The political economy of seigniorage ☆

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Abstract

While most economists agree that seigniorage is one way governments finance deficits, there is less agreement about the political, institutional and economic reasons for relying on it. This paper investigates the main political and institutional determinants of seigniorage using panel data on about 100 countries, for the period 1960–1999. Estimates show that greater political instability leads to higher seigniorage, especially in developing, less democratic and socially-polarized countries, with high inflation, low access to domestic and external debt financing and with higher turnover of central bank presidents. One important policy implication of this study is the need to develop institutions conducive to greater political stability as a means to reduce the reliance on seigniorage financing of public deficits.

1. Introduction

The purpose of this paper is to identify the main determinants of cross-country and cross-time differences in seigniorage — real revenues a government acquires by using newly issued money to buy goods and non-money assets.[1] This is a challenge not yet satisfactorily confronted by the economics profession for four reasons. First, several political and institutional variables used as explanatory variables in earlier studies were relatively poorer measures of political instability and of the institutional environment than those available in new datasets such as the Cross National Time Series

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[1] Some studies, such as Buiter (2007), distinguish seigniorage (change in monetary base) from central bank revenue (interest earned by investing the resources obtained through the past issuance of base money). This distinction is useful to study central bank operations and monetary policy effectiveness. For the purposes of this paper, however, it suffices to broadly define seigniorage as revenues obtained by a consolidated government (treasury and central bank) from the issuance of base money.

Data Archive (CNTS), Database of Political Institutions (DPI), the Polity IV Database, State Failure Task Force (SFTF) database, and the Freedom House ratings. Second, our analysis is based on a richer and wider dataset, covering more countries and years than those used in previous studies, and includes a larger variety of alternative model specifications. Third, although Aisen and Veiga (2006) study the determinants of inflation using a similar dataset, one should not expect that variables affecting inflation should affect seigniorage in the exact same way, since the latter might be consistent with two different levels of the former in the presence of a well-defined Laffer curve. According to Easterly et al. (1995), studying inflation is different to studying seigniorage, especially for developing and high-inflation countries. Accordingly, the correlation between inflation and seigniorage in our sample fluctuates significantly depending on the rate of inflation (see Table 1). While it is positive most of the time and for most of the countries, it declines with the level of inflation and becomes negative for inflation rates above 400% per year. Thus, it is misleading to assume that the determinants of inflation are necessary the same as those of seigniorage, which means that separate studies of these variables should be made. As an example, changes in inflation may result from supply-side shocks, such as fluctuations in oil prices, which do not directly affect seigniorage. Conversely, the structure of the economy, which affects the capacity to raise taxes and the reliance on seigniorage revenues, may not affect inflation in the same way. Fourth, our models are able to identify the circumstances under which the relationship between political instability and seigniorage is stronger, a central topic of our research and virtually absent from previous empirical studies on the determinants of seigniorage. While seigniorage seems to be a less attractive method of government financing for several countries, the truth

is that it was still used to a greater extent in the 1990s than in the 1960s. Furthermore, seigniorage revenues are on average five times higher in developing countries than in industrial countries for the period 1960–1999. In the 1990s, average seigniorage revenues represented 14.65% of total government revenues for developing countries, compared to only 1.64% for industrial countries. Therefore, analyzing the determinants of seigniorage is an important endeavor, primarily for developing countries.

Relying upon the theoretical literature and using a dataset covering around 100 countries for the period 1960–1999, we estimate panel data models to investigate the main economic, political and institutional determinants of seigniorage. After controlling for the countries' economic structure and for several other variables that may affect seigniorage, we find that greater political instability leads to higher seigniorage levels, confirming previous results by Cukierman et al. (1992) and Click (1998).

This paper's major contribution to the literature is the identification of the circumstances under which the above-referred relationship is stronger. That is, we find that political instability has stronger effects on seigniorage levels in higher inflation than in moderate and low inflation countries, and also in developing than in industrial nations. In addition, this relationship is also stronger in countries with (i) higher social polarization; (ii) a tradition of high political instability;[2] (iii) higher central bank president turnover (lower *de facto* central bank independence); (iv) lower indexes of economic freedom; (v) more authoritarian regimes; (vi) higher domestic debt levels as a percentage of GDP; (vii) lower access to international financing (expressed in poorer creditworthiness ratings); and, (viii) lower openness to international trade. It is also worth mentioning that, besides its effects on the relationship between political instability and seigniorage, social polarization is by itself a major determinant of seigniorage. Empirical results show quite clearly that higher degrees of social polarization (lower ethnic homogeneity) are associated with higher levels of seigniorage.

The paper is structured as follows. A survey of the empirical and theoretical literature on the relationship between seigniorage, political instability and institutions is presented in Section 2. The dataset and the empirical models are described in Section 3. Section 4 presents the empirical results, and Section 5 concludes the paper.

Table 1
Correlation between inflation and seigniorage

Sample	Observations	Correlation
All	3171	.214
Inflation < 10%	1967	.102
Inflation < 100%	3083	.305
Inflation > 100%	88	.132
Inflation > 200%	43	.058
Inflation > 300%	34	.0001
Inflation > 400%	28	−.007
Inflation > 500%	26	−.038
Inflation > 1000%	18	−.139

Notes: inflation is the annual inflation rate (IFS line 64×). Seigniorage is the change in reserve money (IFS, line 14a) as a percentage of government revenues (IFS line 81).

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[2] Expressed in a high number of state failure events in the last 15 years, such as revolutionary wars, ethnic wars, regime crises, and genocides/politicides.

2. The political economy of seigniorage

Most economists acknowledge that differences on the way countries conduct their fiscal policies are behind the variability of the seigniorage levels they sustain.[3] But this explanation leads to a much deeper and fundamental question, which is why countries differ on the way they conduct fiscal policies (see Woo, 2003, 2005). In particular, governments that are able to finance their expenditures through taxes or debt do not need to rely on seigniorage revenues. Several studies have explored the idea that structural features of a particular economy help determine its "taxable capacity". Chelliah et al. (1975), for example, provide evidence that countries with larger per capita non-export income, more open to trade and with larger mining but smaller agricultural sectors have, on average, a higher "taxable capacity" or ease of collection. This result leads to the conclusion that the countries' ability to tax is techno-logically constrained by their stage of development and by the structure of their economies (e.g. size of the agricultural sector in GDP), and as tax collecting costs are high and tax evasion pervasive, countries might use seigniorage more frequently. But what if governments, independently of their countries' economic structures, find it optimal to finance expenditures using seigniorage rather than levying other taxes (e.g. taxes on output)? The Theory of Optimal Taxation (see Phelps, 1973; Végh, 1989; Aizenman, 1992) rationalizes government behavior in many countries showing that it might be optimal for governments to rely on seigniorage if other taxes are highly distortionary. According to this theory, governments optimally equate the marginal cost of the inflation tax with that of output taxes, therefore minimizing the distortions to the economy when choosing the optimal combination of taxes to finance their expenditures. Edwards and Tabellini (1991) and Cukierman et al. (1992) fail to find evidence that this theory applies to developing countries. Click (1998) estimates a model using 90 countries, from 1971–90, and finds that only 40% of the cross-country variation in seigniorage can be explained with the Theory of Optimal Taxation. The empirical failure of this theory to fully explain the cross-country differences in the use of seigniorage revenues motivated the use of theoretical and empirical models focusing on the role played by political and institutional variables.

Cukierman et al. (1992) develop a theoretical model whereby political instability and ideological polarization determine the equilibrium efficiency of the tax system and the resulting combination of tax revenues and seigniorage that governments use. Using a probit model to determine the likelihood of an incumbent government to remain in power, they show evidence that higher political instability and ideological polarization lead to higher seigniorage. In the empirical analysis of Section 4, we employ alternative and more direct measures of political instability, such as variables that count the exact number of cabinet changes, executive changes or government crises taking place in a particular year. Moreover, whereas they use a dummy variable for democratic regimes as a proxy for ideological polarization, we use the Polity Scale (ranged between −10 and +10) to measure the degree of democracy in different countries, and an ethnic homogeneity index as a proxy for the degree of social polarization.[4]

In line with Cukierman et al. (1992), we conjecture that economies with weaker institutions might be unable to build efficient tax systems leading them to use more frequently seigniorage as a source of revenue. In the next sections, in addition to the effects of political instability on seigniorage, we also estimate the effects of institutions such as democracy and economic freedom. Besides structural variables accounting for the taxing capacity of the economy and political and institutional variables affecting the use of seigniorage financing of fiscal deficits, we also consider, in line with Click (1998), variables that measure the ability of governments to finance transitory expenditures with domestic or external debt. To the extent that a government is able to finance its expenditure through debt, there is less need to rely on seigniorage.

Our main contribution to the literature is that our models not only identify the main political and economic determinants of seigniorage, but also reveal under which circumstances the effects of political instability on seigniorage are stronger. Our results indicate that the causal effect of political instability on seigniorage is stronger in developing and high-inflation countries. In addition, it is also stronger in socially-polarized,[5] less

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[3] See Catão and Torrones (2005) for an empirical analysis on the relationship between fiscal deficits and inflation and Fischer et al. (2002) for a survey on modern hyper- and high inflations that includes results showing a positive relationship between fiscal deficits and seigniorage.

[4] An additional shortcoming of the analysis in Cukierman et al. (1992) is the use of a cross-sectional dataset using averages from 1971 to 1982 for only 79 countries, while we use a panel dataset covering around 100 countries for the period 1960–99.

[5] See Beetsma and Van Der Ploeg (1996), Bhattacharya et al. (2005) and Albanesi (2007) for studies presenting evidence suggesting that inflation and income inequality are positively related. In Desai et al. (2005) that relationship is conditional on the political structure. Woo (2005) finds that social polarization is associated with fiscal instability while generating incentives to engage in short-term policies leading to lower growth. Our findings indicate that the fiscal instability channel may also lead to higher seigniorage and inflation.

democratic, traditionally unstable, and highly indebted countries. Finally, political instability has greater effects on seigniorage in countries that have lower *de facto* central bank independence, lower economic freedom, lower creditworthiness ratings and lower openness to international trade. In our view, and to the best of our knowledge, there is no comprehensive study in the literature fully analyzing the relationship between political instability and seigniorage. As it will become clear in the following sections, this paper is an attempt to contribute in this direction.

