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Seigniorage in a Cross-Section of Countries

Empirical investigation of the average level of seigniorage in a cross-section of (up to) ninety countries for the period 1971–1990 suggests that optimum tax theory explains up to 40 percent of the cross-country variation in seigniorage, since seigniorage is higher where its deadweight losses are probably lower and where deadweight losses from conventional taxation are probably higher, but that average government spending is *not* a determinant of seigniorage. Practical concerns about financing transitory government spending explain some of the remaining variation in seigniorage, and central bank independence and political instability are useful as well. In contrast, 90 percent of the cross-country variation in conventional taxation appears to be determined by the level of government spending and deadweight losses, and additional variables do not add to the results.

THE REVENUE a government gets from its monopoly control over the creation of money—known as *seigniorage*—has interested economists for a long time. The original focus of the literature was on revenue maximization (Cagan 1956, Friedman 1971, Auernheimer 1974), but seigniorage was soon incorporated into theories of public finance (Baily 1956, Tower 1971, Phelps 1973). Recent investigations of seigniorage—such as Mankiw (1987), Grilli (1989), Poterba and Rotemberg (1990), and Trehan and Walsh (1990)—concentrate on models of optimum seigniorage vis-à-vis conventional taxation and empirical tests of the first-order conditions that emerge from such models. These investigations therefore focus on temporal properties, although sometimes for several countries. Compared to the amount of time series research on seigniorage, relatively little has been done on the cross-country properties of optimum tax models, or even on empirical patterns of seigniorage across countries. Fischer (1982) reports the levels of seigniorage worldwide, Canzoneri and Rogers (1990) investigate optimum seigniorage in an exclusively European context, and Cukierman, Edwards, and Tabellini (1992) relate seigniorage to political instability and a few control variables,¹ but no other cross-country literature is available. This paper therefore investigates seigniorage in a cross-section of coun-

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1. Substantially similar results are also in Edwards and Tabellini (1991) and Cukierman (1992).

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TABLE 1
AVERAGE ANNUAL RATES OF SEIGNIORAGE (1971–1990)

Country	Seigniorage as Percent of GDP	Seigniorage as Percent of Gov't Spending	Country	Seigniorage as Percent of GDP	Seigniorage as Percent of Gov't Spending
New Zealand*	0.3810	1.0436	India*	1.7192	11.8175
Denmark*	0.3943	1.0512	Venezuela	1.7948	7.6515
United States*	0.4295	1.9552	Dominican Republic	1.8561	11.6631
Canada*	0.4371	2.0144	Morocco*	1.8887	5.9533
Kuwait*	0.4610	1.2196	Ethiopia	1.9988	8.5599
United Kingdom*	0.4737	1.2800	Singapore*	2.0098	9.1736
Belgium*	0.4910	1.0187	Spain*	2.0267	7.5584
Rwanda	0.5262	n.a.	Lesotho	2.1606	5.1142
Netherlands*	0.5352	1.0184	Tanzania	2.1641	8.2810
France*	0.5520	1.3863	Pakistan*	2.1722	11.4778
Norway*	0.5630	1.4598	Ecuador	2.1725	15.8076
Gabon	0.5756	1.5615	Mauritius	2.1757	8.7001
Finland*	0.5966	2.1217	Paraguay	2.2438	21.6222
Switzerland*	0.6189	6.7397	Colombia*	2.3178	17.5651
Australia*	0.6271	2.5722	Iceland*	2.3250	8.3515
Cameroon	0.6376	3.3825	Jamaica	2.3427	n.a.
South Africa*	0.6535	2.5281	Italy*	2.3572	7.4229
Qatar	0.6536	n.a.	Uganda	2.3754	21.6516
Germany*	0.6869	2.3539	Romania	2.4491	6.5803
Austria*	0.6940	1.8944	Togo	2.7308	7.7544
Sweden*	0.7234	1.9301	Brazil	3.0394	13.7132
Burundi	0.8524	6.1174	Greece*	3.1291	10.5149
Honduras	0.8994	5.2043	Zaire	3.2641	10.6499
Congo	0.9026	n.a.	Ghana	3.3136	22.0139
Niger	0.9037	n.a.	Costa Rica	3.3337	15.0873
Zimbabwe*	0.9442	2.7438	Zambia*	3.5082	10.4253
Japan*	0.9585	5.6200	Sierra Leone	3.5618	16.5434
Kenya	0.9837	3.9985	Turkey	3.5821	15.2030
Thailand	1.0872	6.3018	Uruguay	3.7044	15.1053
Trinidad & Tobago	1.1148	3.0989	Mexico*	3.7207	18.9687
Mauritania	1.1524	n.a.	Burma	3.7268	24.9233
Barbados	1.1924	3.7201	Bolivia	3.8067	19.7555
Central African Rep.	1.1961	n.a.	Portugal*	4.0034	10.0712
Philippines*	1.2251	8.9611	Sudan	4.4325	n.a.
Tunisia	1.3418	4.0607	Iran	4.6616	15.0880
Indonesia*	1.3908	6.8590	Jordan	4.9885	12.1835
Cote d'Ivoire	1.4156	n.a.	Peru*	4.9935	28.2328
Ireland*	1.5178	3.4922	Egypt	5.4170	12.1084
Sri Lanka	1.5179	4.9710	Poland	6.9379	n.a.
El Salvador	1.5259	10.8938	Malta	7.5743	18.3596
Nepal	1.5343	10.0539	Nicaragua	7.8601	23.7008
Botswana	1.5484	4.4003	Argentina*	9.7299	62.0003
Korea*	1.5690	9.6979	Chile*	10.3001	32.5765
Nigeria*	1.5728	11.1197	Yugoslavia	11.8731	148.9518
Malaysia*	1.5749	5.2696	Israel*	14.8424	22.2781

NOTES: * denotes countries for which money demand is estimated; n.a. denotes "not available."

tries using optimum seigniorage theory as a benchmark, and subsequently expands the analysis to include other aspects of seigniorage in public finance.

