

Post-Conflict Monetary Reconstruction

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Abstract

During civil war governments typically resort to inflation to raise revenue. In this paper we model and quantify this phenomenon and then apply it to the choices and constraints faced in the post-conflict period. We show that far from there being a fiscal peace dividend, post-conflict governments tend to face even more pressing needs than during war. In consequence, in the absence of post-conflict aid, inflation sharply increases and this frustrates a more general monetary recovery. Aid decisively transforms the path of monetary variables in the post-conflict period, enabling the economy to regain peacetime characteristics. Post-conflict aid thus accomplishes a monetary ‘reconstruction’ analogous to its more evident role in infrastructure.

1. Introduction

This paper investigates a hard choice facing governments in the post-conflict period following a civil war. It provides a macroeconomic rationale for post-conflict assistance entirely distinct from the usual concerns about reconstruction.

War is expensive and so has powerful economic consequences. Civil war, which is now far the most common form of war, is particularly damaging, reducing income, increasing capital flight, and diverting activity into subsistence. All these effects can be expected to reduce the demand for money. The resulting decline in seigniorage collides with increased government fiscal needs, both effects tending to raise inflation. A likely economic legacy of war is thus a deterioration in the trade-off between seigniorage and inflation. Just as the post-war government faces a hard choice between continued military spending and the reconstruction of infrastructure, so in the monetary sphere, it faces a choice between continued inflation and the ‘reconstruction’ of monetary variables.

In Section 2 we set out the decision problems facing households and governments. The demand for money on the part of households is the constraint against which the government maximizes. In Section 3 we apply the model to the data. The expansion in data on civil wars has recently made it a researchable phenomenon using standard quantitative techniques (Miguel *et al.* 2004, Collier and Hoeffler, 2004). We estimate both how money demand is affected by civil war and its aftermath, and how the revealed preferences of governments alter when faced with both these changed constraints and changed needs. Potentially, the harsh policy trade-offs that governments face in post-conflict situations can be alleviated by aid, and indeed this is the context for which aid was invented. In Section 4 we introduce aid into the analysis, estimating how aid alters constraints and choices and showing the path of inflation, money demand and seigniorage with and without post-conflict aid. Section 5 discusses the implications of our results.

2. The government decision problem

We assume that prior to civil war the government is conducting its monetary policy on a sustainable basis. This may well involve the choice of a positive rate of inflation but it does not involve the government attempting to fool private agents through delivering more inflation than they expect. We do not assume that the government is necessarily trying to maximize social welfare. The actual choice of inflation will depend upon how costly it is to the government relative to other sources of revenue, where the costs taken into account by the government may differ from those that concern the society.

Civil war takes the society and the government by surprise. This is a reasonable characterization since, although the event can to an extent be anticipated, no predictive model has been able to get beyond low probabilities: the main news occurs around the outbreak. First, consider the effect upon private agents. Civil war reduces the growth of GDP. A typical estimate of the economic loss is that growth is reduced by around 2.3%, over a period of seven years (Collier, 1999). Heightened insecurity tends to divert economic activity towards relatively sheltered sectors, notably subsistence, and agents

attempt to protect assets by capital flight. In the post-conflict decade the economy usually recovers, a typical estimate being that growth is around 1.1% above normal (Collier and Hoeffler, 2004a). Thus, for a prolonged period, the demand for money is likely to be reduced both directly due to the fall in income, and indirectly due to activity and asset substitution

The fall in money demand worsens the seigniorage-inflation trade-off facing the government. However, the government will want to increase its spending for the duration of the conflict. Typically during civil war military spending increases by nearly two percentage points of GDP (Collier and Hoeffler, 2006). This need for temporarily increased military spending increases the government discount rate. In the context of civil war borrowing is difficult, so that the government will choose a higher rate of inflation.

We now set out the decision problem more formally using a simple model in which a forward-looking government chooses how much conflict-related expenditure is to be financed at the margin through seigniorage. The model, which is similar to that used by Bruno and Fischer (1990) and Adam (1995), is based on a simple Cagan (1956) characterization of the private sector's demand for money.

To sharpen the exposition we make a number of simplifying assumptions. The first and least important is that other than due to war we hold private income and other sources of financing constant. We therefore abstract from broader questions of the optimal fiscal response to expenditure shocks (see, for example, Mankiw, 1987 and Cashin *et al* 2002).¹ Second, we assume a simple monetarist framework in which the instrument controlled by the authorities is base money which is the only domestic financial liability. Money is held by both the bank and non-bank private sectors and in the empirical analysis reported below we distinguish between seigniorage earned on currency in circulation and bank reserves, but without loss of generality we conflate these demands in our model.

Third, we set up the model under the assumption that the private sector's inflation expectations are formed adaptively. Given the context, this has an intuitive appeal as we might expect private agents to respond with a lag, possibly a very short one, to conflict-related changes in public expenditure. Employing an adaptive expectations framework has other merits, however. Specifically, given the Cagan-form money demand function, inflation equilibria on the 'good side' of the seigniorage Laffer curve are dynamically stable under the assumption of adaptive expectations, whereas those on or beyond the top of the Laffer curve are unstable. As Bruno and Fischer (1990) show, the opposite holds under rational expectations, a feature which gives rise to the 'high inflation trap' analysed in their paper.² Given that our analysis starts from a position where the economy is in an initial equilibrium on the 'good side' of the Laffer curve, it makes sense that this initial equilibrium is dynamically stable. Finally, we assume away time-inconsistency problems

¹ Equivalently, the government's problem can be characterized in terms of the change in expenditure requirements *net* of other financing items.

² This property of adaptive expectations is replicated under rational expectations if there is lagged adjustment of money demand.

in the strict sense that the initial and any subsequent long-run inflation equilibria are credible.

The model

We start with government preferences which are defined as

$$V(g(\phi_t), k(\phi_t)) \quad (1)$$

where g denotes government expenditure and $k(\phi_t)$ the discounted future costs of current inflation distinct from the inflation-tax distortion on the demand for money. For example, $k(\phi_t)$ could reflect the reduction in investment efficiency associated with higher inflation. We assume $V_g \geq 0$, $V_k \leq 0$, $k'(\phi_t) \leq 0$.

