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OPTIMAL GOVERNMENT FINANCE AND DEMOCRACY IN DEVELOPING COUNTRIES

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Optimal government finance models illustrating trade-offs between different policy instruments, such as seigniorage and income taxes, have focused on industrialized countries. In this paper, a model that includes the effective reserve ratio and currency growth rate as instruments is derived from a welfare loss function and is estimated using fixed effects for a sample of 29 developing countries. The results indicate that the governments in the sample use the reserve requirement to minimize the welfare losses associated with seigniorage revenue. Mid-level democracies are associated with the highest effective reserve ratios.

Keywords: Reserve Ratio, Currency Growth, Seigniorage, Democracy
JEL classification: E6, H2

1. INTRODUCTION

Seigniorage, defined as government revenue from increases in the monetary base, is a greater source of revenue in developing countries than in industrialized countries. This paper examines the trade-off between the two components of the monetary base, reserves and currency, using an optimal government finance model for a sample of 29 developing countries. Developing countries generally are believed to use seigniorage extensively because they have ineffective tax systems and do not conduct open market operations to a significant extent (Chamley (1991)). In addition, the percentage of seigniorage extracted from the reserve component of the monetary base is greater in developing countries than in industrialized countries. For example, Latin American countries procure four to five times as much seigniorage as a percentage of GNP as industrial economies, and more than half of it comes from the reserve component (McKinnon (1991)). Such financial repression may be optimal for government revenue maximization in countries where tax evasion is prevalent (Roubini and Sala-i-Martin (1995)).

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While high reserve requirements constitute financial repression, some economists favor a relatively low rate. A fundamental argument for a minimal reserve requirement is based on the asymmetric information between depositors and bank investors. Depositors cannot observe the investments made by banks. As a result, banks are inclined to hold too few reserves and make riskier investments than are optimal. Bank reserves also allow depositors a greater measure of liquidity. Consequently, a minimal reserve requirement theoretically leads to a Pareto superior portfolio than would occur without restrictions (Cothren (1987)). However, reserve requirements typically average 7 percent in industrialized countries but average over 20 percent in developing countries (Fry (1995)). While part of this disparity may be due to greater asymmetric information in developing countries, it is unlikely that such high reserve requirement ratios are optimal for financial market efficiency. McKinnon and Mathieson (1981, p.5) characterize the high reserve requirements in some countries as "forced sales of government debt to the banking system." The premise of this paper is that the reserve requirement is used strategically in developing countries to augment seigniorage revenue while minimizing the welfare losses of seigniorage creation. The reserve requirement may be used to increase the base on which the inflation tax is levied while keeping inflation at a rate lower than it otherwise would be.

Evidence of such optimizing behavior has been found by Brock (1989). An increase in the reserve requirement ratio is likely to be deflationary - money supply decreases through a decrease in the money multiplier and real demand for money is likely to increase.[1] Thus, in the absence of government intervention, negative correlations between the reserve requirement and currency growth can be expected. If the government is using the reserve requirement strategically, the reserve requirement may be increased in tandem with the currency growth rate to ameliorate the overall welfare loss. In this case, a positive association can be expected between the reserve requirement and currency growth rate. Brock finds positive correlations between reserve ratios and inflation rates in Latin American and African countries and negative or insignificant correlations in most Asian countries. He interprets the positive correlations as the result of government policy actively raising reserve requirements when inflation rates rise in order to minimize the welfare cost of inflation.

Reserve requirements and inflation interact to affect the economy in general and the

[1] An increase in the reserve requirement has three main effects on the demand for money. First, there is a direct increase in the demand for reserves which increases the demand for money. Second, to the extent that the rate on deposits decreases, households may switch out of deposits to currency, which also increases the demand for money because the decrease in the demand for deposits reduces money demand only fractionally while the increase in the demand for currency is one-for-one. Third, following a decrease in the deposit rate, households may switch from deposits to non-cash assets, such as earning assets, which decreases the demand for money. Because the first two effects are likely to outweigh the third effect, an increase in the reserve requirement is likely to be deflationary.

financial sector in particular. Any printing of currency by the government in excess of money demand results in inflation. High and variable inflation rates reduce financial intermediation and slow economic growth by increasing uncertainty and shifting investments to nonproductive physical assets.

Excessive reserve requirements have a similar effect on financial intermediation and economic growth. An increase in the reserve requirement transfers funds from the private to the public sector and induces an increase in the interest rate spread as bank officials try to make up for the lost profit of idle reserves (Killick and Martin (1993)). Financial intermediation decreases and resources are not directed to their most productive uses. The reduction in the return to saving slows the accumulation of income-producing assets and reduces the tax base over time (Drazen (1989)). In addition, if loan rates increase significantly, adverse selection (in which safer borrowers are discouraged from applying for loans) and the incentive effect (which encourages riskier investments) may also reduce bank profits (Stiglitz and Weiss (1981)). Thus, both the inflationary and noninflationary components of seigniorage may impose significant social costs. The model outlined in Section 3 follows from the minimization of these social costs.