The investigation in this paper examines average levels of seigniorage in a pool of (up to) ninety countries for the period 1971–1990. Table 1 presents the countries, the average of seigniorage as a percent of GDP, and the average of seigniorage as a percent of government spending. For this data set, seigniorage on average amounts to $2\frac{1}{2}$ percent of GDP and finances $10\frac{1}{2}$ percent of government spending. Seigniorage

ranges from less than $\frac{1}{2}$ percent of GDP to more than 10 percent, and from less than 1 percent of spending to more than 100 percent. The primary question under investigation is simply, "What explains the variation of seigniorage across countries?" However, an auxiliary question designed to illuminate the answer to the primary question is, "How is this different from conventional taxation?" For the data set used, conventional taxation on average finances $78\frac{1}{2}$ percent of government spending, and varies from just under 50 percent to more than 100 percent. The investigation tests for the significance of different explanatory variables in regressions where seigniorage or conventional tax revenues are the dependent variables.

Section 1 begins by considering the cross-country implications of optimum seigniorage theory. Three determinants of revenues are considered: deadweight losses associated with seigniorage, deadweight losses associated with conventional tax revenue, and the level of government spending. Section 2 analyzes the cross-country implications of financing transitory government spending when debt may be constrained, a topic not considered in the traditional optimum seigniorage theory. Three additional determinants are considered: the standard deviation of government spending, country creditworthiness, and the outstanding stock of domestic debt. Section 3 briefly builds on these basic results by examining two institutional features of these countries: the degrees of central bank independence and political instability.

There are three major findings of this investigation with respect to seigniorage. First, optimum tax theory explains some aspects of the cross-country variation in seigniorage—perhaps up to 40 percent—since seigniorage is higher where its deadweight losses are probably lower and where the deadweight losses from conventional taxation are probably higher. However, the level of government spending is not a statistically significant determinant of seigniorage. Second, practical concerns about financing transitory government spending explain some of the remaining variation in seigniorage since the standard deviation of government spending and an index of country creditworthiness are significant determinants of seigniorage (although the outstanding stock of domestic debt is not). In fact, the most successful results together explain approximately half of the cross-country variation in seigniorage. Third, theories of central bank independence and political instability explain some additional cross-country variation in seigniorage, but only in their most general forms. Taken together, the variables under consideration explain roughly 60 percent of the cross-country variation in seigniorage. In contrast, 90 percent of the cross-country variation in conventional taxation appears to be determined by the level of government spending and deadweight losses, and additional variables do not add anything to the results.

1. CROSS-COUNTRY IMPLICATIONS OF OPTIMUM SEIGNIORAGE THEORY

1.1 *The Theory*

The typical models of optimum seigniorage and conventional taxation require the government to choose paths of revenues to finance an exogenously determined stochastic sequence of expenditure requirements. To simplify the model, all variables are

taken as ratios to output. The sequence of expenditure requirements is $\{g_t\}_{t=0}^\infty$, where g_t is the ratio of government spending to output in period t . The government's task is to choose a plan for conventional tax revenues as a fraction of output, $\{\tau_t\}_{t=0}^\infty$, and for seigniorage as a fraction of output, $\{s_t\}_{t=0}^\infty$, that satisfies an intertemporal budget constraint. Government debt is denoted as a fraction of output with $\{d_t\}_{t=0}^\infty$.

Conventional taxation and seigniorage are typically associated with quadratic deadweight losses of welfare, represented here by $1/2[a\tau_t^2 + bs_t^2]$ in each period t . The welfare loss associated with each instrument is assumed to be an increasing function of revenue as a portion of output, where a and b are positive coefficients that determine the marginal excess burdens of taxation. These are the usual distortionary effects of taxes on decisions concerning the supply of labor (and output) and the demand for cash balances. In equilibrium, the marginal deadweight loss from each source of revenue will be equal, and more revenues will be raised by the less costly instrument.

In the traditional optimum tax models, the government is a social optimizer in the sense that excess burdens and the solvency condition are taken into account when taxes are levied. The government's objective is to choose stochastic processes $\{\tau_t, s_t, d_t\}_{t=0}^\infty$ to minimize the present discounted value of welfare costs:

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{2} [a\tau_t^2 + bs_t^2] \quad (1)$$

subject to the periodic budget constraint:

$$g_t = \tau_t + s_t + d_t - (1 + \delta)d_{t-1} \quad (2)$$

for all $t \geq 0$, and subject to an intertemporal budget constraint that imposes solvency (given d_{-1} , an initial condition). The parameter β is the discount factor. The parameter δ is the growth rate of the outstanding debt/output ratio due to interest accrual in excess of output growth, and is assumed to be constant for simplicity. Part of the interest on the national debt is therefore offset by regular growth of the economy. This δ must be positive, indicating that the real interest rate in the economy exceeds the real growth rate of the economy, in order for current debt as a portion of output to be bounded. Furthermore, note that the definition of δ in real terms does not allow for government revenue from the erosion of the value of nominal outstanding debt due to inflation. In this framework, erosion of the nominal debt is fully compensated by higher interest rates, or the debt is either indexed or denominated in foreign currencies. For further details of the traditional model, see Mankiw (1987), Grilli (1989), Poterba and Rotemberg (1990), and Trehan and Walsh (1990).

