

Paper prepared for presentation at conference on Economic Development in Africa, 18-20 March 2007, St Catherine's College, Oxford; organized by Centre for the Study of African Economies (CSAE), University of Oxford

Seigniorage and Civil War

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Abstract

This paper provides empirical evidence on government recourse to seigniorage during and after civil war, and the macroeconomic consequences. Using a panel of 65 developing countries I test the hypothesis that post-civil war seigniorage is lower than peacetime, based on the underlying idea that governments end up killing the seigniorage goose during civil war. I estimate seigniorage revenue functions by Least Squares Dummy Variables and Two-Stage Least Squares estimation methods. The results indicate that seigniorage revenue is about 0.7 to 1.2 percentage points of GDP higher during war relative to peacetime. The additional seigniorage comes from taxation of the banking system. Post-war seigniorage is not significantly different to peacetime, implying that the seigniorage goose is not actually killed during civil war.

1. INTRODUCTION

What happens to seigniorage during and after civil war? I investigate this question using a panel of 65 developing countries of which 29 experienced at least one episode of civil war between 1964 and 2002. The rest enjoyed peace throughout this period. I test the hypothesis that post-war seigniorage revenue is lower than peacetime. The idea underlying the hypothesis is that governments end up killing the seigniorage goose during civil war, lowering post-war seigniorage capacity.

During civil war governments typically resort to seigniorage to raise revenue. One reason is that financing needs increase. Military spending increases by nearly two percentage points of GDP (Collier and Hoeffler, 2006); while the tax base, aid inflows and the scope for borrowing tend to contract, constraining financing options towards money issue. Civil war might also raise the government discount rate and its preference for seigniorage: A higher risk of government demise might produce incentive incompatibility for fiscal restraint as the government might not be in office to reap the benefits. Moreover, fiscal restraint might be irrational to the extent that restraining military expenditure increases the risk of government demise. However, private agents are likely to reduce their demand for money in response to the ensuing inflation, and to war itself. This could lower post-war seigniorage relative to peacetime, as hypothesized. Actual seigniorage outcomes would depend on the duration and severity of the conflict; the extent of wartime recourse to seigniorage; aid inflows; the scale of prior capital flight and currency substitution; and private expectations.

The econometric estimates indicate that seigniorage revenue rises by about 0.9 to 1.2 percentage points of GDP during wartime. The additional seigniorage comes from taxation of the banking system. Post-war seigniorage is not significantly different to peacetime.

To my knowledge this is the first study to use cross-country panel data to investigate the evolution of seigniorage revenue during and after civil war. Thus, the paper provides original empirical evidence on the macroeconomic consequences of civil war.

I develop an analytical framework in Section 2 and describe the data in Section 3. I undertake the empirical analysis in Section 4 and conclude in Section 5.

2. ANALYTICAL FRAMEWORK

Seigniorage is the real value of money issue. Money issue increases the monetary base. The observed level of seigniorage reflects the interaction between government attempt to collect real revenues from money issue – driven by its financing needs, preferences and options – and constraints to such an attempt: private sector response in terms of the demand for money. The monetary base comprises currency in circulation which can be regarded as a private-sector choice variable, and bank reserves which are not entirely a choice variable by the private sector. Rather, bank reserves are determined by the interaction of government reserve requirements, the banking sector's liquidity preference, and the private sector's demand for inside

money. Thus, in raising seigniorage the government has two distinct instruments at its disposal, the supply of currency and reserve requirements.

Developing countries have large financing needs relative to conventional tax revenues, forcing a reliance on seigniorage (Agénor 2000, Agénor and Montiel 1999, and Herrendorf 1997). Other sources of financing include aid inflows; implicit finances such as financial repression (Giovannini and de Melo 1993), or purchase of foreign exchange from the private sector at overvalued exchange rates (Pinto 1989)¹; and debt accumulation.

Seigniorage can be written as

$$Seigniorage = \frac{\Delta M}{P} = \frac{\Delta M}{M} \cdot \frac{M}{P} = \hat{M}m$$

where m is real base money and a hat (^) over a variable denotes its growth rate.

$$\text{Noting that } M = Pm \Rightarrow \hat{M} = \hat{P} + \hat{m} = \pi + \hat{m}, \text{ and } \hat{m} = \frac{\Delta m}{m} \Rightarrow m = \frac{\Delta m}{\hat{m}}$$

$$\text{Thus, } Seigniorage = \hat{M} \cdot m = (\pi + \hat{m}) \frac{\Delta m}{\hat{m}} = \pi m + \Delta m \quad (1)$$

πm is the inflation tax and Δm is the change in real balances

Equation 1 decomposes seigniorage into an inflation tax and changes in real balances. A trade-off between the two components can eventually occur with higher and higher inflation taxation inducing a fall in real balances, decreasing seigniorage revenues.