3. Data and the empirical model

The dataset is composed of annual data on political, institutional and economic variables for the years 1960 to 1999. Although we collected data for 178 countries, missing values for several variables reduce the number of countries in our estimations to around 100. The sources of political and institutional data are: the *Cross National Time Series Data Archive* (CNTS); the *Polity IV* dataset;[6] Gwartney and Lawson (2002);[7] the *Database of Political Institutions* (DPI 3.0);[8] the *State Failure Task Force* dataset (SFTF);[9] and the *Freedom House* ratings.[10] Economic data was collected from the World Bank's *World Development Indicators* (WDI) and *Global Development Network Growth Database* (GDN),[11] the International Monetary Fund's *International Financial Statistics* (IFS), the *Penn World Tables* (PWT 6.1),[12] *Euromoney* creditworthiness ratings,[13] Cukierman et al. (1995),[14] Dollar and Kraay (2002),[15] and Levy-Yeyati and Sturzenegger (2003).[16]

To investigate the main political, institutional and economic determinants of seigniorage levels across countries and time, we estimate panel data models, controlling for countries' fixed effects. Seigniorage is defined in two alternative ways: (1) the change in reserve money (line 14a of IFS–IMF) as a percentage of nominal GDP (line 99b in IFS–IMF); (2) the change in reserve money (line 14a of IFS–IMF) as a percentage of government revenues (line 81 in IFS–IMF). Appendix A shows the number of observations, means and standard deviations of these seigniorage measures for all countries for which data is available.[17]

We hypothesize that seigniorage levels depend on the following explanatory variables:

- A set of variables representing political instability, polarization and institutions:
  o *Cabinet Changes* (CNTS), a proxy for political instability, counts the number of times in a year in which a new premier is named and/or 50% of the cabinet posts are occupied by new ministers. A positive coefficient is expected, as greater instability should lead to greater reliance on seigniorage revenues.

  Why may the number of cabinet changes be a good indicator of political instability? First, in a country characterized by frequent changes in the composition of government, there are also frequent changes in macroeconomic policies, as new prime ministers or ministers of finance/economics do not necessarily share the views of their predecessors. Second, frequent cabinet changes shorten the horizon of the members of government, as they are not certain that they will keep their posts during an entire term. The higher the probability of being replaced, the greater will be the importance attributed to short-term objectives. Then, since the costs of future inflation are not fully internalized, it is difficult to resist the temptation to finance current expenditures with seigniorage revenues.

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[6] Available on the Internet (http://www.cidcm.umd.edu/inscr/polity/index.htm).

[7] Available on the Internet (http://www.freetheworld.com/release.html).

[8] On this database, see Beck et al. (2001). Available on the Internet though Philip Keefer's page in the World Bank's site (http://www.worldbank.org/research/bios/pkeefer.htm).

[9] Available on the Internet (http://www.cidcm.umd.edu/inscr/stfail/sfdata.htm).

[10] Available on the Internet (http://www.freedomhouse.org/ratings/).

[11] Available on the Internet (http://www.worldbank.org/research/growth/GDNdata.htm).

[12] Available on the Internet (http://pwt.econ.upenn.edu/php_site/pwt_index.php).

[13] The data on the *Euromoney* creditworthiness index, raging from 0 to 100, from 1982 to 1999, was kindly provided by Reid Click.

[14] Underlying data available on the Internet (http://www.tau.ac.il/~alexcuk/pdf/WebbPoltime2.xls).

[15] Underlying data available on the Internet (http://siteresources.worldbank.org/INTRES/Resources/469232-1107449512766/648083-1108140788422/Growth_is_good_for_the_poor_data.zip).

[16] Underlying data available on the Internet (http://www.utdt.edu/~fsturzen/base_2002.xls).

[17] There is data on *ΔRM/GDP* for 144 countries and on *ΔRM/GR* for 122 countries. These are the seigniorage measures most commonly used in the literature. We performed all estimations for both measures but, to make our results more easily comparable to those of Cukierman et al. (1992), we report in most tables those obtained when using the change in reserve money as a percentage of government revenues. Two additional ways of measuring seigniorage, used by Cukierman et al. (1992), are the product of reserve money by the inflation rate divided by either GDP or government revenues. These authors have shown that these two additional alternative measures of seigniorage provide similar results for a cross-section of countries. Another alternative, used by Click (1998), is the change in the monetary base as a percentage of government spending.

- o *Ethnic Homogeneity Index* (SFTF): ranges from 0 to 1, with higher values indicating ethnic homogeneity, and equals the sum of the squared population fractions of the seven largest ethnic groups in a country. For each year, it takes the value of the index in the beginning of the respective decade. According to Woo (2003, 2005) higher social polarization, which can be proxied by ethnic heterogeneity, leads to higher polarization of preferences for different types of government spending and to public deficits. Thus, a negative coefficient is expected;
  - o *Polity Scale* (Polity IV): from strongly autocratic (−10) to strongly democratic (10). Although the economic theory is not conclusive, we anticipate that democracy is associated with lower reliance on seigniorage (negative coefficient);[18]
- A set of economic structural variables that reflect characteristics of the countries that may affect their capacity to control inflation:
  - o *Agriculture* (%GDP): share of the value added of agriculture in GDP (WDI, WB). According to Chelliah et al. (1975), a positive coefficient is expected. An alternative proxy for the structure of the economy is *Urban Population* (% of total), the urbanization ratio (WDI, WB), which according to Edwards and Tabellini (1991) should have a negative sign;
  - o *Trade* (%GDP): openness to trade (WDI, WB). Since it is associated with larger revenues of import duties, we expect that countries more open to trade rely less on seigniorage revenues (a negative coefficient is expected);[19]
  - o *Real GDP per capita* (PWT 6.1). Richer countries have more efficient tax systems and, thus, have a lesser need for seigniorage (negative coefficient expected);
- Variables accounting for economic performance and external shocks:
  - o *% Change in Terms of Trade* (WDI, WB). Favorable evolution of terms of trade provides greater tax revenues (negative coefficient expected);
  - o *Growth of real GDP* (WDI, WB). Higher growth rates are associated with increasing tax revenues, reducing the need for seigniorage (negative coefficient);

- Variables accounting for fixed effects of countries and time:
  - o Country dummy variables;
  - o Dummy variables for each decade: 1960s, 1970s, 1980s and 1990s.

Appendix B presents the descriptive statistics for the above-described dependent and independent variables and for additional/alternative explanatory variables that appear in the tables shown in the paper.

The empirical model for seigniorage levels can be summarized as follows:

$$S_{it} = \alpha PI_{i,t-1} + \beta SP_{it} + \delta PS_{it} + \mathbf{Eco}'_{it}\varphi + \mathbf{EcP}'_{it}\gamma \quad (1)$$
$$+ v_i + \varepsilon_{it}, \quad i = 1,\ldots, N \quad t = 1,\ldots, T_i$$

where *S* is seigniorage, PI is a proxy for political instability, SP is a proxy for social polarization, PS is the *Polity Scale*, **Eco** is a vector of economic structural variables, **EcP** is a vector of variables accounting for economic performance and external shocks, v_i is the fixed effect of country *i*, and ε_{it} is the error term.

It is worth noting that seigniorage is not persistent (its first lag is never statistically significant when included as an explanatory variable) and that the error term of Eq. (1), ε_{it}, is not serially correlated. Fisher type unit root tests for panel data reject the null hypothesis that seigniorage is non-stationary in all countries.[20] Dickey–Fuller and Augmented Dickey–Fuller tests performed on each individual country reject unit root behavior of seigniorage for all countries that have at least ten observations (in 15 countries, a drift term has to be included). These results, which are available upon request, are consistent with those of Click (2000), who rejected a unit root behavior of seigniorage in the four countries considered in his study (USA, UK, Brazil, and Argentina).

The proxy for political instability $(PI_{i,t-1})$ is lagged one period for two reasons. First, political instability may translate into higher seigniorage only after some time. Furthermore, if a cabinet change occurs in the end of one year, it is very likely to lead to higher seigniorage

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[18] Although ethnic homogeneity and the polity scale may also be related with political instability, we see them more as institutional variables than as indicators of political instability.
[19] The outcome on seigniorage may be similar, even if more open countries are imposing lower tariffs. These countries may rely less on seigniorage in order to avoid the real appreciation of the home currency associated with higher inflation. We owe this rationale to an anonymous referee.

[20] The results of three of those tests are presented below:

Fisher Test (0 lags, no drift). Ho: unit root
      $chi^2(244) = 1964.3487$ $Prob > chi^2 = 0.0000$
Fisher Test (1 lag, no drift). Ho: unit root
      $chi^2(240) = 1360.5939$ $Prob > chi^2 = 0.0000$
Fisher Test (0 lags, with a drift term). Ho: unit root
      $chi^2(240) = 2095.2873$ $Prob > chi^2 = 0.0000$.

only in the following year. Second, since from Aisen and Veiga (2006) higher seigniorage leads to higher inflation, which may affect political instability, using the contemporaneous value of political instability could create simultaneity/endogeneity problems. Taking the first lag avoids these problems, as current seigniorage does not affect past political instability. Since current seigniorage can affect current economic growth, *Growth of GDP* is also lagged one period.[21]

4. Empirical results

The first objective of our empirical analysis is to identify the main political, institutional and economic determinants of seigniorage levels across countries and time. Then, after finding strong support for our hypothesis that greater political instability leads to higher seigniorage, we try to determine under which circumstances or country characteristics this relationship is stronger. Finally, we perform a sensitivity analysis that checks whether or not the main results hold for alternative proxies of political instability, for an alternative definition of seigniorage, for a sample that only includes developing countries, when our main proxy for political instability (*Cabinet Changes*) is defined in a different way, for a cross-section and for samples of 5-year and 10-year periods, when outliers are controlled for, and when instrumental variables are used to account for the possibility that some explanatory variables are endogenous.

4.1. Main determinants of seigniorage levels

The estimation results of the model described in the previous section, using a fixed effects specification,[22] are shown in Table 2. The dependent variable is the change in reserve money as a percentage of government revenues, and all explanatory variables described in the previous section were included in the estimation reported in column 1. Results confirm the hypothesis that greater political instability leads to higher seigniorage levels, and show that the effects are sizeable: an additional cabinet change increases seigniorage as a percentage of government revenues by 4.15 percentage points. Higher values of the *Ethnic Homogeneity Index* (lower social polarization)

are associated with lower use of seigniorage, which is consistent with the findings of Cukierman et al. (1992) [23] and Woo (2003), and with the theoretical model of Woo (2005). Democracy does not seem to affect seigniorage, as the *Polity Scale* is not statistically significant.[24] Regarding the economic variables, only *Agriculture (%GDP)*, *Real GDP per capita*, and *Growth of Real GDP(− 1)* are statistically significant, with the expected signs. Finally, the coefficients on the decade dummy variables are all positive and statistically significant.