The cross-section implications from this model come from comparing steady-state equilibria across countries. When government spending follows a stationary stochastic process $\{g_t\}_{t=0}^\infty$ with positive mean, \bar{g} ,² the equilibrium level of seigniorage is $\bar{s} =$

2. This could be a white noise or autoregressive process. A random walk, implying that government spending is nonstationary and could reach infinity or negative infinity, is ruled out.

$[a/(a + b)]\bar{g}$, where the overbars denote long-run steady-state averages. In logarithms, the equilibrium is

$$\ln \bar{s}_i = \ln a_i - \ln (a_i + b_i) + \ln \bar{g}_i \quad (3)$$

where the subscripts i have been introduced to index different countries. There is a similar solution for the equilibrium level of conventional tax revenue:

$$\ln \bar{\tau}_i = \ln b_i - \ln (a_i + b_i) + \ln \bar{g}_i. \quad (4)$$

From equation (3), it is clear that models of optimum seigniorage invariable contain three implications for the long-run average ratio of seigniorage to output across countries:

1. It will optimally be higher where the deadweight losses from the use of seigniorage are lower, since seigniorage is then a more efficient tax ($\partial \bar{s}_i / \partial b_i < 0$);
2. It will optimally be higher where the deadweight losses from conventional taxation are higher, since seigniorage is again a more efficient tax ($\partial \bar{s}_i / \partial a_i > 0$);
3. It will optimally be higher where the average ratio of government spending to output is higher, since all taxes must be higher ($\partial \bar{s}_i / \partial \bar{g}_i > 0$, $\partial \ln \bar{s}_i / \partial \ln \bar{g}_i = 1$).

This list suggests that empirical analysis based on optimum tax models would be constructed around the average seigniorage/output ratio as the dependent variable in a regression using three independent variables: (1) deadweight losses from seigniorage, (2) deadweight losses from conventional taxation, and (3) the average government spending/output ratio. Data on average seigniorage/output ratios and average government spending/output ratios are readily available for a broad cross-section of countries, but since a and b are not directly observable empirical measures of marginal deadweight losses must take the form of proxies. The next subsection considers some of the available data, and the following subsection presents estimation results.

The three implications for seigniorage can be compared to similar implications for conventional taxation. Equation (4) suggests that conventional tax revenues will optimally be higher where the deadweight losses from the use of seigniorage are higher ($\partial \bar{\tau}_i / \partial b_i > 0$) and higher where the deadweight losses from conventional taxation are lower ($\partial \bar{\tau}_i / \partial a_i < 0$), the reverse of the implications for seigniorage. As with seigniorage, conventional tax revenues will also be optimally higher where government spending is higher ($\partial \bar{\tau}_i / \partial \bar{g}_i > 0$, $\partial \ln \bar{\tau}_i / \partial \ln \bar{g}_i = 1$).

1.2 Descriptions of the Data

The basic data come from *International Financial Statistics (IFS)*. Seigniorage is the change in the monetary base, normalized using GDP. The average for the twenty-year period 1971–1990 (or as much of the period that is available) has been calculated for ninety countries and is reported in Table 1. Government spending, taken as an ex-

ogenous variable, is from *IFS*, and is again normalized using GDP. Conventional tax revenues are also from *IFS* and normalized using GDP.

One proxy for the deadweight losses from seigniorage would be the elasticity of the demand for money. If the demand for money is elastic (inelastic), seigniorage would be a relatively inefficient (efficient) form of taxation and should be lower (higher). This point was made early in the seigniorage literature by Phelps (1973). Fair (1987) presents a study of the demand for money in which the semi-elasticity of demand is reported for twenty-seven countries. Preliminary analysis using Fair's semi-elasticities suggested that seigniorage is indeed higher where the demand for money is less semi-elastic. In order to expand the pool of countries and the measures of elasticity examined, new estimates of money demand have been made, using Fair (1987) as a guide, for forty-one countries for which adequate data are available in *IFS* (indicated with an asterisk in Table 1). The output from the investigation consists of four measures of the sensitivity of the demand for money to interest rate changes: the short-run semi-elasticity of the demand for money (available for 41 countries), the long-run semi-elasticity of the demand for money (available for 36 countries), the short-run elasticity of the demand for money (available for 40 countries), and the long-run elasticity of the demand for money (available for 37 countries), where some outliers are removed. Complete results are reported in an appendix available on request from the author. These four measures are tested as proxies for the (absence of) deadweight losses from seigniorage. These are generated regressors, so the estimates of standard errors on the coefficients should be examined with caution.³ Another issue is that these proxies may not be truly exogenous because the level of seigniorage may affect the estimate of the measure: the semi-elasticity may be positively related to the average level of interest rates and the elasticity may be negatively related to the average level of interest rates.⁴ Coefficients on the semi-elasticities may therefore be biased upward and coefficients on the elasticities may be biased downward. Empirically, though, the bias is probably minor because a systematic relationship between each of the elasticity measures and the log of the average interest rate appears to exist.⁵

One proxy for the (absence of) deadweight losses from conventional taxation would be the level of per capita income, capturing the idea that the level of development probably indicates how efficient the conventional tax system is. Conventional taxes are more efficiently collected where the level of technological sophistication is high, which is in high-income countries. Cukierman, Edwards, and Tabellini (1992) find this effect, and assert the same reason. Fischer (1982) casually notes the relationship between seigniorage and per capita income, but does not statistically test it or ex-

3. However, Pagan (1984) points out that the standard errors are unbiased under the null hypothesis that the coefficient is zero, and this is precisely the hypothesis that needs to be tested.

4. Nonlinear estimates of money demand reported in Easterly, Mauro, and Schmidt-Hebbel (1995) suggest that the semi-elasticity decreases with inflation when it is not restricted to be constant. Whether this is because money demand follows a constant elasticity is not discussed.