The amount of seigniorage the government collects or attempts to collect at time t would depend on the government discount rate; and government expenditure needs. It would also depend on private sector money demand, the constraint to money issue. Seigniorage outcomes depend on how inflation expectations are formed, and the level and growth of income. Income growth also increases government financing options by raising the conventional tax base, resulting in an ambiguous overall effect on seigniorage.

War and its aftermath

Civil war is likely to increase recourse to seigniorage first by increasing government financing needs. Military spending increases by nearly two percentage points of GDP (Collier and Hoeffler, 2006). On the other hand, tax revenues may fall as falling income or loss of territory shrinks the tax base while aid inflows and the scope for borrowing tend to contract, constraining financing options towards money issue. Civil war might also raise the government discount rate, leading to a preference for seigniorage: A higher risk of government demise might produce incentive incompatibility for fiscal restraint as the government might not be in office to reap the benefits. A collapsing government might even spend indiscriminately to create havoc. Moreover, fiscal restraint might otherwise be irrational for the government to the

¹ This could be a source of net implicit expenditures if government is a net seller (see Morris 1995 and Davies 2002)

extent that restraining military expenditure might increase the risk of government demise.

Actual seigniorage outcomes would depend on private sector response, that is changes in real balances due to war directly, or indirectly through price and income changes. Macroeconomic conditions at war onset affect private response. An already high inflation rate with the economy close to the point of maximum seigniorage offers little prospect for additional seigniorage. War intensity also matters. Government financing needs, and hence recourse to money issue, might increase with conflict intensity. This could also affect the public's response to war. Notably, capital flight could increase with conflict intensity, reducing money demand.

Peace changes the above scenario. Though large financing needs may persist due to demobilisation and reconstruction activities, financing options may expand: Peace tends to trigger an aid surge; improve government creditworthiness; and lower the government discount rate, reducing the risk of government demise and hence the incentive incompatibility for fiscal restraint. However, peace could produce a dilemma for the government. Foregoing seigniorage revenues restrains inflation, boosts money demand and revives the seigniorage goose over time. On the other hand, inflated expenditures might raise the need for seigniorage. The option chosen would depend on factors affecting the government discount rate such as its expected life span (as a government); aid inflows; macroeconomic conditions upon war termination; and how the war ended: A power-sharing peace settlement producing an enlarged government and an army absorbing former rebels requires substantial financing.

3. THE DATA

I use annual data for a panel of 65 developing countries of which 29 experienced at least one episode of civil war between 1964 and 2002. The remaining 36 countries enjoyed peace throughout this period. OECD countries are excluded, being generally civil war-free; and not dependent on seigniorage as a major source of government revenues (Agénor and Montiel 1999, Easterly and Schmidt-Hebbel 1994). Former communist countries are excluded. One reason is that they lack the required data. Currency-union economies are also excluded because union membership constrains their scope for seigniorage. However, South Africa is included because its currency serves as an anchor for other currencies in its monetary union, allowing much scope for seigniorage. In terms of regional distribution, Africa has 10 conflict countries, South Asia 9; the Americas 5, and the Middle East and North Africa 5. Caribbean countries are all non-conflict. The sample yields a total of over 1500 annual observations including 290 civil war, and 160 post-war, episodes. Appendix 1 lists the civil war episodes and countries in the panel.

Seigniorage measures

I estimate seigniorage as a proportion of GDP as:

$$seig_t = \frac{\Delta M_t}{Y_t} \quad (2)$$

seig is seigniorage (proportion of GDP)

M is the nominal monetary base.

Y is nominal GDP.

The subscript t denotes time.

I estimate the currency in circulation and bank reserves components of seigniorage using Equation 2 but with only the relevant component included in the monetary base. The data are from the International Financial Statistics, January 2006.