The government's period budget constraint is

$$g_t = \frac{\tilde{M}_t}{P_t} + a_t + \vartheta_t \quad (2)$$

where a_t denotes the real domestic value of aid inflows, ϑ_t conventional tax revenues,

M_t nominal base money, and $\frac{\tilde{M}_t}{P_t}$ the real value of seigniorage, which is defined as

$$s_t = \frac{\tilde{M}_t}{P_t} = \frac{\tilde{M}_t}{M_t} \frac{M_t}{P_t} = \hat{M}_t m_t = (\hat{m}_t + \phi_t) m_t = \tilde{m}_t + \phi_t m_t \quad (3)$$

We treat aid and tax revenue as fixed so that at the margin, changes in government expenditure are financed by changes in domestic deficit financing. The private sector's demand for money is characterised by a Cagan money demand function of the form

$$m_t = A_t y_t e^{-\zeta \phi_t^e} \quad (4)$$

where y denotes private incomes, ϕ_t^e denotes expected inflation, defined

$\phi_t^e = \phi_t^e / (1 + \phi_t^e)$, where ϕ_t^e is the conventional measure of inflation. Inflation defined in this manner has the feature that its upper bound is 1 as the conventional measure of inflation becomes arbitrarily large. In the context of seigniorage revenue, this gives it a natural interpretation as a tax rate where a value of 1 implies complete confiscation.³

³ Calvo and Leiderman (1992) show that under specific restrictions on functional form, equation (4) derives directly from the dynamic first-order condition for a representative agent maximizing utility of the

form $U = \int_0^{\infty} [u(c_t) + v(m_t)] e^{-\rho t} dt$.

Finally, the private sector adjusts its inflation expectations in response to the deviation of actual inflation from the level anticipated in the previous period:

$$\dot{\phi}_t^e = \eta(\phi_t - \phi_t^e) \quad (5)$$

where $0 < \eta < 1$ measures the speed of adjustment.

Equilibrium

The government's problem is to maximize (1) subject to (2) and (4). Given our assumption that government can credibly commit to a given inflation rate, then in equilibrium inflation expectations are correct which, assuming no growth in real income, implies a constant rate of inflation and monetary growth: $\dot{\phi}_{t21}^e = \dot{\phi}_{t21} = \dot{\phi}_t = \dot{\phi}_t^*$ (and, from (5), $\dot{\phi}_{t21}^e = 0$). In these circumstances, the first order condition with respect to inflation is given by

$$\frac{4V_k k'(\phi_t)}{V_g} = m_t(1 + \zeta \phi_t). \quad (6)$$

The solution to (6) defines the optimal (constant) inflation rate, $\phi_t^* = \phi_0^*$, and rate of growth of the money supply. Substitution into (4) and (3) yields optimal seigniorage. This is shown as point A in Figure 1. The right hand side of (6) is simply the slope of the seigniorage Laffer curve defined by the demand for money, (4). The seigniorage revenue maximizing point is attained at $\phi^{\max} = 1/\zeta + \nu \hat{y}$, where \hat{y} denotes the growth rate of real income. The left hand side of (6) is the slope of the government's indifference curve; measuring the rate at which the government trades off present government consumption against future damage to the economy. This can be thought of as a quasi-discount rate. It follows from (6) that

$$\frac{\partial \phi_t^*}{\partial V_G} > 0 \text{ and } \frac{\partial \phi_t^*}{\partial V_k} < 0. \quad (7)$$

Dynamics

The short-run dynamics of the model in response to anticipated and unanticipated changes in the fiscal deficit emerge directly from equations (3) to (5). We assume that in the short run both A_t and y_t in (4) are constant. Then, taking the log derivative with respect to time, and assuming we get

$$\frac{d \ln m_t}{dt} = \hat{m}_t = 4\zeta \dot{\phi}_t^e. \quad (8)$$

Using the definition $\hat{M}_t | (\hat{m}_t, 2\phi_t)$, and denoting the growth in the money supply by $\omega_t | \hat{M}_t$, inflation can be expressed as

$$\phi_t | \omega_t \zeta \phi_t^e. \quad (9)$$

Substitution of (9) into (6) lead to the following differential equation for inflation expectations

$$\dot{\phi}_t^e | \left(\frac{\eta}{\zeta} - \omega_t \right) \phi_t^e. \quad (10)$$

When inflation expectations adjust sufficiently slowly, such that $\eta \ll \frac{1}{\zeta}$, equation (10) is dynamically stable and denoted by the saddle path SS in Figure 1. As η and ζ rise the saddle path gets steeper and eventually when $\eta \geq \frac{1}{\zeta}$ its polarity reverses so that departures from the equilibrium Laffer curve generate an explosive path for inflation expectations.

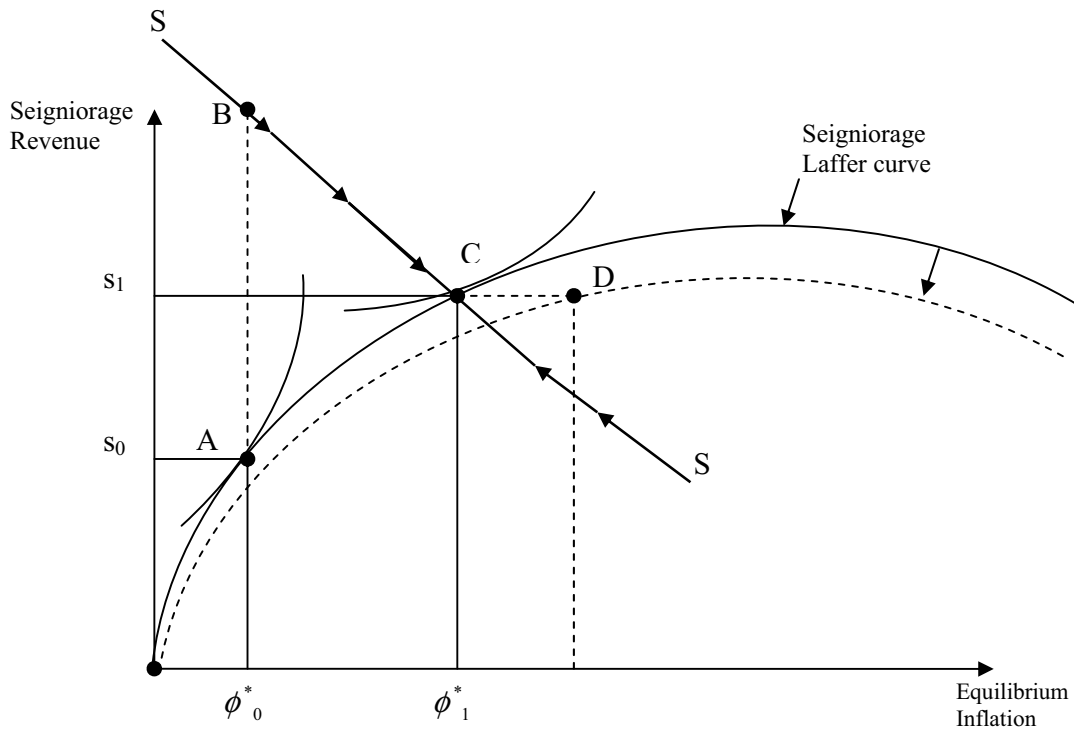


Figure 1: Inflation and seigniorage revenue during conflict

Responses during conflict

During the period of conflict the government faces increased pressure to spend in order to confront its opponents. However, at the same time, and not necessarily independently, the private sector demand for money declines. Consider first the government's choice, assuming for the moment no change in the private sector's demand for money.