2. OPTIMAL GOVERNMENT FINANCE

The optimal government finance framework entails the minimization of a social loss function which is comprised of an assumed parameterization of two instruments, such as seigniorage and income taxes. Because the marginal costs of each tax are equated at the optimum, the levels of the two instruments can be expected to move together. The literature in this area has focused on the United States and other industrialized countries. Mankiw (1987), using 33 years of U.S. data, finds that the level of direct taxation moves in the same direction as inflation, consistent with a social loss minimization objective. Poterba and Rotemberg (1990) also examine an expected loss function with an income tax and the inflation rate as variables. They find positive correlations between taxes and inflation in the U.S. and Japan but negative or statistically insignificant correlations for Britain, France, and Germany. Berument (1994) builds on the work of Poterba and Rotemberg by differentiating between political parties. Using seigniorage and tax revenue as instruments for a sample of 15 industrialized countries, he finds some support for the optimal government finance hypothesis and also that left-wing administrations use more seigniorage revenue than right-wing administrations to finance spending.

Other authors have focused on the effect of political variables, such as polarization, political instability, and influence of pressure groups, on macroeconomic outcomes. Alesina and Sachs (1988) present a model to explain business cycles in the U.S. in which the Republican party is relatively averse to money growth while the Democratic party is more concerned with an employment target. Eaton (1994) shows that governments that weigh the interests of current lenders more than those of borrowers

will impose higher reserve requirements both to reduce the need for inflationary seigniorage and to raise the interest rate on loans. In Cukierman *et al*. (1992), governments may rely on seigniorage as a major source of revenue if they perceive a low probability of re-election and are therefore less inclined to reform the tax system. They conclude that tax system efficiency is a function of political instability and polarization.

Some authors have rejected the optimal government finance approach outright based on the results of this political economy approach. Edwards and Tabellini (1991), using data for 21 developing countries over 34 years, find little support for the optimal government finance framework, and instead posit that inflation will be higher the more polarized the society and the greater the political instability. In such societies, the government has weak reputational incentive. Polarization and political instability, both variously measured, are not significant in explaining trade taxes as a percentage of government revenue, but political instability is positively related to budget deficits.

Roubini (1991) also rejects the optimal government finance framework. Tax revenues are significantly positively associated with seigniorage revenue in only 37 of the 90 countries in his sample. Using the frequency of government change as a proxy for political instability, he tests the hypothesis that political instability causes high budget deficits. He finds that seigniorage and political instability are significant explanatory variables for fiscal deficits.

The latter two articles examine developing countries and refute optimal government finance theory, while the studies that find support for the theory focus on industrialized countries. Much of the existing optimal government finance literature examines the relationship between money growth and a direct tax and does not differentiate between the two components of seigniorage - the non-inflationary reserve component and inflationary currency growth. It is this trade-off however, that governments in developing countries, where tax collection is ineffective, may be considering.

In this paper, an optimal government finance model is examined using the effective reserve ratio and currency growth as instruments for a sample of 29 developing countries.[2] The model is further specified by the addition of a democracy variable and openness to trade. The remainder of the paper is organized as follows. The model is described in Section 3. Section 4 discusses the empirical specification. Section 5 discusses the data. Section 6 presents the results, including those with other government revenue added to the model and those using lagged values of some potentially endogenous variables. Section 7 concludes.

[2] The effective reserve ratio is defined as reserves as a proportion of total money demand.

3. THE MODEL

The model is based mainly on the work of Poterba and Rotemberg (1990) and Berument (1994). An equation is derived from a welfare loss function that is convex in two variables - the effective reserve ratio and the negative inverse of the currency growth rate.

The objective function is

$$W_t = E_t \sum_{j=0}^{\infty} \rho_t \left[\tau_{t+j}^{1+\alpha} - \left(\frac{C_{t+j-1}}{C_{t+j}} \right)^{1-\beta} \right], \tag{1}$$

where W_t is welfare loss in time t, E_t is the expectations operator, ρ_t is the discount factor and equals $\frac{1}{(1+r)^t}$ (r is the real interest rate), C_{t+j-1} and C_{t+j} are the currency levels at times $t+j-1$ and $t+j$ respectively, τ_t is the effective reserve requirement ratio at time t, α is a positive constant, and β is a constant between zero and one. The objective function may be interpreted as the cost of raising seigniorage revenue or as the welfare loss of seigniorage creation. The elasticities are assumed to be constant so the objective function is a generalization of the constant elasticity of substitution (CES) welfare function as in Poterba and Rotemberg (1990) and Berument (1994). The deadweight loss associated with the currency growth rate is stated as the negative inverse of the growth rate to allow derivation of a testable equation.

Government revenue from seigniorage is equal to the real change in the monetary base

$$\begin{aligned} \frac{M_t - M_{t-1}}{P_t} &= \frac{C_t + \tau_t D_t - C_{t-1} - \tau_{t-1} D_{t-1}}{P_t} = \frac{C_t - C_{t-1}}{P_t} + \frac{\tau_t D_t - \tau_{t-1} D_{t-1}}{P_t} \\ &= \left(1 - \frac{C_{t-1}}{C_t}\right)\frac{C_t}{P_t} + \frac{\tau_t D_t}{P_t} - \frac{\tau_{t-1} D_{t-1}}{P_t}, \end{aligned} \tag{2}$$

where M_t is the monetary base, P_t is the price level, and D_t is the nominal level of deposits.