War

I focus on civil wars which occur between the government of a state and internal opposition groups. I use a threshold of 1000 battle-related deaths and consider only the country where the conflict is fought as being at war. I exclude “minor” conflicts with an accumulated total of fewer than 1000 battle-related deaths as they are unlikely to trigger significant changes in seigniorage-related behaviour. The data are from the UCDP/PRIO Armed Conflict Dataset Version 4-2006 (see Gleditsch *et al* 2002). The dataset represents the most recent and comprehensive effort at war data collection and has become the main source of data on armed conflicts around the world. Lastly, I assume a decade-long post-war period after which, barring conflict recurrence, a country reverts to peace status.

Stylized facts

Three stylized facts for conflict countries emerge from Table 1 which reports descriptive statistics for the principal variables. First, mean seigniorage rises during war by close to one percentage point of GDP from a peacetime level of 1.8% of GDP. Post-war, seigniorage declines but remains higher than its peacetime level. Mean inflation also follows a similar pattern to seigniorage, rising from 19% during peacetime to 96% during war and falling to 86% post-war. Median inflation rises from 5.7% during peacetime to 12.2% during war and falls to 9.7% post-war. Second, the composition of seigniorage changes from peacetime to wartime: Mean bank reserves seigniorage rises from 0.7% of GDP during peacetime to 1.7% during war, and falls to 0.92% post-war. On the other hand, currency seigniorage decreases from 1.1% of GDP during peacetime to 1% during war and rises to 1.1% post-war. Third, and consistent with the above change in the composition of seigniorage, mean currency holdings of the non-bank private sector fall from around 9.1% of GDP during peacetime to 6.4% during war, while bank reserves rise from 4.3% to 5.9%. Post-war, currency holdings rise to 7.5%, lower than the peacetime level; while bank reserves fall to 5.1%, higher than the peacetime level.

Table 1: Descriptive Statistics

Variable		Conflict countries				Non-conflict countries
		Peace time	Wartime	Post-war	All	
Seigniorage % GDP	Total	1.8	2.7	2.1	2.0	1.9
	Currency component	1.1	1.0	1.1	1.1	0.81
	Bank reserves component	0.70	1.7	0.92	0.86	1.1
Real reserve money balances % GDP	Total	13.4	12.3	11.8	12.9	11.2
	Currency	9.1	6.4	7.5	8.1	5.5
	Bank reserves	4.3	5.9	4.3	4.8	5.6
Real per capita income growth %		1.6	0.65	2.4	1.5	1.5
Inflation %		19.2	96	86	53	45
Inflation % (median)		5.7	12.2	9.7	8.2	10

Notes: All variables are means except otherwise stated

4. EMPIRICAL ANALYSIS

To analyse the effects of war and its aftermath on seigniorage revenue, I estimate the following model for seigniorage. I repeat the estimations using the currency in circulation and bank reserves components of seigniorage as the dependent variable. To circumvent endogeneity, I use mostly exogenous proxies for government financing needs, options and constraints.

$$\begin{aligned} \text{seig} = & \beta_1 \text{agric} + \beta_2 \text{trade} + \beta_3 \ln \text{pci} + \beta_4 \text{growth} + \beta_5 \ln \text{urban} + \\ & \beta_6 \text{aid} + \beta_7 \text{worldinflation} + \beta_8 \text{money} + \beta_9 \text{war} + \beta_{10} \text{wduration} \\ & + \beta_{11} \text{postwar} + \beta_{12} \text{pwduration} + \beta_{13} \text{time} \end{aligned} \quad (3)$$

seig is seigniorage (% GDP).

agric is agriculture value added (% GDP)

trade is foreign trade (% GDP).

lnpci is log of per capita income (constant US dollars).

growth is GDP growth (%)

lnurban is log of urban population (% of total).

aid is change in the level of foreign aid (% GDP)

worldinflation is world inflation (%)

money is real money balances

war is the war dummy.

wduration is war duration in years

postwar is the post-war dummy

pwduration is post-war duration in years

time is decadal time dummies

Data availability and stationarity concerns dictated the specification of Equation 3. All the variables are stationary. Variables specified in logs were non-stationary in levels.

