NBER WORKING PAPER SERIES

SEIGNORAGE AND POLITICAL INSTABILITY

Alex Cukierman

Sebastian Edwards

Guido Tabellini

Working Paper No. 3199

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 1989

A first version of this paper was presented at the National Bureau of Economic Research Conference on Political Economy, Cambridge, MA, May 19-20, 1989. We are grateful to the participants of the UCLA Macro lunch group and to participants in seminars held at the University of Chicago, Northwestern, the Catholic University of Chile, the NBER Summer Institute, the University of California, San Diego, the World Bank, Stanford University, and the macro workshop at Tel-Aviv University for very helpful comments. We are particularly grateful to Nouriel Roubini and Sule Ozler for their comments and suggestions. We thank Daniel Heyman for many helpful discussions at an early stage of this project and Tom Harris for excellent research assistance. We gratefully acknowledge support from the University of California Pacific Rim Research Program and from the National Science Foundation. This paper is part of NBER's research programs in International Studies and Financial Markets and Monetary Economics. Any opinions expressed are those of the authors not those of the National Bureau of Economic Research.

NBER Working Paper #3199
December 1989

SEIGNORAGE AND POLITICAL INSTABILITY

ABSTRACT

The importance of seignorage relative to other sources of government revenue differs markedly across countries. The main theoretical implication of this paper is that countries with more unstable and polarized political systems rely more heavily on seignorage. This result is obtained within the context of a political model of tax reform. The model implies that the more unstable and polarized the political system, the more inefficient is the equilibrium tax structure (in the sense that tax collection is more costly to administer), and the higher therefore, the reliance on seignorage. This prediction of the model is tested on cross-section data for 79 countries. It is found that, after controlling for other variables, political instability significantly contributes to explain the fraction of government revenue derived from seignorage. This finding is very robust. We also find that seignorage is positively related to political polarization, even though here the evidence is weaker because of difficulties in measuring polarization.

Alex Cukierman
Tel Aviv University and
Princeton University
Princeton, NJ 08544

Sebastian Edwards
UCLA
8283 Bunch Hall
405 Hilgard Avenue
Los Angeles, CA 90024

Guido Tabellini
UCLA
8283 Bunch Hall
405 Hilgard Avenue
Los Angeles, CA 90024

1. Introduction

Over the years economists and other social scientists have recurrently wondered why inflation rates and seignorage have, over long periods of time, differed so markedly across countries. How can we explain, for example, that during the period 1971-82 inflation in Chile was on average 147% per annum, in Indonesia 17%, in Burnundi 10% and in Germany only 5%? Some of the more popular explanations have relied on the obvious, arguing that more inflationary countries have exhibited more lax fiscal and monetary policies than the more stable nations.[1] But this begs the obvious question of why some countries are able to maintain fiscal and monetary discipline while others are unable (or unwilling) to do it. A different approach has focused on the characteristics of the tax system, arguing that for institutional or technological reasons the less developed countries are unable to build sophisticated tax systems, and thus have to rely heavily on inflation to finance government expenditure. This line of thought however fails to explain the significant inflation differentials in many countries with roughly the same level of development or the same economic structure. For instance, contrary to popular mythology, not all Latin American countries are highly inflationary.[2]

In this paper we accept the traditional explanation that seignorage reflects high costs of administering and enforcing the collection of regular taxes. But we argue that the evolution of the tax system of a country also depends on the features of its political system, and not just on those of its economic structure.

The central idea of the paper can be stated as follows. An inefficient tax system (i.e., one that facilitates tax evasion and imposes high tax collection costs) acts as a constraint on the revenue collecting policies of

the government. This constraint may be welcome by those who disagree with the goals pursued by the current government. In particular, previous governments (or legislative majorities) may deliberately choose to maintain (or create) an inefficient tax system, so as to constrain the behavior of future governments (or majorities) with which they might disagree. Of course, this is more likely to happen in countries with more unstable and polarized political systems. This argument is formalized and made more precise in Section 2 of the paper.

This idea leads to an obvious empirical implication. Namely that, after controlling for the stage of development and the structure of the economy, more unstable and polarized countries collect a larger fraction of their revenues through seignorage compared to more stable and homogeneous societies. This conjecture is tested in Section 3 of the paper. In the remainder of this section we present some empirical evidence that motivates our investigation.

1.1 Cross Country Differentials in Inflation and Seignorage: The Empirical Evidence

Table 1 shows average inflation and seignorage over 1971-82 for 79 countries for which data are available.[3] Inflation is defined as the rate of change of the consumer price index, while seignorage is defined as the ratio of the increase in base money to total government revenues.[4] This table points to a very wide range of inflationary experiences. While some countries, even some very poor ones, have been very stable, others have had extremely high rates of inflation. Also, the table shows that the extent to which countries use money creation to finance their expenditures varies very widely, with some countries relying on seignorage to cover over 28 percent of their revenues.[5]

How much of this cross-country variability can be explained by economic variables alone? To answer this question, we estimate some cross country linear equations that relate seignorage to a set of structural variables suggested in the literature.[6] All variables are averaged over the period 1971-82, except if otherwise noted. Seignorage is the dependent variables. The independent variables fall into three categories: (1) The sectoral composition of gross domestic product, to account for differences in administering tax collection across sectors. We expect the agricultural sector to be the hardest to tax, and thus to have a positive coefficient in the regressions. The mining and manufacturing sector are assumed to be the easiest to tax, and thus to have a negative coefficient. We also include the ratio of foreign trade to GNP, since in many developing countries imports and exports are a cheap tax base; hence its coefficient too is expected to be negative. (2) Two measures of economic development: GDP per capita, and a dummy variable taking a value of 1 for the industrialized countries and 0 otherwise. We expect both variables to have a negative coefficient, since the technology for enforcing tax collection is likely to be more inefficient in less developed countries. (3) A measure of urbanization, since tax collection costs are likely to be smaller in urban areas than in rural areas; this leads us to expect a negative coefficient.[7] These variables are defined more precisely in the Data Appendix.

The results are reported in Table 2, for alternative specifications of the regressions. The first three columns refer to all the countries in the sample. The last two columns refer to developing countries only.[8] Most of the coefficients have the expected sign. One exception is the share of manufacturing and mining which is positive in equation (5). Its coefficient is, however, insignificant. A second exception refers to the coefficient of

urbanization, which is always positive and highly significant. We interpret this as preliminary evidence in favor of a political explanation of seignorage differentials. As noted by political scientists, political awareness and political conflicts are likely to be more prominent in urban areas than in rural societies. We return to this point below, in Section 3.

In column (3) of the table we added two dummies that group countries into continents. The Latin America dummy is positive and significant at the 5 percent level. This is further evidence that non-economic variables play a role in explaining cross country inflation differentials.

These regressions account for 33% to 42% of the variance in the data, irrespective of whether or not the industrialized countries are included. (These figures refer to the regressions R^2, rather than the $\bar{R}^2$ depicted in the table.) This result is not discouraging, given how different these countries are. However, it leaves a large margin for improvement. This is what we attempt to do in the remainder of the paper. In the next section we analyze a simple model of tax reforms that has implications for cross country differences in seignorage. We then show that this theoretical explanation is consistent with the data.

2. A Political Model of Tax Reforms

The central feature of the model of this section is a distinction between fiscal policy and tax reforms. A fiscal policy is the choice of tax rates, and of the level and composition of government spending. A tax reform is the broad design of a tax system that determines the available tax bases and the technology for collecting taxes. Even though in practice it may be difficult to decide where to draw the line, at a conceptual level this distinction has important implications. A tax reform that changes the tax

system will typically take time and resources, since it requires investment in the acquisition of information and in infrastructure. A fiscal policy, on the other hand, can be implemented more swiftly. Thus, at any given moment in time, the existing tax system acts as a constraint on the fiscal policy of the current government. This suggests that tax reforms are also determined by strategic considerations: a tax system is designed by taking into account how it will constrain the fiscal policies of future governments. The central idea of this section is that, if there is political instability and political polarization, these strategic considerations may induce the current government to leave an inefficient tax system to its successors.[9]

2.1 The Model

To focus the analysis on the political determinants of the tax system, the economy is described only by two simple equations: the budget constraint of the government (eq. (1)) and of the private sector (eq. (2)).

$$g_t + f_t \leq \tau_t(1-\theta_{t-1}) + s_t \tag{1}$$

$$c_t \leq 1 - \tau_t - s_t - \delta(\tau_t) - \gamma(s_t) \tag{2}$$

Subscripts denote time periods. Each individual is endowed with one unit of output in each period. g_t and f_t are two different public goods in per capita terms and c_t is private consumption, also per capita. The government collects from each individual an amount s_t in the form of "seignorage", and an amount τ_t of tax revenue. The main difference between taxes and seignorage is that a fraction θ_{t-1} of the tax revenue is wasted due to tax collection costs, whereas seignorage carries no administrative costs. Both taxes and seignorage impose deadweight losses on the private sector, equal to $\delta(\tau_t)$ and $\gamma(s_t)$ respectively. These distortions increase at an increasing rate. Thus:

$$\delta'(\cdot) > 0, \quad \delta''(\cdot) > 0$$

$$\gamma'(\cdot) > 0, \quad \gamma''(\cdot) > 0$$

The assumptions about θ, $\delta(\cdot)$ and $\gamma(\cdot)$ can be altered without affecting the main qualitative result.