Additional expenditure needs temporarily increase the marginal utility of government consumption, V_g . This implies an increase in the quasi-discount rate for the duration of the conflict, and, from (7), a higher optimal rate of inflation, chosen in order to generate a higher rate of seigniorage. Thus, the government seeks to move round the Laffer curve. This is achieved through an increase in the growth of the money supply to ω_1 which generates an initial jump in seigniorage to point B. From equation (9) expected inflation rises, inducing a decline in real money balances. This continues along SS to the new equilibrium at C, at which point inflation expectations have fully adjusted such that $\phi_i^e | \phi_1^* | \omega_1$. The initial real resource flow at B occurs regardless of how rapidly inflation expectations subsequently adjust since the increased growth in the money supply is exchanged for real private resources at the price level prevailing in the initial equilibrium. How much further transitional seigniorage revenue accrues thereafter depends on the private sector's speed of adjustment: the slower inflation expectations adjust to the new rate of growth of the money supply, the larger the windfall.

This assumes, however, no change in the underlying demand for money. For the reasons noted in the introduction this is unlikely. Most directly, conflict reduces incomes and hence, by (4) and (3) will lower the demand for money and hence seigniorage for any inflation rate. But conflict also induces private agents to disengage from the formal economy and to seek opportunities for capital flight and currency substitution, entailing both an autonomous shift out of domestic currency (a decline in A_t in equation (4)) and an increase in the inflation semi-elasticity of the demand for money, ζ . These effects on the private sector money demand combine to unambiguously shift the Laffer curve downwards so that the level of seigniorage expected at point C cannot now be achieved at inflation rate ϕ_1^* . It could be generated at a higher rate of inflation, such as prevailing at D, but clearly the shift inwards could be sufficiently strong as to render this level of seigniorage infeasible in equilibrium, forcing government to accept a lower (credible) seigniorage yield.⁴

Responses post-conflict

The post-conflict period is in some respects a half-way house between peace and war. Although GDP starts to recover, the process takes many years and, given the legacy of conflict, money demand is likely to remain below its peacetime counterfactual.

⁴ Depending on the precise changes in the demand for money, the seigniorage-maximizing rate of inflation may either increase or decrease. As noted earlier, this inflation rate is defined as $\phi^{\max} | (1/\zeta) 4 \nu \hat{y}$. Whether this rises or falls during and after conflict depends on the impact on inflation semi-elasticity of money demand, the income elasticity of demand and the growth of income.

Moreover, there is evidence that episodes of the loss of fiscal control tend to lower the post-crisis income elasticity of the demand for money, thereby slowing the re-monetization of the economy once inflation pressures have passed and growth has recovered (Adam and Bevan, 2004). Similar patterns are likely to be present in the wake of conflict-induced increases in inflation.

While the constraint on raising seigniorage remains tight, government spending needs remain inflated and are indeed likely to increase. Post-conflict reconstruction cannot generally be financed by a fiscal peace dividend because the high risk of conflict reversion typically keeps military spending close to wartime levels (Collier and Hoeffler, 2006a). The persistence of the reduced demand for money and the increased demand for spending both imply that the government would choose a higher rate of inflation, such as entailed by a point in the region of D on the new Laffer curve.

3. Empirical Analysis

The Data and Descriptive Statistics

We 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 because they are generally civil war-free and do not rely on seigniorage as a source of government revenues. Former communist countries are excluded, in part because 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, offering it scope for seigniorage like non-currency union countries.

We follow a now-standard definition of civil war, based on a threshold of 1,000 battle-related deaths. All war-related data are from the UCDP/PRIO Armed Conflict Dataset Version 4-2006 (see Gleditsch *et al* 2002). Our sample of countries is reported in the Appendix.

Table 1 reports sample means and medians for the central variables in this analysis. Four stylized facts are apparent. On average, inflation rises during conflict and falls post-conflict but remains higher than the pre-conflict period. Seigniorage follows a similar pattern to inflation, rising by a full percentage point of GDP (against a pre-conflict/no-conflict level of 1.8% of GDP). Post-conflict, seigniorage falls back towards its pre-conflict level. The composition of seigniorage revenue changes markedly. During conflict governments tend to raise seigniorage through reserve requirements on the banking system. The differential responses of the (unconstrained) non-bank private sector and the (highly constrained) bank sector are reflected in the summary statistics on real balances. Currency holdings of the non-bank private sector fall from 6.7% of GDP to 5.8% while bank reserves rise by 0.5% of GDP. As a result, the average seigniorage yield on bank reserves rises sharply during conflict. Post-conflict, both revert towards their pre-conflict values.

Money Demand

We now turn to regression analysis, starting with money demand since this constitutes the constraint upon government choices. We distinguish between currency in circulation and reserve holdings by the banking system since the latter may be subject to government control rather than being a choice variable for the private sector. Table 2 reports the results from estimating Cagan-style money demand functions of the form:

$$\ln(m/y)_{it} = \alpha_0 + \alpha_1 \ln(y)_{it} + \alpha_2 \ln(pop)_{it} + \alpha_3 \phi_{it} + \alpha_4 war_{it} + \alpha_5 postwar_{it} + \alpha_6 [\ln(y)_{it} \cdot war_{it}] + \alpha_7 [\ln(y)_{it} \cdot postwar_{it}] + \alpha_8 [\phi_{it} \cdot war_{it}] + \alpha_9 [\phi_{it} \cdot postwar_{it}] + \kappa_{it}$$

The dependent variable, corresponding to each of the measures of money is defined in terms of GDP, y denotes real aggregate GDP, pop is population and ϕ is inflation as defined in equation (4) above. The dummy variable war takes the value of one if country i is in conflict at time t and zero elsewhere while $postwar$ takes the value of one in the first ten years following the ending of hostilities. Finally, $\kappa_{it} = \sigma_t + \omega_i + v_{it}$ is a conventional two-way error component residual. Each equation is estimated using a within-groups / fixed effects estimator with a full set of common time dummies. Pooling tests reject the null of a common intercept.⁵

Controlling for income and inflation we first introduce conflict and its aftermath as dummy variables (columns 1 to 3). Both are highly significant and negative for reserve money as a whole and for both of its components. Over-and above any effects via income and inflation the demand for money is reduced by conflict. More surprisingly, this direct erosion in the demand for money appears to intensify during the post-conflict decade. During the post-conflict period money demand declines by 21% relative to peacetime and a *further* 8% relative to wartime. The decline relative to wartime is statistically significant, overall and for currency demand.

As noted, bank reserves are not a direct choice variable by the private sector. Rather they are determined by the interaction of government policy on reserve requirements, the banking sector's liquidity preference, and the private sector's demand for inside money. Given this, it is not surprising that aside from the autonomous war and $postwar$ shift effects, the results for bank reserves are weak: neither income nor inflation is statistically significant and the overall fit is markedly lower than for currency demand. In what follows, therefore, we concentrate on the demand for currency although we shall return later to the question of how the authorities balance their seigniorage extraction between these two sources.