The unit roots' tests results are presented in Appendix 2. The GDP shares of agriculture and foreign trade capture the structure of the economy which affects explicit taxes and hence indirectly affect reliance on seigniorage. Foreign trade is easy to tax, implying less dependence on seigniorage revenue as its GDP share increases, and hence a negative relationship with seigniorage revenues is expected. A positive relationship is expected for peasant agriculture which is difficult to tax. Data constraints preclude controlling for the share of mining in GDP and force me to use total value added in agriculture in place of peasant agriculture. The manufacturing share in GDP, which could also reflect the structure of an economy, was not used because it was non-stationary in levels and logs. Per capita income is used as a proxy for the efficiency of the conventional tax machinery and the size of the tax base which both tend to increase with the level of development. Hence a negative relationship with seigniorage revenue is expected.

The relationships between seigniorage, on the one hand, and GDP growth and urban population share are unpredictable a priori: While GDP growth could decrease reliance on seigniorage revenues by enhancing the revenue potentiality of conventional taxes, it could also ease the constraint on seigniorage by boosting money demand. Urban communities tend to be more sensitive to explicit taxation, suggesting a positive relationship between urban population share and seigniorage. On the other hand, lower urban tax collection costs may induce a negative relationship.

Aid inflows might substitute for seigniorage, suggesting a negative relationship between the two variables. World inflation increases the opportunity cost of private sector response to inflation by way of currency substitution and capital flight, suggesting a positive relationship with seigniorage. Real money balances constrain money issue, suggesting a positive relationship. Other factors that would have been controlled for, data permitting, include central bank independence, political regime turnover, the extent of fiscal decentralisation and the policy-making process. Episodes of an economic stabilization programme were too few to control for.

I quantify civil war first as a dummy variable "war" with a value of 1 for countries experiencing civil war in a given year, and zero otherwise. Second, I quantify civil war as a duration variable, "wduration", that is, the number of years of war. Thus, the value of wduration for Mozambique 1981 is 3 since that country was in its third year of war in 1981. I assume that the post-war period lasts for ten years after which, barring war recurrence, a country reverts to peace status. I also quantify the post-war period first as a dummy variable "postwar"; and then as a count variable "pwduration", that is, the number of years of peace after a civil war. pwduration ranges from 0 to 10, 0 being for non-post-war episodes. Under the hypothesis that seigniorage revenue falls post-war relative to peacetime, β_{11} , the post-war dummy coefficient, must be negative.

Equation 3 is somewhat in the tradition of Cukierman *et al* (1992) and Edwards and Tabellini (1991). However, the war and post-war variables, and several other regressors are absent in those models. Furthermore, those models capture steady-state seigniorage using cross-sectional data while I use annual panel data to capture short-run changes in seigniorage.

Estimation method

I eschew estimation techniques such as first differencing that reduce the variation in the variables since the variables are generally slow-changing. Accordingly, the estimation is based first on robust Least Squares Dummy Variable (LSDV). LSDV is preferred to simple OLS which may produce biased and inconsistent estimates due to unobserved country-specific effects. Also, compared with the fixed-effects estimator, the LSDV estimator produces the appropriate estimate of the variance of the error term.

Aid might be endogenous in Equation 3. For instance, donors might increase aid in response to fiscal difficulties. Accordingly, I carry out Two-Stage Least Squares estimation, following Tavares (2003) to instrument for aid. Tavares' underlying idea is that bilateral donor governments provide aid to an extent according to historical ties and domestic budgetary circumstances that are unrelated to circumstances in the recipient country. I proceed as follows: I compute three variables capturing proximity between each of the five largest OECD aid donors – United States, United Kingdom, Japan, Germany and France – and each country in the sample. The first variable is physical proximity given by the inverse of the distance between aid donor and aid recipient capital cities. Second is a dummy variable for linguistic proximity which takes a value of one if the official language of the aid donor and recipient is the same, and zero otherwise. Third is a dummy variable for religious proximity which takes a value of one if aid donor and recipient share the same dominant religion, and zero otherwise. I interact the three variables with the donor country's aid to GNI ratio. I drop the interaction terms for the same language as Japan and Germany because no aid recipient meets that criterion. I then regress aid on the 13 remaining "proximity" variables and the other exogenous regressors in Equation 3, and use only the statistically significant proximity variables as my instruments for aid.

All data, besides those relating to seigniorage and related variables, and war, are from World Development Indicators, April 2006.