Here, θ_{t-1} is a rough measure of the efficiency of the tax system. A lower value of θ implies a more efficient tax system. Thus, in this simple model, a tax reform amounts to a choice of θ, whereas a fiscal policy is a choice of g, f, r and s. To capture the greater inertia in reforming the tax system than in changing fiscal policy, we assume that θ, but not the other policy variables, must be chosen one period in advance. Thus, θ_t is chosen at time t but exerts an influence on tax collection costs only at time t+1 (cf., eq. (1)). In a previous version of the paper, we generalized all the results to alternative ways of modelling the inertia of the tax system (such as with lump sum costs). In the empirical analysis of the next section we also allow θ to be partially determined by technological features of the economy, like those proxied by the variables of Table 2.[10]

There are two possible policymaker types, L and R, who randomly alternate in office. The policymaker of type i, i = L,R maximizes:

$$W_t^i = E_t\left(\sum_{k=0}^{\infty} \beta^k [U(c_{t+k}) + H^i(g_{t+k}, f_{t+k})\right), \quad 1 > \beta > 0 \qquad (3)$$

where $E_t(\cdot)$ denotes the expectation operator, $U(\cdot)$ is a concave and twice continuously differentiable utility functions, and $H^i(\cdot)$ is defined as follows. If i = L:

$$H^L(g,f) = \frac{1}{\alpha(1-\alpha)} \text{Min}[\alpha g, (1-\alpha)f], \quad 1 > \alpha > 0 \qquad (3')$$

and if i = R, then $H^R(\cdot)$ is defined as in (3'), but with α replaced by

$(1-\alpha)$. Thus, these two policymakers differ only in the desired composition of the public good. For simplicity, their disagreement is parameterized by α. The more distant is α from 1/2, the more they disagree. By construction, the overall weight given to private versus public consumption does not depend on α.

The political system is described as a Markov process with transition probabilities π and $(1-\pi)$: the government who is in office at time t has a fixed probability $(1-\pi)$ of being reappointed next period. With probability π, it is thrown out of office and the other policymaker type is appointed. These simplifying assumptions can be extended in several ways. All the results go through if the political process is modelled as in Alesina and Tabellini (1987), where rational voters elect the policymaker type at the beginning of each period. A previous version showed that, under appropriate conditions, the results generalize to a concave $H(\cdot)$ function in (3). Similarly, the symmetry of the model and the fact that both government types assign the same weight to private versus public consumption simplify the exposition but do not effect the nature of the results.

In our model, then, the political system has two important features: its <u>instability</u>, represented by the probability of losing office, π. And the degree of <u>polarization</u> between the alternating governments, represented by the disagreement parameter α. As we shall see below, these two features determine the equilibrium efficiency of the tax system.

2.2 <u>Economic Policy Within a Given Tax System</u>

This subsection characterizes the equilibrium choice of τ_t, s_t, g_t and f_t for a given value of θ_{t-1}. The choice of θ_t is studied in the next subsection. Since θ is the only state variable, the equilibrium values of τ, s, g and f as a function of θ are found by solving the static

problem of maximizing $[U(c)+H^i(g,f)]$, subject to (1) and (2). Time subscripts are omitted when superfluous. We only describe the equilibrium when type L is in office; for concreteness, we assume $\alpha > 1/2$. By symmetry, the opposite case of R in office is obtained by replacing g with f.

Let $x = g + f$ denote the total amount of government spending. After some transformations, the first order conditions of this problem give[11]

$$g^L = (1-\alpha)x, \quad f^L = \alpha x \tag{4a}$$

$$1 = U'(c)(1+\gamma'(s)) \tag{4b}$$

$$(1+\gamma'(s)) = \frac{1+\delta'(\tau)}{1-\theta} \tag{4c}$$

Equation (4a) describe the optimal allocation of public consumption. The L superscripts remind us that type L is in office. Equation (4b) compares the marginal utility of public and private consumption. With distortionary taxes, at an optimum the marginal utility of public consumption (unity) exceeds the marginal utility of private consumption. Equation (4c) is the Ramsey rule: it equates at the margin the distortions associated with the last dollar collected from each source of revenue. These three conditions underscore that the identity of the government only matters for the composition of public consumption. Both government types choose the same level of overall public spending and the same tax policy, irrespective of the value of α.

Together with (1)-(2), equations (4) implicitly define the equilibrium values of all variables as functions of the efficiency of the tax system, θ:

$$c^* = C(\theta), \quad x^* = X(\theta), \quad s^* = S(\theta), \quad \tau^* = T(\theta) \tag{5}$$

Applying the implicit function theorem to (1), (2) and (4) yields (the proof is available upon request):

Proposition 1

$$X'(\theta) < 0 \qquad S'(\theta) > 0 \qquad C'(\theta) > 0 \qquad T'(\theta) < 0$$

Thus, as intuitive, a more inefficient tax system discourages public spending and forces the government to rely more on seignorage and less on regular taxes as a source of revenue. Also, a more inefficient tax system raises private consumption.[12]

2.3 Choosing the Efficiency of the Tax System

We now turn to the question of how the efficiency of the tax system is determined in equilibrium. Since, by assumption, θ_t has to be set one period in advance and there is no cost in changing it, to characterize the infinite horizon equilibrium it suffices to look one period ahead. With probability $(1-\pi)$, tomorrow type L is reappointed in office. In this case, by (4a) and (3), his utility is:

$$U(c(\theta_t)) + X(\theta_t) \tag{6a}$$

With probability π, tomorrow type R is appointed. By symmetry, $g^R = f^L$ and $f^R = g^L$. Hence, by (4a) and (3), and since $\alpha > 1/2$, type L utility if out of office is:

$$U(C(\theta_t)) + \frac{(1-\alpha)}{\alpha} X(\theta_t), \quad \frac{1-\alpha}{\alpha} < 1 \tag{6b}$$

Thus θ_t is chosen so as to maximize the following expected utility function (because of the symmetry of the model, this is also the utility function of type R, when in office):

$$(1-\pi)[U(C(\theta_t))+X(\theta_t)]+\pi\ [U(C(\theta_t))+\frac{(1-\alpha)}{\alpha}\ X(\theta_t)]=U(C(\theta_t))+\beta(\pi,\alpha)X(\theta_t) \tag{7}$$

where $\beta(\pi,\alpha) = (1-\pi) + \pi(1-\alpha)/\alpha \leq 1$.

The equilibrium value of θ satisfies the first order condition:[13]

$$U'(C(\theta))C'(\theta) + \beta(\pi,\alpha)X'(\theta) \leq 0 \qquad (8)$$

with (8) holding as an equality if $\theta > 0$. Time subscripts are omitted from now on, since all periods are alike. The first term on the left hand side of (8) is the marginal gain of raising the inefficiency of the tax system; since $C'(\theta) > 0$, this gain takes the form of higher private consumption. The second term is the expected marginal cost of a more inefficient tax system, that takes the form of reduced public consumption (recall that $X'(\theta) < 0$)).

According to (8), the magnitude of this expected marginal cost depends on $\beta(\alpha,\pi)$. The following facts about $\beta(\cdot)$ are worth noting:

$$\beta_\pi(\pi,\alpha) < 0, \quad \beta_\alpha(\pi,\alpha) < 0, \quad \lim_{\substack{\alpha\to 1 \\ \pi\to 1}} \beta(\pi,\alpha) = 0, \qquad (9)$$

where a subscript denotes a partial derivative. Thus, the expected marginal cost of having an inefficient tax system is lower: (i) the more unstable and (ii) the more polarized is the political system. In the limit, this marginal cost tends to zero as the political system becomes extremely unstable and polarized.

By (8) and (9), the equilibrium efficiency of the tax system, θ^*, is a function of the stability and polarization of the tax system: $\theta^* = \Theta(\pi,\alpha)$. We have:

Proposition 2: (i) $\Theta(0,\alpha) = \Theta(\pi,\frac{1}{2}) = 0$

(ii) There exists a pair $\pi_0 < 1$ and $\alpha_0 < 1$ such that $\Theta(\pi,\alpha) > 0$ for any $\pi > \pi_0$, $\alpha > \alpha_0$.

(iii) If $\theta^* > 0$, then $\Theta_\pi > 0$ and $\Theta_\alpha > 0$.

The first statement follows by combing (4) and (8), and noting that $\beta(0,\alpha) = \beta(\pi,\frac{1}{2}) = 1$. The rest of the proof is obtained applying the implicit

function theorem to (8), and invoking (9) and the second order conditions.