The government's intertemporal budget constraint is

$$b_t = \frac{1}{\rho_t} b_{t-1} + \frac{G_t}{P_t} - \left(1 - \frac{C_{t-1}}{C_t}\right)\frac{C_t}{P_t} - \frac{\tau_t D_t}{P_t} + \frac{\tau_{t-1} D_{t-1}}{P_t}, \tag{3}$$

where b_t is government debt and G_t is government spending at time *t*.

The Lagrangian in time t is

$$L_t = \left[\tau_t^{1+\alpha} - \left(\frac{C_{t-1}}{C_t}\right)^{1-\beta}\right] - \lambda\left[b_t - \frac{1}{\rho_t}b_{t-1} - \frac{G_t}{P_t} + \left(1 - \frac{C_{t-1}}{C_t}\right)\frac{C_t}{P_t} + \frac{\tau_t D_t}{P_t} - \frac{\tau_{t-1}D_{t-1}}{P_t}\right]. \tag{4}$$

Following from the first-order conditions, the marginal cost of currency growth is

$$\frac{(1-\beta)\left(\frac{C_{t-1}}{C_t}\right)^{-\beta}}{\frac{C_t}{P_t}(1+\varepsilon_c)} = \lambda\ , \tag{5}$$

where $\varepsilon_c = \dfrac{\partial\left(\frac{C_t}{P_t}\right)}{\partial\left(\frac{C_{t-1}}{C_t}\right)}\dfrac{\left(\frac{C_{t-1}}{C_t}\right)}{\left(\frac{C_t}{P_t}\right)}$ and is the elasticity of real currency holdings with respect to the currency growth rate inverse. The marginal cost of the reserve requirement ratio is

$$\frac{(1+\alpha)\tau_t^{\alpha}}{\frac{D_t}{P_t}(1+\varepsilon_d)} = \lambda\ , \tag{6}$$

where $\varepsilon_d = \dfrac{\partial\left(\frac{D_t}{P_t}\right)}{\partial\tau_t}\dfrac{\tau_t}{\left(\frac{D_t}{P_t}\right)}$ and is the elasticity of real deposit holdings with respect to the reserve requirement ratio.

The government equates the marginal cost of the reserve requirement ratio to the marginal cost of currency growth at the optimum. Equating marginal costs and taking natural logarithms yields

$$\ln(1-\beta) - \beta \ln\left(\frac{C_{t-1}}{C_t}\right) - \ln\left(\frac{C_t}{P_t}\right) - \ln(1+\varepsilon_c) = \ln(1+\alpha) + \alpha \ln \tau_t - \ln\left(\frac{D_t}{P_t}\right) - \ln(1+\varepsilon_d). \quad (7)$$

Solving for τ_t and simplifying yields

$$\ln \tau_t = \phi_0 + \phi_1 \ln \frac{D_t}{C_t} + \phi_2 \ln \frac{C_t}{C_{t-1}}, \quad (8)$$

where $\phi_0 = \frac{1}{\alpha} \ln \frac{(1-\beta)(1+\varepsilon_d)}{(1+\alpha)(1+\varepsilon_c)}$, $\phi_1 = \frac{1}{\alpha}, \phi_2 = \frac{\beta}{\alpha}$.

If the governments in the sample are using the reserve requirement strategically to minimize the welfare losses of seigniorage creation, ϕ_2 will be positive and significant. Under this scenario, the government may use the reserve ratio to increase the base on which the inflation tax is levied while tempering increases in inflation, such that inflation may increase less than what it would without the mitigating effect of the reserve ratio. Absent government intervention, the reserve ratio and the currency growth rate are expected to move in opposite directions - an increase (decrease) in the effective reserve ratio would be expected to be deflationary (inflationary).

4. EMPIRICAL SPECIFICATION

Equation (8) reflects the preferences of the government as stated in the welfare loss function. Democracy and openness to trade are added to the final estimation. While these variables are *ad hoc*, there is justification for them in the existing literature, and their inclusion leads to a better specification of the model.

Political variables are often significant determinants of macroeconomic policy in the literature.[3] One approach has been to use some measure of political instability to explain macroeconomic outcomes as in Edwards and Tabellini (1991) and Roubini (1991). Political instability as it is usually defined, however, is not independent of regime-type. For example, Roubini uses the frequency of government change as a proxy for political instability. Democracy is naturally more "unstable" than authoritarianism. According to Przeworski *et al*. (2000, p.212): "The phenomena that constitute anomalies, breakdowns of rule, under dictatorship are just essential, definitional features of democracy."

[3] See Alesina and Sachs (1988), Cukierman *et al.* (1992), Edwards and Tabellini (1991), and Roubini (1991).