Estimation results

The seigniorage results in Table 2, regressions 1-4, indicate that seigniorage rises during war relative to peacetime: The war dummy is always significant at less than 5%, with a coefficient of 0.89 to 1.2, implying that seigniorage rises during war by 0.89 to 1.2 percentage points of GDP. The increase is substantial, given that peacetime seigniorage is approximately 1.8% of GDP (see Table 1). The war duration and post-war variables are insignificant, implying that seigniorage does not change significantly with war duration, nor is it significantly different post-war relative to peacetime. In regression 5 I interact the post-war dummy with aid which often surges after war and may have a differential post-war impact. The coefficient of the interaction term is -0.45, which is large and significant at 6%. Thus aid serves as a major substitute for seigniorage post-war.

In the currency seigniorage regressions in Table 3 the war and post-war dummies, and the war duration variables are insignificant, implying that currency seigniorage is not significantly different between war and peacetime, and war duration makes no significant difference. However, the post-war duration variable is significant at 10% in regressions 2 and 4, suggesting that currency seigniorage increases with peace duration.

In the bank reserves regressions in Table 4 the war dummy coefficient is positively significant at 5% or less. That this variable is significant here but insignificant in the currency regressions accord with the descriptive statistics which indicate a rise in bank reserves seigniorage revenue during war and a slight fall in currency seigniorage. The war duration variable is also significant (and negative) in regressions 1, 2, 5 and 6, suggesting that bank reserves seigniorage decreases with war duration. On the other hand the insignificance of the post-war dummy and duration variables suggest that bank reserves seigniorage is not higher post-war relative to peacetime.

Turning to the controls in Tables 2-4, the foreign trade and agriculture value-added variables were dropped because they were always statistically insignificant and did not affect the other regressors. World inflation is almost always significant at 1%, with a small coefficient of 0.01 to 0.06, implying that a one percentage point increase in world inflation increases seigniorage by 0.01 to 0.06 percentage points of GDP. Aid is never significant in the seigniorage regressions, contrary to expectations that aid reduces reliance on seigniorage. Rather, it is significant at less than 5% in currency regressions 1, 4 and 6 with a coefficient of around 0.02, implying that a one percentage point increase in aid is associated with a 0.02 percentage point increase in currency seigniorage. The log of the urban population share is mostly significant across the regressions, with a coefficient of 0.4 to 1.9. Thus, a doubling of the urbanization rate increases seigniorage by 0.4 to 1.9 percentage points of GDP. This positive relationship implies that the negative effect of urban political sensitivity to explicit taxation outweighs the positive effect of lower urban administrative costs. The log of per capita income is negatively significant at various levels in most of the LSDV regressions, implying that an increase in per capita income is associated with a fall in seigniorage. GDP growth is never significant. The first lag of the dependent variable is significant at 1% in the currency and bank reserves regressions where it is used. With a lagged dependent variable the war dummy indicates how much additional seigniorage war induces, conditional on past seigniorage. The long run coefficients of the regressors is obtained by dividing the coefficient estimates by one minus the coefficient of the lagged dependent variable. Thus, in regression 4, Table 4, the long run war dummy coefficient is 1. On the whole the introduction of the lagged dependent variable does not change the key results.

The Wooldridge (2002) test for serial correlation in the residuals generally indicates the absence of first order serial correlation. The results also contain the F statistic of the Davidson-Mackinnon (1993) endogeneity test for aid. The test involves estimating the model using as an additional regressor predicted aid – the suspected endogenous regressor – as a function of the exogenous variables. An F test is then used to test the null that predicted aid is not statistically significant. Regressions 4 of Table 2, and 5 of Table 3 reject the null, implying that aid is endogenous in these regressions and the 2SLS estimates are to be preferred. Aid is not endogenous in the other 2SLS regressions and the LSDV estimates are to be preferred. Appendix 3 presents the first-stage regression results. The F test statistic indicates the joint significance of the regressors.

Consistent with the above evidence of a large increase in bank reserves seigniorage during war, the mean observed bank reserve ratio rises from 20.2% during peacetime to 24.4% during war. It falls to 19.6% post-war. I estimated Equation 9 which shows

that the increase in the observed bank reserve ratio during war is statistically significant:

$$\text{ORR} = 19.6 + 4.4\text{war} - 0.18\text{wduration} + 2.0\text{postwar} - 0.13\text{pwduration} \quad (9)$$

(0.00)*** (0.01)*** (0.06)* (0.23) (0.59)

* significant at 10%, *** significant at 1%.

where ORR is observed reserve ratio, war is the war dummy, wduration is war duration, postwar is the post-war dummy, and pwduration is post-war duration. p-values are in parentheses. The war dummy is statistically significant at 1%, with a coefficient of 4.24, implying that observed reserve ratios are significantly higher during war relative to peacetime. The war duration term is also statistically significant at 3% with a coefficient of -0.20, implying that the ratio falls with war duration. The post-war dummy and duration variables are statistically insignificant, implying that post-war observed reserve ratios are not significantly different from peacetime.