To investigate the transmission paths for this erosion in the private sector's money demand we introduce interaction terms between the war and postwar dummy variables,

⁵ We also allow for different behaviour across the first and second five year post-conflict periods. Since the data do not reject the pooling across these two sub-periods we only report a single 'post-war' effect.

and income and inflation (column 4). Both of the direct effects of the dummies are now insignificant. As suggested by the model in Section 2, the wartime erosion of currency demand works principally through a heightened sensitivity to inflation: not only does inflation rise significantly during war, but since inflation also rises, this generates a disproportionate reduction in money demand. Postwar, however, the inflation semi-elasticity of demand is not significantly different from the pre-war environment. What drives the postwar erosion of currency demand is the reduced sensitivity to income: the recovery in postwar income does not rebuild money demand because the private sector continues to reduce its need for currency per unit of income.

The Government Choice of Seigniorage

We now turn to government choices. In raising seigniorage it has two distinct instruments at its disposal, the supply of currency and the reserve requirements on the banking system. The former induces inflation; the latter is a tax on the banking system which is liable to reduce the allocative efficiency of finance.

$$(s/y)_{it} | \eta_0 + \eta_1 war_{it} + \eta_2 postwar_{it} + \zeta_1 \ln(m/y)_{it} + u_{it}$$

where (s/y) is the seigniorage revenue corresponding to the three measures of money, in each case expressed as percentage points of GDP, and u_{it} is a two-way error term as defined above. Substituting for $\ln(m/y)$ from the money demand equations we can express choices as determined by the direct and indirect ‘structural’ effects of war and post war. Collecting the war and postwar terms we can express seigniorage outcomes as:

$$\begin{aligned} (s/y)_{it} | & (\hat{\eta}_0 + \hat{\zeta}_1 \hat{\nu}_0) + \hat{\zeta}_1 [\hat{\nu}_1 \ln(y)_{it} + \hat{\nu}_2 \ln(pop)_{it} + \hat{\nu}_3 \phi_{it41}] \\ & 2[\hat{\eta}_1 + \hat{\zeta}_1 (\hat{\nu}_4 + (\hat{\nu}_1 + \hat{\nu}_6) \ln(y)_{it} + (\hat{\nu}_3 + \hat{\nu}_8) \phi_{it41})] war_{it} \\ & 2[\hat{\eta}_2 + \hat{\zeta}_1 (\hat{\nu}_5 + (\hat{\nu}_1 + \hat{\nu}_7) \ln(y)_{it} + (\hat{\nu}_3 + \hat{\nu}_9) \phi_{it41})] postwar_{it} + w_{it} \end{aligned}$$

where w_{it} is the composite error term from the two regressions. The parameters $\hat{\eta}_1$ and $\hat{\eta}_2$ reflect the direct ‘choice’ effects while the terms multiplied by $\hat{\zeta}_1$ reflect the indirect effects of war and post war operating on the demand for money.

First, we consider the combined seigniorage from currency in circulation and bank reserves. Columns 1 to 3 of Table 3 report the results of the seigniorage regressions. Controlling for the level of real money balances we introduce dummy variables for the war and postwar periods. Both are highly significant: wartime and postwar governments resort more heavily to seigniorage. The coefficients on the two dummies are not significantly different from each other: postwar governments are as desperate for revenue as are wartime governments. Conditional on the level of the constraint, war conditions increase seigniorage extraction by around 1.1% of GDP. Given that pre-war seigniorage is approximately 1.8% of GDP (see Table 1) this is a substantial increase in needs. In the post-conflict decade the direct effect is virtually as large as during the war, at 0.8% of

GDP. This is consistent with the observed continuing high levels of government military spending in post-conflict conditions.

While in total the direct effects of wartime and postwar conditions on the government's resort to seigniorage are the same, their decomposition as between printing currency and taxing the banking system differ. During war governments rely predominantly on taxing the banking system, with four-fifths of the total seigniorage generated from this source. Postwar, however, although taxation of the banking system still dominates, there is some shift towards greater reliance upon printing currency. This shift may be appropriate: during conflict because of the collapse of investment, allocative financial efficiency may temporarily be unimportant.

War and postwar conditions alter seigniorage not only through direct effects on government choices but through their effects on income and money demand. While government needs increase the resort to seigniorage, the tightening of the constraint resulting from lower income and the erosion in the demand for money reduce the amount of seigniorage that can be raised. The direct effect combined with the two offsetting indirect effects determines the overall effect of war and postwar on seigniorage. The three effects are summarized in the first three columns of Table 4 which show how the decline in overall seigniorage from war to postwar noted in Table 1 reflects both a decline in needs, of around 0.3% points of GDP on average, and a reduction in the seigniorage tax base of about the same amount.

4. Post-Conflict Assistance

During the postwar period the government is faced with a harsh trade-off. As we have shown, the need for revenue increases, but the capacity to raise it through seigniorage deteriorates as the demand for money further erodes. From the long run perspective there is a case for reducing resort to seigniorage, thereby investing in the reconstruction of money demand, and so restoring the future potential for sustainable seigniorage. From the short run perspective there is a case for further resort to seigniorage, despite its rising cost in terms of inflation and damage to the banking system. We now investigate whether aid resolves this dilemma.

Post-conflict reconstruction is the original rationale for aid. Indeed, the original name for the World Bank was the *International Bank for Reconstruction*, onto which the words 'and Development' were added as an afterthought. Following the end of conflict there is typically a surge in aid as donors respond to perceived post-conflict needs. Aid has indeed been found to be significantly more effective in enhancing growth during the post-conflict decade than at other times (Collier and Hoeffler, 2004a). We now investigate the monetary effects of postwar aid. We first consider how aid affects the government need for seigniorage.

Aid and the government choice of seigniorage

We first introduce aid, expressed as a share of GDP, into the previous seigniorage regression.

$$(s/y)_i = \eta_0 + \eta_1 \text{war}_i + \eta_2 \text{postwar}_i + \eta_3 [\text{aid}_i \cdot \text{war}_i] + \eta_4 [\text{aid}_i \cdot \text{postwar}_i] + \zeta_1 \ln(m/y)_i + u_i$$

The supply of aid cannot be assumed to be exogenous to government fiscal choices. Donors might plausibly either increase aid flows in response to fiscal desperation, or reduce them in response to fiscal irresponsibility. We therefore instrument aid using a now-standard approach originally due to Tavares (2003). The 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.

In Table 3, columns 4 and 5 we introduce aid so-instrumented into the seigniorage regressions. During wartime aid is unsurprisingly negligible, and so instrumented aid is insignificant when interacted with the wartime dummy. In effect, the aversion of donors to funding warfare overrides the proclivities of the bilateral donors to provide aid to a country. When the interaction of aid with this wartime dummy is dropped, the interaction between aid and the postwar dummy is negative and substantial. Although it is only on the borderline of significance, it is fully theory-consistent: it is scarcely surprising that aid reduces the resort by the government to seigniorage. A one percentage point of GDP increase in aid reduces seigniorage by approximately one third of a percentage point of GDP.

