AN ISLM MODEL FOR ZIMBABWE AND MACROECONOMIC POLICY IMPLICATIONS*

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Abstract:

This study constructs a partially open macroeconomic model (ISLM model) for Zimbabwe, which takes into account imports and exports. By simultaneous-equation approaches, the paper derives estimates of parameters of the IS and LM equations. These estimates have important implications for demand management and growth policy. This is a very important issue for investigation currently in Zimbabwe, because the country is attempting to come out of a recession lasting more than a decade. An understanding of structural conditions that existed before the recession fully set in is critical in making decisions on how to get out of it. The study is, therefore, based on data from 1975 to 1998. The results show that the IS curve is vertical due to the insensitivity of investment to interest rate. The income coefficient in the LM equation, albeit consistent with theory, is insignificant, leaving the LM curve very gentle. The results clearly support a fiscal policy driven growth. A fiscal expansion focused on development of productive resources and efforts to curb corruption and rent seeking, and a monetary policy that encourages productive borrowing, are recommended in order to minimize the inflationary effects of fiscal expansion.

Keywords: Goods market, money market, investment, interest rate, IS curve, LM curve

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Introduction:

In 1965, economic sanctions were imposed on Zimbabwe (then Rhodesia) after the country made a Unilateral Declaration of Independence (UDI) from Britain. While sanctions presented challenges to the economy, they also presented opportunities for the strengthening of the local industry through import-substitution. After the intensification of the war of liberation in the late 1970s, economic infrastructure was badly damaged. At independence in 1980, the new government inherited an economy with sophisticated and elaborate infrastructure, which was however, outdated and war-ravaged (Roussos, 1988, p.1). There were also serious distributional inequalities related to ownership of production means and access to basic services.

The government espoused the policy of *growth with equity* as it sought to redress the socio-economic imbalances created by the colonial past (Roussos, 1988, p.1). This was conceived within the ideological context of socialism. The government sought to achieve equity by raising the standards of living of the poor rather than by lowering those of the rich, which essentially required growth. It embarked on expansionary fiscal policy – promotion of domestic demand through minimum wages, increased foreign currency allocations, increase in agricultural producer prices, implementation of resettlement schemes, expenditure on roads and railways, expansion in education and health services, *et cetera*. In 1980, there were several positive exogenous factors, including a high gold price, improvement in the terms of trade, removal of economic sanctions, and favorable weather conditions, which saw significant positive real growth rates in the early 1980s (1980-1981).

However, increased minimum wages and foreign currency allocation financed by borrowing resulted in increased domestic demand and imports (Roussos, 1988). After 1981 export performance was poor due to three years of drought, world recession, diversion of exports to domestic market to meet increased local demand, inflation which resulted from expanded government expenditure, and the Z$ appreciation in the period 1980-1981. Thus, large current account deficits were recorded in 1980-1981. The Government revised its economic policy in order to reduce domestic demand, inflation and imports and to enhance exports. The essentially

contractionary policy was a combination of monetary and fiscal measures including a rise in bank rate in 1981, wage freezes between 1982 and mid-1985, restriction of forex allocation for imports, and restriction of profit remittances. Exports were incentivized through allocation of forex for exporting industries to import inputs and a move towards a more flexible exchange rate in order to make exports more competitive. However, fiscal spending continued in order to address commitments on income distribution, effects of drought and recession, continued expansion of social services, parastatal subsidies and increased defense spending due to instability in the region.

The socialist orientation was eventually abandoned in the early 1990s for the World Bank sponsored Economic Structural Adjustment Programme (ESAP). Policies implemented under ESAP included liberalization of wages and prices, rationalization of government expenditure, removal of subsidies, trade liberalization, commercialization and privatization of state enterprises, and restructuring of various public and quasi-public enterprises (Sichone, 2003, in Mlambo 2011, p.1). As it became evident that ESAP was not yielding the expected benefits, there came in the late 1990s (1997) a sudden, dramatic and chaotic 'indigenization' drive, in which the liberation war veterans not only demanded land from the whites, but also unbudgeted payouts (compensation) from government. This drive precipitated a serious economic decline which was to last more than a decade.

Prior to 1997, all major economic indicators were on impressive trends. Real gross national income was Z$12,530 million in 1975 and by 1997 had increased to Z$24,204 million, an increase of 93% (Central Statistical Office (CSO) figures). Other economic indicators also improved over the period showing growths of 27% for real gross national investment, 107% for real consumption, and 137% for real exports. Between 1975 and 1997 absolute national employment increased by 26% and in 1999, a noticeable decreasing trend set in. While inflation was low at below 10% (creeping) in 1975 and it fluctuated on an increasing trend over the years, it significantly escalated after 1997 and continued to increase almost monotonically thereafter (CSO). ITA (1995-2009) argues that inflation was caused by the routine printing of money by the Reserve Bank of Zimbabwe to fund the budget deficit. The same article reports inflation to have

increased from 32% in 1998 to 11.2 million percent in 2008. Travel Document Systems (1996-2009) reports that by July 2008 official inflation had actually reached 200 million percent, with independent economists putting it in the quadrillions percent. This trend has only stopped recently after the dollarization of the economy. Inflation had become so bad that in July 2007 the government directed that prices be slashed by half, which caused persistent shortages.