Table 2: Seigniorage Regression Results

Dependent variable: seigniorage % GDP

Regressors	Estimation Method				
	LSDV			2SLS	
	(1)	(2)	(3)	(4)	(5)
War dummy	0.90 (0.04)**	0.89 (0.04)**	1.07 (0.00)***	1.24 (0.01)***	0.70 (0.02)**
War duration	-0.03 (0.15)	-0.03 (0.16)	-0.01 (0.80)	-0.04 (0.19)	0.00 (0.77)
Post-war dummy	0.21 (0.39)	0.19 (0.44)	0.57 (0.09)*	0.42 (0.31)	3.4 (0.01)**
GDP growth %	-0.02 (0.25)	-0.01 (0.31)	-0.00 (0.74)	-0.00 (0.82)	0.03 (0.24)
World inflation rate %	0.06 (0.00)***	0.06 (0.00)***	0.05 (0.00)***	0.05 (0.05)*	0.06 (0.04)**
Log (per capita income)	-0.94 (0.01)***	-0.84 (0.03)**	-0.53 (0.19)	-0.26 (0.84)	-0.02 (0.01)***
Log (urban population share %)	1.90 (0.00)***	1.87 (0.00)***	0.87 (0.11)	0.56 (0.45)	0.02 (0.01)***
Foreign aid %GDP		0.01 (0.59)	0.01 (0.47)	0.03 (0.84)	
Reserve money % GDP			0.24 (0.00)***	0.18 (0.00)***	
Log (reserve money % GDP)					0.03 (0.00)***
Foreign aid x post-war dummy					-0.45 (0.06)*
Wooldridge test for 1 st order Serial correlation	1.34 (0.25)	1.36 (0.25)	1.27 (0.26)		
Test statistic for over-identifying restrictions	Sargan			1.44 (0.23)	
	Basman			1.37 (0.24)	
Davidson Mackinnon F test statistic				15.04 (0.00)***	
Observations	1878	1874	1874	1597	1769
R-squared	0.28	0.27	0.36	0.35	0.20

Robust p values in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3: Currency Seigniorage Regression Results

Dependent variable: currency seigniorage %GDP

Regressors	Estimation Method							
	LSDV				2SLS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
War dummy	0.01 (0.96)	0.04 (0.69)	0.02 (0.87)	0.15 (0.20)	-0.04 (0.84)	-0.03 (0.88)	-0.134 (0.784)	0.070 (0.614)
War duration	0.01 (0.16)	0.01 (0.22)	0.01 (0.28)	0.01 (0.18)	0.00 (0.86)	0.01 (0.45)	0.015 (0.208)	0.012 (0.174)
Post-war dummy	0.07 (0.47)						1.146 (0.092)*	1.109 (0.076)*
GDP growth %	0.00 (0.79)	0.00 (0.98)	0.00 (0.79)	0.01 (0.21)	0.00 (0.41)	0.01 (0.13)	0.019 (0.219)	0.015 (0.089)*
World inflation rate %	0.02 (0.00)***	0.03 (0.00)***	0.01 (0.00)***	0.02 (0.00)***	0.00 (0.61)	-0.00 (0.91)	0.022 (0.019)**	0.021 (0.017)**
Log (per capita income)	-0.24 (0.08)*	-0.40 (0.00)***	-0.17 (0.19)	-0.15 (0.27)	0.15 (0.76)	0.85 (0.13)	-0.657 (0.002)***	-0.688 (0.003)***
Log (urban population share %)	0.70 (0.00)***	0.76 (0.00)***	0.60 (0.00)***	0.43 (0.03)**	0.52 (0.09)*	0.10 (0.76)	0.587 (0.004)***	0.623 (0.002)***
Foreign aid %GDP	0.02 (0.02)**		0.01 (0.10)	0.02 (0.00)***	0.05 (0.35)	0.14 (0.03)**		
Dependent variable: 1 st lag			0.33 (0.00)***		0.32 (0.00)***			
Currency in circulation % GDP				0.13 (0.00)***		0.12 (0.00)***		
Log(currency in circulation %GDP)							0.74 (0.00)***	0.74 (0.00)***
Post war duration		0.03 (0.06)*	0.02 (0.16)	0.03 (0.10)*	0.01 (0.53)	0.01 (0.80)		
Aid x war							0.029 (0.68)	
Aid x post-war							-0.17 (0.15)	-0.16 (0.13)
Wooldridge test for 1 st order Serial correlation	0.38 (0.54)	0.49 (0.49)	17.4 (0.00)	0.29 (0.59)				
Test statistic for over-identifying restrictions	Sargan				2.96 (0.09)	1.52 (0.22)		
	Basman				2.83 (0.09)	1.45 (0.23)		
Davidson Mackinnon F test statistic					16.9 (0.00)	0.00 (0.99)		
Observations	1867	1871	1846	1867	1573	1591	1762	1762
R-squared	0.38	0.38	0.45	0.41	0.43	0.23	0.23	0.26

