUMMARY AND CONCLUSION

The macroeconomic model for Romania provides real and financial sector forecasting and policy simulation capabilities. As such, it serves a dual purpose. First, it provides a framework for making rational and consistent predictions about Romania's overall economic activity, the standard components of the balance of payments, and the production and expenditure concepts of the national accounts. Secondly, it offers a means of quantitatively evaluating the impact of monetary and fiscal policies on the economy, and assessing the feedback effects that changes in key macroeconomic variables of the economy produce in other sectors. These two objectives are closely related since the capacity to make successful predictions depends on the model's ability to capture the interrelationships of the real and financial sectors of the economy.

The modeling procedure described in this study has sought to account for the structure of the Romanian economy, the availability of data, and the degree of stability of time-series estimates of parameters during the country's transition process. The nature of the transition process of the Romanian economy has motivated the design of a model that can grow and evolve with the economy. The present version of the model incorporates both the real and financial sectors of the economy within the flexible exchange rate system that now characterizes the Romanian economy. The objective is to provide a mechanism to link policies and targets while, at the same time, providing an easy and adaptable means of both forecasting key macroeconomic variables and simulating the interrelationships between economic policy initiatives. The present form of the model therefore provides a relatively parsimonious representation of the Romanian economy that allows for considerable flexibility in its usage for forecasting, selection of the policy mix and instruments for the targets of a program, and determination of the appropriate sequencing of policy changes.

The present model applies a conventional IS-LM framework to a transition economy under both fixed and flexible exchange rate systems and, as a policy-oriented system, it incorporates key parameters for policy formulation. At the onset, the model is designed as a parsimonious representation of the underlying data generating system for key behavior relationships. The conceptual approach to the present model is instead based on conventional economic theory, although the empirical specification of the conventional theory is not well established since there are numerous approaches to the specification, estimation and testing procedures in standard macro models.

The introduction of a flexible exchange rate system in the Romanian economy has altered the channels through which economic policies operate, and in so doing, it has altered the effectiveness of those policies. Under the previous fixed exchange rate system, the stock of money adjusted to the exchange rate selected by the NBR. In the presence of capital controls, an expansionary monetary policy augmented the current account deficit, which reduced foreign exchange reserves and counters the initial expansion in the money supply. In contrast, under the

present flexible exchange rate system, output, prices, and the exchange rate adjust to the level of money established by the NBR, as well as the government's level of fiscal revenue and expenditures. With controls over capital movements still in place, an expansionary monetary policy now leads to an exchange rate depreciation and a rise in domestic prices, which tends to offset the initially fall in interest rates albeit at a higher output level.

Thus, the move to a flexible exchange rate system has important implications for the economic policy mechanisms of Romania, and the system of equations used to characterize the data-generating process of the economy. In the model formulated in this study, the channels through which economic policies operate are explicitly introduced into the system of equations. The parsimonious nature of the model makes it tractable from an operational point of view, and it provides the basis for subsequent extensions of the public and financial sectors, as well as the private domestic and external sectors of the economy.

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ANNEX B: ECONOMETRIC SPECIFICATION AND ESTIMATION

A.TAXONOMY OF EQUATION SPECIFICATIONS

In the following specifications, lower-case letters denote logarithms of upper-case letters. Thus, $y = \ln(Y)$.

1.Autoregressive Distributed (AD) Lag (1,1):

(a)Linear:

$$Y_t=\alpha + \beta Y_{t-1} + \gamma X_t + \theta X_{t-1} + \varepsilon_t$$

(b)Log-Linear:

$$y_t=\alpha + \beta y_{t-1} + \gamma x_t + \theta x_{t-1} + \varepsilon_t$$

2.AD (1,0):

(a)Linear

$$Y_t=\alpha + \beta Y_{t-1} + \gamma X_t + \varepsilon_t$$

(b)Log-Linear:

$$y_t=\alpha + \beta y_{t-1} + \gamma x_t + \varepsilon_t$$

Consideration of AD(1,1) with $\gamma = 0$; AD(0,1) and AD(0,0) are normally excluded.

B.COMPARISON OF LINEAR AND LOG-LINEAR ESTIMATES

To test between linear and log-linear equations, apply a Box and Cox (1964) transformation to the dependent variable and compare the residual sum of squares based on the chi-squared distribution. Alternatively, the Godfrey and Wickens (1981) test can be used. Although more satisfying, it is less easy to compute.