Since *Trade (%GDP)* and *%Change in Terms of Trade* are not statistically significant in the first column, they are excluded from the model of column 2.[25] Results remain practically the same. Then, in column 3, *Agriculture (%GDP)* was replaced by an alternative proxy for the structure of the economy, *Urban Population (% of total)*, for which there is a higher number of observations. The negative coefficient conforms to the idea that greater urbanization ratios are associated with greater ease to collect taxes and, thus, with lower seigniorage (see Edwards and Tabellini, 1991). The only changes in results are that the *Ethnic Homogeneity Index* becomes highly statistically significant, and the coefficients of the decade dummies indicate that seigniorage increased until the 1980s and slightly decreased in the 1990s. Since this specification of column 3 increases the number of observations by 324 (or 16.3%) and the number of countries by 7 (or 7%) relative to that of column 2, it will be used as our reference model.

Results regarding political instability[26] conform to our expectations and are consistent with those found by Aisen and Veiga (2006) for inflation levels, and with those of Cukierman et al. (1992) using cross-sectional data. Those concerning economic variables are consistent with the findings of previous studies, such as Chelliah et al. (1975), Edwards and Tabellini (1991), and Click (1998), indicating that larger agricultural

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[21] The contemporaneous values are used for the remaining explanatory variables, since they are taken as exogenous.

[22] Hausmann tests indicate that the fixed effects specification is preferable to a random effects model, and the joint statistical significance of the country dummies implies that a fixed effects model is preferable to a simple pooled OLS model. These results are available from the authors upon request.

[23] Although Cukierman et al. (1992) refer to ideological polarization, the crucial factor in their model is the polarization of preferences for different types of government spending, which can also result from social polarization. Furthermore, higher social polarization is generally associated with higher ideological polarization.

[24] This is not surprising, as Aisen and Veiga (2006) found that democracy marginally affects inflation and the effect is very small.

[25] They are never statistically significant when included in the models of the following columns of Table 2 or in those of the following tables. Wald tests allow for the exclusion of these variables from the model.

[26] The results obtained when using three alternative proxies of political instability also available in the Cross National Time Series Data Archive – *Government Crises*, *Executive Changes*, and the *Weighted Conflict Index* – are very similar. These results are not shown here, but are available from the authors upon request.

Table 2
Results for seigniorage

Seigniorage	1	2	3	4
Cabinet Changes (−1)	4.149	3.688	4.282	4.309
	(2.52)**	(2.45)***	(3.01)***	(2.99)***
Ethnic Homogeneity Index	−22.776	−22.419	−24.054	−24.747
	(−1.78)*	(−1.86)*	(−2.65)***	(−2.78)***
Polity Scale	.380	.379	.300	.306
	(1.44)	(1.55)	(1.45)	(1.50)
Agriculture (%GDP)	1.748	1.594		
	(3.62)***	(3.57)***		
Urban population (% of total)			−.486	−.565
			(−2.39)**	(−2.58)***
Trade (%GDP)	.013			
	(.20)			
Real GDP per capita	−.001	−.001	−.002	−.002
	(−3.77)***	(−4.23)***	(−5.32)***	(−5.11)***
% Change in terms of trade	.89e−07			
	(1.32)			
Growth of real GDP (−1)	−.467	−.432	−.664	−.655
	(−2.97)***	(−3.05)***	(−3.85)***	(−3.87)***
Dummy1970s	10.247	8.779	7.088	
	(3.88)***	(4.09)***	(3.83)***	
Dummy1980s	18.575	16.998	13.448	
	(3.97)***	(4.17)***	(3.85)***	
Dummy1990s	19.476	17.651	12.367	
	(3.34)***	(3.56)***	(2.80)***	
Trend				1.622
				(4.67)***
Trend^2				−.026
				(−4.06)***
# Observations	1836	1982	2306	2306
# Countries	97	101	108	108
Adjusted R^2	.25	.25	.22	.22
Adjusted R^2 (without fixed effects)			.07	.07

Notes: Panel regressions with fixed effects of countries and a constant. *T*-statistics based on heteroskedastic consistent standard errors are in parenthesis; Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%; Seigniorage, the dependent variable, was defined as the change in reserve money (IFS, line 14a) as a percentage of government revenues (IFS line 81).

sectors, lower urbanization ratios, lower GDP per capita levels, and slower economic growth are associated with greater reliance on seigniorage revenues.[27]

The time-dimension of seigniorage is captured by the decade dummies (column 3) and by a quadratic trend (column 4). These indicate that seigniorage increased until the 1980s, and declined during the nineties. In fact, the estimated coefficients of *Trend* and *Trend*^{2} indicate that seigniorage hit its peak in 1990, and declined afterwards. Although one would expect the increased independence of central banks in industrial countries to

start reducing seigniorage sooner, several developing countries still had high inflation (or even hyperinflation) and seigniorage in the late 1980s and in the beginning of the 1990s.[28] It is also interesting to note that most explanatory variables, with the exception of *Cabinet Changes*, exhibit relatively low time-series variation within each country. In fact, while *Cabinet Changes* has an average coefficient of variation within countries of 1.48, those of the other explanatory variables are all below .25 (the lowest is .065 for the *Ethnic Homogeneity Index*, which varies very little over time).

As mentioned above, the country dummy variables are always jointly statistically significant. They account for a considerable part of the adjusted R^2 of .22 reported

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[27] The first three variables were not statistically significant in Aisen and Veiga (2006). That is, those structural variables help explain seigniorage but not inflation, supporting our assertion in the introduction that their determinants are not the same and that separate studies for inflation and seigniorage should be implemented.

[28] For example, Argentina had hyperinflation in 1989, Brazil in 1990 and 1994, Peru in 1990, etc.

Table 3
Additional determinants of seigniorage

Seigniorage	1	2	3	4	5	6	7
Cabinet Changes (−1)	4.638	4.372	4.299	5.686	5.965	3.150	1.253
	(2.62)***	(3.07)***	(3.03)***	(2.59)***	(2.78)***	(2.76)***	(1.51)
Ethnic Homogeneity Index	−56.688	−23.074	−23.869	−86.308	−74.736	−22.404	−6.727
	(−3.22)***	(−2.62)***	(−2.68)***	(−1.89)*	(−3.29)***	(−2.15)**	(−.63)
Polity Scale	.529	.266	.313	.550	.148	.121	.178
	(1.74)*	(1.35)	(1.49)	(1.32)	(.31)	(.49)	(1.18)
Urban population (% of total)	−.573	−.430	−.548	−1.144	−.654	−.502	−.033
	(−2.19)**	(−2.29)**	(−2.46)**	(−2.52)**	(−1.64)	(−2.21)**	(−.22)
Real GDP per capita		−.002	−.001	−.001	.001	−.001	−.001
		(−5.15)***	(−5.62)***	(−1.13)	(1.41)	(−1.94)*	(−4.11)***
Growth of real GDP (−1)	−.568	−.617	−.616	−.701	−.624	−.510	−.380
	(−2.89)***	(−3.88)***	(−3.85)***	(−3.03)***	(−2.97)***	(−3.43)***	(−2.72)***
Index of economic freedom	−9.381						
	(−5.27)***						
Revolutionary war		12.561					
		(1.86)*					
Civil/ethnic conflicts in border states			5.530				
			(1.99)**				
Exchange rate regime				−2.416			
				(−2.91)***			
Creditworthiness					−.309		
					(−2.40)**		
Deposit money bank assets/central bank assets						−32.155	
						(−1.95)*	
Liquid liabilities (%GDP)							−3.325
							(−.41)
# Observations	1758	2295	2293	1433	1168	2182	1688
# Countries	93	108	108	101	106	107	94
Adjusted R^2	.24	.22	.22	.20	.34	.25	.25

Notes: Panel regressions with country fixed effects. *T*-statistics based on heteroskedastic consistent standard errors are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%; Seigniorage, the dependent variable, was defined as the change in reserve money (IFS, line 14a) as a percentage of government revenues (IFS line 81); Models estimated with a constant and 3 decade dummies (1970s, 1980s, and 1990s). Their estimated coefficients are not shown in order to economize space.

in columns 3 and 4. Since a pooled OLS, without fixed effects, would only have an adjusted R^2 of .07, roughly .15 of the variation in seigniorage is not explained by independent variables listed. This also means that more work needs to be done in this topic in order to improve the explanatory power of our models.

The results of robustness tests based on the model of column 3 are shown in Table 3. Those reported in column 1 indicate that higher economic freedom is associated with lower reliance on seigniorage. A higher *Index of Economic Freedom*[29] is associated with smaller governments, stronger legal structure and security of property rights, access to sound money, greater freedom

to exchange with foreigners, and more flexible regulations of credit, labor, and business. Since these are characteristics of more advanced economies with lesser need of seigniorage financing, the negative coefficient found conforms to our expectations. Revolutionary wars in the country and civil/ethnic conflicts in Border States (columns 2 and 3, respectively) lead to higher reliance on seigniorage. This result is intuitive, since these occurrences are associated with larger military spending, which may be at least partially seigniorage-financed. The model of column 4 indicates that fixed exchange rates[30]

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[29] Gwartney and Lawson's (2002) data on the *Index of Economic Freedom* starts in 1970 and has a 5-year frequency. In order to avoid missing values, straight line interpolation was used to generate annual data. Since *Access to Sound Money* is affected by seigniorage, we avoided eventual endogeneity problems by using a transformed index that excludes that area (Area III).

[30] The result reported in column 7 is for the 5-way classification system of *de facto* exchange rate regimes of Levy-Yeyati and Sturzenegger (2003). Results are the same when their 3-way classification system is used instead. Since their data starts only in 1974, the inclusion of this variable originates a large number of missing values. That is why it was not included in the models of the previous columns. When included, it is always statistically significant, with a negative sign.

lead to lower seigniorage levels. A possible explanation is that fixed exchange rates constrain monetary policy to the defense of the fixed parity and, thus, make the collection of seigniorage revenues harder. The results of column 5 confirm Click's (1998) result that seigniorage will be higher when the international creditworthiness of the country is lower. That is, when external borrowing is less available (or costlier), the government has to rely more heavily on seigniorage revenues. Finally, the last two columns test the effects of financial depth, which Woo (2003) found to be positively related with fiscal deficits. Two proxies taken from the database of financial development and structure of Beck et al. (2000) are used: the ratio of deposit money bank assets to central bank assets, and liquid liabilities as a percentage of GDP. Although both have the expected negative sign, indicating that countries with more developed financial markets are more capable of financing higher deficits without resorting to seigniorage, only the first of these variables is statistically significant.[31]

Despite all the tests implemented, which involved regressing seigniorage on a vast array of potential determinants, robustness may still be a concern. As the empirical economic growth literature has shown (see Durlauf et al., 1995, and Sala-i-Martin et al., 2004) the parameter estimates obtained in growth regressions are often sensitive to the inclusion of other conditional variables. Unfortunately, to our knowledge, there are no studies of the robust determinants of seigniorage that can be used to guide the decision of which variables to include in our estimations.[32] Nevertheless, considering the persistence of our main results across a vast array of alternative specifications, it might be safe to argue that they are robust.