5. For further details, see the appendix available from the author. Unfortunately, the relationship between the elasticity measures and the log of the interest rate is not strong enough to use the log of the interest rate as an instrument for the elasticity in instrumental variables estimation, so the measures are regarded as exogenous variables.

plain why it prevails. This raises the possibility that per capita income might be measuring something other than the efficiency of the conventional tax system, although it is not clear what. Average per capita GNP denominated in dollars for the period 1971–1990 has been calculated from *World Tables* for use as an independent variable.

Other proxies for the deadweight losses of conventional taxation could utilize the composition of employment or the components of conventional tax revenue. The sectoral composition of employment might be able to account for differences in the efficiency of tax collection in different sectors; the industrial sector is likely to be much more efficient to tax than the agricultural sector. Data on employment in the industrial and agricultural sectors as a percentage of total employment are available from *Social Indicators of Development*. Additionally, countries which receive proportionately large shares of revenue from income, profits, and capital gains taxes (including social security taxes) are generally thought to have relatively efficient tax collection systems, whereas countries that receive large shares of revenue from taxes on international trade are generally thought to have relatively inefficient tax collection systems. Data on the composition of conventional tax revenue are taken from *Government Finance Statistics*.

1.3 Empirical Results

Tables 2–4 present least squares regressions testing the cross-country implications of optimum tax models using averages of data for the period 1971–1990 for as many countries as possible. Because heteroskedasticity is usually important in cross-country analysis, all regressions compute a consistent estimate of the covariance matrix using the method of White (1980). In all regressions, the dependent variable is either the log of the ratio of seigniorage to GDP or the log of the ratio of conventional tax revenues to GDP, as suggested by equations (3) and (4). The basic equations use three independent variables: one of the aforementioned measures of money demand semi-elasticity or elasticity, per capita GNP, and the log of the ratio of government spending to GDP.⁶

Table 2 presents the determinants of seigniorage. The size of the cross-section pool is initially limited to the forty-one countries for which money demand equations could be estimated. The coefficients on the elasticity measures all have the expected positive sign, suggesting that seigniorage is indeed higher where the demand for money is less elastic, and are all significant at the 10 percent level or better. The fifth column reports the regression without any measure of the sensitivity of the demand for money for the initial forty-one countries, and the sixth column enlarges the sample to as many countries as possible. The coefficients on per capita GNP all have the expected negative sign, suggesting that seigniorage is higher where the costs of conventional taxation are likely to be high, and are significant at the 1 percent level. However, none of the regressions produce statistically significant coefficients on the ratio of government

6. Using the logs of the ratios also serves to reduce the influence of outliers. However, per capita GNP fits much better in level form than in log form since there are no severe outliers, so the level is taken as an indication of the efficiency of the conventional tax system.

TABLE 2
DETERMINANTS OF SEIGNIORAGE: OPTIMUM TAX MODELS
Dependent Variable is Log of Average Seigniorage/GDP Ratio

	1	2	3	4	5	6	7
Constant	-3.426** (.598)	-2.985** (.677)	-3.349** (.553)	-3.113** (.674)	-3.407** (.617)	-3.457** (.405)	-3.730** (.096)
Short-run Semi-elasticity	45.040* (26.959)						
Long-run Semi-elasticity		6.213** (1.876)					
Short-run Elasticity			8.799** (3.697)				
Long-run Elasticity				0.493* (.298)			
Per Capita GNP	-0.111** (.022)	-0.117** (.022)	-0.105** (.020)	-0.123** (.022)	-0.127** (.022)	-0.119** (.015)	-0.102** (.014)
Gov't. Spending/ GDP (log)	0.072 (.360)	0.328 (.389)	0.119 (.331)	0.247 (.385)	0.121 (.370)	0.129 (.265)	
Observations	41	36	40	37	41	79	89
Adjusted R ²	.38	.44	.42	.39	.36	.30	.26
Standard Error	.752	.743	.719	.769	.763	.730	.746

NOTES: White-corrected standard errors in parentheses. * denotes significant at 10 percent level. ** denotes significant at 5 percent level.

spending to output. This is, in fact, a quite general conclusion, as subsequent regressions do not produce significant estimates of the coefficient either. The seventh regression therefore removes government spending. Overall, variation in the average level of seigniorage appears to be determined by cross-country differences in the efficiency of seigniorage and conventional taxation, and the result that seigniorage does not depend on the level of government spending is somewhat surprising in the context of the optimum tax model.

How do the results for seigniorage compare to the results for conventional taxation? Table 3 presents the determinants of conventional tax revenue.⁷ The significance of the elasticities on money demand is much smaller, although there is some evidence based on the short-run elasticity that conventional taxation is lower where the demand for money is less elastic. As expected, conventional taxation is positively related to the level of per capita GDP. Finally, in stark contrast to the null results for seigniorage, conventional taxation is shown to be higher where government spending is higher, as all coefficients are significant at the 5 percent level. In fact, five of the six cases cannot reject the hypothesis that $\partial \ln \bar{\tau}_i / \partial \ln \bar{g}_i = 1$. Overall, this suggests that conventional taxation is primarily determined by the level of government spending and relative deadweight losses.

Table 4 examines the sectoral composition of employment and the components of conventional tax revenue. The results do not depend on the presence of a measure of money demand elasticity, so regressions without these measures are reported, thus enabling the pool of countries to be larger. Regressions examining the shares of em-

7. The equations have also been estimated in tandem with the equations in Table 1 using the seemingly unrelated regression (SUR) system estimator. Results are not materially different from the single-equation estimates, so are not presented here.