Changes of chief executive are regular and expected under democracy, while in authoritarian regimes changes often occur only by coup. Przeworski *et al.* (2000) find that political instability is much more frequent under democracies but affects economic performance only under dictatorships. Thus, for the purposes of this paper, political instability is not a very informative construct.

Another approach has been to incorporate political preferences in empirical models according to partisan theory; the interests of different constituencies are represented by different political parties. For example, in Alesina and Sachs (1988) the Republican party is more averse to money growth while the Democratic party is more concerned with employment. Similarly, in Berument (1994) party R is relatively more averse to money growth than party D. As a result, the Democratic party is more likely to create inflationary surprises to exploit the Phillips curve and thereby increase employment. This dichotomy is often applicable in developed countries, but it becomes more intractable in the developing world. One reason is that labor rarely has had significant influence in developing countries (Geddes (1995)). Moreover, in most countries, business groups are quite varied in their interests and often opposed regarding economic policy (Sullivan (1995)). Rather than clearly defined partisanship, what appears to occur in developing countries, is a marked increase in demands from a myriad of interest groups as the country enters a democratic transition. The government must then contend with the old elite of the authoritarian regime as well as newly vocal interest groups. The compulsion to augment government revenue with seigniorage may be at its greatest during this period.

Evidence in accord with this view is found by Haggard and Kaufman (1989). Using data from 25 Latin America, Asian, and African countries, they find that: (1) while democratic governments did not control expenditures as well as authoritarian governments, they did as well controlling deficits and credit expansion, and (2) countries undergoing democratic transitions appeared to pursue more expansionist policies than either established democracies or authoritarian governments. Both changes in expenditure as a proportion of GDP and expansion of central bank credit were significantly higher in countries undergoing democratic transitions than in either continuous democratic or authoritarian regimes. This suggests a nonlinear relationship between the level of democracy and financially oppressive measures such as the reserve ratio; governments in the mid-range of the democracy scale may use the reserve requirement to a greater extent than those at the ends.

A defining characteristic of democracy is significant competition among political candidates (Przeworski *et al.* (2000)). A democracy variable based on this definition and described in greater detail in Section 5, is included in the regression equation along with its square. The sign for the level of democracy is expected to be positive while the sign for the squared term is expected to be negative.

Lastly, openness to trade may also affect the dependent variable. Romer (1993) has found a significant negative relationship between openness to trade and inflation. A surprise monetary expansion causes the real exchange rate to depreciate. The more open

the economy, the greater the harm caused by the depreciation. In countries less open to trade, the incentive to inflate is greater, and the equilibrium inflation rate is higher. Countries less open to trade may be more inclined to use the effective reserve ratio to moderate the higher equilibrium inflation rate. In addition, countries that are not open to trade have limited ability to earn foreign exchange and are more likely to experience debt crises. Governments in these countries may be predisposed to using seigniorage revenue. The logarithm of the ratio of exports plus imports to GDP is included in the set of explanatory variables and the sign is expected to be negative.

The final regression equation is

$$\ln \tau_t = \phi_0 + year + \phi_1 \ln \frac{D_t}{C_t} + \phi_2 \ln \frac{C_t}{C_{t\text{-}1}} + \phi_3 Dem_t + \phi_4 Dem_t^2 + \phi_5 \ln \frac{X_t + M_t}{GDP_t} + e_t, \qquad (9)$$

where $\ln \tau_t$ is the natural logarithm of the effective reserve ratio in time t. *Year* is the two-digit year included to capture any deterministic time trend. $\ln \frac{D_t}{C_t}$ is the natural logarithm of the deposit-currency ratio in time t and represents the decisions of households to put money in deposits versus currency. The parameter for this variable is expected to be positive. $\ln \frac{C_t}{C_{t-1}}$ is the natural logarithm of the currency growth rate between times t and $t-1$. If the optimal government finance model applies to the sample countries, currency growth rates and reserve requirement rates will move in the same direction. Thus, the parameter estimate for this variable is expected to be positive. A negative or insignificant parameter estimate will counter optimal government finance theory for the developing countries in this sample. Dem_t is the level of democracy in time t. Democracy is an eight-point scale ranging from one to eight, with one being the lowest level of democracy and eight being the highest. The parameter estimate for the level of democracy is expected to be positive, while that for the squared term is expected to be negative indicating an inverted-U relationship with respect to the dependent variable. $\ln \frac{X_t + M_t}{GDP_t}$ is the natural logarithm of the ratio of exports plus imports to gross domestic product in time t. This variable is expected to have a negative parameter estimate. Finally, e_t is the random error term and is independently identically distributed $(0, \sigma^2)$.