4.2. Circumstances under which the effects of political instability on seigniorage are stronger

Although our results regarding the relationship between political instability and seigniorage are clear, it is possible that they are stronger in some circumstances or in countries with specific characteristics. Aisen and Veiga (2006) found that political instability affect inflation levels especially in high-inflation and developing countries, whereas that relationship was practically non-existent in low inflation and industrialized countries. In order to check if the same happens with seigniorage, we performed estimations based in the model of column 3 of Table 2 in which *Cabinet Changes* was interacted with dummy variables accounting for annual inflation rates above and below 50% and for developing and industrial countries. Results, illustrated in Fig. 1,[33] are consistent with those of Aisen and Veiga (2006). That is, greater political instability, expressed in a higher number of cabinet changes, leads to higher seigniorage levels only in high-inflation and developing countries.

According to Woo (2003, 2005), social polarization, which can be proxied by income inequality and ethnic or religious heterogeneity/fractionalization, and the quality of institutions are important determinants of budget deficits. In highly polarized societies, the high heterogeneity of preferences may translate to political parties and interest groups lobbying for different types and amounts of government spending. Then, high polarization of interests may lead to higher seigniorage, in the presence of political instability.[34] The quality of institutions is also very important because more stringent and transparent budgetary procedures, independence of the central bank, and greater parliamentary influence in the budgetary process can reduce the government's ability to increase budget deficits and extract seigniorage revenues.

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[31] A series of additional robustness tests, whose results are not shown here, were also performed. First, the Freedom House ratings of *Political Rights* and *Civil Liberties* were used instead of the *Polity Scale*. None was statistically significant. The same result was obtained when using indicators of *Executive Constraints* (CNTS) and of *Checks and Balances* (DPI). Second, indicators of *Ideological Polarization* (DPI), *Ideological Orientation* (DPI) and *Religious Homogeneity* (SFTF) were added to the reference model, but were not statistically significant. Third, we also found that trading partners GDP growth (GDN), external debt (WDI), domestic debt (IFS), *de jure* central bank independence (CW), U.S. Treasury Bill rates (IFS), real effective exchange rates (WDI), current account balance (IFS), government revenues as a percentage of GDP (IFS), and dollarization ratios (share of dollar deposits) do not affect seigniorage in a statistically significant way. All results not shown in the paper are available from the authors upon request. Although the indicator of *Ideological Polarization* taken from the DPI was not statistically significant, we should not interpret this result as a rejection of the model of Cukierman et al. (1992) in which greater ideological polarization leads to higher seigniorage. Since this indicator only takes the values of 0, 1 or 2, it does not satisfactorily represent the wide differences in ideological polarization among countries. These may be better proxied by the indicators of social polarization used in this paper.

[32] Implementing an analysis such as that of Sala-i-Martin et al. (2004) to determine the robust determinants of seigniorage is beyond the scope of this paper.

[33] The coefficient obtained for *Cabinet Changes* (*Pol.Instability*) in column 3 of Table 2 is shown in the first bar of Fig. 1. The estimation results for the interactions of *Cabinet Changes* considered in Fig. 1 are reported in Appendix C.

[34] In the model of Cukierman et al. (1992), this high polarization of interests results in higher seigniorage.

Fig. 1. Interactions of political instability. Notes: the grey bars show estimated coefficients of panel regressions: see column 3 of Table 2 for the coefficient of "Pol.Instability" (*Cabinet changes*), and in Appendix C, for the remaining coefficients (each pair, separated by vertical lines, corresponds to a separate estimation). 2-standard error bands are shown on top of the bars. In the horizontal axis, "H." stands for *High*, and "L." stands for *Low*. Seigniorage, the dependent variable, was defined as the change in reserve money (IFS, line 14a) as a percentage of government revenues (IFS line 81). The proxy used for political instability was *Cabinet Changes* (CNTS).

The hypothesis that the relationship between seigniorage and political instability is affected by social polarization is tested interacting *Cabinet Changes* with dummy variables for average Gini coefficients above and below 40,[35] for high and low ethnic homogeneity,[36] and for high and low religious homogeneity. Results clearly support the hypothesis that political instability has stronger effects on seigniorage in countries with large social polarization (high income inequality and low ethnic or religious homogeneity). Finally, we test the hypothesis that political instability will have greater effects on seigniorage in countries that have traditionally been more unstable. Two dummy variables were created using the variable *Upheaval* from the SFTF,[37] which indicates the sum of the maximum magnitude of events in the prior 15 years, including revolutionary wars, ethnic wars, regime crises, and genocides/

politicides. Although both dummies turned out as statistically significant, the magnitude of the coefficients implies that the number of cabinet changes in the previous year (our proxy for political instability) has greater impact on seigniorage in traditionally unstable countries.[38]

The hypothesis that institutions affect that relationship was tested interacting *Cabinet Changes* with dummy variables for high and low turnover rates of central bank presidents,[39] for high and low economic freedom,[40] and for *Polity Scale* below and above zero. The results, illustrated in the second and third bars of Fig. 2,[41] imply that greater political instability

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[35] The dummy *Gini > 40* takes the value of one for countries whose average Gini coefficient is above 40, and equals zero for the remaining countries (*Gini ≤ 40) = 1 − (Gini > 40*).

[36] The dummy *Low Ethnic Homogeneity* takes the value of one for countries whose respective index is equal to or lower than the 25th percentile, and equals zero for the remaining countries (*High Ethnic Homogeneity = 1 − Low Ethnic Homogeneity*). The same procedure was adopted for the religious homogeneity dummies.

[37] *High Upheaval* equals one when the value of *Upheaval* is above 3, and equals zero otherwise (*Low Upheaval = 1 − High Upheaval*).

[38] When *Cabinet Changes* is interacted with regional dummy variables, the positive effect of political instability on seigniorage is statistically significant only for Western Hemisphere (Latin American) and African countries. These results are not shown here, but are available upon request.

[39] Cukierman et al. (1995) use this turnover rate as an indicator of *de facto* central bank independence. The dummy *High Turnover* takes the value of one when the turnover rate is above the sample median of 0.20, and is zero otherwise (*Low turnover = 1 − High Turnover*).

[40] The dummy variable *High Economic Freedom* takes the value of one when the *Index of Economic Freedom* is greater than 5, and equals zero otherwise (*Low Economic Freedom = 1 − High Economic Freedom*). Again, we used a transformed index that excludes Area III (Access to Sound Money).

[41] The estimation results for the interactions of *Cabinet Changes* considered in Fig. 2 are reported in Appendix D.
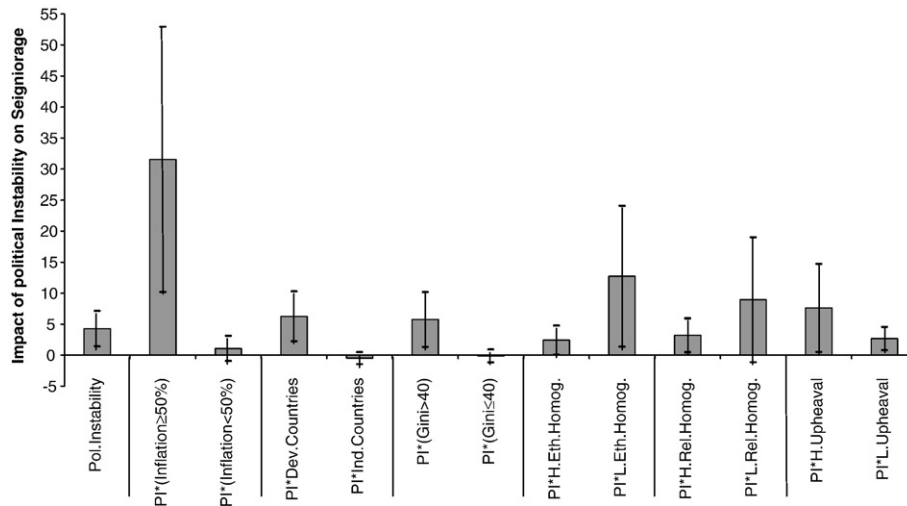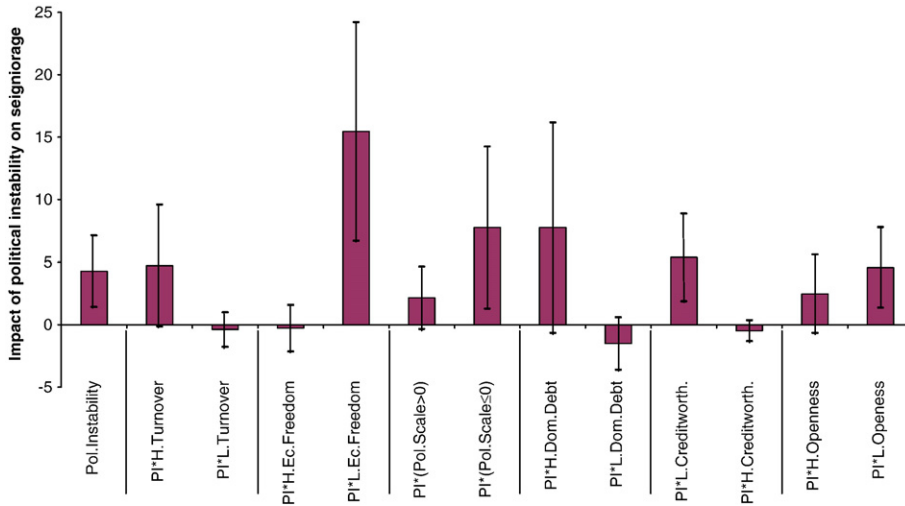
Fig. 2. More interactions of political instability. Notes: the grey bars show estimated coefficients of panel regressions: see column 3 of Table 2 for the coefficient of "Pol.Instability" (*Cabinet changes*), and in Appendix D, for the remaining coefficients (each pair, separated by vertical lines, corresponds to a separate estimation). 2-standard error bands are shown on top of the bars. In the horizontal axis, "H." stands for *High*, and "L." stands for *Low*. Seigniorage, the dependent variable, was defined as the change in reserve money (IFS, line 14a) as a percentage of government revenues (IFS line 81). The proxy used for political instability was *Cabinet Changes* (CNTS).

leads to higher seigniorage only when there is a high turnover rate of central bank presidents, that is, when the *de facto* independence of the central bank is low. When independence is high, seigniorage does not increase, as the government is no longer able to affect reserve money.[42] Political instability also seems to affect seigniorage only in countries that have a low *Index of Economic Freedom*. This implies that the establishment of sounder and freer economic institutions is a way to reduce the impact of political instability on seigniorage. More democratic institutions also seem to matter, as the results indicate that political instability affects seigniorage less in democratic countries (*Polity Scale>0*) than in countries under authoritarian regimes (*Polity Scale≤0*).