TABLE 3
DETERMINANTS OF CONVENTIONAL TAXATION: OPTIMUM TAX MODELS
Dependent Variable is Log of Average Conventional-Tax-Revenue/GDP Ratio

	8	9	10	11	12	13
Constant	-0.292** (.089)	-0.318** (.089)	-0.315** (.070)	-0.359** (.090)	-0.298** (.080)	-0.347** (.095)
Short-run Semi-elasticity	-15.328 (9.335)					
Long-run Semi-elasticity		0.132 (.262)				
Short-run Elasticity			-2.620** (.874)			
Long-run Elasticity				-0.053 (.053)		
Per Capita GNP	0.011** (.005)	0.018** (.006)	0.010** (.005)	0.017** (.006)	0.016** (.006)	0.019** (.006)
Gov't. Spending/ GDP (log)	0.943** (.063)	0.910** (.058)	0.932** (.051)	0.888** (.059)	0.926** (.056)	0.897** (.064)
Observations	41	36	40	37	41	78
Adjusted R ²	.89	.90	.90	.88	.87	.81
Standard Error	.151	.148	.141	.154	.161	.202

NOTES: White-corrected standard errors in parentheses. * denotes significant at 10 percent level. ** denotes significant at 5 percent level.

ployment in agriculture and industry do not seem to do as well as the simple level of per capita GNP in explaining seigniorage. The coefficient on agricultural employment has the expected positive sign, but the coefficient on industrial employment has an unexpected positive sign as well. (One possible explanation related to urbanization is presented in section 3.) Furthermore, the influence of agricultural employment disappears when per capita GNP is included, which is not surprising given a high correlation of -0.84 between the two variables. The ratio of income, profits, and capital gains tax revenues (including social security revenues) to total conventional tax revenue used as a unique independent variable reveals an inverse relationship with seigniorage, as expected. The ratio of international trade tax revenues to total conventional tax revenue used as a unique independent variable reveals a direct relationship, again as expected. (Since these variables are endogenous in models of optimum public finance, the ratios used as independent variables in the regressions are for 1970 and are therefore taken as predetermined variables in the regressions studying the period 1971–1990.⁸) However, these results do not supplement the information captured by per capita GNP, as revealed in the last two columns of Table 4. Furthermore, the two ratios of revenue sources are highly negatively correlated (at -0.79) so do not together provide much more information than they provide separately. Essentially, countries that receive a high proportion of revenues from income taxes are countries that receive a low proportion of revenues from trade taxes, and vice versa, even though the two taxes together account for only 65 percent of total revenues on average.⁹

8. In a few circumstances, the ratios are for 1971, 1972, or 1973 due to data limitations, but are nonetheless taken as predetermined variables.

9. Taxes on goods and services were also investigated, but did not produce any useful results. In some countries, these consumption taxes consist mainly of the VAT, and in other countries these consumption taxes consist mainly of excise taxes on specific goods.

TABLE 4

DETERMINANTS OF SEIGNIORAGE: COMPOSITION OF EMPLOYMENT OR CONVENTIONAL TAXES
Dependent Variable is Log of Average Seigniorage/GDP Ratio

	14	15	16	17	18	19
Constant	-7.597** (.702)	-4.622** (.976)	-3.519** (.190)	-4.390** (.170)	-3.712** (.178)	-3.457** (.241)
Per Capita GNP		-0.161** (.037)			-0.117** (.023)	-0.129** (.025)
Agricultural Employment (log)	0.577** (.114)	-0.070 (.188)				
Industrial Employment (log)	0.586** (.127)	0.467** (.121)				
Income Taxes/ Revenue			-1.386** (.467)		0.134 (.508)	
Trade Taxes/ Revenue				1.269** (.497)		-0.638 (.599)
Observations	88	88	74	74	73	73
Adjusted R^2	.22	.40	.08	.05	.28	.29
Standard Error	.757	.662	.853	.867	.756	.750

NOTES: White-corrected standard errors in parentheses. * denotes significant at 10 percent level. ** denotes significant at 5 percent level.

By way of summary, three basic conclusions can be drawn concerning the variation of average seigniorage across countries (as a proportion of output) in the context of optimum tax models:¹⁰

1. It is higher in countries where the measured demand for money is less elastic, probably because it is a more efficient form of taxation.
2. It is higher in countries with low per capita income, probably because conventional taxation is inefficient relative to seigniorage taxation. On average, an increase in per capita GNP of one thousand dollars reduces seigniorage as a fraction of output by 10 percent. This conclusion is buttressed by the findings that seigniorage is (1) higher in countries where employment in the agricultural sector is high, (2) lower in countries that collect a large portion of conventional revenues from taxes on income, profits, and capital gains, and (3) higher in countries that collect a large proportion of conventional revenues from taxes on international trade, since all of these variables are highly correlated with per capita income.
3. It does not depend on the ratio of government spending to output, directly counter to the implications of the optimum tax model, and in contrast to results for conventional taxation.

Based on the regressions, the relative efficiency of seigniorage vis-à-vis conventional taxation is able to explain approximately 40 percent of the variation of seigniorage across countries. Since average seigniorage is not a function of average government

10. Several other regressions have been estimated, but have not produced results worth presenting. Of particular interest are regressions using interactions between independent variables as additional independent variables. For example, per capita GNP interacted with each measure of government spending was used to check for a relationship between seigniorage and government spending based on the level of per capita GNP. Interactions between all other variables were also tested. The results were highly consistent: interaction variables do not add any insights not already revealed.

spending, it is apparently something like a pot of revenue that is larger where it is more efficient to have that revenue. In contrast, 90 percent of the cross-country variation in conventional taxation appears to be determined by the level of government spending and relative deadweight losses.