This Proposition summarizes the central theoretical result of the paper. If the current government is certain of being reappointed, or if there is no polarization, then it always brings about the most efficient tax system. However, with a sufficient degree of political instability or polarization, a more inefficient system may be preferred. More generally, the lower is the probability that the current government will remain in office and the greater is polarization, the more inefficient is the tax system left as a legacy to its successors. This happens for a purely strategic reason, and even though it is costless to improve the efficiency of the tax system: A more inefficient tax collection apparatus discourages future governments from collecting taxes and spending them on goods that are not valued by the incumbent policymaker. The equilibrium value of θ is chosen so as to equate the expected marginal benefit of constraining future governments to the marginal cost caused by inefficient taxation. When π decreases or α approaches $\frac{1}{2}$, the marginal cost of an inefficient tax system rises, since the current government is more likely to be reappointed, or if not reappointed it does not care much since it is more similar to its opponent. As a result, θ^* decreases.

Finally, the equilibrium inefficiency of the tax system that emerges when $\theta^* > 0$ can, in some sense, be socially efficient. By construction, θ_t^* maximizes the expected utility of the government in office at time t. If $\pi = \frac{1}{2}$, θ_t^* also maximizes the expected utility of the policymaker who is out of office in period t. In this case, $\theta_t^* > 0$ is socially efficient (in an ex ante sense). Even if $\pi \neq 1/2$, the ex ante efficient value of θ can be positive -- even though it does not coincide with the equilibrium of the model. The reason is that a positive value of θ, by constraining the

tax collection capacity of future governments, reduces the variance in the composition of public spending and increases private consumption. The optimality for society as a whole of having high tax collection costs may seem surprising. But it is really in the nature of a third best result. Political instability and polarization create a distortion, in the form of a high variance in the composition of public spending. High tax collection costs offset this distortion, and hence are socially efficient.[14]

Combining Propositions 1 and 2 yields the following central empirical implication: Countries with more unstable and polarized political systems rely more heavily on seignorage as a source of revenue than more stable and homogeneous societies. The remainder of this paper tests this positive implication.

3. The Evidence

In this section we extent the cross-sectional investigation of Table 2, Section 1, by adding explanatory variables that refer to the political system. Each observation corresponds to a time average for a specific country. Our goal is to estimate an equation of the following general form:

$$s_i = \alpha + \beta z_i + \gamma p_i + u_i \qquad (10)$$

where the subscript refers to country i; s_i denotes the level of seignorage as a fraction of total government revenues (including seignorage); z_i is a vector of variables measuring the economic structure of country i; p_i is a vector of political variables designed to capture the degree of instability and of polarization of the political system; and u_i is an error term. We are interested in the sign of the estimated coefficient γ.

The economic variables are the same as in Table 2. They account for economic and structural factors affecting the cost of administering and

enforcing tax collection. The measurement of the political variables presents several difficulties. Even though the notions of political instability and polarization are conceptually well defined, they do not have an obvious measurable counterpart. We deal with this problem in the next subsection, where we estimate a probit model to obtain a measure of political instability. We defer the discussion on polarization to subsection 3.3. Subsection 3.2 provides a general description of the data. The estimation of equation (10) is carried out in Subsection 3.3. Finally, Subsection 3.4 shows that the results are robust to alternative specifications of the model, to alternative measurements of some of the variables, and to the possible presence of errors in variables.

3.1 Measures of Political Instability and Polarization

The theoretical model isolates a central feature of the political system: the degree of political instability, defined as the probability of a government change as perceived by the current government. This feature is unobservable. As a proxy, we construct a measure of political instability from the data of Taylor-Jodice (198_ . These data contain yearly observations on regular and irregular (i e. coups) government transfers, unsuccessful coup attempts, executive adjustments, and other political events.

We proceed as follows. First, we estimate a yearly probit model on time series data, or on pooled time series and cross country data, over the period 1948-82. At this stage we do not discriminate between regular and irregular government changes -- even though we do it below, in the cross country regressions. The dependent variable takes a value of 0 for the years in which there is no government change (regular or irregular), and a value of 1 otherwise. Changes in the composition of the executive are not considered to be changes in government.[15] The explanatory variables in the

probit model fall in three broad classes: economic variables, designed to measure the recent economic performance of the government; political variables, accounting for significant political events that may signal the imminence of a crisis; and structural variables, accounting for institutional differences and country specific factors that do not change, or that change only slowly over time. These structural variables consist of three dummy variables that group countries in three categories, according to their political institutions: (i) democracies; (ii) democracies in which the election date is determined by the constitution; and (iii) democracies ruled by a single majoritarian party. Even though these three groups are too broad to account for the variety of existing political institutions, at least they discriminate between very different constitutional environments. All these variables are defined in Table 3A below.

Table 3B reports the results of the probit regression when all countries are pooled together in the same data set and a constant dummy for each country is added. Most variables have the expected sign, even though only a few are significant. In particular, government change is made more likely by unusual inflation in the previous year, and by unusually low growth of private consumption over the current and previous two years. (As explained in Table 3A, these variables are measured in deviation from their country means.) Moreover, riots, political repressions, adjustments in the composition of the executive, and unsuccessful attempts to change the government all signal the imminence of a political crisis. Two of the institutional dummies are significant: democracies have more frequent government changes than non-democratic regimes. And coalition governments or minority governments are less stable than majoritarian governments. Several of the country specific dummies (not reported in the table) are also

significant, indicating that there are additional factors contributing to instability of the political system which are not fully captured by our explanatory variables. These estimates are very robust to changes in the model specification. This same regression has been estimated on each country separately (except that the structural variables have been dropped and all lags of the same variables have been constrained to have the same coefficient, in order to save degrees of freedom).

Using the pooled time series-cross country and the country specific probit regressions, we compute two estimated frequencies of government change in each country during the period 1971-82. They are obtained by averaging the estimated probabilities of government change over that time period. These two estimated frequencies of government change provide two alternative measures of political instability. We label them P and PS respectively.

As a third measure, we also compute the actual frequency (F) of government change. As shown in Maddala (1983, pp. 25, 26), for any logit regression that includes the intercept, actual and estimated frequencies in the sample always coincide. Hence the actual frequency also provides a measure of the expected frequency of government change. As shown in Table 4, these three measures of political instability are highly correlated with each other. They are also correlated with other measures, estimated from alternative specifications of the probit model.

There are two possible sources of error in these estimates. First, they contain more information than was available to the governments at the time, since they are estimated form data up to 1982. Second, they omit relevant information that was available to the governments but is not reflected in our explanatory variables. Presumably the most important omitted information

concerns institutional detail not observable or not easy to quantify.

We deal with the first problem by also estimating the cross country regressions, equation (10), by instrumental variable methods. As argued in subsection 3.4, the chosen instrument is likely to be uncorrelated with this source of error. We deal with the second problem in subsection 3.5, by showing that the results are robust to errors in variables.

Besides political instability, the theoretical model of Section 2 emphasizes the importance of another political variable: the degree of polarization between the current government and its likely future contenders. Measuring this form of polarization is a significantly more difficult task. In the next subsection we discuss the inclusion of variables that may proxy for it.

The remainder of the paper investigates whether these measures of political instability and polarization can explain the facts described in the Introduction, as predicted by our theory.

3.2 Data Description

The sample of countries, determined by data availability, is the same as in Tables 1 and 2. The data sources are described in the Data Appendix. The variables are averaged over the time period 1971-82, except if otherwise noted -- see also footnote 3. In Subsection 3.4 we report the results of experimenting with other periodizations.

The means, variances and simple correlation coefficients of the relevant economic and political variables are reported in Tables 5A and 5B. It is apparent from these tables that the political variables are not highly correlated with most of the economic variables (including seignorage). This may contribute to explain why the results reported below are very robust to alternative specifications of the cross section regressions and to

alternative measures of political instability.

However, once we control for the effect of the economic variables, seignorage and political instability are more highly positively correlated. Table 6 reports the Spearman Rank correlation coefficients between the various measures of political instability and the residuals of the equations in Table 2, Section 1. For all measures of political instability and for all residuals, the rank correlation coefficient is positive. It is often significant for the measure of instability estimated from the probit regressions. The same is true of the Pearson simple correlation coefficients (not reported in the table).

This is prima facie evidence that the predictions of the theory are consistent with the data. We now turn to a more systematic investigation of this issue.