Besides the war veterans' compensation and the chaotic land reform, there are several other views regarding the downturn beginning 1997. These include political turmoil; poor economic management; recurrent interference with the judiciary (which killed stakeholders' confidence in security of private property); controls on prices and exchange rates which resulted in reduced investor confidence; involvement in DRC war (1988-2002); and suspension from IMF due to arrears on loans as well as government unwillingness to implement reforms to stabilize the economy (Travel Document Systems, 1996-2000; ITA, 1995-2009). 1997-2009 was a period of serious policy bankruptcy on the part of government and monetary authorities, since the much taunted 'look east policy' was no economic policy at all. While economic stability returned after dollarization, the performance of the economy during the inclusive Government era beginning 2009 has been adversely affected by the continuous bickering among the political parties. The question regarding how the economy can be put into a mode of long-term stability and growth is still relevant.

This research report is organized as follows. The next section briefly highlights the inadequacy of current economic discourses in Zimbabwe in addressing the question raised above. It introduces the objective of the study – the estimation of a partially open ISLM model, highlighting the importance of adopting a simultaneous equation approach. The literature section reviews the validity of ISLM models and culminates in the development of a simple model for estimation. Theoretical implications of macroeconomic policy are illustrated in the context of the developed model. The section on methodology and data discusses estimation approaches and gives a detailed record of data sources. This is followed by presentation, interpretation and analysis of results. The paper finally closes with the conclusion section, which summarizes the findings of

the paper, indicates specific policy implications and suggestions for future research in light of highlighted limitations of the current study.

Problem statement, objectives and significance of the study:

The theoretical debate around the question of how to stimulate an economy out of a recession is very controversial. The major division on this question is between the monetarists and the Keynesians. The former maintain that solutions to this and many other major economic questions lie on tinkering with monetary variables, while the latter assert that the government needs to come in with various fiscal measures (taxation and expenditure). It is generally agreed that the practical solution, in fact, lies somewhere in between the two extremes. Generally, since the Great Depression, it has been held that the government has a crucial role to stabilize errant market forces that tend to produce economically and socially undesirable outcomes. Thus, the Keynesian argument tends to prevail in times of crises. When free market forces produce a crisis, the consequences of waiting for the market to readjust itself to correct the crisis can sometimes be ghastly. Therefore, especially in developing countries, the argument goes – the government has an important first role in initiating growth. This has meant that the government acts first through fiscal measures and the monetary authorities come in to complement this effort by policies to mitigate the undesirable effects of fiscal policy.

The wisdom of a fiscal policy-driven growth in Zimbabwe needs to be put to the test. This is because the efficacy of a macroeconomic policy is dependent on the structural characteristics of the economy in question. Several econometric studies have been done on the structural characteristics of the Zimbabwean economy, but most of them are isolated single-equation approaches, which do not take into account the mutual interdependence of economic variables. To the knowledge of the author, not many attempts if any have been made to model the Zimbabwean macroeconomy by the ISLM approach.

This study seeks to construct a partially open macroeconomic model (ISLM model) for Zimbabwe, which takes into account imports and exports. By simultaneous estimation of

structural functions characterizing the goods market and the money market, the paper seeks to derive estimates of the parameters of the IS and LM equations, which parameters include marginal propensity to consume, marginal tax rate, marginal response of investment to changes in interest rate, and marginal propensity to import. These estimates have important implications for demand management and growth policies, particularly on whether fiscal or monetary policy should be used to initiate growth. This is a very important question for Zimbabwe currently. The model used is simple. The author takes the suggestion from Kuezenkamp and McAleer (1995) (in Mlambo, 2012, p.1) who argue that models that are more complicated should be used after simpler ones have proved not useful.

The study is based on data from 1975 to 1998. The chosen period is long enough to be representative of the status of the economy before the recession fully set in. An understanding of structural conditions that existed before the recession fully set in is important in making decisions on how to get out of it, even though the question is coming more than a decade later.

Literature review:

The IS-LM model is traceable to John Hicks (Hicks, 1980-1981, p.139; Patinkin, 1987, p.1). It was originally developed as an interpretation of Keynes' *General Theory*. The change in popularity of and attitude toward the IS-LM model reported in various papers also occurred to its *inventor*, John Hicks, to the extent that he excluded it in his work on the reconstruction of Keynesian theory (Hicks, 1974, cited in Hicks 1980-1981, p.139). The model's critics, to support their position, readily cite this point (Patinkin, 1987, p.2). One issue Hicks (1980-81) had with the model is time reference. The concern is that the IS curve represents a flow relation while the LM represents a stock relation. That is, IS shows equilibrium points over a given accounting period (year) since income, investment, and other accounting components are measured over a year. However, the LM being an equation of money demand to money stock, is a stock relation. Thus, how can the IS and the LM curves be put in one graph? This would necessitate other assumptions, for example, that the point of intersection represents an average stock relation for

LM over the period, or that the economy is in stock equilibrium at every point throughout the year so that it becomes similar to equilibrium over a year.

However, having been developed in the late 1930s (Hicks, 1980-1981, p.139; Patinkin, 1987, p.1), the current use of the ISLM model is by itself a demonstration of resilience. This resilience is clearly acknowledged (for example, Colander, 2003; Vercelli, 1999). This has been attributed by Colander (2003) to several factors: (a) it developed as a pedagogical tool, which can only be removed by another pedagogical model (see also Hicks, 1980-1981, p.152); (b) its similarity in appearance to a demand and supply framework, with both a downward sloping curve and an upward sloping curve, makes students comfortable; (c) it provides a graphic depiction of monetary policy, fiscal policy and crowding out; and (d) it is a tool that can be used in policy discussions without an in-depth understanding of the underlying reasoning or processes. In the 1960s the IS/LM model formed the centre for both policy and theoretical debates, a centrality which continued into the mid-1970s.