2. FINANCING TRANSITORY GOVERNMENT SPENDING

The traditional models of optimum taxation relate levels of revenues to the long-run level of government spending. These models distinguish between this “permanent” level of spending and any “transitory” spending, which does not affect levels of revenues as long as government debt can be adjusted to “smooth” revenue, as developed by Barro (1979). The previous section essentially used the twenty-year average of government spending as an indication of the level of permanent government spending. The results suggested that conventional taxation is directly determined by long-run government spending, but seigniorage is not. These findings are indicative of a more practical analysis of public finance which recognizes differences between conventional tax revenue and seigniorage. In particular, seigniorage may not be used to finance permanent spending, but may be used to finance transitory spending when debt financing is constrained. As Fischer (1982) states, “It might be argued that the right to print money is peculiarly important in providing a government with a ready source of finance in an emergency . . .” (p. 297). Poterba and Rotemberg (1990) point out that seigniorage would be utilized in such a case because conventional taxes are difficult to adjust immediately.¹¹

In practice, debt is indeed likely to be constrained for some countries. Furthermore, it is likely to be constrained asymmetrically, since governments typically face constraints on their ability to issue debt but are not usually limited in their ability to accumulate assets. Foreign debt is limited by foreigners’ willingness to lend, which is based on the government’s international creditworthiness (ability to repay in foreign currency). Domestic debt is limited by domestic willingness to lend, and there will be concern that the government will be unable to repay the debt as the debt grows. If the government cannot repay domestic debt out of conventional taxes, however, it can simply print money.¹² This serves to raise expectations of inflation and further constrain the government’s ability to issue debt. It also creates an incentive for the government to resort to seigniorage not only to finance transitory government spending, but to create unanticipated inflation which devalues the existing stock of debt; however, erosion of the debt may be negligible over long periods of time, as unanticipated inflation is likely to average zero when private agents form expectations rationally.

The asymmetric nature of the debt constraint further creates an asymmetry with re-

11. From page 4: “Income tax schedules are often legislated several years in advance. This commitment is in part the result of time lags in the legislative process.” On the other hand, “the Federal Reserve can react quickly to changed circumstances: time lags are shorter.”

12. For example, Sargent and Wallace (1981) show that if the government embarks on a path of unsustainable deficits, the central bank will eventually be forced to inflate to fund the deficits.

spect to the financing of transitory spending. In particular, the government may be able to save (or retire debt) when transitory expenditure is negative, but may not be able to borrow (or draw on assets) when transitory expenditure is positive. (On average, transitory expenditure is zero.) How, then, will a government react to (positive) transitory spending requirements? Unless the government can simply draw on assets, in which case the traditional tax model holds, it will have to raise revenue to balance its budget. If conventional taxes are “sticky,” as suggested by Poterba and Rotemberg (1990), the government will resort to seigniorage. Hence, seigniorage finances transitory spending, which corresponds to conventional wisdom that seigniorage is a residual revenue source.¹³

The cross-country implication of the insight that positive transitory spending may be financed by seigniorage, whereas negative transitory spending is not, is that countries in which average transitory expenditure is high rely more on seigniorage than countries in which it is low. One estimate of average transitory spending is the standard deviation of government spending, as this measures transitory variation around the permanent (average) level of government spending. When the standard deviation is high, the government is confronted with high transitory spending on average, which may be financed by seigniorage. This finding also depends on the degree to which government debt is constrained and the degree to which conventional tax revenues are sticky. Hence, seigniorage will be higher when the international creditworthiness of the country is lower, since foreign credit is less likely to be available, and when the ratio of domestic debt to output is higher, since domestic borrowing is less available and since governments resorting to seigniorage may enjoy additional benefits associated with unanticipated erosion of the value of their outstanding domestic debt. When debt is constrained in this way, governments will use seigniorage to finance transitory spending. If conventional taxes are not sticky, seigniorage and conventional tax revenue will respond proportionately to transitory spending requirements. However, if conventional taxes are completely sticky, the government will rely completely on seigniorage.

These departures from the traditional model suggest that three additional variables may help explain cross-country variation in seigniorage (or conventional taxation). The standard deviation of government spending is calculated from *IFS*. An index of country creditworthiness (on a scale from 1 to 7) is taken from *Euromoney*, which is available starting in 1976 for almost all of the countries under consideration. Regressions reported below use the average of the period 1976–1985 as representative of the longer 1971–1990 period.¹⁴ Data on domestic debt are available from *IFS* for more than half of the ninety countries, and are normalized using GDP. Since debt is determined endogenously in the optimum seigniorage model, the debt/output ratios for 1970 are used as instruments for the average debt/output ratios for the entire

13. Formal models of this are presented in Click (1994), which relies on simulations using software accompanying Hansen and Sargent (1992).

14. The *Institutional Investor* country risk ratings on a scale from 0 to 100 are available starting in 1979. Regressions have also been run using this data set but produce substantially similar results as those using the *Euromoney* index so are not presented here. The two indices attempt to measure the same thing, so are highly correlated, at 0.84.