3.3 The Cross Country Regressions

Table 7 reports the estimates of equation (10) on the cross country data. In the first three columns, the measure of political instability estimated from Table 3B, P, is added to the explanatory variables in the first three columns of Table 2. This variable is positive and highly significant. It remains so even after including dummy variables that group countries into continents. Compared to Table 2, the estimated coefficients of these dummies drop significantly and the $\bar{R}^2$'s improve considerably. The same results emerge if we replace P with the other two measures of political instability discussed in the previous subsections, or if we estimate the equation on developing countries only.[16] These results then provide clear support to our view that, after controlling for structural variables, countries with a more unstable political system rely more heavily on seignorage as a source of revenue.[17]

Our model suggests that the degree to which countries rely on seignorage not only depends on political instability but also on political polarization. A problem with this proposition at the empirical level is that it is not easy to find indexes of polarization. To tackle this issue we considered a number of proxies for polarization. We first note that the variable P in equations (1)-(3) in Table 7 does not discriminate between regular government changes and those originated by coups. This distinction however may be important as an indicator of polarization: a government change taking the form of a coup is likely to be a much more radical change than one occurring through regular democratic procedures. Hence, according to our theory, seignorage should be positively related to the expected frequency of coups, even after controlling for other measures of instability. This prediction is borne out by the regression analysis. In the fourth column of Table 7, the actual frequency of coups is included among the explanatory variables. Its estimated coefficient is positive and highly significant. In equation (5) in Table 7 we further refine the idea that the frequency of coups captures polarization. There we include the actual frequency of regular government changes in 1971-82, RF, and the actual frequency of coups as separate variables. Both variables have a positive and significant estimated coefficient. But the estimated coefficient of coups is much larger than that of regular government changes, which is consistent with the view that in addition to instability the frequency of coups also proxies for polarization. This provides preliminary evidence suggesting that both instability and polarization positively affect the reliance on seignorage.

Highly polarized societies are also likely to have totalitarian political systems, in which it is difficult to transfer political power.

Democracies are more likely to be viable in societies with a higher degree of internal cohesiveness (Usher (1981)). Thus, democracies are likely to have lower levels of polarization than totalitarian regimes. Hence our theory suggests that, controlling for political instability, seignorage should be larger in more totalitarian countries. To test this conjecture, we replaced the coups variable in column 4 of Table 7 by a dummy taking a value of 1 in democratic regimes, and 0 otherwise; its estimated coefficient (not reported in the table) is negative and highly significant; it remains negative (even though it becomes barely significant) if the coups variable is also included. In addition to this dummy variable, we also used a ranking of totalitarianism compiled by Freedom House (higher numbers corresponding to more totalitarian regimes -- see the data appendix for detail). This index of totalitarianism is qualitative, and it does not make much sense to include it in the regressions as an explanatory variable.[18] To overcome this difficulty, we compute the Spearman rank correlation coefficient between this index of totalitarianism and the residuals of each of the equations in Table 7. This coefficient, denoted by ρ at the bottom of Table 7, is always positive, but almost never significant.

As an alternative way to capture the role of polarization, we incorporated in our analysis an index of income distribution as an additional independent variable. To the extent that societies with more unequal income distribution are more polarized, we would expect them to have higher seignorage. Unfortunately data on income distribution are available for a very limited number of countries. In spite of this, an index of income distribution was constructed for 37 countries. The index is defined as the proportion of total income received by the 20% richest relative to that received by the 20% poorest fraction of the population. Thus a higher value

of this index indicates a more unequal income distribution. As expected, for the limited sample of 37 countries, the coefficient of income inequality turned out to be positive although not significant at conventional levels.[19]

Finally, as we noted in the Introduction, the positive and significant estimated coefficient of urbanization is also an indication that seignorage is higher in more polarized countries. As remarked by several political scientists, political conflicts are generally more intense and disruptive in urban areas than in rural societies.[20]

A possible objection to the results presented in Table 7 is that they could be due to reverse causality: governments that create excessive inflation lose popular support, and are more likely, therefore, to be thrown out of office. Hence, inflation can lead to political instability rather than the other way around. Indeed, the probit estimates of Table 3B indicate that previous inflation, although not significant, reduces the probability of reappointment.

One way to cope with this problem would be to jointly estimate a time series process of seignorage and government changes, along the lines of a recent study on economic growth and coups by Londregan and Poole (1988). However, our theoretical model has no predictions for the time series properties of seignorage. More importantly, even if we account for the effect of past economic performance on the likelihood of reappointment, political stability also reflects other, permanent or slowly changing, features of a political system: political institutions, culture, tradition, underlying conflicts, cleavage of the population in organized groups, extent of political participation and involvement of the citizens, are all semi-permanent features of a country that affect its political stability.

These considerations suggest an alternative line of attack: to estimate equation (10) by an instrumental variable method. The economic variables are used as instruments for themselves. And as an instrument for political instability we use the expected frequency of government change in the previous decade, estimated by truncating the probit regressions of Table 3B in 1970 and computing the expected frequency in the decade 1960-70. This variable is highly positively correlated with the estimated frequency for the period 1971-82, used in Table 7, confirming that political instability is a semi-permanent feature of a country. The Appendix discusses under what conditions this instrument is uncorrelated with the error term of (10), for the 1971-82 period. Essentially, these conditions require that the error term of (10) not be highly correlated across different decades.

Besides correcting for a possible simultaneity bias, this instrumental variable procedure is also likely to correct for one of the two likely errors in measuring political instability that were mentioned in subsection 3.2. Our estimate of P incorporates more information than was available to the governments at the time. Now, this error is corrected because the instrument is based on probit estimates up to 1970, and thus excludes any information incorporated in P but not available to the governments.

The results of this instrumental variable estimation are reported in Table 8. The first three columns are the analogue of the first three columns in Table 7. The results are very similar to those of the previous table. The fourth column adds the dummy variable for democracies (in place of the coups frequency which may also be correlated with the error term). The results confirm those of Table 7. Finally, the fifth column replaces the estimated probability from Table 3B with that estimated on each country separately; the same procedure is used to obtain an instrument. The results

are very similar, even though the fit deteriorates and the estimated coefficients on some of the economic variables become insignificant. This occurs because the instrument has a low correlation with the variable it is replacing. These results too are very robust to alternative specifications of the model and to alternative measures of political instability.

Finally to evaluate the relative importance of the different independent variables, for each regression we computed the standardized estimates of each coefficient.[21] The results suggest that, for our sample and time period, political instability is one of the most important variables affecting seignorage. For example, in equation (1), Table 8, the following standardized estimates were obtained: agriculture, 0.415; foreign trade, -0.206; GDP per capita, -0.287; urbanization, 0.466; industrialization dummy, -0.571; political instability, 0.593.

Summarizing, the data are strongly consistent with the predictions of the theory: more unstable countries collect a larger fraction of their revenue in the form of seignorage. Moreover, the evidence is not inconsistent with the view that political polarization also leads to more seignorage.

We turn now to a systematic analysis of the robustness of these results, and to a discussion of some possible econometric problems.

3.4 Sensitivity Analysis

Perhaps the single most important question is whether the previous findings are robust to possible errors in measuring the explanatory variables.[22] Three variables in particular are likely to be measured with error: political instability, GDP per capita and urbanization.[23]

To answer this question, we compute consistent bounds on the coefficient of the variable of interest, political instability. Under the traditional hypothesis of the errors in variables literature, the true

coefficients that maximize the likelihood function of the measured data lie within these bounds.[24]

Our procedure exploits the results of Klepper and Leamer (1984). First, we estimate the coefficients of each of the three variables that are measured with error by alternatively interchanging each of them with seignorage, thus including seignorage as a regressor. We thus obtain four sets of estimates for each coefficient, one of which corresponds to that reported in Table 7. The signs of the various coefficients are the same across the four steps of estimators. As shown by Klepper and Leamer (1984), we can then conclude that the true maximum likelihood coefficients lie within the convex hull of these four estimates.

Table 9 reports the bounds on the coefficient of political instability for equations (1) and (4) in Table 7; political instability is measured by the pooled probit estimate, P. In both cases, the lower bound is positive. Equivalent results are obtained for urbanization and if we measure political instability in the two other ways discussed in subsection 3.1. We infer from this table that the findings of the previous subsection are robust to the possibility of measurement error in political instability, urbanization and per capita income.

A second important question is whether the results are robust to alternative specifications of the model. We already commented on the fact that alternative specifications of the probit model all yield results similar to those reported in Tables 7 and 8. In addition, we tried several alternative specifications of the cross country regressions, again with no influence on the result that seignorage is positively related to political instability.

Specifically, we changed the economic variables by adding other sectors of the economy (manufacturing and mining in isolation), or dropping some of

the variables in Table 7. None of this matters for the sign and significance of the political variables, even though it matters for some of the economic variables. We also tried adding other social and political variables that may reflect political polarization. Dropping urbanization matters for some of the economic variables, but again not for the political variables.

We also replaced the dependent variable (change in reserve money scaled by total government revenue) with three alternative measures of seignorage: (a) inflation times reserve money at the beginning of the period divided by the total revenue (including inflation times reserve money) of the central government; (b) change in reserve money divided by GNP; (c) change in reserve money over tax revenues inclusive of the change in reserve money. All measures yielded the same qualitative results as those described in the previous subsections.

The results are also robust to alternative specifications of the sample of countries. No qualitative change occurs if the industrialized countries are dropped from the sample (see column 6, Tables 7 and 8), or when other countries are dropped because of missing data on some of the variables reported in the previous paragraph. An analysis of the estimated residuals reveals the presence of five outlier countries.[25] When these countries are dropped from the sample, the results are virtually unchanged. Finally, the same results emerge if we reestimate the model by averaging the data over time periods shorter than the 1971-82 interval.