One strong advocate of the model is Patinkin (1987). While he acknowledges that the model "has come on hard times", he praises it (Patinkin, 1987, p.1). He argues that the model is valid from the point of view of Keynes General Theory, supporting this argument by citing the maximum validation possible - a quotation from Keynes himself: "I found it very interesting and really have next to nothing to say by way of criticism" (Collected Writings, vol.XIV, p.79, in Patinkin, 1987, p.2). He contends that (besides this validation) it is also a useful analytical tool, citing various works in which it has been used, including Patinkin (1956 and 1965), Robert Mundel (1968) in his open IS-LM, David Laidler (1968) in dynamic analysis by introducing lags, and William Poole's (1970) analysis of optimal monetary policy under uncertainty. Looking at this argument, it may be that the critics of IS-LM model have wanted the model to be sufficient for all macroeconomic questions, in the process failing to realize the immense opportunities offered by the model for its (the model's) further extension to cover several other macroeconomic questions. Patinkin (1987) also directly demonstrated usefulness of the model in analysis of effects of an increase in investment that is partly financed by a decrease in liquidity preference, and how it can be used to deal with inflationary problems.

Vercelli (1999) also believes that IS-LM models are still crucial in macroeconomics and "remain the core of many introductory and intermediate-level textbooks (e.g. Dornbusch and Fischer 1978; Gordon 1987; Hall and Taylor 1988; Blanchard and Fischer 1989; Mankiw 1992; Blanchard 1996)" (Vercelli, 1999, p.199). They also remain crucial for evaluation of policy. Vercelli attributes the resilience of the models to the various roles they have played, which include: (a) propaedeutic role - didactic (pedagogical) and heuristic (enabling learning by oneself); (b) hermeneutic (interpretive) role; (c) descriptive role – forecasting macroeconomic performance; and (d) policy prescriptive role. Pervading all these roles is apparently the characteristic that the model is simple – for example, it reduces the whole economy into two equations representing two sectors (real and monetary) and analyses their interaction vis-à-vis policy. Its simplicity facilitates communication between macroeconomists and the general public. Because the model can analyze various policies and perspectives, it has become a meeting point for people from various schools of thought whereby it provides a common platform for debates.

However, while the model has remained in use, Colander (2003) argues that this use has significantly changed over time since the 1960s when it played a major role theoretically and empirically. In economic principles texts it has been (gradually) replaced by the AS/AD framework, which however, is its derivative. At the other end of the professional ladder - the top-level journals and graduate courses in macroeconomics, reference to this model is seldom. Thus, its treatment has remained mainly at the intermediate level of macroeconomics, and is no longer taught as a step to some higher level theoretical or empirical work as it used to be in the 1960s and 1970s, a view that is sharply contradicted by Vercelli (1999) and Findlay (1999). Findlay (1999) notes that many contemporary textbooks use the model, such as Baily and Friedman (1995), Blanchard (1997b), Dornbusch and Fischer (1994), Froyen (1996), and Mankiw (1996). Reference is made to model parameters and slopes of the two curves in analysis of macroeconomic policy effects. However, apparently, as Colander (2003) suggests, the model no longer forms the core of theoretical and empirical debates.

Judging its usefulness, it seems even from Colander (2003) that the alleged change in the way ISLM model has been used or the pressure to eliminate it has nothing much to do with the model's demerits, but a lot to do with the modern economics curricula being crowded with modern thoughts. Apparently, there is acknowledgement that even the modern professors who have put it out of their theoretical core-discussions find it a useful framework to discuss policy almost mechanistically.

Model development:

The background model that is used in this paper is the standard ISLM model to which has been added the export-import sector.

The goods market:

The goods market is represented by the following structural characteristics, which characteristics are used to derive the IS equation as shown below.

Private consumption function:	$C_t = c_0 + c_1 Y_{dt}, \quad 0 < c_1 < 1$	(1)
Taxation function:	$T_t = \tau_0 + \tau_1 Y_t, \quad 0 < \tau_1 < 1$	(2)
Investment function:	$I_t = \alpha_0 + \alpha_1 r_t, \quad \alpha_1 < 0$	(3)
Import function:	$M_t = m_0 + m_1 Y_t, \quad 0 < m_1 < 1$	(4)
Disposable income:	$Y_{dt} = Y_t - T_t$	(5)
Government expenditure:	$G_t = G_0$	(6)
Exports:	$X_t = X_0$	(7)
National income identity:	$Y_t = C_t + I_t + G_t + X_t - M_t$	(8)

In the equations above C = consumption, T = tax, I = investment, M = imports, G = government expenditure, X = exports, r = interest rate, d indicates 'disposable' while t denotes 'period'. All the variables are nominal. Equations (1) to (8) above constitute a simultaneous equation model

with endogenous variables consumption, tax, investment, imports, disposable income, and income, and exogenous variables including government expenditure, exports, and interest rate. Interest rate is exogenous in that it is determined outside the goods market, in the money market, and comes into the goods market through its influence on investment. Imports are a function of national income, and not disposable income, because the state also imports from its tax revenue.