TABLE 5

DETERMINANTS OF SEIGNIORAGE: FINANCING TRANSITORY GOVERNMENT SPENDING
Dependent Variable is Log of Average Seigniorage/GDP Ratio

	least squares				instrumental variables	
	20	21	22	23	24	25
Constant	-3.971** (.269)	-3.924** (.178)	-2.845** (.572)	-3.369** (.320)	-2.996** (.330)	-3.269** (.384)
Short-Run Elasticity	9.467** (2.609)		9.570** (2.676)		6.310 (4.235)	
Per Capita GNP	-0.100** (.021)	-0.112** (.016)	-0.044* (.025)	-0.072** (.027)	-0.028 (.030)	-0.033 (.026)
S.D. of Gov't. Spending	10.673** (5.040)	6.062** (2.836)	7.252* (3.759)	4.261 (2.779)	14.598** (7.075)	6.336 (4.495)
Creditworthiness Index			-0.257** (.101)	-0.151** (.075)	-0.286** (.126)	-0.247** (.084)
Domestic Debt/GDP					-0.611 (.693)	0.211 (.639)
Observations	40	80	40	76	28	45
Adjusted R ²	.50	.34	.57	.38	.51	.51
Standard Error	.668	.715	.941	.706	.579	.578

NOTES: White-corrected standard errors in parentheses. * denotes significant at 10 percent level. ** denotes significant at 5 percent level.

1971–1990 period.¹⁵ Table 5 presents regressions using these three independent variables. In order to build on the results from section 1.3, regressions include capita GNP, and are run with and without the short-run elasticity of money demand. The coefficients on the standard deviation of government spending are positive and generally statistically significant, implying that countries in which the standard deviation of government spending is high are indeed the countries in which seigniorage is high, and suggesting that seigniorage may be used to finance transitory expenditure. The coefficient on the index of country creditworthiness is consistently significantly negative, suggesting that countries with poor credit ratings indeed rely on seigniorage to a greater extent than countries with good credit ratings. When creditworthiness is introduced, however, some of the coefficients on per capita GNP weaken; this is because the credit ratings are positively correlated with per capita GNP (at 0.71), indicating that poor countries are poor credit risks. Finally, the coefficients on the ratio of domestic debt to output are not significant, suggesting that seigniorage is not related to the amount of domestic debt outstanding.

Findings on the role of conventional taxation in financing transitory spending provide additional support for the idea that governments rely on seigniorage because conventional taxes are completely sticky. Coefficients on the standard deviation of government spending, the creditworthiness index, and the ratio of domestic debt to output are not significant in regressions using conventional tax revenues as the dependent variable, so conventional taxation therefore appears to be unaffected by transitory spending requirements.

15. These have been adjusted for debt held by the central bank when such information is presented. In a few circumstances, the data for the initial ratio are for a few years before or a few years after 1970, due to availability. The ratio of total debt to output was also tested as an independent variable, but did not produce results any different from those reported since the ratios of domestic debt and total debt are highly correlated (at 0.90).

In summary, four basic conclusions can be drawn concerning the variation of seigniorage across countries with respect to financing transitory government spending:

1. It is directly related to the standard deviation of government spending, suggesting that it plays an important role in financing transitory spending.
2. It is higher in countries that have poor credit ratings, suggesting that transitory spending cannot be completely financed by issuing debt.
3. It does not depend on the ratio of outstanding domestic debt to output, suggesting that a high domestic debt does not cause governments to rely on seigniorage to finance transitory spending or to act on the incentive to use seigniorage as a way to reduce the value of the debt (possibly because there cannot be unanticipated inflation on average).
4. It is probably the exclusive source of financing transitory spending when debt is constrained since conventional tax revenues appear to be completely sticky.

A major conclusion from the empirical results in sections 1 and 2 is that seigniorage appears to be used predominantly to finance transitory spending while conventional tax revenue appears to be used exclusively to finance permanent spending. At this point, roughly half of the variation in seigniorage is explained.

3. CENTRAL BANK INDEPENDENCE AND POLITICAL INSTABILITY

Models of optimum taxation present the government as a social optimizer. There needs to be an individual or group with control over both conventional tax policy and the central bank, or separate groups coordinating policies between themselves. However, this unification may not be the case in practice. In particular, the monetary authority may enjoy some degree of independence from the government's fiscal apparatus, so monetary policy will be less likely to be determined by revenue considerations. The government will still receive seigniorage, as asserted in equation (2), but the amount will not be a choice variable since it will be determined exogenously by the independent central bank. Seigniorage would presumably be lower where the central bank is more independent.¹⁶

Another recent line of research relates average seigniorage to the level of domestic political instability; see Cukierman, Edwards, and Tabellini (1992). The link between seigniorage and political instability is based on *de facto* control of the central bank by the government's fiscal authorities. Governments that are not likely to be in power for very long—hence, are politically unstable—have greater incentives to use seigniorage. However, central bank independence may preclude a link between seigniorage and political instability, something Cukierman, Edwards, and Tabellini (1992) do not take into account. Further investigation therefore reexamines the link between seigniorage and political instability adjusting for central bank independence.

16. If the central bank gets to keep (and spend) the seigniorage, however, this creates an obvious incentive to boost seigniorage for institutional gain. Hence, the issue is really that decisions concerning the amount of seigniorage collected are separate from decisions concerning how the seigniorage is spent, not simply that the central bank is independent from the fiscal apparatus.

Various measures of central bank independence and political instability have previously been developed. An index of legal central bank independence and the turnover rate of the central bank governor (associated with a lack of central bank independence) are obtained from Cukierman, Webb, and Neyapti (1992). Political instability represented by the actual frequency of the transfer of power, and the estimated probability of a transfer of power based on a probit regression, are obtained from Edwards and Tabellini (1991). In addition, an urbanization ratio is used as a measure of general political instability, advanced by Cukierman, Edwards, and Tabellini (1992) since "political conflicts are generally more intense and disruptive in urban areas than in rural societies" (p. 550).