The White (1980) test on the covariance matrix of the residuals rejects the hypothesis that there is no heteroscedasticity. However, when the covariance matrix of Table 7 is estimated using White (1980) consistent estimator, the t-statistics are not substantially different from those reported in the table and all the political variables remain significant.[26] In addition, when

the equations in Table 7 are reestimated by weighting each observation with per capita income, the results are virtually unchanged (except for agriculture, that becomes insignificant) and the regression fit improves.

4. Conclusions

Seignorage is an optimal source of government revenue if there is widespread tax evasion or in the presence of large tax collection costs. In the existing literature, the nature of these costs is left unspecified, or it is postulated to depend exclusively on exogenous features of a country, like its stage of development or the structure of the economy. In this paper we argue that the efficiency of the tax system also reflects deliberate political decisions. In particular, the equilibrium efficiency of the tax system, and hence seignorage, also depend on political stability and polarization. The evidence supports this implication: more unstable countries rely relatively more on seignorage to finance the government budget than stable and homogeneous societies.

This empirical finding could have other explanations besides that advanced in this paper. Political instability for instance could reflect the fact that the collective decision process is temporarily blocked. Seignorage would then reflect the inability to reach any policy decision, rather than being due to costs of enforcing and administering tax collections. Alesina-Drazen (1989) have recently studied a theoretical model with this property. But their model implies that after the identity of the weaker party in the struggle over shares is revealed, the use of seignorage should subside. It seems therefore that their framework is more appropriate for explaining temporary bursts of seignorage whereas our framework is better suited for explaining persistent cross country differences in seignorage

of the type illustrated by the data in Table 1.

Discriminating between these alternative political explanations is important, since they are likely to have different normative implications. According to the theory formulated in this paper, it may be ex ante efficient for a politically unstable and polarized country to maintain an inefficient tax system: such a system reduces the variance in the structure of public spending or of redistributive tax policies. But this normative conclusion would probably not follow from alternative political explanations of why countries collect revenue in the form of seignorage. Further investigation of these issues promises to be an exciting task for future research.

FOOTNOTES

[1]See, for example, Vogel (1974). Fischer (1982) reports substantial cross country differences in the relative amount of seignorage.

[2]See Edwards (1989)

[3]For a number of countries data on seignorage are available only for a subinterval during 1971-82. In this case, the average is taken over the longest time period within 1970-82 for which data are available. The countries for which more than 3 years of data are missing are: Trinidad and Tobago, Cameroon, Botswana, Central African Republic, Chad, Gabon, Cote d'Ivoire, Lesotho, Mauritania, Niger, Zimbabwe, Rwanda, Somalia, Togo, Papua New Guinea.

[4]The denominator in this ratio is total revenue inclusive of seignorage. That is, it is defined as the sum of tax revenue plus money creation.

[5]Alternative ways of measuring seignorage basically provide us with the same picture. In addition to the measure used in the text we have defined seignorage as $\Delta H/E$, $\pi H/Y$, $\pi H/E$, where H is high powered money, E are total government expenditures, π is inflation, and Y is nominal income.

[6]On the relationship between inflation tax and structural variables see, in particular, Hinrichs (1966), Musgrave (1969) and Aizenman (1987). Goode (1984) presents a survey of the more recent literature.

[7]Urbanization is the average of two years: 1965 and 1985.

[8]The non-developing countries have been defined as those that the IMF classifies as industrialized, plus Greece, Portugal and Turkey.

[9]This same idea is at the core of some recent research that views public debt as a strategic variable used by the current government to influence its successors -- see the survey by Persson and Tabellini (1989, Ch. IX). Rogers (1989) also studies tax reforms in this way.

[10]This specification of the economy abstracts from two possible complications. First, it presumes that neither the government nor the private sector have access to a capital market. Second, by not explicitly modelling the distortionary effects of seignorage and regular taxes, it abstracts from the time-inconsistency problems associated with both instruments. These two complications have already been extensively investigated in the literature, and their effects are well known -- see Persson and Tabellini (1989). Here we neglect them in order to focus on the novel issue of how the political system of a country governs the evolution of its taxing institutions.

[11]Because of the concavity of $U(\cdot)$ and the convexity of $\delta(\cdot)$ and $\gamma(\cdot)$, the second order conditions are always satisfied.

[12]Because the $H^i(\cdot)$ function is linear, all the income effects of a more inefficient tax system fall on public consumption. If $H^i(\cdot)$ was concave, this would no longer be true, and we would need additional conditions to sign $C'(\theta)$ and $T'(\theta)$.

[13]We assume that the second order conditions are satisfied. As in all optimal taxation problems, this involves some hypothesis on the third derivatives of $U(\cdot)$ and $H(\cdot)$.

[14]This finding is similar to those of Brennan and Buchanan (1980); except that here the government is not modelled as a revenue-maximizing Leviathan, but as ideologically motivated. The source of the political distortion is not in the nature of the government objectives, but rather in their instability over time.

[15]Jodice-Taylor (1983) define a regular government change as a change in the office of national executive from one leader or ruling group to another that is accomplished through conventional legal or customary procedures.

[16]The variable P is a generated regressor. As such, our estimates of the standard errors may be biased in general. However, this problem does not invalidate the t-statistics for the null hypothesis that the estimated coefficient of P is zero, since under the null the standard errors are unbiased -- see Pagan (1984). Since we are interested in testing precisely this hypothesis, we do not attempt any correction. However, this may be a problem in interpreting the t-statistics of the remaining variables.

[17]Of course there is a possibility of reverse causality -- from inflation to instability. We deal with this issue in Table 8.

[18]Doing so results in a positive and barely significant coefficient in most regressions.

[19]The following is an example of the results obtained when income distribution was added to the analysis:

$$
\begin{aligned}
s = {} & \underset{(0.0388)}{0.0408} + \underset{(0.0012)}{0.0010}\ \text{Mining \& Manufacturing} - \underset{(0.0157)}{0.041}\ \text{Foreign trade} \\
& - \underset{(0.52E\text{-}5)}{0.13E\text{-}4}\ \text{GDP Capita} + \underset{(0.0004)}{0.0014}\ \text{Urbanization} - \underset{(0.0326)}{0.0438}\ \text{Industrial Dummy} \\
& + \underset{(0.0594)}{0.0723}\ P + \underset{(0.0010)}{0.0011}\ \text{Income inequality} \qquad N_2 = 37,\ \bar{R}^2 = 0.557
\end{aligned}
$$

[20]This point of view is stressed for instance in Berg-Sachs (1988) and Huntington (1968).

[21]A standardized coefficient is the estimated coefficient divided by the size of its standard error.

[22]The dependent variable, seignorage as defined in Table 1, is also most certainly measured with error. However, this fact merely increases the standard error of the regression, without introducing any bias in the estimates.

[23]As noted above, the instrumental variable estimation can remove a component of the error in measuring political instability. But a large margin of error is likely to remain unaccounted for, since we have little confidence about the correct specification of the probit regressions.

[24]The hypothesis is that the measurement errors are orthogonal to each other and to the unobserved correctly measured regressors.

[25]The outliers are: Portugal, Bolivia, Mexico, Ghana and Uganda.

[26]White (1980) estimator does not rely on a formal model of the structure of heteroscedasticity.

APPENDIX

This section outlines the identifying assumptions implicit in the instrumental variables procedure of Section 3.4. According to the theoretical model, seignorage in country i at time t should be: $\bar{s}_{it} = S(\theta_{i,t-1})$ where the function $S(\theta)$ has been discussed in the text. Presumably, the observed data on seignorage also reflect other country and time specific shocks due to policy mistakes or exogenous events. Thus,

$$s_{it} = \bar{s}_{it} + v_{it} \tag{A.1}$$

where s_{it} is observed seignorage and v_{it} is a shock. For any variable x_{it}, let $x_i = 1/12 \sum_{t=1971}^{1982} x_{it}$. Thus, x_i is the average of x_{it} during the 1971-82 period. We assume that the function $S(\theta)$ can be approximated as follows:

$$\bar{s}_i = \alpha + \beta x_i + \gamma \pi_i + e_i \tag{A.2}$$

where x_i is a vector of observed economic variables that measure the structure of the economy (the variables in Table 2), π_i is the indicator of political instability, and e_i is an unobserved error term. Combining (A.1) and (A.2), we have:

$$s_i = \alpha + \beta x_i + \gamma \pi_i + (v_i + e_i) \tag{A.3}$$

The null hypothesis is: $H_o: \gamma = 0$.