Click (1998) shows that when governments face greater constraints to issue domestic and/or external debt, they tend to resort more often to seigniorage revenues. We hypothesize that the effects of political instability on seigniorage levels also depend on the ratios of domestic debt to GDP and on the countries' creditworthiness. That is, when greater political instability leads to higher deficits, governments resort more often to seigniorage revenues to finance them when domestic or foreign borrowing is more difficult (or costlier). The results provide empirical support for the above-referred hypothesis, as a greater number of *Cabinet Changes* is associated with higher seigniorage only in countries that have *High Domestic Debt*[43] or *Low Creditworthiness*.[44]

Finally, we test the hypothesis that political instability will lead to greater seigniorage essentially in countries with lower trade openness ratios. Although we did not identify a direct relationship between openness and seigniorage in the estimations of Table 2, it is possible that openness to international trade affects the relationship between political instability and seigniorage. That is, in more open economies, the increase in government expenditures caused by political instability may be partially financed by higher taxes on

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[42] It is worth noting that this result does not hold when the Cukierman et al. (1995) legal index of Central Bank Independence is used instead of the turnover rate of presidents (that proxies *de facto* independence). This may happen because what really matters for the conduct of monetary policy is the *de facto* independence and not what is written in the central bank law.

[43] *High Domestic Debt* (*H.Dom.Debt*) is a dummy variable that takes the value of one for the countries whose average ratio of domestic debt to GDP is above the countries' median ratio (13.28), and takes the value of zero otherwise (*Low Domestic Debt = 1 − High Domestic Debt*).

[44] *High Creditworthiness* (*H.Creditworth.*) is a dummy variable that equals one for the countries whose average *Euromoney's* creditworthiness rating is above 60 (the 75th percentile of the country averages), and equals zero otherwise (*Low Creditworthiness = 1 − High Creditworthiness*).

Table 4
Results for indexes of political instability generated by Principal Components Analysis

Seigniorage	Political Instability Index 1			Political Instability Index 2			Political Instability Index 3		
	1	2	3	4	5	6	7	8	9
Political Instability Index (−1)	1.642			1.105			2.274		
	(3.04)***			(1.67)*			(3.34)***		
[Political Instability Index*(inflation ≥ 50%)] (−1)		9.430			7.430			14.618	
		(3.38)***			(2.62)***			(3.53)***	
[Political Instability Index*(inflation < 50%)] (−1)		.056			−.470			.438	
		(.14)			(−.86)			(1.23)	
[Political Instability Index*(developing countries)] (−1)			2.117			1.211			3.978
			(3.05)***			(1.63)*			(3.50)***
[Political Instability Index*(industrial countries)] (−1)			−.061			.247			−.237
			(−.17)			(.35)			(−1.24)
Ethnic Homogeneity Index	−29.887	−29.735	−29.699	−30.688	−30.818	−30.614	−29.388	−27.612	−28.425
	(−3.21)***	(−3.29)***	(−3.17)***	(−3.30)**	(−3.38)***	(−3.29)***	(−3.20)***	(−3.13)***	(−3.08)***
Polity Scale	.353	.361	.350	.374	.382	.374	.318	.311	.286
	(1.69)*	(1.76)*	(1.68)*	(1.77)*	(1.80)*	(1.77)*	(1.52)	(1.56)	(1.38)
Urban population (% of total)	−.483	−.435	−.468	−.519	−.512	−.517	−.466	−.363	−.419
	(−2.38)**	(−2.19)**	(−2.32)**	(−2.52)**	(−2.47)**	(−2.51)**	(−2.34)**	(−1.97)**	(−2.16)**
Real GDP per capita	−.002	−.001	−.002	−.002	−.002	−.002	−.002	−.001	−.002
	(−4.96)***	(−4.86)***	(−5.02)***	(−5.01)***	(−5.01)***	(−5.04)***	(−4.90)***	(−4.61)***	(−5.01)***
Growth of real GDP (−1)	−.627	−.467	−.606	−.658	−.570	−.656	−.636	−.437	−.582
	(−3.75)***	(−2.97)***	(−3.67)***	(−3.93)***	(−3.52)***	(−3.93)***	(−3.79)***	(−2.77)***	(−3.55)***
# Observations	2300	2300	2300	2306	2306	2306	2300	2300	2300
# Countries	108	108	108	108	108	108	108	108	108
Adjusted R^2	.22	.24	.22	.21	.23	.21	.22	.25	.22

Notes: Panel regressions controlling for country fixed effects. Seigniorage, the dependent variable, was defined as the change in reserve money (IFS, line 14a) as a percentage of government revenues (IFS line 81). Models estimated with a constant and 3 decade dummies (1970s, 1980s, and 1990s). Their estimated coefficients are not shown in order to economize space. T-statistics based on heteroskedastic consistent standard errors are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10% Variables used in the Principal Components Analysis to define each Political Instability Index (all variables were taken from the CNTS): P.I. Index 1: Assassinations, Cabinet Changes, Constitutional Changes, Coups, Executive Changes, Government Crises, and Revolutions; P.I. Index 2: Assassinations, Constitutional Changes, Coups, Government Crises, and Revolutions; P.I. Index 3: Cabinet Changes, Executive Changes, and Government Crises.

Table 5
Additional sensitivity analysis

| | ΔReserve money (% GDP) | | | Developing countries | | 3-Year MA of Cabinet Changes | | |
| | | | | ΔReserve money (% GovRev) | | ΔReserve money (% GovRev) | | |
	1	2	3	4	5	6	7	8
Cabinet Changes (−1)	.202			6.076		9.467		
	(2.00)**			(3.03)***		(3.29)***		
[Cabinet changes* (inflation ≥ 50%)] (−1)		2.019			52.191		51.331	
		(3.41)***			(2.99)***		(2.95)***	
[Cabinet changes* (inflation < 50%)] (−1)		−.046			7.575		4.252	
		(−.50)			(2.39)**		(2.06)**	
[Cabinet changes* (developing countries)] (−1)			.276					15.067
			(2.11)**					(3.61)***
[Cabinet changes* (industrial countries)] (−1)			−.029					−2.817
			(−.37)					(−3.77)***
Ethnic Homogeneity Index	−3.982	−3.621	−3.987	−25.868	−25.541	−26.390	−24.714	−25.903
	(−3.64)***	(−3.51)***	(−3.63)***	(−2.56)**	(−2.39)**	(−2.81)***	(−2.60)***	(−2.70)***
Polity Scale	.032	.037	.032	.450	.507	.308	.364	.284
	(1.77)*	(2.17)**	(1.75)*	(1.88)*	(1.92)*	(1.50)	(1.62)	(1.40)
Urban population (% of total)	−.15	−.015	−.015	−.548	−.653	−.486	−.546	−.472
	(−1.11)	(−1.11)	(−1.13)	(−2.10)**	(−2.41)**	(−2.53)**	(−2.60)***	(−2.51)**
Real GDP per capita	−.0002	−.0001	−.0002	−.002	−.001	−.002	−.001	−.002
	(−5.85)***	(−5.48)***	(−5.81)***	(−4.64)***	(−2.43)**	(−5.09)***	(−3.75)***	(−5.10)***
Growth of real GDP (−1)	−.043	−.037	−.043	−.713	−.532	−.655	−.450	−.629
	(−3.68)***	(−3.07)***	(−3.62)***	(−3.69)***	(−3.17)***	(−3.86)***	(−3.01)***	(−3.77)***
# Observations	3040	2908	3040	1674	1547	2282	2179	2282
# Countries	122	122	122	89	88	108	107	108
Adjusted R^2	.24	.27	.25	.19	.24	.22	.27	.23

Notes: Panel regressions with fixed effects. *T*-statistics based on heteroskedastic consistent standard errors are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%; Models estimated with a constant and 3 decade dummies (1970s, 1980s, and 1990s). Their estimated coefficients are not shown in order to economize space; The sample and the definition of seigniorage used (the dependent variable) are indicated in the first row.

trade, reducing the need to resort to seigniorage financing. Results shown in the last two bars of Fig. 2 are consistent with this hypothesis.[45]

4.3. Sensitivity analysis

Three alternative indexes of political instability were constructed by applying the Principal Components Analysis. The variables used to define each Political Instability Index were (all from the CNTS):[46]

o P.I. Index 1: Assassinations, Cabinet Changes, Constitutional Changes, Coups, Executive Changes, Government Crises, and Revolutions;
o P.I. Index 2: Assassinations, Constitutional Changes, Coups, Government Crises, and Revolutions (same as in Woo, 2003);
o P.I. Index 3: Cabinet Changes, Executive Changes, and Government Crises.

Table 4 reports the results of estimations using these alternative indexes. They are very similar to those obtained for *Cabinet Changes*, reported in Table 2 and Appendix C. Thus, our results are not sensitive to the choice of the proxy for political instability. That is, for all variables used, political instability is positively related to seigniorage.

Columns 1 to 3 of Table 5 report results obtained for an alternative definition of seigniorage: Change in Reserve Money as a percentage of GDP. In the models of columns 4 and 5 the sample contains only developing countries, and seigniorage is defined as in the previous

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[45] It is worth noting that the interactions of *Cabinet Changes* with *High Turnover* and with *High Domestic Debt* are only statistically significant at the 10% level.
[46] This technique for data reduction describes linear combinations of the variables that contain most of the information. It analyses the correlation matrix and the variables are standardized to have mean zero and standard deviation of 1 at the outset. Then, for each of the three groups of variables, the first component identified, the linear combination with greater explanatory power, was used as the political instability index.

tables. Finally, in the models of columns 6 to 8, a three-year moving average of *Cabinet Changes* was used instead of its annual values, in order to better capture eventual persistent situations of political instability. In all cases, results are similar to those obtained in Tables 2 and Appendix C, meaning that our conclusions regarding the effects of political, institutional and economic variables on seigniorage levels remain practically the same.

Results for alternative data frequencies are shown in Table 6. In columns 1, 3 and 5 the reference model was estimated for a cross-section of 108 countries and for panels of 10-year and 5-year averages. Results are still supportive of the hypothesis that political instability leads to greater seigniorage. Although the *Ethnic Homogeneity Index* is not statistically significant in the cross-section (column 1), the results for the panel estimations provide evidence in favor of the view that social polarization leads to seigniorage. The *Index of Economic Freedom* was added in columns 2, 4 and 6. As happened in column 1 of Table 3, this variable is highly statistically significant, with a negative sign, reinforcing the conclusion that greater economic freedom is associated with lower reliance on seigniorage revenues.