Results suggest that central bank independence and political instability explain some additional cross-country variation in seigniorage, but only in their most general forms so they are not explicitly presented here; see Click (1994) for complete results. High turnover of the central bank governor is consistently associated with higher seigniorage, suggesting that seigniorage may indeed be higher where the revenue is likely to be enjoyed by the government. Legal independence of the central bank does not seem to be a determinant of seigniorage. Urbanization, as an indicator of political instability, has the expected positive sign. It may be, in fact, that urbanization leads to black market activities, undertaken using cash, which cannot be taxed using conventional taxes but which can be taxed through seigniorage. This point is made in Barro (1989, p. 7) and is the foundation of the optimal tax model in Canzoneri and Rogers (1990). If this is the case, urbanization essentially captures additional inefficiencies or deadweight losses of the conventional tax system. Urbanization, in fact, explains why the coefficient on industrial employment investigated in section 2 is positive; the correlation between urbanization and industrial employment is 0.87, so countries in which industrial employment is high are highly urbanized. A surprising result of this analysis is that the elaborate indices of political instability developed by Edwards and Tabellini (1991)—which are apparently substantially the same as those in Cukierman, Edwards, and Tabellini (1992)—do not seem to play a role in determining seigniorage either with or without adjustment for central bank independence.¹⁷ Hence, the link between indices of political instability and seigniorage may not have the generality often claimed.¹⁸ Overall, the most successful results together explain approximately 60

17. Only two of the seventy-six countries used in Edwards and Tabellini (1991) are left out here, so the result is not due to changes in the sample of countries. The measures of seigniorage are somewhat different and represent slightly different time periods [Edwards and Tabellini (1991) and Cukierman, Edwards, and Tabellini (1992) examine seigniorage as a ratio to total government revenue for the period 1971–1982], but this does not account for the differences either. In simple regressions using the Edwards and Tabellini (1991) data, the significance of the political instability variables is determined to be due to the two extreme values (Turkey and Bolivia are more than 25 percent higher than the next highest values); throwing out these two causes the indices of instability to become insignificant. It is also true that Edwards and Tabellini do not use the log of their seigniorage ratio, whereas this paper considers the log because it reduces the influence of outliers. In simple regressions, taking the log of the Edwards and Tabellini seigniorage measure improves the fit of the regressions and destroys the significance of the indices of political instability even without removing the two extreme values.

18. Furthermore, decomposition of the turnover rate of the central bank governor into political and non-political components from Cukierman and Webb (1993) (where a change in the central bank governor within six months of a transfer of power in government is dubbed "political") produces the surprising result that political turnover appears not to matter at all, whereas the nonpolitical turnover significantly raises seigniorage (possibly due to the arbitrary nature of the break-down).

percent of cross-country variation in seigniorage. Empirical results also reveal that central bank independence and political instability do not affect conventional tax revenue.

4. CONCLUSION

Although there has recently been interest in temporal aspects of seigniorage, relatively little research has been done on the cross-country patterns of seigniorage. This paper therefore investigates the determinants of seigniorage for a pool of ninety countries. The initial focus is on the cross-country implications of typical optimum tax models, but the scope is subsequently broadened to examine other aspects of seigniorage in public finance.

Three main conclusions emerge from this study. The first is that optimum tax theory explains some aspects of the cross-country variation in seigniorage, since seigniorage is higher where its deadweight losses are probably lower and where the deadweight losses from conventional taxation are probably higher. In fact, the results suggest that roughly 40 percent of the cross-country variation in the ratio of seigniorage to output can be attributed to these factors. However, seigniorage does not appear to be higher where the level of government spending is higher. Average seigniorage is therefore something like a pot of revenue that is larger where it is more efficient to have that revenue. A second result is that transitory government spending probably explains some additional variation in seigniorage. Seigniorage is higher where the standard deviation of government spending is higher, suggesting that transitory spending is higher on average. Commercial indices of country creditworthiness are also significant, suggesting that countries with poor credit ratings may face credit constraints and resort to seigniorage to finance transitory spending that countries with good credit ratings are able to finance by issuing debt. However, the ratio of domestic debt to output is not an empirically important determinant of seigniorage. Seigniorage is furthermore likely to be the exclusive source of financing transitory government spending when debt is constrained because conventional tax revenues appear to be completely sticky. Hence, seigniorage appears to be used predominantly to finance transitory spending while conventional tax revenue appears to be used exclusively to finance permanent spending. Third, and finally, central bank independence and political instability further explain some cross-country variation in seigniorage. Seigniorage is higher where the turnover of the central bank governor is higher. It is also higher where urbanization is higher, possibly because of political instability associated with urban societies, but possibly because it is a tax on black market activities. Beyond this, however, the role of political instability in explaining cross-country variation does not seem to have the generality claimed in some papers. This paper also illustrates that the multifaceted results for seigniorage distinguish this source of revenue from the more mundane conventional tax revenue. Most of the cross-country variation in conventional taxation is explained by the level of government spending and welfare costs, and the additional variables do not add anything to the results.

These main results have been checked for robustness, and most are indeed general.

One investigation split the sample into two subperiods, 1971–1980 and 1981–1990, in order to use the 1981–1990 average seigniorage (normalized using GDP) as the dependent variable regressed onto independent variables calculated for the 1971–1980 period as preexisting exogenous conditions (to the extent that this was possible); this serves to reduce any endogeneity not already taken into account. Others considered alternative dependent variables based on data in Table 1. One normalized seigniorage by total government revenue rather than by GDP, as in Cukierman, Edwards and Tabellini (1992). Another examined the separate components of seigniorage: creation of currency and creation of bank reserves. In these specifications, roughly 60 percent of the cross-country variation in seigniorage is explained by the six key variables developed throughout this paper. The short-run elasticity of money demand, per capita GNP, the creditworthiness index, and turnover of the central bank governor are the most important explanatory variables, and the standard deviation of government spending and urbanization are occasionally useful.

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