The likelihood ratio test may be used to compare the linear and log-linear estimates (as suggested by Box and Cox). The likelihood ratio statistic is easily calculable from the sum of squared errors in the two equations and the mean of the dependent variable in its logarithmic form.

C.USE OF TWO STAGE LEAST SQUARES (2SLS)

Because private consumption is such a large part of GDP (an even larger part of disposable income), there is a tremendous amount of simultaneous equation bias associated with using ordinary least squares (OLS) to estimate the consumption function. This bias will also be present in many of the other estimated equations, most obviously for investment and the other final demand components explained by GDP or some component of GDP. Two stage least squares (2SLS) eliminates this problem entirely in large samples and partially in the small sample available for Romania. Limited information maximum likelihood (LIML) seems to be unbiased even in small samples (e.g., see Anderson and Sawa, 1979).

As noted by McCarthy (1971: 251-259), the selected instruments must always include all predetermined variables in the equation being estimated in order to ensure consistency. Some of the instrumental variable sets are suggested by Fair (1970).

For instance, the possible instrumental variables to be used in the import demand equations are as follows:

- One-period lagged dependent variable.
- One-period lagged endogenous right-hand-side variables (e.g., the domestic activity variable, the exchange rate, and the domestic price).
- Current and one-period lagged exogenous variables (e.g., the import price variable).

D.AUTOCORRELATIONS

Serial correlation suggested by the Durbin-Watson is not to be corrected by the Cochrane-Orcutt or Hildreth-Liu procedure, or any other procedure, without first analyzing the residuals and testing for misspecification, omitted variables, or other causes. Use of the transformation of the dependent levels variables into a first-differenced variable in the estimation of the equation can keep this problem from arising with otherwise trending variable data.

When serial correlation exists, it has been found that the Prais-Winsten (P-W) estimator is substantially superior to the Cochrane-Orcutt and Hildreth-Liu (see Maeshiro, 1976; and Park and Mitchell, 1980).

ANNEX C: FORECASTING WITH THE MODEL

From a theoretical point of view, the estimates of the behavioral relationships in a model provide the most efficient means by which forecasts can be generated. Thus, for example, the estimated coefficients of a dynamic relationship such as that for private consumption that were obtained by minimizing the mean-square-error of observations in a sample would be used to generate forecasts of private consumption.

In practice, however, there are two reasons to adjust the forecast:

(1)*The actual value of the last observation in the sample is likely to differ from the value calculated by the estimator.*

To demonstrate this phenomenon for the Romanian model, consider the case where behavioral estimates were often made on the basis 1980-92 data. Without any corrections, a forecast would use the *estimated* value of 1992 to generate the value of a variable in 1993. Suppose the percentage change between the *estimated* value of that variable in 1992 and the predicted value in 1993 were 4 percent. Unless the *actual* and *estimated* values for 1992 were exactly the same, the model would forecast a 1993 value for the variable which was significantly different than 4 percent. As a result, the 1993 value of the variable will not in fact reflect the model's true forecast and, in a simultaneous system of equations, it will bias the results of the other variables forecasted by the model.

(2)*The actual, or preliminary, value for a variable is known at the beginning of the forecast period.*

In the case of the Romanian model, preliminary data are currently available for several variables, including Government revenue and expenditures. It would not only be inefficient to not utilize that data in the forecast, but use of estimated, rather than actual, values for those variables might lead to erroneous forecasts in the other variables of the model.

Addfactors are commonly used in projected time series in order to adjust for differences between the actual and estimated values of the last observation of the series. As mentioned above, if the estimated and actual values were the same, then the forecast value would change by the same amount. In contrast, the change in the forecast value would be different if the estimated and actual values are not the same. The purpose of the addfactor is to effectively shift the estimated value of the last observation of the fitted curve to the actual level so that the forecast yields the correct values predicted by the model.

Addfactors may indeed have to be in the form of *multiplicative factors* when the data-generating process is represented by a log-linear equation. In the case of the Romanian model,

the functional form of the behavior relationships are log-linear and the identities are linear. Consequently, it is important to use addfactors for the identities and multiplicative factors for the behavioral equations.

To demonstrate the correct application of these two types of factors, addfactors and multiplicative factors are introduced to a general dynamic specification.