By appropriate substitution of equations (1) to (7) into equation (8) and further mathematical manipulation we get the following IS equation:

$$r_t = \frac{\tau_0 c_1 + m_0 - c_0 - \alpha_0 - G_0 - X_0}{\alpha_1} + \frac{1 + c_1\tau_1 + m_1 - c_1}{\alpha_1} Y_t \qquad (9)$$

A simple inspection of the coefficient of Y in equation (9) reveals that it is negative. Therefore, the IS curve is negatively sloped. Note that the vertical intercept of the IS curve is determined by the exogenous and autonomous components of aggregate demand as well as marginal propensity to consume and investment sensitivity to interest rate changes. A change in government expenditure or exports will shift the curve, upwards if the change is positive, and downwards if the change is negative, given that the marginal response of investment to changes in interest rate (α_1) is assumed negative. Note also that the numerator of the slope term is the inverse of the simple multiplier adjusted for the marginal tax rate and the marginal propensity to import. Therefore the slope of the IS curve depends on the size of the multiplier and the marginal response of investment to changes in the interest rate. The smaller are the multiplier and the responsiveness of investment to changes in interest rates the steeper the slope and vice-versa. If investment does not at all respond to changes in interest rates and/ or the multiplier is zero the IS curve would be vertical and the converse is true.

The money market:

The LM model (money market) is characterized by the following equations:

Money demand function: $L = \varphi_0 + \varphi_1 Y_t - \varphi_2 r_t, \quad \varphi_i > 0,$ (10)

Money Supply: $M_t^S = M_0^S$ (11)

Equilibrium condition: $L = M_t^S$ (12)

In equations (10) to (12), L = money demand (liquidity preference), M^s = money supply and t is as defined earlier. L and r are in this model endogenous (see Dornbusch & Fischer, 1981, p.97), while M^s and Y are exogenous. All the variables are nominal. M^s is determined by the monetary authorities and Y is determined in the goods market. By applying the equilibrium condition (equation 12) and further mathematical manipulation, we get the following LM equation:

$$r_t = \frac{\varphi_0}{\varphi_2} - \left(\frac{1}{\varphi_2}\right) M_0^S + \frac{\varphi_1}{\varphi_2} Y_t \quad (13)$$

Since both φ_1 and φ_2 are positive, the slope of the LM curve is positive, and its magnitude is determined by the ratio of the marginal responses of money demand to changes in income and interest rate (φ_1 and φ_2 respectively). The greater the ratio the steeper is the slope and vice-versa.

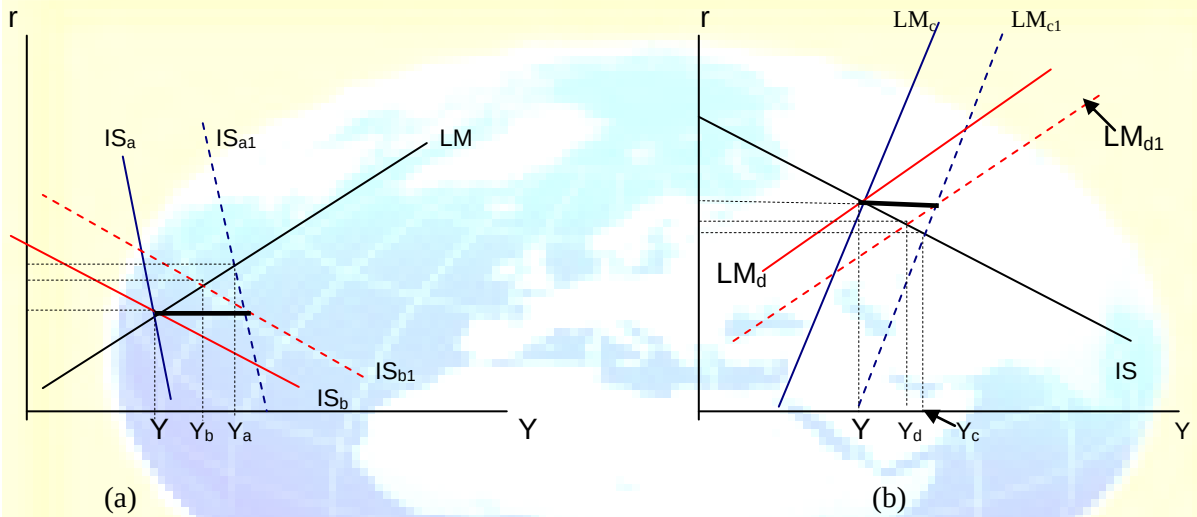
Macroeconomic policy implications of the ISLM model:

The intersection of the IS and LM curves indicates simultaneous equilibrium in the goods and money markets. Policy implications of demand management can be visualized diagrammatically in the ISLM model. Demand management policy can be either fiscal (using the tools of government revenue and expenditure – budget, taxes, subsidies, transfers and so forth) or monetary (using money supply and interest rate policies).

Figure 1(a) below demonstrates that fiscal policy is more effective when the IS curve is steep – that is, the smaller are the multiplier and responsiveness of investment to changes in interest rates. The blue lines show the pair of steeper IS curves, with the dotted one showing the effect of expansionary fiscal policy. The pair of red lines show the gentler IS curves, also with the dotted

one showing the effect of an equivalent expansionary fiscal policy. The bold black horizontal line shows that the shifts in both the blue and the red IS curves are equal as measured along the horizontal axis. However the shift in the steeper IS results in greater equilibrium income (Y_a) than that from the same shift in the gentler IS (Y_b). Fiscal policy would even be more effective if, besides a steep IS curve, the LM curve is gentler.