Robust p values in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Bank Reserves Seigniorage Regression Results

Dependent variable: bank reserves seigniorage % GDP

Regressors	Estimation Method							
	LSDV				2SLS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
War dummy	0.85 (0.02)**	0.85 (0.02)**	0.74 (0.02)**	0.67 (0.04)**	1.26 (0.00)***	1.36 (0.00)***	0.020 (0.982)	0.423 (0.021)**
War duration	-0.04 (0.02)**	-0.04 (0.02)**	-0.02 (0.49)	-0.03 (0.21)	-0.05 (0.05)*	-0.07 (0.01)**	0.001 (0.944)	-0.005 (0.718)
Post-war dummy	0.10 (0.60)		0.43 (0.14)	0.16 (0.59)	0.54 (0.11)		1.144 (0.235)	1.068 (0.220)
GDP growth %	-0.01 (0.19)	-0.02 (0.16)	-0.01 (0.26)	-0.01 (0.31)	-0.01 (0.20)	-0.01 (0.27)	0.006 (0.812)	-0.001 (0.920)
World inflation rate %	0.04 (0.00)***	0.04 (0.00)***	0.03 (0.01)***	0.03 (0.04)**	0.06 (0.01)***	0.06 (0.01)***	0.041 (0.052)*	0.040 (0.053)*
Log (per capita income)	-0.57 (0.07)*	-0.52 (0.08)*	-0.43 (0.22)	-0.50 (0.17)	-1.23 (0.25)	-1.52 (0.15)	-0.565 (0.160)	-0.626 (0.141)
Log (urban population share %)	1.46 (0.00)***	1.41 (0.00)***	0.75 (0.13)	1.10 (0.04)**	0.85 (0.19)	1.29 (0.06)*	0.865 (0.071)*	0.938 (0.051)*
Foreign aid %GDP	-0.01 (0.52)		-0.00 (0.88)	-0.02 (0.16)	-0.12 (0.32)	-0.16 (0.19)		
Dependent variable: 1 st lag				0.33 (0.00)***		0.16 (0.00)***		
Log (bank reserves % GDP)							1.10 (0.00)***	1.10 (0.00)***
Post war duration		0.03 (0.33)						
Aid x war dummy							0.057 (0.65)	
Aid x post-war dummy							-0.14 (0.42)	-0.11 (0.41)
Wooldridge test for 1 st order Serial correlation	0.58 (0.45)	0.53 (0.47)	0.57 (0.45)	16.88 (0.00)				
Test statistic for over-identifying restrictions	Sargan				4.4 (0.04)	2.99 (0.08)		
	Basman				4.2 (0.04)	2.86 (0.09)		
Davidson Mackinnon F test statistic					0.00 (0.99)	1.41 (0.24)		
Observations	1867	1871	1867	1846	1591	1573		
R-squared	0.22	0.23	0.34	0.31	0.22	0.15		

Robust p values in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

6. CONCLUSIONS

I have investigated the hypothesis that post-war seigniorage revenue is lower than peacetime, based on the underlying idea that governments end up killing the seigniorage goose during civil war, lowering post-war seigniorage capacity. In the process I have generated evidence on the consequences of civil war for seigniorage. The evidence is that while indeed seigniorage rises during war, post-war seigniorage is not significantly different to peacetime. Thus, the typical civil war government does not end up killing the seigniorage goose, permitting a return to peacetime seigniorage levels.