(a)General Dynamic Specification

Consider the general form of a long-run equilibrium relationship of any of the behavioral equations in the Romanian model. A simple representation of such a relationship is one between two variables X and Y described by a nonlinear function of the form:

$$Y = kX^{\varepsilon} \tag{1}$$

where k is some constant. When the foregoing relationship is expressed as a logarithmic function, then the function becomes linear-in-logarithms and is consistent with the form of the equation used to empirically estimate the relationship:

$$y = \alpha + \varepsilon x \tag{2}$$

where lower-case letters denote the logarithms of upper-case letters, i.e. $x = \ln X$, $y = \ln Y$, and $\alpha = \ln k$. A useful property of equation (2) is that the calculated coefficient ε directly yields the point elasticity of the dependent variable in the expression.

The first-order stochastic difference equation of the theoretical relationship in equation (2) is expressed as:

$$\ln(Y_t) = \alpha_0 + \alpha_1 \ln(Y_{t-1}) + \alpha_2 \ln(X_t) + \alpha_3 \ln(X_{t-1}) + v_t \tag{3}$$

where $0 < \alpha_1 < 0$ for the system to be stable; where $\alpha_2, \alpha_3 > 0$ for purpose of exposition; and where all variables are measured in logarithmic terms.

(b)The Addfactor

It is straightforward to demonstrate the function of addfactors in linear equations, including the identities used in the Romanian model. Consider the following linear relationship between two variables

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 X_t + \alpha_3 X_{t-1} \tag{4}$$

where $0 < \alpha_1 < 0$ and where $\alpha_2, \alpha_3 > 0$.

Suppose that data are available for Y in the first year of the forecast at period t = m and that the projected period is t = m, m+1, ... , m+n. Then the difference between the observation at m, denoted X^a, and its estimated value, X^e, is the addfactor:

$$Z_m = X^a_m - X^e_m \tag{5}$$

The value of Z_m is a constant that is added to equation (4) to yield:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 X_t + \alpha_3 X_{t-1} + Z_m \tag{6}$$

for the forecast period at t = m, m+1, ... , m+n.

If data are unavailable for Y in the first year of the forecast, then Z_m is instead calculated for the last year of the sample period.

(c)The Multiplicative Factor

The adjustment for a log-linear equation of the form given in equation (3) is different from that for the linear equation. In this case the multiplicative factor is:[1]

$$z = X^a_m / X^e_m \tag{7}$$

Then the values of Y for the forecast period at t = m, m+1, ... , m+n are given by:

$$Y_t = z \times \exp[\alpha_0 + \alpha_1 \ln(Y_{t-1}) + \alpha_2 \ln(X_t) + \alpha_3 \ln(X_{t-1})] \tag{8}$$

(d)Addfactors and Multiplicative Factors in the Romanian Model

The proper construction of addfactors and multiplicative factors is fairly straightforward for medium-scale econometric models. In the Romanian model, there are two possible approaches to their construction:

(1)*Calculation on Spreadsheet Environment*

Historical data for the model are currently stored on a Lotus-compatible spreadsheet. Calculations of the addfactors and multiplicative factors can be made on the spreadsheet. Projections for part or all of the variables in the model made directly on the spreadsheet using the estimated behavioral equations and identities in the period of the forecast.[2]

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[1]To derive the multiplicative factor, let π represent the rate of growth projected in the first year. Then the desired relationship for the adjustment factor is one that satisfies the following condition:

$$\pi = X_{m+1}/X^a_m = zX_{m+1}/zX^e_m.$$

[2]Undoubtedly the recursive part of the model can be solved in the spreadsheet environment. It is also possible to solve a medium-size system of simultaneous equations in Lotus. However, it will be more efficient to solve the system of equations using Micro TSP software since the Romanian model will be expanded and the algorithm properties of Lotus for solving large-scale systems of simultaneous equations are inefficient.

(2) *Calculation on MicroTSP Environment*

Calculations of the addfactors and multiplicative factors can continue to be made on the Lotus-compatible spreadsheet. The values of the adjustment factors can then be introduced into the system of equations in Micro TSP using the command EDIT {model name}, followed by the EDIT LINE command. This is the preferable approach.

ANNEX D: THE DATA

Table

Romania: National Income Accounts

Romania: Balance of Payments

Romania: Consolidated Government

Romania: State Government

Romania: Local Government

Romania: Social Security Budget

Romania: Value Added by Sector

Romania: Merchandise Trade

Romania: Price and Employment Concepts

Romania: Monetary Survey

Romania: Exchange Rate