Because aid usually surges postwar, the addition of aid makes a substantial difference to the other components of the regression. In particular, the direct effect of the postwar dummy is now around four times its previous value. Although the regression involves a small reduction in the sample, this is not the explanation for the change⁶. Thus, controlling for aid, postwar governments appear to be far more desperate for revenue even than they are during war. The surge in aid postwar accommodates these needs and thereby reduces resort to seigniorage.

In columns 6 and 7 we investigate how the resort to seigniorage is split between the two components of currency and bank reserves but the results are insignificant, possibly because of the reduced sample size.

⁶ Re-estimating the regression in column 1 on the reduced sample does not significantly alter the coefficient estimates.

Aid and money demand

Since aid reduces the resort to seigniorage, it thereby reduces inflation. Indirectly the aid will therefore raise the demand for money. Aid also significantly augments growth in the postwar context (Collier and Hoeffler, 2004a) and this will also directly raise the demand for money. The theoretical specification of the demand function suggests that conditional on income and inflation, aid should have no direct effect on the private sector demand for money. However, in the context of the aftermath of civil war there may be such an effect. One likely explanation for the severe erosion of the demand for money in the postwar period is a ‘Peso effect’ in which the high risk of a reversion to conflict supports expectations of further inflation in excess of that directly implied by current experience. Conceivably, large aid programs might tend to reassure citizens and thereby directly increase the demand for money. We test for this, modifying the demand for money function as follows:

$$\ln(m/y)_{it} = \nu_0 + \nu_1 \ln(y)_{it} + \nu_2 \ln(pop)_{it} + \nu_3 \phi_{it41} + \nu_4 war_{it} + \nu_5 postwar_{it} + \nu_6 [\ln(y)_{it} \cdot war_{it}] + \nu_7 [\ln(y)_{it} \cdot postwar_{it}] + \nu_8 [\phi_{it41} \cdot war_{it}] + \nu_9 [\phi_{it41} \cdot postwar_{it}] + \nu_{10} [aid_{it} \cdot war_{it}] + \nu_{11} [aid_{it} \cdot postwar_{it}] + \kappa_{it}$$

In a reduced form regression of the type estimated here any impact of aid inflows must reflect a direct effect since the regression controls for the indirect effects.

It is reasonable to assume that aid is weakly exogenous with respect to the private sector demand for money and so we introduce aid into the demand for money function using OLS (Table 3, columns 5 to 7). Again we consider first reserve money, and then its two components, currency in circulation and bank reserves. In the reserve money regression the aid effects are very small and statistically insignificant. However, this is because it has strong but offsetting effects on each component. Aid significantly increases the demand for currency in circulation both during war and in the post-conflict period (column 6), and equally reduces the demand for bank reserves to the same order of magnitude. The ‘demand’ for bank reserves in the context of civil war and its aftermath is most reasonably interpreted as being a coerced demand: banks must comply with central bank regulations. Hence, the decline in ‘demand’ as a result of postwar aid is likely to reflect the reduced pressure for government revenue. These aid effects are not large but they are significant: since the regression controls for both income and inflation, the result is consistent with the hypothesis that aid reassures and so reduces the ‘Peso problem’ arising from fears of collapse.

Further, the inclusion of aid in the money demand regression changes the direct effect of the postwar dummy very substantially. In the analysis of Section 3 which omitted aid, it appeared that the demand for money eroded considerably more during the postwar period than during the war itself. Controlling for aid, this is no longer the case. The ‘pure’ effect of the postwar period on money demand continues to be substantially adverse in

comparison to the pre-war peace, but it is now significantly and substantially better than during the war itself.

There are thus three distinct routes by which postwar aid ‘reconstructs’ the demand for money and hence seigniorage capacity. First, post-conflict aid directly substitutes for seigniorage revenue, enabling the government to reduce its reliance on inflationary finance and thereby stimulating a recover in the demand for money. Second, post-conflict aid restores money demand indirectly through its effect on income growth. While the overall effect of aid on growth is controversial, there is evidence that in postwar situations it is considerably more effective than usual (Collier and Hoeffler, 2004a). Finally, as our regression results suggest, aid also appears to play a role in supporting a modest portfolio shift in favour of domestic money demand.

Applications to Post-Conflict Monetary Reconstruction

We now apply these regression results to two pertinent questions concerning post-conflict aid. The first concerns the marginal effects of post-conflict aid, and the second the paths of reconstruction of monetary variables post-conflict, with and without aid.

In Table 5 we use the evidence from the seigniorage and money demand regressions, combined with the evidence from Collier and Hoeffler (2004a), to simulate the marginal impact on inflation and money demand of an increase in post-conflict aid. Given the peculiar nature of the demand for bank reserves, we focus exclusively on currency demand. Using the sample estimates for the levels of inflation and money demand at the start of the post-conflict period, we compute the marginal impact of a one percentage point increase in aid sustained over a ten-year period. The impact consists of two distinct elements. In the first step we compute the change in inflation arising from the aid-induced fall in seigniorage needs given the private sector’s end-of-conflict demand for currency: this represents a movement along the immediate post-conflict Laffer curve. In the second step we calculate the effect of the improvement in the post-conflict currency demand, including the induced effect of the further fall in inflation associated with rising currency demand given the marginal change in seigniorage needs. The calculations in Table 5 suggest that if the fall in desired seigniorage noted in Table 3 is sustained over the 10-year post-war period, the aid inflow would lead to a substantial restoration in real money balances of around 2.5 percentage points of GDP (an increase of almost 45% over the end-of-conflict level) and an almost halving of inflation from around 20% to just over 10% per year.

In Figure 2 we apply the regression results to track the evolution of monetary variables for the typical conflict-affected country under two scenarios: no aid, and aid at the level typical of post-conflict situations. Each dynamic simulation is computed as a recursive forecast. Exploiting the adaptive inflation expectations specification used in the estimations, and given exogenous paths for real income growth (from Tables 1 and 5), the demand for currency at time t is pre-determined, given the relevant coefficient values from Table 3. With currency demand pre-determined, changes in seigniorage needs from Table 2 then imply changes in inflation and the current seigniorage yield. The change in

inflation is used to update the demand for money in $t+1$ and so forth. We should note that the coefficients on the war and post-conflict dummies variably are derived from a cross-section of observations and so only approximate a genuinely dynamic analysis. In particular, they produce discrete jumps upon the onset and end of war which exaggerate the likely actual speed of adjustment. These artificial jumps are juxtaposed upon more genuinely dynamic adjustments to inflation and income.