Figure 1: Demand Management Using Fiscal and Monetary Policy



This figure shows the effects of expansionary fiscal and monetary policies under alternative IS and LM conditions.

On the other hand, Figure 1(b) shows that monetary policy is more effective when the LM curve is steep – that is, the greater is transaction response of money demand and the smaller is speculative response. The bold black line, similar to that in Figure 1(a), shows that the shifts in both the steeper and gentler LM curves are equal. Monetary policy will even be more effective when, apart from a steep LM curve the IS curve is gentler – that is, when the multiplier and interest elasticity of investment are large. The reasoning is that when money supply increases, interest rates will fall, which induces massive investments because of the high interest elasticity of investment. This in turn leads to huge increases in income due to the high multiplier effect.

It should be noted in Figure 1 that fiscal policy achieves growth at the cost of increasing interest rates while monetary policy achieves growth with interest rates falling. However, since both

policies shift the aggregate demand curve outwards both policies cause a rise in prices. The main argument against monetary expansion is that it causes high rates of inflation.

Methodology and data:

This paper estimates the above ISLM model for Zimbabwe. Equations (1) to (13) give the complete ISLM model. The task of getting the values of the parameters in the IS and LM equations (that is, equations 9 and 13) requires simultaneous estimation of equations (1) to (4) of the IS model, on the one hand, and equation (10) of the LM model on the other. By applying the rank order condition we find that all the four equations of the IS model are over identified. However, since investment is a function only of a pre-determined variable equation (3) can be estimated directly by the ordinary least squares method (OLS). Therefore, the two-stage least squares method (2SLS) is used to estimate equations (1), (2) and (4). In the 2SLS estimations, estimates of endogenous variables regressed over all exogenous variables in the model (IS) are used as instrumental variables. Equation (10) in the LM model is exactly identified; therefore, the indirect least squares method (ILS) is used. These estimation procedures are applied to the data in Table 1. The LimDep Version 7.0 by William Greene is used in running the regressions. All regression estimates are corrected for autocorrelation using the Cochrane-Orcutt method.

The study makes use of a wide range of secondary data, including national income, disposable income, total private consumption, investment, imports, exports, government expenditure, tax revenue, money supply, and nominal interest rate. The data are time-series and annual, and they cover the years 1975-1998. All the data are nominal and, with the exception of interest rates which are in percentages, all data are in Z$ million. Sources of data include the Central Statistical Office (various *Quarterly Digest of Statistics, Statistical Yearbooks and the Compendium of Statistics 2000*) and the Reserve Bank of Zimbabwe (*Quarterly Economic and Statistical Reviews*). The specific sources are detailed below.

National income figures are obtained from Reserve Bank of Zimbabwe (1999) and Central Statistical Office (2000b). Investment figures (which are Gross Fixed Capital Formation) are

obtained from Reserve Bank of Zimbabwe (1999) and Central Statistical Office (1986, 2000b). Consumption figures are sums of private consumption (household) and consumption of private non-profit bodies, and the data come from Central Statistical Office (1986, 1993b, 2000b, 2002). Exports and Imports refer to goods and services only and data sources include Central Statistical Office (1986, 1991, 2000b). Government expenditure figures are totals of government expenditure including maturing debt (1975-1979) or net lending (1980-1986). Figures for 1975-1986 are given for year ending June 30, while those for 1997-1998 are computed sums of the respective monthly figures. Sources of data for government expenditure include Reserve Bank of Zimbabwe (1980, 1998, 1999). Money supply definition used is M2 and all data are from Central Statistical Office (1981, 1986, 1991, 1993a, 1996, 2000b). Interest rates are averages of the principal money market rates obtained from Central Statistical Office (1986, 1993b, 2000b). Tax figures are sums of direct and indirect taxes (1977-1985, 1993-1998) and sums of taxes on income, profits, goods, services and miscellaneous taxes (1986-1987, 1990-1992). Tax figures for 1975-1976 and 1988-1989 are not available and are estimated by multiplying respective government expenditure figures by the average ratio of tax to government expenditure for the years for which tax figures are available, which ratio is 0.71. Available tax figures are from Central Statistical Office (1987, 1989, 2000a).

Table 1: National Income (Y_t), Investment (I_t), Consumption (C_t), Imports (M_t), Exports (X_t), Government Expenditure (G_t), Tax Revenue (T_t), Money Supply (M_2), Interest Rate (r_t) and Disposable Income (Y_{dt})

Year	Yt	It	Ct	Mt	Xt	Gt	Tt	M2	r	Ydt
1975	1,953	468	1,240	613	590	518	368	441	5.13	1,585
1976	2,108	427	1,375	533	617	577	410	518	4.78	1,698
1977	2,150	379	1,417	558	610	754	508	552	4.53	1,642
1978	2,317	341	1,560	593	675	848	503	626	4.61	1,814
1979	2,769	395	1,956	803	798	945	542	710	4.65	2,227
1980	3,394	528	2,330	1,146	1,043	1,050	699	952	4.80	2,695
1981	4,318	830	2,978	1,442	1,117	1,284	1,044	1,035	11.67	3,274
1982	5,003	1,039	3,400	1,450	1,141	1,681	1,416	1,236	9.82	3,587
1983	6,058	1,238	4,299	1,544	1,338	2,247	1,738	1,270	11.57	4,320