5. DATA

The data are annual and range from 1967 to 1994. The 29 countries in the sample have been chosen mainly based on data availability.[4] Data for the effective reserve ratio, deposit levels, currency levels, exports, imports, and GDP are from *International Financial Statistics* (IFS) by the International Monetary Fund.[5] The democracy variable is from the *Polity III* dataset constructed by Jaggers and Gurr (1996). The variable is constructed from two of the three components of the ten-point institutional democracy variable - competitiveness of executive recruitment and competitiveness of political participation - resulting in an eight-point scale.[6] The third element comprising the institutional democracy variable, constraints on the chief executive, is omitted. In the *Polity III* dataset, institutional democracy increases with increases in executive constraints. However, increases in executive constraints may hinder the government's ability to manipulate the dependent variable, and therefore this aspect of institutional democracy may have a confounding influence in the regression. The measure used in this paper is designed to capture only the competitiveness of the political process.

Thirteen countries are missing anywhere from one to five years of data for the democracy variable. For each case, these missing values are replaced based on the chief executive in power during the respective year and information such as his or her party

[4] The countries included in the sample are Argentina, Bolivia, Brazil, Chile, the Dominican Republic, Ecuador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Paraguay, Peru, Uruguay, Venezuela, India, Korea, Malaysia, Pakistan, the Philippines, Sri Lanka, Thailand, Ghana, Kenya, Madagascar, Malawi, Morocco, Nigeria, and Sudan for a total of 29 countries - fifteen Latin American and Caribbean, seven Asian, and seven African.

[5] IFS item numbers 14, 14a, 24, 34, 35, 90c, 98c and 99b, referring to total reserve money, currency held outside banks, demand deposits, money, quasi-money, exports, imports, and GDP respectively, are used in the calculations. The effective reserve ratio is equal to $(14-14a)/(34+35-14a)$. The deposit-currency ratio is $24/14a$, the currency growth rate is $14a_t/14a_{t-1}$, and the proportion that exports plus imports comprise of GDP is $(90_c+98_c)/99b$. Data for exports, imports, and GDP are missing from the March 1996 CD-ROM for the years 1992-94 for Sudan. These data were obtained from the CIA *World Factbook*.

[6] Competitiveness of executive recruitment is a three-point scale coded as follows: (1) if the chief executives are determined by hereditary succession, designation, or some combination of the two, (2) if there are dual executives with one chosen by hereditary succession and the other by competitive elections or if there is some transitional arrangement, or (3) if chief executives are chosen through competitive elections. Competitiveness of political participation is a five-point scale coded as follows: (1) if no significant oppositional activity is allowed outside of the ruling party, (2) if some limited, organized political competition occurs outside the ruling party, (3) if there are factional patterns of competition, (4) if there is a transition from restricted or factional competition to fully competitive elections or vice versa, or (5) if elections are fully competitive with competition rarely causing widespread violence or disruption. (Gurr *et al.* (1989))

affiliation or the value for other years in power. A more detailed explanation is available from the author upon request.

6. RESULTS

Before pooling the data, each individual time series is tested for stationarity using three formal tests, the augmented Dickey-Fuller (ADF), the Leybourne-McCabe (LM), and the Elliot-Rothenberg-Stock (ERS) tests. The Box-Jenkins approach, in which an appropriate ARIMA model is fit to the data followed by residual diagnostics to ensure that the residuals are white noise, is also employed. Including a constant and trend, the ADF test indicates nonstationarity in 95 percent of the time series, the LM test in 85 percent, and the ERS test in 74 percent. However, the Box-Jenkins approach indicates nonstationarity in only four percent of the time series. The ADF test has been shown to have low power in small samples (see Agiakloglou and Newbold (1992)). While the LM and ERS tests purportedly have better power than the ADF test, due to the small sample size per country (28 observations), the Box-Jenkins approach is given the most weight. Thus, the data are treated as stationary and corrected for first-order autocorrelation. Stata, version 7.0, is used to estimate the model. The "xtpcse" command which calculates panel-corrected standard error estimates is used. The parameters are estimated by the Prais-Winsten method.

Results of the least-squares dummy variable (LSDV) estimation are presented in Table 1. All coefficient estimates have the expected sign, and all but that for the trend variable are significant at the one or five percent level. The parameter estimate for the currency growth rate is positive and significant, indicating that the sample-country governments are indeed using the reserve ratio in a strategic way to minimize the welfare losses associated with the creation of seigniorage revenue. The coefficient estimate indicates that a 10 percent increase in the currency growth rate leads to a 1.62 percent increase in the effective reserve ratio. In addition, the democracy variable in levels is positive and significant while the squared term is negative and significant, indicating an inverted U-shape with mid-level democracies having the highest effective reserve ratios. Openness to trade is also negative and significant providing support for the hypothesis that the governments likely to have higher equilibrium inflation rates also have higher effective reserve ratios. Using $\phi_1 = 0.213$ and $\phi_2 = 0.162$ to calculate α and β from the welfare loss function yields $\alpha = 1/0.213 = 4.695$ and $\beta = (4.695)(0.162) = 0.761$.

Table 1. Results of the LSDV Model

Independent Variable (Natural Logarithm)	Coefficient Estimate	*t* statistic
Year	-0.003	-1.13
Deposit/Currency Ratio	0.212	2.94**
Currency Growth Rate	0.162	4.13**
Democracy	0.121	2.86**
Democracy Squared	-0.014	-2.51*
(Exports + Imports)/GDP	-0.150	-2.51*
R^2	0.497	

Notes: The dependent variable is the natural logarithm of the effective reserve ratio, defined as reserves as a proportion of total money demand. One asterisk next to the *t* statistic indicates the coefficient estimate is significant at the 5% level; two indicate significance at the 1% level.