The problem is that π_i is unobserved. Our two stage procedure can be described as follows. In the first stage, we assume that π_{it} can be estimated using a probit procedure from annual data. Thus, we postulate:

$$\pi_{it} = \text{prob}(0 \leq \phi z_{it} + \mu v_{it-1} + u_{it}) \tag{A.4}$$

where ϕ and μ are coefficients to be estimated, z_{it} is a vector of

observed variables, and u_{it} is an error term. Besides observing z_{it}, we also observe whether or not the inequality in (A.4) holds. The interpretation is that a government change is triggered by specific realizations of the explanatory variables in (A.4) or of the error term u_{it}. By (A.1) the shocks $v_{i,t-1}$ can be interpreted as competence shocks, along the lines of Rogoff-Sibert (1988) and Rogoff (1990): an incompetent government, one with a high $v_{i,t-1}$, is punished by the voters through a higher probability of losing office. This is the first important identifying assumption. It is not seignorage <u>per se</u> that causes a government change. It is a higher seignorage than warranted by the efficiency of the inherited tax system. In the empirical implementation of (A.4), we proxy $v_{i,t-1}$ by the observed inflation rate in previous years, in deviation from the country specific mean. The remaining variables corresponding to the vector z_{it} are listed in Table 3. They, as well as the error term u_{it}, are assumed to be uncorrelated with the error term of (A.3), (v_i+e_i).

By estimating the coefficients ϕ and μ in (A.4) with a probit model, we obtain an estimate of π_{it}, $\hat{\pi}_{it}$. The average of $\hat{\pi}_{it}$ is thus a complicated nonlinear function of past values of $v_{i,t-1}$, z_{it} and u_{it}:

$$\hat{\pi}_i = F(v_{i,t-1}, z_{it}, u_{it};\ t = 1948\text{-}82). \qquad (A.5)$$

In the second stage, we estimate (A.3) by replacing π_i with $\hat{\pi}_i$. The OLS procedure of Table 7 is consistent under the additional identifying assumption that $\mu = 0$ in (A.4). That is, the competence shocks do not effect the probability of government change. Incidentally, this assumption is consistent with the findings of Table 3.

If however $\mu \neq 0$, then OLS estimation of (A.3) gives inconsistent estimators, since by (A.5) $\hat{\pi}_i$ and v_i are correlated with each other. To

deal with this problem, we estimate (A.3) by means of the following instrumental variables procedure. First, we truncate the probit estimation of (A.4) in 1970. Then, we take the average of the estimated π_{it} over the period 1960-70. Let us denote this average by $\hat{\pi}_{is}$, where the s reminds us of the different subperiod. We have

$$\hat{\pi}_{is} = \bar{F}(v_{i,t-1}, z_{it}, u_{it};\ t = 1948\text{-}70) \tag{A.6}$$

$\hat{\pi}_{is}$ is our instrument for $\hat{\pi}_i$. Clearly, it is correlated with $\hat{\pi}_i$. By (A.6), it is not correlated with the error term of (A.3), (v_i+e_i), if v_{it} is a statistically independent process or, more weakly, if the realizations of the competence shocks v_i, during the 1970s are statistically independent from their realizations during the 1948-70 period. This is our second identifying assumption. Obviously this identifying restriction remains the same if we interpret the v_is more broadly as any deviation between s_{it} and $\bar{s}_{it}$ rather than just as competence shocks. This assumption is consistent with a lot of serial correlation in inflation. By (A.1), this serial correlation is due to inertia in the tax system, and hence to the variable $\bar{s}_i$, but not to the "competence shocks" of the government.

Bibliography

Aizenman, J. "Inflation, Tariffs and Tax Enforcement Costs," Journal of International Economic Integration, 2, 1987, 12-28.

Alesina, A., A. Drazen "Why are Stabilizations Delayed? A Political - Economic Model," Harvard University, mimeo, 1989.

Alesina, A., and G. Tabellini, "A Positive Theory of Fiscal Deficits and Government Debt in a Democracy," NBER Working Paper #2308, 1987.

Banks, A. Political Handbook of the World, various issues.

Berg, A. and J. Sachs, "The Debt Crisis: Structural Explanations of Country Performance," NBER working paper No. 2607, 1988.

Brennan, G. and J. Buchanan The Power to Tax, Cambridge University Press, Cambridge, 1980.

Edwards, S. "Exchange Controls, Real Exchange Rates and Devaluations," Economic Development and Cultural Change, April 1989.

Goode, R. Government Finance in Developing Countries Brookings Institution, Washington DC, 1984.

Hinrichs, H. A General Theory of Tax Structure Change During Economic Development, Harvard University Law Scool, 1966.

Huntington, S. Political order in Changing Societies Yale University Press, New Haven, 1968.

Klepper, S. and E. Leamer, "Consistent Set of Estimates for Regressions With Errors in All Variables," Econometrica, 52, 1, June 1984.

Londregan, J. and K. Poole, "Coups d'État and the Military Business Cycle," mimeo, Carnegie-Mellon University, 1989.

Maddala, G.S. Limited Dependent and Qualitative Variables in Econometrics, Cambridge University Press, Cambridge, 1983.

Musgrave, R. Fiscal Systems, Yale University Press, 1969.

Pagan, A. "Econometric Issues in the Analysis of Regressions with Generated Regressors," International Economic Review , 25, 221-247, Feb. 1984.

Persson, T., and G. Tabellini, Macroeconomic Policy, Credibility and Politics, Harwood Publishers, London, forthcoming, 1989.

Rogers, C., "Changing Tax Based in a Model of Endogenous Tax Reforms," mimeo, Georgetown University, 1989.

Rogoff, K., "Equilibrium Political Budget Cycles," American Economic Review, 1990.

_____ and A. Sibert, "Equilibrium Political Business Cycles," Review of Economic Studies, January 1988.

Summers, R. and A. Heston "A New Set of International Comparisons of Real Product and Price Level estimates for 130 Countries, 1950-1985," Review of Income and Wealth, 1-25, 1987.

Taylor, C.L. and D. Jodice World handbook of Social and Political Indicators, Yale University Press, New Haven, 1983.

Usher, D., The Economic Prerequisite to Democracy, Columbia University Press, New York, 1981.

Vogel, R. "Money and Inflation in Latin America," American Economic Review, 1974.

White, H. "A Heteroskedasticity -Consistent Covariance Matrix Estimator and a Direct test for Heteroskedasticity," Econometrica, 817-838, 48, May 1980.

</ref_section>

TABLE 1

Inflation and Seignorage: Average 1971-1982

	Country	Inflation	Seignorage
1	Australia	10.449	3.0953
2	Austria	6.266	2.7795
3	Belgium	7.534	1.8847
4	Bolivia	30.360	21.6997
5	Botswana	11.411	3.6838
6	Brazil	47.435	17.7971
7	Burma	9.907	15.2439
8	Burundi	12.197	6.4300
9	Cameroon	10.874	5.1577
10	Canada	8.663	3.0331
11	Central African Republic	•	20.0184
12	Chad	•	9.5075
13	Chile	147.623	17.5215
14	Colombia	22.067	17.1446
15	Congo, Peoples Republic	9.759	4.6259
16	Cote d'Ivoire	11.552	1.1941
17	Denmark	10.043	0.7939
18	Dominican Republic	10.015	6.7991
19	Ecuador	13.271	14.4242
20	El Salvador	11.255	11.4186
21	Ethiopia	9.087	9.6008
22	Finland	11.207	1.6283
23	France	10.154	2.1369
24	Gabon	12.035	3.6822
25	Germany, Federal Republic	5.205	2.5232
26	Ghana	47.849	28.0381
27	Greece	15.869	14.6109
28	Honduras	8.324	5.8065
29	India	8.450	13.1732
30	Indonesia	16.781	9.0132
31	Iran	14.323	12.9966
32	Ireland	14.593	5.8489
33	Italy	14.738	12.4645
34	Jamaica	17.046	4.7058
35	Japan	8.225	8.3875
36	Jordan	10.708	20.9823
37	Kenya	12.763	4.5367
38	Kuwait	8.978	2.6873
39	Lesotho	0.133	2.4979
40	Malaysia	6.278	7.3299
41	Mauritania	0.108	3.0139
42	Mauritius	14.665	10.6670
43	Mexico	21.236	23.9667
44	Morocco	9.085	7.3626
45	Netherlands	7.169	1.1281
46	New Zealand	13.076	1.6511

Table 1 (cont).

	Country	Inflation	Seignorage
47	Nicaragua	16.833	8.8829
48	Niger	12.267	9.4040
49	Nigeria	15.504	7.2871
50	Norway	9.095	2.1367
51	Oman	.	4.4334
52	Pakistan	12.081	12.8817
53	Papua New Guinea	8.614	0.4102
54	Paraguay	12.888	15.4742
55	Peru	38.258	20.7334
56	Philippines	14.3800	6.7275
57	Portugal	18.8558	16.6171
58	Rwanda	12.5267	10.3078
59	South Africa	11.3408	2.8834
60	Sierra Leone	13.7550	9.5254
61	Singapore	6.6017	8.8053
62	Somalia	18.8608	15.4258
63	Spain	14.9967	9.1178
64	Sri Lanka	9.8292	7.1650
65	Sudan	18.7458	16.9323
66	Sweden	9.4258	2.2645
67	Tanzania	16.4100	9.3542
68	Thailand	9.8033	7.9708
69	Togo	11.1592	10.3311
70	Trinidad and Tobago	13.0967	4.2145
71	Tunisia	6.9983	4.9747
72	Turkey	33.6559	15.3024
73	Uganda	34.3831	24.8536
74	United Kingdom	13.2083	1.7822
75	United States	7.9258	2.3104
76	Venezuela	9.2433	5.7636
77	Zaire	42.8084	15.5744
78	Zambia	11.5517	2.6588
79	Zimbabwe	8.3250	4.0676

Source: Computed from raw data obtained from International Financial Statistics.