1984	6,209	1,185	3,792	1,673	1,708	2,627	1,911	1,553	9.35	4,298
1985	8,876	1,299	5,618	2,002	2,020	2,923	2,117	1,619	9.44	6,759
1986	10,045	1,559	6,091	2,230	2,492	3,308	2,246	1,838	10.20	7,799
1987	10,875	1,804	6,602	2,383	2,690	4,053	2,637	2,064	9.78	8,238
1988	13,718	2,197	6,115	2,873	3,350	4,681	3,324	2,562	10.10	10,394
1989	17,062	2,452	11,319	3,803	4,087	5,676	4,030	3,140	9.59	13,032
1990	20,787	3,913	13,564	4,899	4,915	6,446	4,637	3,803	10.50	16,150
1991	28,644	6,097	20,162	8,048	7,075	8,356	5,917	4,687	21.90	22,727
1992	32,985	7,690	22,308	12,548	9,364	11,073	8,315	5,611	28.14	24,670
1993	40,877	10,021	27,189	13,784	13,050	13,408	9,093	9,081	22.75	31,784
1994	53,754	11,879	34,536	20,509	19,431	15,811	11,507	12,203	22.97	42,247
1995	58,969	14,996	36,853	25,216	23,562	21,814	13,572	16,116	25.30	45,397
1996	81,837	19,245	57,218	30,747	30,910	26,024	16,746	19,979	17.94	65,091
1997	97,111	20,509	78,435	45,535	38,375	38,127	27,545	37,514	26.07	69,566
1998	126,567	23,931	92,808	64,812	62,332	48,852	40,543	43,133	32.20	86,024

This table shows the time series of economic variables.

Empirical results:

Consumption function:

Version not corrected for autocorrelation

$$C_t = -2{,}164 \quad +1.0379Y_{dt}, \qquad r^2 = 0.99$$
$$(797.0230) \quad (0.0258) \qquad df = 22$$
$$t = (-2.715) \quad (40.169) \qquad F_{1,22} = 1{,}613.53$$

Version corrected for autocorrelation

$$C_t = -2{,}308 \quad +1.0434Y_{dt}$$
$$(740.0178) \quad (0.0241) \qquad (14)$$
$$t = \quad (-3.119) \quad (43.331)$$

The uncorrected version of the consumption function is inconsistent with economic theory in that even though the coefficient of Y_{dt} is positive it is greater than 1, indicating that on average

marginal consumption exceeded increase in income. This probably means that there was a lot of consumptive dissaving and/or borrowing associated with increases in current income, a behavior that may exhibit itself in patterns of spending on luxuries such as holidays and social parties. The negative value of autonomous consumption is also unusual. The model as a whole is very significant, while the individual coefficients are also significant, at 5% level of significance. Computed F (= 1,613.50) > critical F (= 4.30), at 5%. The explanatory power of the model is very high at 99%. The estimates remain consistent and significant after correction for autocorrelation.

Other studies have also obtained negative autonomous consumption values accompanied with high levels of coefficients of determination (for example, Zellner, 1957). A negative autonomous consumption implies that over certain positive levels of income there is no consumption. That is, there is a positive level of income below which income cannot fall. For analytical convenience, we may make the simplifying assumption that autonomous consumption equals zero.

Taxation function:

Version not corrected for autocorrelation

$$\begin{aligned} T_t &= -889 \quad + 0.2862 Y_t, \quad r^2 = 0.98 \\ &\quad (320.6716)\ (0.0076) \quad df = 22 \\ t = &\quad (-2.771)\ \ (37.851) \quad F_{1,22} = 1{,}432.71 \end{aligned}$$

Version corrected for autocorrelation

$$\begin{aligned} T_t &= -834{,}221 \quad + 0.3607 Y_t \\ &\quad (577{,}104.16) \quad (0.0195) \\ t = &\quad (-1.446) \quad\ \ (18.486) \end{aligned} \qquad (15)$$

The uncorrected version of the taxation function is consistent with economic theory which states that there is a positive income tax rate since the main source of government revenue is tax. The model as a whole also shows a good fit and overall significance at 5% with the coefficient of determination and a computed F values of 98% and 1,432.70 (>4.30) respectively. All estimates are significant at 5%. The estimates remain significant after correction for autocorrelation. Using the corrected version, the results show that the marginal income tax rate over the period was 36%. The negative autonomous tax indicates that when income is zero the government, instead of taxing its citizens, pays them.

Import function:

Version not corrected for autocorrelation

$$\begin{aligned} M_t &= -2{,}439 \quad + 0.4829Y_t, \quad r^2 = 0.99 \\ &\quad (416.0205) \quad (0.0098) \quad df = 22 \\ t &= \quad (-5.864) \quad (49.232) \quad F_{1,22} = 2{,}423.82 \end{aligned}$$

Version corrected for autocorrelation

$$\begin{aligned} M_t &= -4{,}208 \quad + 0.5194Y_t \\ &\quad (1{,}543.7351) \quad (0.0170) \\ t &= \quad (-2.726) \quad (30.534) \end{aligned} \qquad (16)$$

The uncorrected version of the import function shows that it is consistent with economic theory. Both the individual estimates and the model as a whole are significant at 5%, and the model shows a very high explanatory power of 99%. The estimates remain significant in the corrected version. The estimate of the marginal propensity to import (corrected version) is 0.52, showing that when national income increases by one million dollars, imports increase by 0.52 million dollars.