The R^2 of 0.497 must be interpreted with caution due to the 28 dummy variables in the model. A better measure of the model's explanatory power may be ascertained by estimating the model with one constant term, omitting the individual effects. When this regression is performed, the R^2 is 0.324.[7]

The Effect of Other Revenue on the Effective Reserve Ratio

The model assumes that tax collection is at a low and inefficient level. However, tax revenue is a component of most optimal government finance models. Accordingly, tax revenue may be an important variable in this model, and its omission would bias the parameter estimates. The social losses associated with taxes can be incorporated into the model by adding a term, $\theta_t^{1+\gamma}$, to the other two choice variables in Equation (1). The Langrangian becomes

$$L_t = \left[\tau_t^{1+\alpha} - \left(\frac{C_{t-1}}{C_t} \right)^{1-\beta} + \theta_t^{1+\gamma} \right] - \lambda \left[b_t - \frac{1}{\rho_t} b_{t-1} - \frac{G_t}{P_t} + \left(1 - \frac{C_{t-1}}{C_t} \right) \frac{C_t}{P_t} + \frac{\tau_t D_t}{P_t} - \frac{\tau_{t-1} D_{t-1}}{P_t} + \theta_t \frac{Y_t}{P_t} \right] , \tag{10}$$

where θ_t is the income tax rate, γ_t is a positive constant, Y_t is income, and all other

[7] In the regression with one constant term, the currency growth rate is significant at the one percent level of confidence and the openness to trade variable is significant at about the five percent level. All other variables are insignificant. These results are not formally presented because the parameter estimates are biased if the individual effects are not taken into account.

variables are as previously defined. The marginal costs of currency growth and the reserve requirement ratio are the same as in Equations (5) and (6), respectively. The marginal cost of taxes is

$$\frac{(1+\gamma)\theta^{\gamma}}{\frac{Y_t}{P_t}(1+\varepsilon_y)} = \lambda \ , \tag{11}$$

where $\varepsilon_y = \frac{\partial\left(\frac{Y_t}{P_t}\right)}{\partial\theta_t}\frac{\theta_t}{\left(\frac{Y_t}{P_t}\right)}$ and is the elasticity of real income with respect to the tax rate.

To solve for the reserve ratio in terms of both the currency growth rate and the tax rate, I take natural logs as before, solve for the reserve ratio in terms of each of the other two variables individually, and then sum the two equations to solve for the reserve ratio again. This leads to the following estimable equation:

$$\ln \tau_t = \phi_0 + \phi_1 \ln\frac{D_t}{C_t} + \phi_2 \ln\frac{C_t}{C_{t-1}} + \phi_3 \ln\frac{D_t}{Y_t} + \phi_4 \ln\theta_t \ , \tag{12}$$

where $\phi_0 = \frac{1}{2\alpha}\ln\frac{(1-\beta)(1+\gamma)(1+\varepsilon_d)^2}{(1+\alpha)^2(1+\varepsilon_c)(1+\varepsilon_y)}$, $\phi_1 = \frac{1}{2\alpha}, \phi_2 = \frac{\beta}{2\alpha}, \phi_3 = \frac{1}{2\alpha}$, and $\phi_4 = \frac{\gamma}{2\alpha}$.

The full model with the democracy and openness to trade variables is estimated using the deposit-GDP ratio and central government revenue as a proportion of GDP for D_t / Y_t and θ_t, respectively.[8] Central government revenue data are insufficient for Madagascar, Malawi, and Sudan, and these countries are dropped from the estimation. The ratio of demand deposits to GDP, which is equivalent to the ratio of M1 minus currency to GDP, may be viewed as a measure of financial deepening. The parameter estimate for this variable is expected to be negative. Tax revenue may act as a substitute for the reserve ratio, in which case ϕ_4 will be negative, or the government may engage in optimizing behavior between the tax rate and the reserve ratio in the same way as the currency growth rate, in which case the parameter estimate will be positive.

The results of the LSDV estimation including the income tax variables are presented in Table 2.[9] The parameter estimates for the deposit/income and tax variables are not

[8] Central government revenue is item number 81 in *IFS*. It includes many types of taxes including income, sales, property, and trade taxes, and it does not include seigniorage revenue.

[9] I do not constrain ϕ_1 to be equal to ϕ_3 as implied by the theoretical model.

significant. All other variables retain their expected signs. The only major changes in the other coefficient estimates are that the trend variable is now significant at the one percent level and the deposit-currency ratio and openness to trade variables are no longer significant.[10] The correlations between the tax variable and the deposit-currency and trade variables are 0.28 and 0.38, respectively, while the correlations between the deposit-GDP ratio and the deposit-currency and trade variables are 0.57 and 0.10, respectively. Thus, the decreased significance of the latter two variables does not appear to be caused by multicollinearity.