It is possible that outliers associated with high-inflation and high-seigniorage episodes affect the results of our regressions. This possibility is accounted for, using annual data, in columns 1 to 4 of Table 7. In column 1, all observations for which annual inflation was above 1000% were excluded. Then, in column 2, we only included the observations for which seigniorage (as a percentage of government revenues) was smaller or equal to its mean plus two standard deviations ($\leq 156.76\%$). Results in both cases are very similar to those of the reference model. Then, we used two robust estimation procedures: least median of squares (LMS), in column 3; and, least absolute deviation (LAD), in column 4. In both cases, a greater number of cabinet changes is associated with higher seigniorage, but the *Ethnic Homogeneity Index* is not statistically significant when using LAD (column 4).

Finally, we estimated instrumental variables (IV) models in order to account for the possibility that some explanatory variables are endogenous. Dealing with inflation, Aisen and Veiga (2006), used the system Generalized Method of Moments (GMM-SYS) estimator for dynamic panel data models. But, since lagged seigniorage is never statistically significant when included in our estimations, we do not have a dynamic panel. Thus, in columns 5 and 6, we performed two-step feasible GMM and LIML (Limited

Table 6
Results for cross-section and period averages

Seigniorage	Cross-section		10-year periods		5-year periods	
	1	2	3	4	5	6
Cabinet Changes (−1)	13.909	13.857	12.059	16.132	8.021	8.415
	(1.73)*	(1.70)*	(2.14)**	(1.98)**	(2.74)***	(2.14)**
Ethnic Homogeneity Index	−2.800	−4.978	−8.937	−14.330	−6.887	−12.871
	(−.52)	(−.89)	(−1.86)*	(−2.69)***	(−2.20)**	(−3.24)***
Polity Scale	−.539	−.423	−.213	−.243	−.268	−.266
	(−2.23)**	(−1.82)*	(−1.23)	(−1.05)	(−2.00)**	(−1.42)
Urban population (% of total)	.246	.171	.266	.127)	.221	.094
	(1.94)*	(1.43)	(3.13)***	(1.47	(3.51)***	(1.36)
Real GDP per capita	−.001		−.001		−.001	
	(−2.84)***		(−5.14)***		(−5.82)***	
Growth of real GDP (−1)	.142	.471	−1.300	−1.567	−1.134	−1.047
	(.38)	(.90)	(−1.56)	(−1.32)	(−1.94)*	(−1.46)
Index of Economic Freedom		−7.198		−7.148		−6.656
		(−2.63)**		(−4.27)***		(−4.49)***
# Observations	108	94	282	219	548	416
# Countries	108	94	96	87	108	94
Adjusted R^2	.14	.21	.15	.18	.13	.14

Notes: Cross-section regressions estimated in columns 1 and 2 (including a constant); Panel regressions controlling for country fixed effects in columns 3 to 6. Models estimated with a constant and period dummies. Their estimated coefficients are not shown in order to economize space; *T*-statistics based on heteroskedastic consistent standard errors are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%; Seigniorage, the dependent variable, was defined as the change in reserve money (IFS, line 14a) as a percentage of government revenues (IFS line 81); In the cross-section regressions of columns 1 and 2, there are no lagged values of *Cabinet Changes* and *Growth of Real GDP* available. Thus, their average values for the entire sample period were used. In the other columns, the first lag is the average over the previous period.

Table 7
Controlling for outliers and instrumental variables estimations

Seigniorage	Inflation ≤ 1000	Seigniorage ≤ (mean + 2 SD)	LMS	LAD	IV GMM	IV LIML
	1	2	3	4	5	6
Cabinet Changes (−1)	3.436	1.284	1.903	1.148	41.135	39.256
	(2.97)***	(2.23)**	(7.04)***	(2.86)***	(1.91)*	(1.79)*
Ethnic Homogeneity Index	−25.853	−17.043	−5.340	.821	−12.812	−11.837
	(−2.76)***	(−2.40)**	(−8.30)***	(.86)	(−1.86)*	(−1.66)*
Polity Scale	.037	.142	.378	−.167	−.195	−.199
	(.19)	(1.25)	(13.9)***	(−4.13)***	(−.99)	(−1.02)
Urban population (% of total)	−.115	−.010	−.029	.081	.297	.313
	(−.76)	(−.12)	(−3.02)***	(5.49)***	(2.32)**	(2.38)**
Real GDP per capita	−.001	−.001	−.001	−.001	−.001	−.001
	(−4.08)***	(−7.08)***	(−15.5)***	(−11.0)***	(−2.33)**	(−2.38)**
Growth of real GDP (−1)	−.293	−.323	.208	−.068	−.564	−.531
	(−2.62)***	(−3.58)***	(6.43)***	(−1.42)	(−2.48)**	(−2.27)**
# Observations	2150	2293	2306	2306	2293	2293
# Countries	107	108	108	108	108	108
Adjusted R^2	.18	.25	.02	.05	.13	.10

Notes: In columns 1 and 2, panel regressions controlling for country fixed effects were performed on the observations that complied with the conditions shown in the first row. Least Median of Squares estimation (LMS) was performed on the full sample in column 3, and Least Absolute Deviation (LAD) in column 4. Finally, instrumental variables estimations were performed in columns 5 and 6, using 2-step feasible Generalized Method of Moments (IV GMM) and Limited Information Maximum Likelihood (LIML), respectively; Seigniorage, the dependent variable, was defined as the change in reserve money (IFS, line 14a) as a percentage of government revenues (IFS line 81); All models estimated with a constant and 3 decade dummies (1970s, 1980s, and 1990s). Their estimated coefficients are not shown in order to economize space; T-statistics based on heteroskedastic consistent standard errors are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%; The IV estimations of columns 5 and 6 were implemented using the command *ivreg2* of Stata. Lagged values one and two periods of *Cabinet Changes* were used as instruments of that variable. Orthogonality tests do not reject the exogeneity of the other explanatory variables. The option *cluster* was used in order to account for intra-country correlation.

Information Maximum Likelihood), respectively, with instrumental variables.[47] Results are consistent with the hypothesis that political instability and social polarization lead to greater reliance on seigniorage revenues.[48]

5. Conclusions

The main purpose of this paper was to identify the major determinants of the cross-country and cross-time variability of seigniorage. Using a dataset covering about 100 countries, from 1960–1999, and applying standard panel data techniques, we found that greater political instability and social polarization lead to higher seigniorage. These results are consistent with the findings of previous studies such as Cukierman et al. (1992), Click (1998) and Woo (2003, 2005).

Our major contribution to the literature is that, in addition to the above-referred results, we succeeded to comprehensively determine the circumstances under which political instability has a greater impact on seigniorage, an important topic that received little attention in previous studies. Our results indicate that the effects of political instability on seigniorage are stronger in high-inflation, developing, socially-polarized, and traditionally more unstable economies. Moreover, the same applies to countries with high turnover rates of central bank presidents (lower *de facto* central bank independence), with lower levels of economic freedom, that are less democratic, with higher domestic debt, with poorer creditworthiness ratings and with lower openness to international trade.

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[47] These estimations were performed using the *ivreg2* command of Stata. Lagged values one and two periods of *Cabinet Changes* were used as instruments for that variable. Using geographical dummies and other variables as additional instruments does not significantly change the results. Orthogonality tests do not reject the exogeneity of the other explanatory variables. The option *cluster* was used in order to account for intra-country correlation.

[48] One should note that the estimated coefficients for *Cabinet Changes* get very large. This may be due to weak instruments. In fact, when good instruments are not available, it may be preferable not to perform instrumental variables estimations.

Although the results concerning political instability and institutional variables are similar to those of Aisen and Veiga's (2006) study of inflation, there are several differences regarding other explanatory variables, which support our assertion that the determinants of inflation and seigniorage are not exactly the same and that it is necessary to conduct separate studies for these variables. In fact, seigniorage does not seem to be affected by changes in oil prices or US Treasury Bill rates (which affect inflation), but is determined by structural variables that condition the government's ability to raise taxes, such as the size of the agricultural sector, the urbanization ratio, and the level of GDP per capita, which do not seem to affect inflation.

The results of this study have policy implications that greatly contribute to the policy debate in high-inflation (seigniorage) and politically unstable economies. Our results show that countries adopting policies targeting greater political stability, lower income inequality, and institutional strengthening, such as new laws governing central bank independence, limit the negative effect of political instability on seigniorage, improving their chances of successfully lowering their dependence on seigniorage revenues to finance their governments' deficits. After some time, they should benefit from lower inflation and, consequently, higher growth and economic prosperity.

Appendix A. Seigniorage across countries

	Observations	Mean	SD
Algeria			
ΔRM/GDP	31	.033	.018
Antigua and Barbuda			
ΔRM/GDP	22	.013	.035
Argentina			
ΔRM/GDP	38	.060	.078
ΔRM/GR	18	1.203	1.287
Armenia			
ΔRM/GDP	5	.026	.026
Australia			
ΔRM/GDP	39	.004	.007
ΔRM/GR	38	.022	.036
Austria			
ΔRM/GDP	38	.005	.002
ΔRM/GR	37	.020	.013
Bahamas			
ΔRM/GDP	23	.004	.004
ΔRM/GR	30	.022	.043
Bahrain			
ΔRM/GDP	24	.008	.022

Appendix A (*continued*)

	Observations	Mean	SD
Bahrain			
ΔRM/GR	24	.031	.073
Bangladesh			
ΔRM/GDP	25	.009	.008
Barbados			
ΔRM/GDP	32	.009	.014
ΔRM/GR	25	.035	.047
Belarus			
ΔRM/GDP	4	.042	.014
ΔRM/GR	4	.134	.047
Belgium			
ΔRM/GDP	39	.005	.005
ΔRM/GR	36	.019	.022
Belize			
ΔRM/GDP	22	.010	.012
ΔRM/GR	19	.041	.052
Benin			
ΔRM/GDP	36	.008	.018
Bhutan			
ΔRM/GDP	15	.035	.053
ΔRM/GR	13	.184	.294
Bolivia			
ΔRM/GDP	39	.026	.031
ΔRM/GR	35	.481	1.076
Botswana			
ΔRM/GDP	22	.005	.011
ΔRM/GR	20	.012	.030
Brazil			
ΔRM/GDP	39	.036	.027
ΔRM/GR	35	.247	.187
Bulgaria			
ΔRM/GDP	7	.068	.036
ΔRM/GR	7	.001	.0001
Burkina Faso			
ΔRM/GDP	35	.010	.012
ΔRM/GR	26	.096	.109
Burundi			
ΔRM/GDP	34	.007	.010
Cameroon			
ΔRM/GDP	35	.005	.008
ΔRM/GR	20	.021	.058
Canada			
ΔRM/GDP	39	.003	.002
ΔRM/GR	35	.021	.013
Central African Rep.			
ΔRM/GDP	37	.011	.018
Chad			
ΔRM/GDP	28	.010	.020
ΔRM/GR	17	.089	.232
Chile			
ΔRM/GDP	39	.069	.077
ΔRM/GR	38	.283	.281
China, P.R.: Mainland			
ΔRM/GDP	13	.063	.026
ΔRM/GR	13	.474	.250
China, P.R.: Hong Kong			
ΔRM/GDP	8	.007	.005
Colombia			
ΔRM/GDP	37	.019	.009