In the first panel we plot the rate of inflation. The typical country in our sample had a pre-conflict rate of inflation of around 12%. During war this rises to around 18%, evidently not as abruptly as depicted in the figure. In the absence of aid, the regressions of Tables 2 (column 5) and 3 (column 5) imply that there would be a further substantial increase in inflation to 21% with the onset of post-conflict peace, an adjustment which is again likely to be more gradual than depicted. This reflects the increased fiscal needs facing post-conflict governments. Post-conflict aid at typical levels is sufficient not only to meet these needs but to enable the government to invest in monetary reconstruction. The inflation rate with aid rapidly reverts to its peacetime level and indeed starts to dip below it as is necessary to rebuild money demand. Since post-conflict aid typically surges immediately after the end of conflict this fiscally-driven effect may well be rapid.

The consequences for the demand for currency as a share of GDP are tracked in the second panel. During war currency demand collapses from around 6.7% of GDP to around 5.2%. In the absence of aid, currency demand nevertheless rebounds somewhat following the end of the conflict, to around 5.8% of GDP, but thereafter it stalls at this level: money demand is never rebuilt to its pre-conflict level. While the rebound followed by stall is likely to be a spurious artifact of the post-conflict dummy variable, the failure to ceiling upon the recovery well short of the pre-conflict level is not. With aid the initial post-conflict rebound is a little higher, at around 6.1%, but the key difference is that thereafter it gradually recovers towards its peacetime level. Even after a decade recovery is not complete, but it is substantially accomplished.

In the third panel we track seigniorage from currency as a percentage of GDP. While during the war such seigniorage is increased, the really dramatic exploitation of the currency occurs with the onset of peace if aid is not forthcoming. While the speed of the increase is surely exaggerated due to the dummy variable, the actual onset of increased fiscal needs is indeed liable to be rapid. Again, aid enables the government not only to avoid this jump in seigniorage, but gradually to bring its taxation of the currency down to its peacetime level. The process of reversion is slow: on our estimate nearly twenty years.

5. Conclusion

Post-conflict situations are characterized by an unusually wide range of outcomes. While on average economies rebound from wartime decline, in some decline continues and around 40% revert to conflict within a decade. Policy choices concerning the economic recovery of these hopeful but fragile situations have received far less attention than issues of political design and humanitarian needs. In this paper we have investigated the affect

of war on monetary variables and whether aid is important in the monetary 'reconstruction'.

We have focused particularly upon seigniorage. Seigniorage is strategic, both because as revenue of last resort it reveals government preferences, and because the ability to raise it reflects the degree of confidence of private actors in a fundamental government commitment. Our results imply a rationale for aid that is peculiar to the post-conflict macroeconomic situation. In effect, just as infrastructure needs to be reconstructed, so does the demand for money. Even controlling for inflation and income, the private demand for money erodes sharply in the postwar period. Yet in the absence of aid post-conflict governments resort to seigniorage far more heavily after war than during it.

While the restoration of the demand for money is beyond the capacity of the typical post-conflict government to finance out of its own resources, it is both an important objective in itself, and a useful indicator of the broader restoration of confidence. We therefore investigated whether aid was effective in reconstructing the long term scope for seigniorage. We found that aid is effective through three distinct routes. The most obvious one is that for which the aid is primarily intended: it raises the growth of income and so raises the demand for money. Unfortunately, this effect is relatively weak in postwar conditions because the income-elasticity of the demand for money is significantly lower than in normal times. However, we have found two other effects. One is that it reduces the need for the government to resort to seigniorage and so reduces inflation. More surprisingly, over-and-above these effects via income and inflation, postwar aid has a direct effect, perhaps through strengthening confidence in the maintenance of peace.

As a result of these three favorable effects, post-conflict aid is indeed decisive in achieving monetary reconstruction. Inflation and seigniorage, which are the monetary variables under the control of the government, revert to peacetime levels as opposed to counterfactuals of further deterioration. The demand for currency, which is the constraint upon government choices, takes longer to recover: unsurprisingly, civil war severely damages confidence in the currency. However, with aid there is a gradual recovery, whereas the counterfactual is that the loss of confidence is persistent. These monetary effects of post-conflict aid have been an unsung success: attention has focused on its more televisual roles in humanitarian relief and the reconstruction of physical infrastructure. They are, nevertheless, real and substantial.