TABLE 2

Seignorage and Structural Variables

Dependent Variable: Seignorage

	All Countries			Developing Countries Only	
	(1)	(2)	(3)	(4)	(5)
Explanatory Variables					
Intercept	0.0558 (0.0404)	0.1185** (0.0194)	0.0343 (0.0312)	0.0156 (0.0316)	-0.0167 (0.0696)
Agriculture	0.0014* (0.0006)	-	0.0017** (0.0006)	0.0020** (0.0006)	0.0024* (0.0011)
Mining and Manufacturing	-	-0.50 E-4 (0.68 E-3)	-	-	0.0007 (0.0013)
Foreign Trade	-0.0514** (0.0184)	-0.0626** (0.0184)	-0.0418* (0.0192)	-0.0546* (0.0190)	-0.0512* (0.0203)
GDP Per Capita	-0.58 E-5* (0.25 E-5)	-0.72 E-5* (0.30 E-5)	-0.57 E-5* (0.25 E-5)	-0.40 E-5 (0.25 E-5)	-0.55 E-5 (0.39 E-5)
Urbanization	0.0014** (0.0004)	0.0010** (0.0004)	0.0011* (0.0004)	0.0022** (0.0004)	0.0023** (0.0005)
Industrialized	-0.0467* (0.0190)	-0.0511* (0.0203)	-	-	-
Asia	-	-	0.0293 (0.0183)	-	-
Latin America	-	-	0.0430* (0.0210)	-	-
$\bar{R}^2$	0.333	0.281	0.357	0.369	0.360
S.E.	0.054	0.056	0.053	0.052	0.052

Notes: Numbers in parentheses are standard errors.
Method of estimation: OLS
Number of countries: columns (1)-(3): 79
columns (4),(5): 58

An asterisk denotes significance at the 5% confidence level. Two asterisks at the 1% level.

TABLE 3A

Variable Definitions

1. Government Change

Government change = Dummy variable taking a value of 1 for the years in which there is either a coup or a regular government transfer, and a value of 0 otherwise. [Source: Taylor-Jodice (1983)].

2. Economic Performance

Inflation = Annual rate of growth of GDP deflator. [Source: Constructed from Summers-Heston (1988)]

Economic Growth = Cumulative rate of growth of private consumption in the current and previous two years. [Source: Summers-Heston (1988)]

3. Political Events

Riots = Violent riots. [Source: Taylor-Jodice (1983)]

Repressions = Political executions and government imposed sanctions. [Source: Taylor-Jodice (1983)]

Executive Adjustments = Changes in the composition of the executive not resulting in government transfers. [Source: Taylor-Jodice (1983)]

Attempts = Unsuccessful attempts to change the government, taking the form of unsuccessful coups and unsuccessful government transfers. [Source: Taylor-Jodice (1983)]

Years = Years from previous government change.

4. Structural Variables

GDP Per Capita in constant U.S. $ of 1975 = [Source: Summers-Heston (1988)]

Democracy = a dummy variable taking a value of 1 for democracies and 0 otherwise. [Source: Banks, various volumes]

Elections = a dummy variable taking a value of 1 if the election date is determined by the constitution and 0 otherwise. [Source: Banks, various volumes]

Majority = a dummy variable taking a value of 1 for presidential systems or for parliamentary governments supported by a single majority party, and 0 otherwise. [Source: Banks, various volumes]

The variables inflation, consumption growth, protests, riots, and repressions are all in deviation from their country-specific means.

TABLE 3B

Probit Estimates

Dependent Variable: Government change

Explanatory Variables:	Current	Lagged Once	Lagged Twice
Government Change	-	-.0793 (.0822)	-.0315 (.0774)
Inflation	-	.0020 (.0012)	-.0030 (.0023)
Consumption Growth	-.3894 (.2652)	-	-
Riots	.0052 (.0040)	-.0016 (.0040)	.0060 (.0037)
Repressions	.0047** (.0018)	-.0013 (.0009)	.0019 (.0013)
Executive Adjustment	.0828** (.0242)	.0493* (.0234)	-.0182 (.0226)
Attempts	.3995** (.0670)	-.0138 (.0358)	-.0232 (.0357)
Years	-.0004 (.0113)	-	-
GDP Per Capita	.13 E-4 (.23 E-4)	-	-
Democracy	.6195** (.2010)	-	-
Election	-.2436 (.2259)	-	-
Majority	-.3291* (.1341)	-	-

Note: Standard errors are in parenthesis. A * (**) denotes significance at the 5 (1%) confidence interval.

The country-specific dummies have been omitted from the table but included in the regression.

Observations: change = 0: 1399
change = 1: 593
Total : 1992

Time period: 1948-82. If a country became independent after 1948, only the years since independence have been included.

TABLE 4

Spearman Rank Correlation Coefficients

Between Measures of Political Instability

	P	PS
PS	.856 (.0001)	*
F	.831 (.0001)	.913 (.0001)

F = Actual average frequency of government change.

P = Estimated average frequency obtained from the probit regressions of Table 3.

PS = Estimated average frequency obtained by running the probit model separately on each country.

The numbers in parentheses are the significance probability of the estimated coefficient under the null hypothesis that the true coefficient is zero.

TABLE 5A

Summary of the Data

Variable	Mean	Std. Dev.
Seignorage	0.089	0.066
Foreign Trade	0.523	0.363
Agriculture	21.292	16.109
Mining & Manuf.	24.625	12.181
GDP Per Capita	3431.521	3856 845
Urbanization	42.943	25.688
F	0.393	0.371
P	0.274	0.154
PS	0.268	0.189

TABLE 5B

Partial Correlation Matrix

	For. Trade	Agr.	Min. & Mfg.	GDP Per Capita	Urban	F	P	PS
Seignorage	-0.2961 (0.0081)	0.4008 (0.0031)	-0.2550 (0.0234)	-0.3826 (0.0005)	-0.1769 (0.1190)	0.1083 (0.3420)	0.1674 (0.1404)	0.0719 (0.5289)
For. Trade		-.2861 (.0106)	.1666 (.1422)	.1419 (.2121)	.1651 (.1459)	-.1038 (.3629)	-.1172 (.3036)	-.1188 (.2969)
Agriculture			-.6941 (.0001)	-.6791 (.0001)	-.7497 (.0001)	-.2399 (0.332)	-.3362 (.0025)	-.3433 (.0020)
Mining and Manufacturing				.6046 (.0001)	.3458 (.0018)	.2093 (.0641)	.2396 (.0334)	.2377 (.0349)
GDP Per Capita					.7071 (.0001)	.2573 (.0221)	.3251 (.0035)	.3981 (.0003)
Urbanization						.2607 (.0203)	.3858 (.0004)	.4337 (.0001)
F							.8157 (.0001)	.8679 (.0001)
P								.8752 (.0001)

Note: The variables, F, P and PS have been defined in Table 4.

The numbers in parentheses are the significance probability of the estimated coefficient under the null hypothesis that the true coefficient is zero.

TABLE 6

Spearman Rank Correlations Between Political Instability and Seignorage Residuals

	Seignorage	Res. 1	Res. 2	Res. 3	Res. 4	Res. 5
F	-0.0248	0.182	0.187	0.116	0.096	0.076
	(0.834)	(0.108)	(0.099)	(0.310)	(0.472)	(0.569)
P	0.084	0.322**	0.313*	0.247*	0.266*	0.218
	(0.460)	(0.004)	(0.005)	(0.029)	(0.043)	(0.100)
PS	-0.025	0.194	0.189	0.115	0.092	0.068
	(0.827)	(0.087)	(0.960)	(0.311)	(0.493)	(0.614)

Notes: Res. i is the estimated residual of eq. (i) in Table 2.

The numbers in parentheses indicate the significance of the estimated coefficient under the null that the true coefficient is zero.

An asterisk denotes significance at the 5% confidence level. Two asterists at the 1% level.