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Appendix 1: Civil War Episodes

Country	Civil war episode
Algeria	1991-
Argentina	1973-77
Bangladesh	1985-92
Burundi	1995-
Colombia	1978-
Egypt	1967, 1969-70
El Salvador	1979-91
Ethiopia	1966-91, 2002-
Guatemala	1966-95
India	1985-
Indonesia	1975-92, 1997-
Iran	1966-68, 1979-88, 1990-93, 1996-97, 1999-2001
Israel	1964-
Morocco	1975-89
Nepal	1999-
Nicaragua	1978-79, 1981-89
Nigeria	1966-70
Pakistan	1971, 1974-77
Peru	1980-99
Philippines	1970-
Rwanda	1991-94, 1997-2002
Sierra Leone	1992-2000
South Africa	1975-88
Sri Lanka	1971, 1983-2001
Sudan	1963-72, 1983-
Syria	1979-82
Thailand	1974-82
Uganda	1978-79, 1981-91, 1994-
Zimbabwe	1974-79

Non-conflict countries

Bahrain, Barbados, Belize, Bhutan, Bolivia, Botswana, Brazil, Cape Verde, Chile, Costa Rica, Ecuador, Fiji, Gambia, Ghana, Haiti, Honduras, Jamaica, Jordan, Kenya, Kuwait, Madagascar, Malawi, Mauritius, Oman, Paraguay, Saudi Arabia, Seychelles, Solomon Islands, Suriname, Tonga, Trinidad, Tunisia, Uruguay, Vanuatu, Venezuela, Zambia.

Appendix 2: Unit roots tests

Variable	Augmented Dickey Fuller Fisher Chi-square		PP- Fisher Chi- square	
	Statistic	Prob	Statistic	Prob
Agriculture value-added	170.1	0.01	206	0.000
Aid (% GNI)	277	0.00	313	0.00
Bank reserves seigniorage % GDP	654	0.00	1211	0.00
Currency seigniorage	484.8	0.00	917	0.00
Foreign trade	178	0.01	203	0.00
GDP growth (%)	892	0.00	968	0.00
Inflation (%)	344	0.00	384	0.00
Log (bank reserves %GDP)	194	0.00	156	0.12
Log (base money %GDP)	180	0.00	187	0.00
Log (currency in circulation %GDP)	233	0.00	182	0.01
Log (manufacturing value-added % GDP)	140	0.19	134	0.33
Log (per capita income constant US\$)	175	0.00	181	0.00
Log (population)	1313	0.00	1508	0.00
Log (real GDP)	1184	0.00	1369	0.00
Log (urban population share %)	349	0.00	840	0.00
Manufacturing value-added % GDP	134.7	0.47	148	0.24
Per capita income (constant US\$)	110	0.95	113	0.92
Seigniorage	531	0.00	996	0.00
Urban population (% of total)	97.6	0.99	327	0.00
US inflation (%)	427	0.00	164	0.05
World Inflation (%)	186	0.00	196	0.00

Notes: the null of both tests is unit roots.

Appendix 3: Two-Stage Least Squares First-Stage Regressions

	(1)	(2)
	Foreign aid %GDP	Foreign aid %GDP
War dummy	2.2 (0.00)***	2.1 (0.00)***
war duration (years)	-0.081 (0.12)	-0.076 (0.01)***
first 5 post-war years dummy	1.5 (0.04)**	1.7 (0.12)
second 5 post-war years dummy	1.7 (0.02)**	1.4 (0.06)*
log(urban population share %)	3.5 (0.00)***	3.4 (0.00)***
World inflation rate %	0.16 (0.00)***	0.16 (0.00)***
log (per capita income)	-8.6 (0.00)***	-8.6 (0.00)***
GDP growth %	-0.014 (0.52)	-0.014 (0.88)
lagged dependent variable	-0.001 (0.98)	
base money % GDP		-0.042 (0.18)
Interaction term of donor aid to GNI ratio % and inverse of distance from UK	3,263 (0.00)***	3,068 (0.00)***
Interaction term of donor aid to GNI ration and inverse of distance from Japan	3,356 (0.58)	2,395 (0.64)
Observations	1589	1597
R-squared	0.70	0.71
F statistic	50 (0.00)***	49 (0.00)***

p values in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%