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Appendix: Data

The Composition of the Sample

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

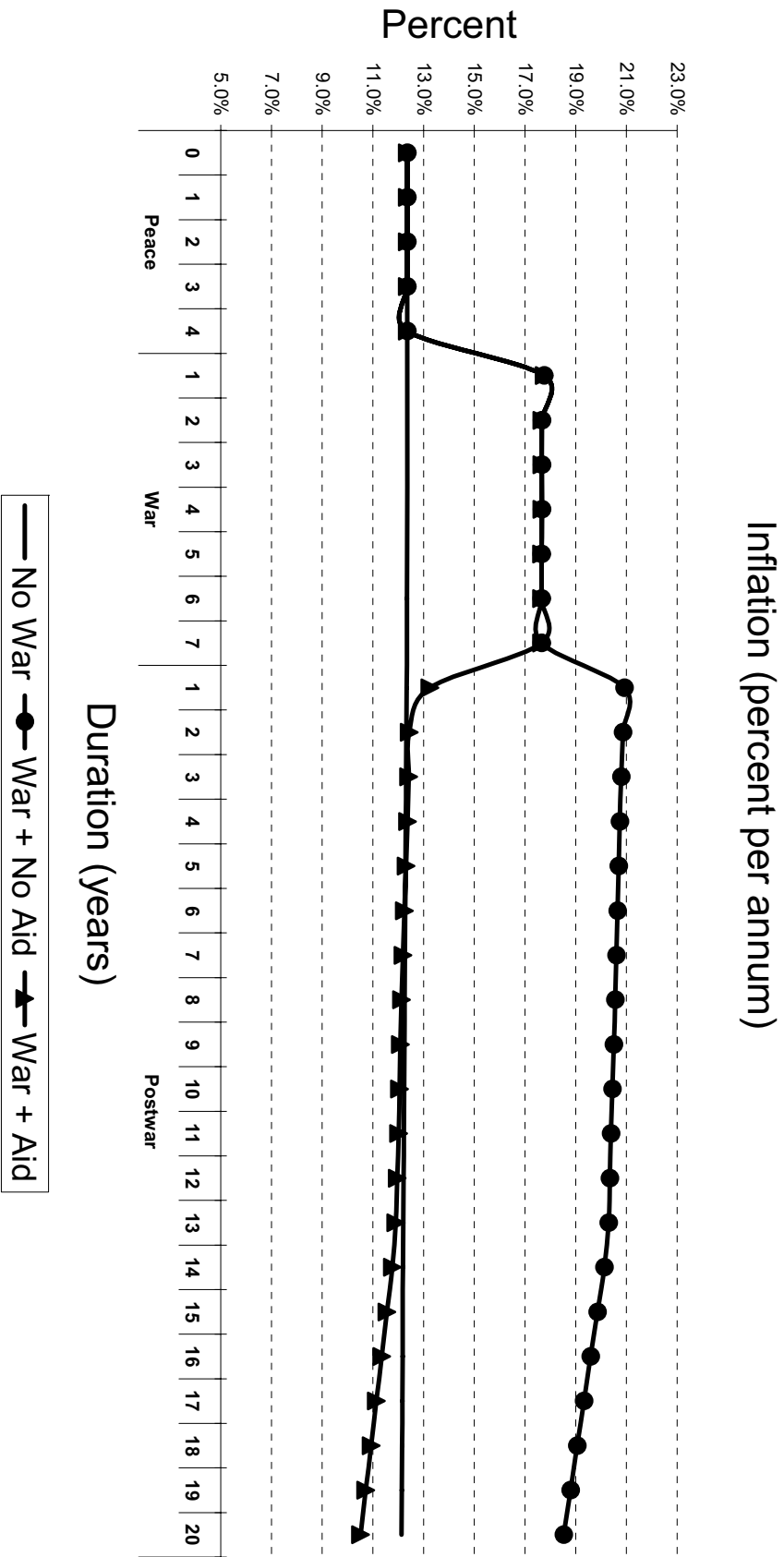
Non-conflict countries

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.

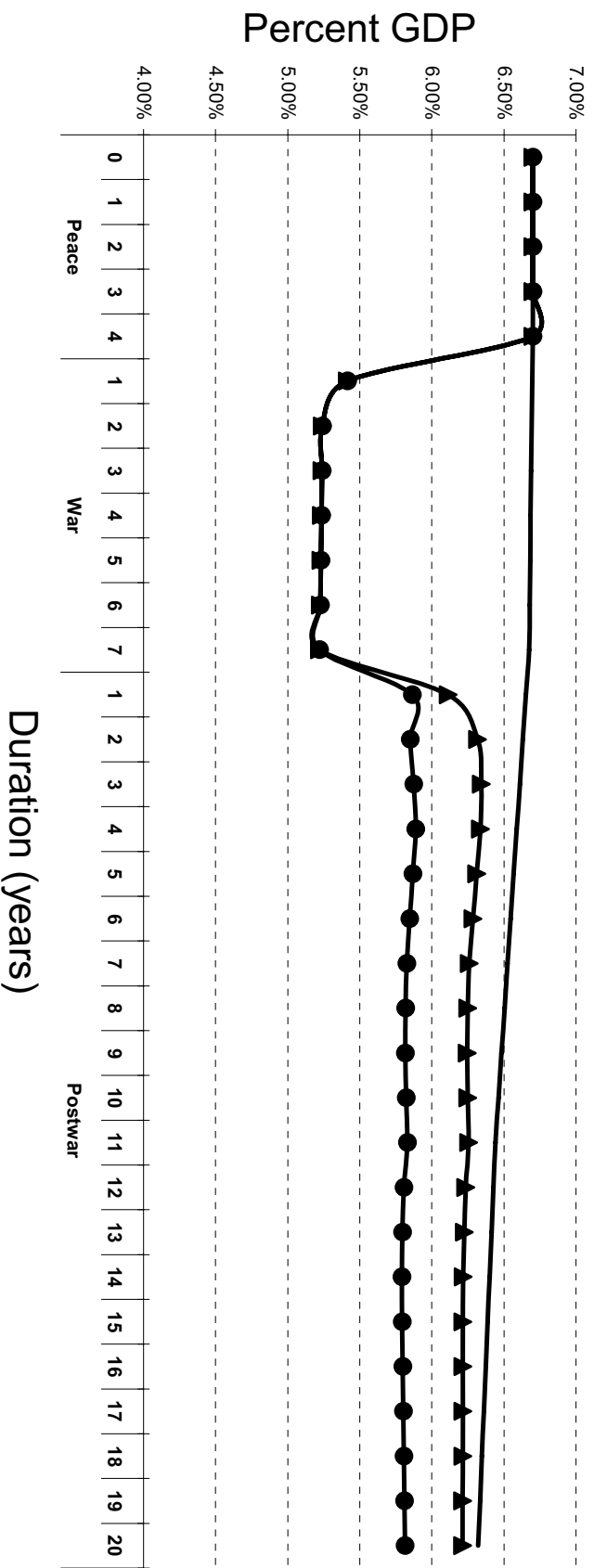
Data sources for the variables

Reserve money and its components, and the consumer price index, are from the International Financial Statistics January 2006 (electronic version). Aid (% GNI), and nominal and real GDP, real GDP growth, and per capita income and its growth rate, are from the World Development Indicators April 2006.

Figure 2: Inflation, Money Demand and Seigniorage during war and postwar



Currency (as % of GDP)



Seigniorage from currency (as % GDP)