Investment function:

Version not corrected for autocorrelation

$$I_t = -4{,}315 + 726.0200 r_t, \quad r^2 = 0.74$$
$$(1{,}475.3715) \quad (91.9595) \quad df = 22$$
$$t = (-2.925) \quad (7.895) \quad F_{1,22} = 62.33$$

Version corrected for autocorrelation

$$I_t = 3{,}208{,}316 + 15.4689 r_t$$
$$(908{,}518.08) \quad (66.3136) \qquad (17)$$
$$t = (3.531) \quad (0.233)$$

In the uncorrected version, the investment function has a negative constant and a positive coefficient, both of which are significant. However, in the corrected version, while the constant becomes positive but remains significant, the coefficient remains positive but becomes insignificant. The positive sign of the coefficient is inconsistent with economic theory, which states that investment is negatively related to interest rate. However, the insignificance of the coefficient and the significant high positive constant show that there are important exogenous factors making up the autonomous component, probably high investment share of FDI. Investment in Zimbabwe over the period of study had little to do with interest rate.

Other detailed studies on investment in Zimbabwe have also concluded that empirical relationships are not consistent with the neoclassical hypothesis that private investment is negatively related to the cost of capital (interest included) (Dzawanda, 1994), while others have obtained results consistent with theory but insignificant (Dailami and Walton, 1989). Elsewhere studies have also obtained results inconsistent with the neoclassical hypothesis (for example, Chetty, 2007). Sandmo (1971) asserts that the neoclassical hypothesis holds in the short run, but in the long run the relationship between investment and interest rate is unstable.

The IS curve:

From the estimation of the above structural equations of the IS model we get the following values of the parameters (using the corrected versions):

$c_0 = -2{,}308,\ c_1 = 1.0434,\ \tau_0 = -834{,}221,\ \tau_1 = 0.3607,\ \alpha_0 = 3{,}208{,}316,\ \alpha_1 = 15.4689,$
$m_0 = -4{,}208,\ m_1 = 0.5194$

Substituting the values of the parameters above into the slope term of the IS curve gives a slope of 0.0551. This slope is positive, which goes against conventional theory on the slope of the IS curve. However, the coefficient indicates that when income increases by 1 million interest rate increases by 0.0551%, which further means that an income increase of 100 million leads to an increase in interest rate of 5.51%. This is clearly a very steep relationship. Since the coefficient of interest rate in the investment function (α_1) is statistically equal to zero, the IS curve is practically vertical.

Money demand function and LM curve:

The money demand function is estimated by the ILS method.

$$M_0^S = \varphi_0 + \varphi_1 Y_t - \varphi_2 r_t$$

$$\therefore \quad r_t = \beta_0 + \beta_1 Y_t + \beta_2 \left(M_0^S\right) \qquad (18)$$

Where $\beta_0 = \frac{\varphi_0}{\varphi_2}, \quad \beta_1 = \frac{\varphi_1}{\varphi_2}, \quad \beta_2 = -\frac{1}{\varphi_2}$.

Note that equation (18) is actually the LM equation (13) derived earlier by using the equilibrium condition that money supply equals money demand. From these we can obtain the structural parameters by the following equations:

$$\varphi_0 = \beta_0\varphi_2, \quad \varphi_1 = \beta_1\varphi_2, \quad \varphi_2 = -\frac{1}{\beta_2} \tag{19}$$

Direct OLS estimation of equation (18) gives the following results:

Version not corrected for autocorrelation

$$r_t = 7 + 0.0005Y_t - 0.0008\left(M_0^s\right), \qquad R^2 = 0.77$$
$$(1.2545)\ (0.0001)\ (0.0003) \qquad df = 21$$
$$t = (5.394)\ (3.977)\ (-2.190) \qquad F_{2,21} = 34.94$$

Version corrected for autocorrelation

$$r_t = 10 + 0.0001Y_t + 0.0003\left(M_0^s\right)$$
$$(3.4614)\ (0.0001)\ (0.0003) \tag{20}$$
$$t = (3.003)\ (0.531)\ (1.025)$$

Therefore, using the corrected results, the LM equation is consistent with theory since the coefficient of income (0.0001) is positive showing that the LM curve is positively sloped. However, the coefficient is insignificant.