Table 2. Results of the LSDV Model Including Other Government Revenue

Independent Variable (Natural Logarithm)	Coefficient Estimate	*t* statistic
Year	-0.010	-3.15**
Deposit/Currency Ratio	0.137	1.63
Currency Growth Rate	0.158	3.64**
Democracy	0.110	2.61**
Democracy Squared	-0.012	-2.27*
(Exports + Imports)/GDP	-0.099	-1.42
Deposit/GDP	-0.078	-1.00
Revenue/GDP	-0.294	-0.31
R^2	0.527	

Notes: The dependent variable is the natural logarithm of the effective reserve ratio, defined as reserves as a proportion of total money demand. One asterisk next to the *t* statistic indicates the coefficient estimate is significant at the 5% level; two indicate significance at the 1% level.

The governments in the sample appear to be minimizing the welfare losses associated with currency and reserve creation regardless of the level of other revenue. In general, government revenue has increased in these countries during the 1967-94 time period. However, it may be that moderate increases in other revenue have not been enough to impact the strategic use of the reserve ratio to augment seigniorage revenue.

Exogeneity of the Currency Growth Rate and the Deposit-Currency Ratio

The model assumes that the governments simultaneously choose the effective

[10] Adding the government revenue variable *ad-hoc* (omitting the $\ln D_t / Y_t$ term) yields similar results. The currency growth rate and democracy variables retain their expected signs and are significant while the trend variable becomes significant at the one percent level and the deposit-currency ratio and openness to trade variables lose significance.

reserve ratio and the currency growth rate. Thus, the currency growth rate and the deposit-currency ratio may be endogenous. However, a joint test of the hypothesis that these variables are exogenous using the Durbin-Wu-Hausman test yields a chi-squared statistic of 2.68, which has a probability level of 0.26. Thus, the null hypothesis of exogeneity cannot be rejected.

Nevertheless, because the deposit-currency ratio and the currency growth rate are theoretically endogenous, the results of the model using the lagged values of these variables are presented in Table 3. All variables retain their expected signs. The currency growth rate drops in significance (the probability level for the *t*-statistic of 1.82 is 0.068), while the deposit-currency ratio is insignificant. The democracy variables and the trade variable are significant at the one and five percent levels, respectively. Thus, the principal results of the other estimations are not refuted.

Table 3. Results of the LSDV Model Using One-Period Lags of the Deposit/Currency Ratio and the Currency Growth Rate

Independent Variable (Natural Logarithm)	Coefficient Estimate	*t* statistic
Year	-0.002	-0.46
LagDeposit/Currency Ratio	0.010	0.13
Lag Currency Growth Rate	0.074	1.82
Democracy	0.140	3.29**
Democracy Squared	-0.017	-3.00**
(Exports + Imports)/GDP	-0.126	-1.99*
R^2	0.498	

Notes: The dependent variable is the natural logarithm of the effective reserve ratio, defined as reserves as a proportion of total money demand. One asterisk next to the *t* statistic indicates the coefficient estimate is significant at the 5% level; two indicate significance at the 1% level.

Regression Results Omitting the Ad-hoc Variables

The democracy variables and the openness to trade measure are not derived from the theoretical model. As a check on the robustness of the theoretical model, the regression is run without the *ad-hoc* variables. The results are presented in Table 4. Both the deposit-currency ratio and currency growth rate are positive and significant at the one percent level of confidence. The R^2 for the regression is 0.440. The results omitting the *ad-hoc* variables strongly support the optimal government finance theory.

Table 4. Results of the LSDV Model Omitting the Ad-hoc Variables

Independent Variable (Natural Logarithm)	Coefficient Estimate	*t* statistic
Year	-0.005	-1.30
Deposit/Currency Ratio	0.193	2.60**
Currency Growth Rate	0.158	4.08**
R^2	0.440	

Notes: The dependent variable is the natural logarithm of the effective reserve ratio, defined as reserves as a proportion of total money demand. One asterisk next to the *t* statistic indicates the coefficient estimate is significant at the 5% level; two indicate significance at the 1% level.

7. CONCLUSIONS

The evidence supports the optimal government finance theory outlined in Section 3. The coefficient estimate for the natural logarithm of the currency growth rate is positive and significant at the one percent level. The countries in the sample appear to be increasing and decreasing the reserve ratio and the currency growth rate in tandem consistent with a welfare minimization objective. This result is robust to the inclusion of other government revenue in the estimation. Evidence for the effect of openness to trade on the effective reserve ratio is mixed; the coefficient estimate is insignificant if government revenue is included in the estimation.

The level of democracy also appears to play a role in the governments' use of the reserve requirement with those governments in the mid-range of the democracy scale having the highest effective reserve ratios. The results are indicative of the difficulties inherent in the transition to democracy. As Barro (1997) notes, in one view democracy encourages free markets and thereby increases economic growth. However, growth-inhibiting aspects of democracy, such as the enhanced role of interest groups in redistributing income, also exist. Such demands on the government appear to be the greatest during democratic transitions.