Appendix A (*continued*)

	Observations	Mean	SD
Colombia			
ΔRM/GR	5	.059	.094
Congo, Dem. Rep. of			
ΔRM/GDP	29	.056	.141
ΔRM/GR	30	.813	1.983
Congo, Rep. of			
ΔRM/GDP	38	.006	.012
Costa Rica			
ΔRM/GDP	39	.026	.024
ΔRM/GR	29	.230	.189
Cote d Ivoire			
ΔRM/GDP	36	.010	.013
Croatia			
ΔRM/GR	5	.57	.043
Cyprus			
ΔRM/GDP	39	.023	.026
ΔRM/GR	33	.127	.138
Czech Republic			
ΔRM/GDP	5	.035	.036
ΔRM/GR	5	.114	.114
Denmark			
ΔRM/GDP	39	.00	.012
ΔRM/GR	36	.015	.029
Dominica			
ΔRM/GDP	22	.015	.053
Dominican Republic			
ΔRM/GDP	39	.015	.016
ΔRM/GR	39	.111	.127
Ecuador			
ΔRM/GDP	39	.018	.010
ΔRM/GR	39	.147	.084
Egypt			
ΔRM/GDP	39	.039	.031
ΔRM/GR	20	.129	.062
El Salvador			
ΔRM/GDP	39	.013	.018
Equatorial Guinea			
ΔRM/GDP	12	.001	.059
Estonia			
ΔRM/GDP	7	.039	.034
ΔRM/GR	6	.159	.147
Ethiopia			
ΔRM/GDP	38	.013	.017
ΔRM/GR	33	.112	.124
Fiji			
ΔRM/GDP	35	.008	.015
ΔRM/GR	29	.039	.070
Finland			
ΔRM/GDP	39	.002	.002
ΔRM/GR	37	.008	.011
France			
ΔRM/GDP	39	.004	.004
ΔRM/GR	38	.017	.021
Gabon			
ΔRM/GDP	37	.005	.010
Gambia			
ΔRM/GDP	30	.016	.029
ΔRM/GR	26	.083	.176

Appendix A (*continued*)

	Observations	Mean	SD
Germany			
ΔRM/GDP	39	.004	.002
ΔRM/GR	38	.019	.011
Ghana			
ΔRM/GDP	38	.024	.020
ΔRM/GR	34	.245	.272
Greece			
ΔRM/GDP	39	.024	.013
ΔRM/GR	37	.120	.065
Grenada			
ΔRM/GDP	26	.017	.027
ΔRM/GR	12	.087	.114
Guatemala			
ΔRM/GDP	39	.010	.011
ΔRM/GR	38	.117	.137
Guinea-Bissau			
ΔRM/GDP	10	.010	.007
ΔRM/GR	6	.436	.214
Guyana			
ΔRM/GDP	38	.050	.095
ΔRM/GR	37	.139	.259
Haiti			
ΔRM/GDP	39	.015	.021
ΔRM/GR	32	.231	.359
Honduras			
ΔRM/GDP	39	.011	.012
ΔRM/GR	39	.074	.074
Hungary			
ΔRM/GDP	13	.025	.045
ΔRM/GR	13	.052	.088
Iceland			
ΔRM/GDP	39	.019	.016
ΔRM/GR	31	.084	.073
India			
ΔRM/GDP	38	.014	.006
ΔRM/GR	38	.132	.049
Indonesia			
ΔRM/GDP	33	.016	.010
ΔRM/GR	29	.081	.056
Iran			
ΔRM/GDP	34	.032	.026
ΔRM/GR	23	.199	.162
Ireland			
ΔRM/GDP	39	.008	.014
ΔRM/GR	39	.028	.060
Israel			
ΔRM/GDP	38	.086	.121
ΔRM/GR	38	.173	.208
Italy			
ΔRM/GDP	36	.007	.003
ΔRM/GR	36	.040	.028
Jamaica			
ΔRM/GDP	39	.021	.021
Japan			
ΔRM/GDP	39	.009	.006
ΔRM/GR	34	.084	.062
Jordan			
ΔRM/GDP	39	.044	.043

Appendix A (*continued*)

	Observations	Mean	SD
Jordan			
ΔRM/GR	38	.225	.203
Kazakhstan			
ΔRM/GR	5	.115	.161
Kenya			
ΔRM/GDP	32	.014	.014
ΔRM/GR	28	.061	.059
Korea			
ΔRM/GDP	39	.014	.013
ΔRM/GR	39	.100	.099
Kuwait			
ΔRM/GDP	35	.002	.019
ΔRM/GR	31	.005	.044
Kyrgyz Republic			
ΔRM/GDP	3	.015	.007
ΔRM/GR	3	.089	.045
Lao People's Dem. Rep			
ΔRM/GDP	9	.014	.009
Latvia			
ΔRM/GDP	5	.016	.012
ΔRM/GR	4	.048	.037
Lebanon			
ΔRM/GR	4	.406	.224
Lesotho			
ΔRM/GDP	18	.019	.024
ΔRM/GR	17	.050	.065
Libya			
ΔRM/GDP	33	.027	.033
Lithuania			
ΔRM/GDP	5	.020	.011
ΔRM/GR	5	.083	.048
Luxembourg			
ΔRM/GDP	35	.003	.015
ΔRM/GR	21	.015	.053
Madagascar			
ΔRM/GDP	36	.011	.013
ΔRM/GR	21	.112	.153
Malawi			
ΔRM/GDP	33	.014	.023
Malaysia			
ΔRM/GDP	38	.018	.020
ΔRM/GR	39	.063	.142
Maldives			
ΔRM/GR	20	.248	.350
Mali			
ΔRM/GDP	36	.013	.018
Malta			
ΔRM/GDP	38	.059	.091
ΔRM/GR	36	.157	.268
Mauritania			
ΔRM/GDP	31	.006	.029
ΔRM/GR	12	.034	.126
Mauritius			
ΔRM/GDP	39	.015	.028
ΔRM/GR	32	.090	.148
Mexico			
ΔRM/GDP	39	.022	.024
ΔRM/GR	27	.235	.220

Appendix A (*continued*)

	Observations	Mean	SD
Moldova			
ΔRM/GDP	6	.077	.075
Mongolia			
ΔRM/GDP	6	.039	.022
ΔRM/GR	5	.197	.118
Morocco			
ΔRM/GDP	39	.015	.009
ΔRM/GR	31	.071	.042
Mozambique			
ΔRM/GDP	11	.074	.049
Myanmar			
ΔRM/GDP	38	.028	.048
ΔRM/GR	33	.332	.516
Namibia			
ΔRM/GDP	7	.006	.005
ΔRM/GR	3	.016	.023
Nepal			
ΔRM/GDP	39	.014	.008
ΔRM/GR	37	.223	.149
Netherlands			
ΔRM/GDP	39	.004	.003
ΔRM/GR	13	.004	.006
Netherlands Antilles			
ΔRM/GR	23	.066	.178
New Zealand			
ΔRM/GDP	39	.001	.008
ΔRM/GR	37	.006	.029
Nicaragua			
ΔRM/GDP	38	.058	.091
ΔRM/GR	39	.255	.370
Niger			
ΔRM/GDP	36	.004	.010
Nigeria			
ΔRM/GDP	35	.014	.016
ΔRM/GR	34	.136	.168
Norway			
ΔRM/GDP	39	.005	.005
ΔRM/GR	37	.020	.016
Oman			
ΔRM/GDP	28	.009	.013
ΔRM/GR	27	.024	.033
Pakistan			
ΔRM/GDP	39	.019	.010
ΔRM/GR	39	.126	.069
Papua New Guinea			
ΔRM/GDP	20	.005	.024
ΔRM/GR	20	.028	.126
Paraguay			
ΔRM/GDP	39	.018	.010
ΔRM/GR	34	.177	.094
Peru			
ΔRM/GDP	39	.034	.029
ΔRM/GR	38	.282	.300
Philippines			
ΔRM/GDP	39	.010	.007
ΔRM/GR	39	.074	.054
Poland			
ΔRM/GDP	18	.050	.059
ΔRM/GR	9	.067	.088

Appendix A (*continued*)

	Observations	Mean	SD
Portugal			
ΔRM/GDP	39	.014	.021
ΔRM/GR	27	.075	.142
Qatar			
ΔRM/GDP	31	.005	.006
Romania			
ΔRM/GDP	19	.031	.035
ΔRM/GR	23	.076	.084
Russia			
ΔRM/GR	4	.185	.077
Rwanda			
ΔRM/GDP	34	.006	.008
ΔRM/GR	20	.124	.120
Saudi Arabia			
ΔRM/GDP	35	.009	.015
Senegal			
ΔRM/GDP	36	.005	.014
Seychelles			
ΔRM/GDP	27	.014	.037
ΔRM/GR	21	.040	.098
Sierra Leone			
ΔRM/GDP	35	.023	.026
ΔRM/GR	37	.268	.362
Singapore			
ΔRM/GDP	35	.016	.012
ΔRM/GR	35	.066	.057
Slovak Republic			
ΔRM/GDP	5	.020	.022
Slovenia			
ΔRM/GDP	5	.010	.003
ΔRM/GR	6	.023	.007
South Africa			
ΔRM/GDP	39	.007	.015
ΔRM/GR	39	.027	.022
Spain			
ΔRM/GDP	39	.011	.004
ΔRM/GR	37	.078	.040
Sri Lanka			
ΔRM/GDP	39	.012	.009
ΔRM/GR	39	.063	.051
St. Kitts and Nevis			
ΔRM/GDP	18	.016	.036
ΔRM/GR	10	.057	.051
St. Lucia			
ΔRM/GDP	22	.012	.014
St. Vincent & Grens.			
ΔRM/GDP	22	.015	.034
ΔRM/GR	20	.049	.121
Sudan			
ΔRM/GDP	38	.035	.031
Suriname			
ΔRM/GDP	31	.069	.074
Swaziland			
ΔRM/GDP	23	.016	.027
ΔRM/GR	24	.057	.105
Sweden			
ΔRM/GDP	39	.005	.011
ΔRM/GR	39	.015	.034