TABLE 7

Seignorage and Political Variables

Dependent Variable: Seignorage

	All Countries					Develop. Countries
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory Variables						
Intercept	0.0071 (0.0294)	0.0898** (0.0189)	-0.0015 (0.0301)	0.0158 (0.0290)	0.0340 (0.0281)	-0.0201 (0.0319)
Agriculture	0.0016** (0.0006)	-	0.0018** (0.0006)	0.0013* (0.0006)	0.0012* (0.0006)	0.0021** (0.0005)
Mining and Manufacturing	-	-0.0007 (0.0168)	-	-	-	-
Foreign Trade	-0.0430* (0.0166)	-0.0511 (0.0169)	-0.0350* (0.0177)	-0.0415* (0.0162)	-0.0474** (0.0166)	-0.0431* (0.0182)
GDP Per Capita	-0.52 E-5* (0.22 E-5)	-0.53 E-5* (0.27 E-5)	-0.46 E-5* (0.23 E-5)	-0.52 E-5* (0.22 E-5)	-0.51 E-5* (0.22 E-5)	-0.44 E-5 (0.24 E-5)
Urbanization	0.0013** (0.0004)	0.0008* (0.0003)	0.0011* (0.0004)	0.0013** (0.0004)	0.0015** (0.0004)	0.0019** (0.0004)
Industrialized	-0.0746** (0.0182)	-0.0844** (0.0218)	-	-0.0694** (0.0180)	-0.0767** (0.0201)	-
Asia	-	-	0.0036 (0.0180)	-	-	-
Latin America	-	-	0.0268 (0.0196)	-	-	-
P	0.1840** (0.0421)	0.1849** (0.0456)	0.1759** (0.0458)	0.1468** (0.0449)	-	0.1583** (0.0539)
RF	-	-	-	-	0.0540** (0.0200)	-
Coups	-	-	-	0.1326* (0.0623)	0.1865** (0.0593)	-
$\bar{R}^2$	0.461	0.407	0.461	0.486	0.464	0.448
S.E.	0.048	0.051	0.048	0.047	0.048	0.049
ρ	0.1923 (0.0895)	0.2460 (0.0289)	0.2192 (0.0523)	0.1632 (0.1508)	0.1216 (0.2857)	0.2704 (0.0401)

Table 7 (cont.)

Notes: Number of observations: 79. All observations are yearly averages, over the period 1971-82.
P is the estimated frequency of government change obtained from Table 3 for the 1971-82 period.
RF is the actual frequency of regular government transfers in 1971-82.
Coups is the average actual frequency of coups (over 1971-82)
ρ is the Spearman rank correlation coefficient between the estimated residuals and the index of Totalitarianism (averaged over 1971-82).
Standard errors are in parentheses. The numbers inside the parentheses below the ρ estimate give the significance probability of the estimate under the null: $\rho = 0$.
An asterisk denotes significance at the 5% confidence level; two asterisks at the 1% level.

TABLE 8

Instrumental Variable Estimation

Dependent Variable: Seignorage

	All Countries					Develop. Countries
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory Variables						
Intercept	-0.0084 (0.0339)	0.0857** (0.0219)	-0.0183 (0.0340)	0.0070 (0.0335)	-0.0160 (0.0505)	-0.0541 (0.0395)
Agriculture	0.0017** (0.0006)	-	0.0019** (0.0006)	0.0015** (0.0006)	0.0015* (0.0007)	0.0021** (0.0006)
Mining and Manufacturing	-	-0.0009 (0.0007)	-	-	-	-
Foreign Trade	-0.0370* (0.0171)	-0.0501** (0.0172)	-0.0287 (0.0182)	-0.0359* (0.0167)	-0.0272 (0.0246)	-0.0278 (0.0209)
GDP Per Capita	-0.48 E-5* (0.22 E-5)	-0.45 E-5 (0.28 E-5)	-0.41 E-5 (0.24 E-5)	-0.55 E-5* (0.22 E-5)	-0.59 E-5* (0.29 E-5)	-0.46 E-5 (0.26 E-5)
Urbanization	0.0012** (0.0004)	0.0007* (0.0003)	0.0010* (0.0004)	0.0013** (0.0004)	0.0009 (0.0005)	0.0016** (0.0005)
Industrialized	-0.0836** (0.0206)	-0.0922** (0.0239)	-0.0707* (0.0323)	-0.0724** (0.0206)	-0.1228** (0.0431)	-
Asia	-	-	-0.0011 (0.0220)	-	-	-
Latin America	-	-	0.0232 (0.0217)	-	-	-
P	0.2508** (0.0759)	0.2327** (0.0857)	0.2562** (0.0887)	0.2430** (0.0737)	-	0.3220** (0.1052)
PS	-	-	-	-	0.3881* (0.1840)	-
Democracy	-	-	-	-0.0307* (0.0148)	-	-
$\bar{R}^2$	0.425	0.361	0.437	0.448	0.264	0.409
S.E.	0.048	0.0504	0.048	0.0472	0.0646	0.0523
ρ	0.1783 (0.1158)	0.2289 (0.0424)	0.2072 (0.0669)	0.0567 (0.0698)	0.1648 (0.1467)	0.3279 (0.0120)

Table 8 (cont.)

Notes: Number of observations: 78 (Papua New Guinea became independent after 1970 and hence is omitted from this sample).
Method of estimation: instrumental variables.
The instrument for P is the estimated frequency of government change for the period 1960-70, estimated by truncating the probit model in 1970.
The instrument for F is the actual frequency of government change during the period 1960-70.
P and F are as defined in Table 6. Democracy is defined as in Table 3.
ρ is the Spearman rank correlation coefficient between the estimated residuals and the index of Totalitarianism (averaged over 1971-82).

TABLE 9

Bounds on the Coefficient of P

Equation	(1)	(4)	(6)
Lower Bound	0.1068	0.0791	0.0466
Upper Bound	0.8878	1.1233	1.1130

Column numbers refer to the equations in Table 7.

Data Source and Definitions

In addition to the variables defined in Table 3A, we used the following variables:

Seignorage = change in reserve money divided by total revenue of central government including seignorage. Source: IFS and GFS, IMF.

Agricultural Product = share of GDP produced in the agricultural sector. Source: World Tables, World Bank.

Mining and Manufacturing Product = share of GDP produced in the mining and manufacturing sectors. Source: World Tables, World Bank.

Foreign Trade = imports plus exports as fraction of GDP. Source: IFS, IMF.

Urbanization = urban population as a percent of total population (average of data for 1965 and 1985). Source; World Development Report (1988).

Inflation = Table 1: rate of change of CPI. Source: IFS, IMF.

Table 3B: rate of change of GDP deflator. Source: Reconstructed form Summers-Heston (1987).

Index of Totalitarianism: Source: Freedom of Issue, various issues.

Workings

Proof of Proposition 1: Inserting the budget constraints (1) and (2) in (4) and (4'), we obtain two functions that implicitly define $s^* = S(\theta)$ and $\tau^* = T(\theta)$:

$$\begin{aligned} F(\tau,S,\theta) &= -(1+\delta'(\tau)) + (1-\theta)(1+\gamma'(s)) = 0 \\ H(\tau,s,\theta) &= 1 - (1+\gamma'(s))u'(1-\tau-s-\delta(\tau)-\gamma(s)) = 0 \end{aligned} \tag{A.1}$$

Let F_x and H_x be the partial derivative of $F(\cdot)$ and $H(\cdot)$ with respect to x. Then, by the implicit function theorem:

$$\begin{aligned} S'(\theta) &= -\frac{1}{\Delta}\,[F_\tau H_\theta - H_\tau F_\theta] \\ T'(\theta) &= -\frac{1}{\Delta}\,[H_s F_\theta - H_\theta F_s] \end{aligned} \tag{A.2}$$

where $\Delta = F_\tau H_s - F_s H_\tau > 0$ by the second order conditions, and where:

$$\begin{aligned} F_\tau &= -\delta'' < 0 \\ F_s &= (1-\theta)\gamma'' > 0 \\ F_\theta &= -(1+\gamma') < 0 \\ H_\tau &= (1+\delta')(1+\gamma')u'' < 0 \\ H_s &= -\gamma''u' + (1+\gamma')^2 u'' < 0 \\ H_\theta &= 0 \end{aligned} \tag{A.3}$$

Combining (A.2) and (A.3) we obtain

$$\begin{aligned} S'(\theta) &= -\frac{1}{\Delta}\,(1+\gamma')^2(1+\delta')u'' > 0 \\ T'(\theta) &= \frac{1}{\Delta}\,(1+\gamma')(-\gamma''u' + (1+\gamma')^2 u'') < 0 \end{aligned} \tag{A.4}$$

Next, differentiate the government budget constraint, equation (1), with

respect to θ, recalling that $f_t + g_t = X(\theta)$. We have:

$$X'(\theta) = -\tau + S'(\theta) + (1-\theta)T'(\theta) \qquad (A.5)$$

Inserting (A.4) and (A.1) in (A.5), it can be shown that $X'(\theta) < 0$.

Similarly, differentiating the private budget constraint, equation (1), with respect to θ, we obtain

$$C'(\theta) = -(1+\delta')T'(\theta) - (1+\gamma')S'(\theta) \qquad (A.6)$$

Inserting (A.4) and (A.1) in (A.6) and simplifying we obtain that $C'(\theta) > 0$.