REFERENCES

Agiakloglou, C., and P. Newbold (1992), "Empirical Evidence on Dickey-Fuller-Type Tests," *Journal of Time Series Analysis*, 13, 471-483.

Alesina, A., and J. Sachs (1988), "Political Parities and the Business Cycle in the United States, 1948-1984," *Journal of Money, Credit, and Banking*, 20, 63-82.

Barro, R.J. (1997), *Determinants of Economic Growth*, Cambridge, MA: MIT Press.

Berument, H. (1994), "Political Parties and Optimum Government Financing: Empirical

Evidence for Industrialized Economies," *Southern Economic Journal*, 61, 510-518.
Brock, P.L. (1989), "Reserve Requirements and the Inflation Tax," *Journal of Money, Credit, and Banking*, 21, 106-121.
Central Intelligence Agency (1996 and earlier issues), *World Factbook*, Washington, D.C: Superintendent of Documents, U.S. G.P.O.
Chamley, C. (1991), "Taxation of Financial Assets in Developing Countries," *World Bank Economic Review*, 5, 513-533.
Cothren, R. (1987), "Asymmetric Information and Optimal Bank Reserves," *Journal of Money, Credit, and Banking*, 19, 68-77.
Cukierman, A., S. Edwards, and G. Tabellini (1992), "Seigniorage and Political Instability," *American Economic Review*, 82, 537-555.
Drazen, A. (1989), "Monetary Policy, Capital Controls and Seigniorage in an Open Economy," in *A European Central Bank? Perspectives on Monetary Unification After Ten Years of the EMS*, eds. by M. de Cecco and A. Giovannini, Cambridge, MA: Cambridge University Press.
Eaton, J. (1994), "Cross-Border Banking," *NBER Working Paper* No. 4686, Cambridge, MA: National Bureau of Economic Research.
Edwards, S., and G. Tabellini (1991), "Explaining Fiscal Policies and Inflation in Developing Countries," *Journal of International Money and Finance*, 10, S16-S48.
Fry, M.J. (1995), *Money, Interest, and Banking in Economic Development*, Baltimore, MD: Johns Hopkins University Press.
Geddes, B. (1995), "Challenging the Conventional Wisdom," in *Economic Reform and Democracy*, eds. by L. Diamond and M.F. Plattner, Baltimore, MD: Johns Hopkins University Press.
Gurr, T.R., K. Jaggers, and W.H. Moore (1989), "Polity II Codebook," Boulder, CO: Center for Comparative Politics, *Department of Political Science*, University of Colorado.
Haggard, S., and R.R. Kaufman (1989), "Economic Adjustment in New Democracies," in *Fragile Coalitions: The Politics of Economic Adjustment*, ed. by J.M. Nelson, Washington, D.C: Overseas Development Council.
International Monetary Fund (March 1996), *International Financial Statistics CD-ROM*, Washington, D.C: International Monetary Fund.
Jaggers, K., and T.R. Gurr (1995), "Polity III: Regime Change and Political Authority, 1800-1994," [Computer file]. 2nd ICPSR version. Boulder, CO: Keith Jaggers/ College Park, MD: Ted Robert Gurr [producers]. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor] (1996).
Killick, T., and M. Martin (1993), "Financial Policies," in *The Adaptive Economy: Adjustment Policies in Small, Low-Income Countries*, ed. by T. Killick, Washington, D.C: The World Bank.
Mankiw, N.G. (1987), "The Optimal Collection of Seigniorage: Theory and Evidence," *Journal of Monetary Economics*, 20, 327-341.
McKinnon, R.I. (1991), *The Order of Economic Liberalization: Financial Control in the*

Transition to a Market Economy, Baltimore, MD: Johns Hopkins University Press.
McKinnon, R.I., and D.J. Mathieson (1981), "How to Manage a Repressed Economy," *Princeton Essays in International Finance*, No. 145, December.
Poterba, J.M., and J.J. Rotemberg (1991), "Inflation and Taxation with Optimizing Governments," *Journal of Money, Credit, and Banking*, 22, 1-18.
Przeworski, A., M.E. Alvarez J.A. Cheibub, and F. Limongi (2000), *Democracy and Development: Political Institutions and Well-Being in the World, 1950-1990*, Cambridge, UK: Cambridge University Press.
Romer, D. (1993), "Openness and Inflation: Theory and Evidence," *The Quarterly Journal of Economics*, 108, 869-903.
Roubini, N. (1991), "Economic and Political Determinants of Budget Deficits in Developing Countries," *Journal of International Money and Finance*, 10, S49-S72.
Roubini, N., and X. Sala-i-Martin (1995), "A Growth Model of Inflation, Tax Evasion, and Financial Repression," *Journal of Monetary Economics*, 35, 275-301.
Stiglitz, J.E., and A. Weiss (1981), "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, 71, 393-410.
Sullivan, J.D. (1995), "Democratization and Business Interests," in *Economic Reform and Democracy*, eds. by L. Diamond and M.F. Plattner, Baltimore, MD: Johns Hopkins University Press.

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