Appendix A (*continued*)

	Observations	Mean	SD
Switzerland			
ΔRM/GDP	39	.009	.015
ΔRM/GR	39	.110	.172
Syrian Arab Republic			
ΔRM/GDP	34	.050	.039
ΔRM/GR	21	.176	.106
Tanzania			
ΔRM/GR	31	.135	.083
Thailand			
ΔRM/GDP	39	.010	.004
ΔRM/GR	39	.068	.029
Togo			
ΔRM/GDP	35	.011	.033
Tonga			
ΔRM/GDP	12	.012	.074
Trinidad and Tobago			
ΔRM/GDP	38	.008	.016
ΔRM/GR	30	.023	.054
Tunisia			
ΔRM/GDP	39	.010	.008
ΔRM/GR	25	.041	.026
Turkey			
ΔRM/GDP	12	.031	.006
ΔRM/GR	29	.179	.052
Uganda			
ΔRM/GDP	24	.018	.013
ΔRM/GR	22	.367	.395
Ukraine			
ΔRM/GDP	5	.074	.072
United Arab Emirates			
ΔRM/GDP	23	.009	.013
ΔRM/GR	16	4.215	8.255
United Kingdom			
ΔRM/GDP	39	.004	.005
ΔRM/GR	36	.013	.015
United States			
ΔRM/GDP	39	.003	.001
ΔRM/GR	36	.021	.009
Uruguay			
ΔRM/GDP	39	.049	.029
ΔRM/GR	33	.267	.175
Vanuatu			
ΔRM/GDP	14	.012	.017
Venezuela			
ΔRM/GDP	39	.015	.016
ΔRM/GR	38	.066	.071
Yemen, Republic of			
ΔRM/GDP	7	.050	.048
ΔRM/GR	8	.261	.298
Zambia			
ΔRM/GDP	30	.019	.022
ΔRM/GR	29	.087	.105
Zimbabwe			
ΔRM/GDP	21	.010	.007
ΔRM/GR	18	.042	.026

RM: reserve money (IMF-IFS-14a).
GDP: nominal GDP (IMF-IFS-99b).
GR: government revenues (IMF-IFS-81).

Appendix B. Descriptive statistics

Variables	Observations	Mean	SD	Min.	Max.	Source
Dependent						
ΔReserve money (% government revenues)	3172	14.41	71.18	−380.78	3108.74	IFS–IFM
ΔReserve money (%GDP)	4376	1.87	3.62	−29.4	65.53	IFS–IFM
Explanatory						
Agriculture (%GDP)	4255	22.52	16.45	.13	78.01	WDI–WB
Cabinet changes	5667	.44	.6	0	5	CNTS
Change in terms of trade	3978	220,801	1.5E+7	−6.3E+7	9.8E+8	WDI–WB
Civil/ethnic conflicts in border states	4957	.87	1.14	0	6	SFTF
Creditworthiness	1988	48.13	25.00	2.01	100	Euromoney
Deposit money bank assets/central bank assets	4973	.78	.22	−.11	1.34	BDKL
Domestic debt (%GDP)	1163	200.57	2588.54	.12	52,345.17	IFS–IMF
Ethnic Homogeneity Index	4869	.58	.28	0	1	SFTF
Exchange rate regime	3345	4.06	1.28	1	5	LYS
Executive changes	5701	.19	.46	0	4	CNTS
Gini coefficient	693	37.49	10.64	16.63	74.33	DK
Government revenues (%GDP)	2561	19.51	9.64	0	50.57	WDI–WB
Government crises	5572	.17	.52	0	7	CNTS
Growth of real GDP	4725	3.73	7.44	−84.12	181.14	WDI–WB
Growth of real GDPpc	4982	2.03	6.72	−41.91	77.69	PWT-6.1
Index of economic freedom	2958	5.52	1.1	2.75	8.99	GL
Inflation (annual rate)	4820	40.9	455.16	−36.74	23,773.1	IFS–IFM
Liquid liabilities (%GDP)	3572	.39	.28	0	2.22	BDKL
Polity Scale	5344	.08	7.62	−10	10	Polity IV
Real GDP per capita	5075	5936.76	6111.8	281.25	44,008.5	PWT-6.1
Religious homogeneity index	4670	.67	.26	0	1	SFTF
Revolutionary war	5431	.09	.29	0	1	SFTF
Trade (%GDP)	4815	70.06	46.37	0	439.59	WDI–WB
Turnover rate governors	1990	.24	.2	0	1.08	CWN
Upheaval	6000	5.63	11.88	0	61.5	SFTF
Urban population (%total)	6688	43.9	24.25	1.75	100	WDI–WB

Notes: IFS–IMF: International Financial Statistics–International Monetary Fund; WDI–WB: World Development Indicators–World Bank; CNTS: Cross-National Time Series database; BDKL: Beck, Demirgüç-Kunt and Levine (2000); SFTF: State Failure Task Force database; LYS: Levy-Yeyati and Sturzenegger (2003); DK: Dollar and Kraay (2002); PWT-6.1: Penn World Tables (Mark 6.1); GL: Gwartney and Lawson (2002); CWN: based on Cukierman et al. (1995).

Appendix C. Interactions of cabinet changes

Seigniorage	1	2	3	4	5	6
[Cabinet changes * (inflation ≥ 50%)] (−1)	31.560 (2.95)***					
[Cabinet changes * (inflation < 50%)] (−1)	1.096 (1.08)					
[Cabinet changes * (developing countries)] (−1)		6.270 (3.12)***				
[Cabinet changes * (industrial countries)] (−1)		−.478 (−.98)				
[Cabinet changes * (Gini > 40)] (−1)			5.753 (2.60)***			
[Cabinet changes * (Gini ≤ 40)] (−1)			−.117 (−.22)			
[Cabinet changes * (low ethnic homogeneity)] (−1)				12.714 (2.24)**		
[Cabinet changes * (high ethnic homogeneity)] (−1)				2.423 (2.06)**		

Appendix C (*continued*)

Seigniorage	1	2	3	4	5	6
[Cabinet changes * (low religious homogeneity)] (−1)					8.940 (1.78)*	
[Cabinet changes * (high religious homogeneity)] (−1)					3.203 (2.34)**	
[Cabinet changes * (high upheaval)] (−1)						7.610 (2.14)**
[Cabinet changes * (low upheaval)] (−1)						2.685 (2.86)***
Ethnic Homogeneity Index	−23.214 (−2.59)***	−24.193 (−2.64)***	−25.843 (−2.90)***	−19.759 (−2.01)**	−22.867 (−2.44)**	−24.289 (−2.69)***
Polity Scale	.336 (1.64)	.295 (1.43)	.120 (.70)	.261 (1.28)	.305 (1.46)	.322 (1.57)
Urban population (% of total)	−.546 (−2.44)***	−.482 (−2.38)**	−.093 (−.87)	−.460 (−2.36)**	−.497 (−2.39)**	−.460 (−2.30)**
Real GDP per capita	−.001 (−4.48)***	−.002 (−5.32)***	−.001 (−5.75)***	−.002 (−5.31)***	−.002 (−5.03)***	−.002 (−5.19)***
Growth of real GDP (−1)	−.521 (−3.09)***	−.640 (−3.73)***	−.421 (−3.47)***	−.644 (−3.80)***	−.660 (−3.72)***	−.647 (−3.78)***
# Observations	2247	2306	2250	2306	2284	2306
# Countries	107	108	105	108	107	108
Adjusted R^2	.25	.22	.33	.22	.22	.22

Notes:Panel regressions controlling for country fixed effects;Seigniorage, the dependent variable, was defined as the change in reserve money (IFS, line 14a) as a percentage of government revenues (IFS line 81);Models estimated with a constant and 3 decade dummies (1970s, 1980s, and 1990s). Their estimated coefficients are not shown in order to economize space; T-statistics based on heteroskedastic consistent standard errors are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Appendix D. More interactions of cabinet changes

Seigniorage	1	2	3	4	5	6
[Cabinet changes * (high turnover)] (−1)	4.735 (1.95)*					
[Cabinet changes * (low turnover)] (−1)	−.383 (−.55)					
[Cabinet changes * (low economic freedom)] (−1)		15.460 (3.53)***				
[Cabinet changes * (high economic freedom)] (−1)		−.274 (−.29)				
[Cabinet changes * (Polity Scale ≤ 0)] (−1)			7.774 (2.40)**			
[Cabinet changes * (Polity Scale > 0)] (−1)			2.166 (1.74)*			
[Cabinet changes * (high domestic debt)] (−1)				7.766 (1.85)*		
[Cabinet changes * (low domestic debt)] (−1)				−1.495 (−1.43)		
[Cabinet changes * (low creditworthiness)] (−1)					5.382 (3.08)***	
[Cabinet changes * (high creditworthiness)] (−1)					−.476 (−1.13)	
[Cabinet changes * (low openness] (−1)						4.580 (2.86)***
[Cabinet changes * (high openness)] (−1)						2.481 (1.59)
Ethnic Homogeneity Index	−32.133 (−3.24)***	−29.650 (−2.93)***	−24.808 (−2.72)***	−18.016 (−2.11)**	−25.416 (−2.85 ***	−24.931 (−2.73)***
Polity Scale	.205 (1.05)	.347 (1.52)	.487 (2.09)**	.294 (1.49)	.155 (.88)	.319 (1.53)

Appendix D (*continued*)

Seigniorage	1	2	3	4	5	6
Urban population (% of total)	−.065	−.413	−.471	−.330	−.095	−.498
	(−.32)	(−1.92)*	(−2.36)**	(−1.49)	(−.89)	(−2.45)**
Real GDP per capita	−.001	−.002	−.002	−.002	−.001	−.002
	(−3.35)***	(−4.56)***	(−5.36)***	(−5.24)***	(−6.03)***	(−5.26)***
Growth of real GDP (−1)	−.348	−.631	−.615	−.574	−.421	−.659
	(−2.48)**	(−3.38)***	(−3.71)***	(−2.97)***	(−3.45)***	(−3.78)***
# Observations	1852	2082	2063	1788	2282	2297
# Countries	102	105	102	104	108	108
Adjusted R^2	.21	.23	.24	.16	.32	.22

Notes:Panel regressions controlling for country fixed effects; Seigniorage, the dependent variable, was defined as the change in reserve money (IFS, line 14a) as a percentage of government revenues (IFS line 81); Models estimated with a constant and 3 decade dummies (1970s, 1980s, and 1990s). Their estimated coefficients are not shown in order to economize space; T-statistics based on heteroskedastic consistent standard errors are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

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