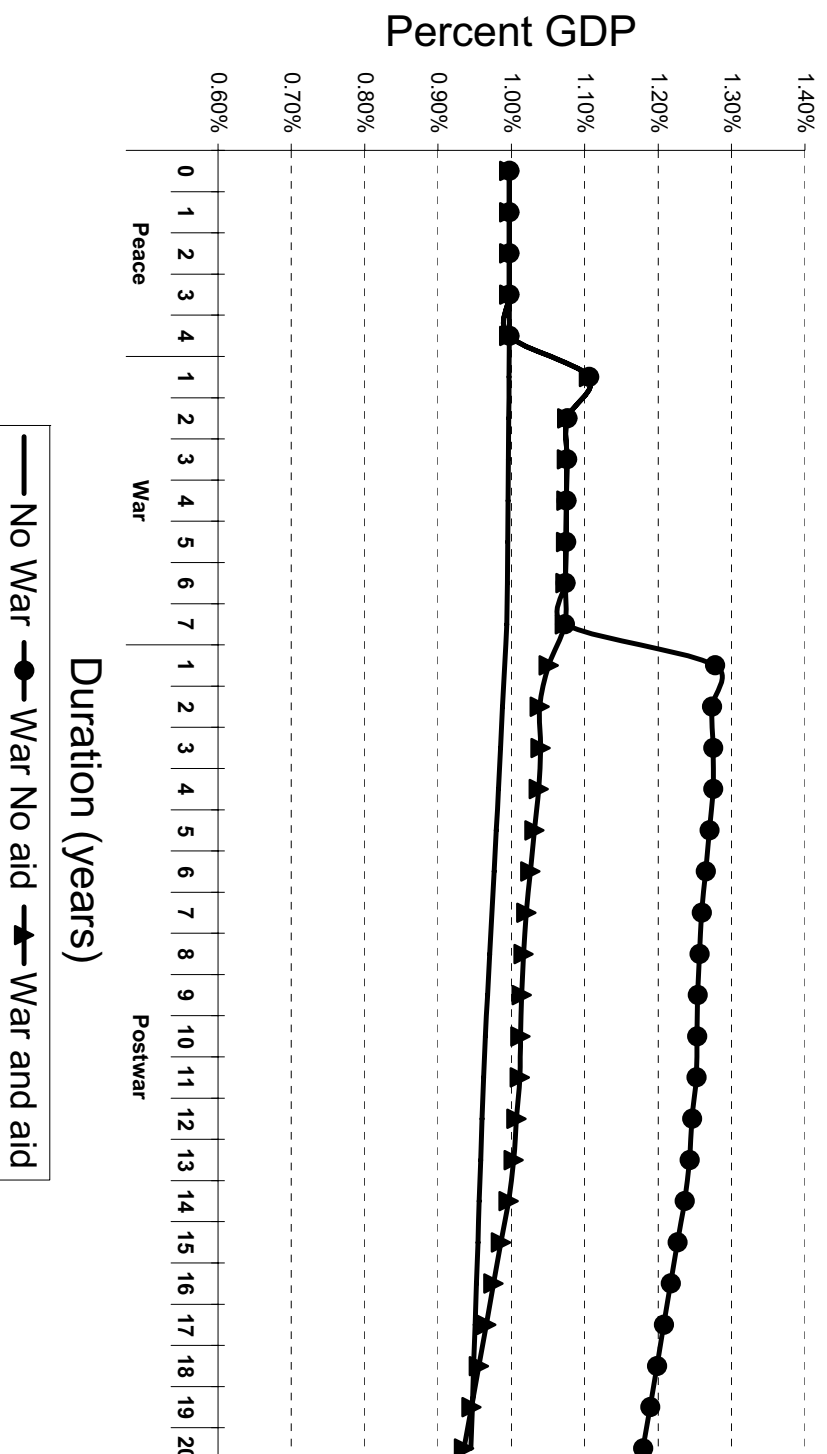


Table 1: Descriptive Statistics (Means)

	Full Sample 1964-2002	Pre-War	War	Post-War
Inflation	14.2%	12.5%	20.2%	16.8%
Reserve Money (% GDP)	11.2%	11.3%	10.9%	10.8%
of which: currency	6.5%	6.7%	5.8%	6.9%
reserves	4.7%	4.7%	5.1%	3.9%
Seigniorage	2.0%	1.8%	2.8%	2.1%
of which: currency	1.0%	1.0%	1.0%	1.1%
reserves	1.0%	0.9%	1.7%	0.9%
GDP per capita (constant 2000 US\$)	1,128	1,237	916	705
Aggregate GDP growth	3.9%	4.1%	3.0%	4.9%
Per capita GDP growth	1.5%	1.6%	0.7%	2.4%
Aid (as % GDP)	6.0%	6.3%	4.6%	6.8%

Table 3. Seigniorage Choice Equations

Fixed Effects estimation		OLS	OLS	OLS	IV	IV	IV	IV
Dependent Variable	Seigniorage (% GDP) res money	Seigniorage (% GDP) currency	Seigniorage (% GDP) bank res	Seigniorage (% GDP) res money	Seigniorage (% GDP) res money	Seigniorage (% GDP) currency	Seigniorage (% GDP) bank res	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	
Constant	0.055 [3.55]	0.030 [5.76]	0.047 [6.96]	0.087 [8.50]	0.087 [8.98]	0.042 [9.47]	0.034 [5.71]	
War	0.011 [3.72]	0.002 [2.17]	0.008 [3.37]	0.009 [0.96]	0.008 [3.29]	0.002 [1.41]	0.005 [3.03]	
Post-War	0.008 [3.69]	0.002 [2.65]	0.005 [2.87]	0.027 [1.78]	0.027 [2.02]	0.007 [1.18]	0.010 [1.09]	
In money demand (% GDP)	0.030 [8.36]	0.007 [5.96]	0.013 [8.15]	0.027 [7.15]	0.027 [7.54]	0.008 [5.62]	0.010 [7.44]	
aid*war [*]	-	-	-	-0.024 [0.15]	-	-	-	
aid*postwar [*]	-	-	-	-0.319 [1.23]	-0.332 [1.50]	-0.087 [0.93]	-0.090 [0.65]	
Country-dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Year-dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
R-squared	0.3357	0.3906	0.277	0.2453	0.2404	0.3195	0.253	
N. obs	2177	2170	2170	2003	2003	1996	1996	
F [war=postwar]	0.83 [0.3610]	0.38 [0.5401]	2.33 [0.1267]					

[*] denotes endogenous; Instrumented via Tavares method

Table 4: Decomposition of war and postwar seigniorage yields (percent of GDP)

		Reserve Money	Currency	Bank Reserves
Change in seigniorage due to:				
War				
	Direct needs	1.10%	0.20%	0.80%
	Constraint shift	-0.39%	-0.07%	-0.31%
	Net seigniorage	0.71%	0.13%	0.49%
Postwar				
	Direct needs	0.80%	0.20%	0.50%
	Constraint shift	-0.64%	-0.13%	-0.42%
	Net seigniorage	0.16%	0.07%	0.08%
Memo: mean pre-war seigniorage (Table 1)		1.81%	0.95%	0.85%

Table 5: Marginal impact of a one percent increase in aid sustained over a 10 year period[1]

		Notes
1. Inflation effect		
<u>(a) Fall in seigniorage needs</u>		
Impact of aid on aggregate seigniorage needs	-0.332	[2]
Decline in seigniorage from currency	-0.12%	[3]
<u>(b) Impact on inflation</u>		
Initial post-conflict currency balances (% of GDP)	5.80%	[4]
Initial postwar inflation rate	20.19%	[4]
Inflation semi-elasticity	-0.780	[5]
Change in inflation	-3.31%	
Induced increase in currency demand (% of GDP)		0.107%
2. Income Effect		
Impact of aid on post-conflict growth (per annum)	0.26%	[6]
Postwar income elasticity of currency demand	0.833	[5]
Increase in currency demand (% of GDP p.a.)	0.22%	2.190%
Postwar inflation semi-elasticity of currency demand	-0.481	[5]
Change in inflation (p.a)	-0.78%	
Change in inflation over 10-year post war period	-6.13%	
Induced increase in currency demand (% of GDP)		0.136%
3. Portfolio effect		
Portfolio shift coefficient	0.689	[4]
Currency balances, incl. Inflation effect (% of GDP)	5.91%	[7]
Increase in currency demand (% points of GDP)		0.041%
Change in inflation over 10-year post war period	-0.15%	
Induced increase in currency demand (% of GDP)		0.003%
Total postwar increase in money demand (% GDP)		2.477%
Total postwar reduction in inflation (percentage points)	-9.58%	

Notes

[1] See text for explanation.

[2] Table 3, column 5

[3] We assume that approximately 36% of seigniorage revenue is raised from currency in circulation

[4] Table 1

[5] Table 2, column 6

[6] From Collier and Hoeffler (2004)

[7] Includes increase in currency demand due to initial post-conflict inflation reduction