From equations (19) and (20) we obtain the following values of the money demand parameters:

$$\varphi_2 = -3{,}333.3333, \quad \varphi_0 = -33{,}333.333, \quad \varphi_1 = -0.3333$$

Therefore, the money demand function is given by:

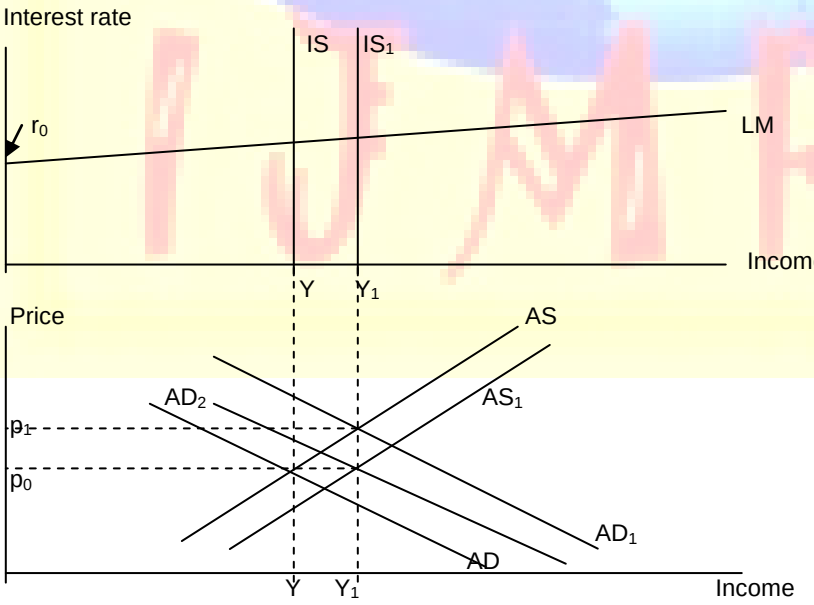
$$L = -33{,}333 - 0.3333Y_t + 3{,}333.3333r_t \quad (21)$$

The money demand function is not consistent with theory as the coefficient of r is positive and that of Y is negative. However, because both φ_1 and φ_2 are negative with the latter having a very large magnitude (of 3,333) the LM curve is gentle, having a very small slope of magnitude 0.0001, which is practically zero (the slope is insignificant at 5% as shown in equation 20) .

Analysis of the implications of the empirical results:

Therefore, the ISLM model for Zimbabwe over the period had an almost horizontal LM curve and a vertical IS curve, as indicated in the sketch below (Figure 2 upper panel). Figure 2 (upper panel) shows that when the IS curve is shifted from IS to IS_1 equilibrium income increases from Y to Y_1. That is, the increase in expenditure proportionately increases equilibrium income.

Figure 2: ISLM Model for Zimbabwe and Demand Management Implications



This figure shows the estimated ISLM model for Zimbabwe (upper panel) and a simulation of the effects of policy in the aggregate demand (AD) – aggregate supply (AS) framework (lower panel).

However, the second panel shows that the increase in income is also accompanied by an increase in prices from p_0 to p_1. Clearly efforts to improve the supply side so that aggregate supply curve can be shifted from AS to AS_1, hence effecting a maximum equilibrium income at unchanged price, would be commendable. This indicates the need for increased government expenditure to focus on development of productive resources, on more efforts to curb unproductive use of resources such as the rampant corruption and rent seeking behaviors. Money spent on fighting directly unproductive activities (that is, corruption and rent seeking) will, in the medium to long-term yield economic benefits as inflation is reduced (corruption and rent-seeking are inflationary because they make available money to people who have not produced anything). What this means is that the fiscal expansion, if designed properly would not only shift the AD curve, but also the AS curve. An accompanying contractionary monetary policy would shift the aggregate demand curve inwards from AD_1 to AD_2. Thus, a higher equilibrium income level of Y_1 can be achieved at the original general price level.

Conclusion:

The paper set out to answer the question of which macroeconomic policy between monetary and fiscal policy should be used to initiate growth, or to investigate the wisdom of a fiscal-policy driven growth. The paper has estimated several structural functions comprising the ISLM model using nominal data and simultaneous equation econometric approaches in order to obtain the estimates of the parameters of the IS and LM equations. The paper finds that the IS curve is vertical while the LM curve is almost horizontal.

The results support a fiscal policy initiated growth in Zimbabwe and that monetary policy should play a supportive role. They show, for example, that an increase in government expenditure would approximately translate in full to growth in income. It is, therefore, recommended that the government, through tools of taxation and government expenditure, takes the lead ahead of monetary policy to try to induce growth. The problem with trying to use monetary policy is that

changes in interest rate do not significantly affect investment, and yet the interest rate marks the transmission route of monetary policy to the real sector.

However, like monetary policy, fiscal policy achieves growth at the cost of inflation. To minimize inflationary effects of fiscal expansion, increased government expenditure should focus on development of productive resources and on efforts to curb unproductive use of resources such as the rampant corruption and rent seeking behaviors. Tax incentives to investment such as investment tax credits may be used. A contractionary monetary policy would also help in reducing the inflationary effects of a fiscal expansion especially if selective credit is designed in such a way that it would discourage consumptive borrowing.

This study is limited in several ways. The model is simplistic in that all the structural functions are two variable functions except the money demand function which is a three variable equation. For example, the consumption function is the simple Keynesian form where consumption is a function of current income. This function could be improved by incorporating other important variables affecting consumption such as wealth, and also consider a permanent income hypothesis. Also investment is affected by many factors other than the rate of interest. Some of these factors, for example, political risk, uncertainty, business confidence and so forth are qualitative which would require use of a very different model than the current one. The model is partially open, only incorporating exports and imports. There are more issues to an open economy than just the trade balance, for example interest rate differentials, capital account, exchange rate regimes, and issues of international capital mobility.

Thus, further research on this question would do well to construct a fully open macroeconomic model that also considers that structural functions characterizing the macroeconomy are more complicated than assumed in the current study. Such a model would show that there are greater interactions among variables than is reflected in this simple model, and would be expected to yield results with finer details, which are sacrificed in this study.

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