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Inflation, Inequality, and Social Conflict

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Inflation, Inequality, and Social Conflict

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Abstract

This paper presents and then tests a political economy model to analyze the observed positive relationship between income inequality and inflation. The model's key features are unequal access to both inflation-hedging opportunities and the political process. The model predicts that inequality and 'elite bias' in the political system interact to create incentives for inflation. The paper's empirical section focuses on this predicted interaction effect. The identification strategy involves using the end of the Cold War as a source of exogenous variation in the political environment. It finds robust evidence in support of the model.

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Contents

I. Introduction

Countries with a more unequal income distribution tend to have higher inflation (Albanesi, 2002; Easterly and Fischer, 2001; Dolmas et al., 2000; Bulir, 1998; Beetsma and Van Der Ploeg, 1996). The correlation between a scaled measure of inflation π (the "inflation tax rate" $\frac{\pi}{1+\pi}$) and income inequality for a cross-section of 90 countries is 0.22.[2] This paper offers a political economy explanation for the relationship, focusing on how the income distribution can affect political power. In many countries, political influence depends on income (characterized as "elite bias"). In these environments, greater income inequality will magnify disparities in political power, biasing policies towards those favored by the elite. Inflation can be one of these, since the wealthy find the inflation tax easier to avoid than many alternatives. This predicted interaction effect between inequality and elite bias offers a hypothesis for testing the model: that reductions in elite bias should reduce inflation more in more unequal societies.

The paper's contributions to the theoretical literature are twofold. First, it explains the inflation-inequality relationship using a model of endogenous policy formation which remains tractable for general classes of income distribution. Second, it captures important stylized facts about the distributional impact of inflation and the role of elite bias in politics. The predicted interaction effect suggests a novel identification strategy which avoids some of the problems associated with cross-country analysis. This is the paper's key contribution to the empirical literature.

The model, outlined in Section II, is motivated by a simple public finance problem: the financing of a public good via a linear income tax and/or seigniorage. Households have diminishing marginal utilities of consumption. To capture financial market imperfections there is a fixed cost of adopting inflation-proof financial assets. As a result, the rich hold little cash and the inflation tax is regressive. Elite bias in the political system is modeled by attributing to agents a political "weight" increasing in income.

For the policymaker, the choice of tax instrument is then determined by two competing motivations. The first is redistribution from rich to poor (because the latter have higher marginal utilities). Hence, in the first-best allocation, consumption is fully equalized and all agents hold cash. Similarly, absent elite bias, policymakers use only the more progressive income tax instrument and all households hold cash. However, there is a third, political bias effect, that causes the policymaker to favor policies more beneficial to richer groups in society. This can lead to positive seigniorage in equilibrium. For a sufficiently high level of elite bias, the model delivers the observed positive relationship between inequality and inflation.

[2] $\frac{\pi}{1+\pi}$ is a useful transformation for empirical work because it prevents extreme values of inflation from dominating results. It also has a useful real-world interpretation: it gives the inflation tax paid on money balances. Income inequality is measured by the Gini coefficient, the most widely used single index of inequality. It lies between 0 and 1 and gives the area under the Lorenz curve as a fraction of the area under the 45^o line (where the Lorenz curve plots cumulative income share against cumulative population share, the population being ordered by income from lowest to highest). Both variables are averaged over 1990-2004. The estimated correlation is statistically significant at the 5 percent level. See data section for discussion of data sources.

The paper's empirical section focuses specifically on the interaction between elite bias and income inequality in creating incentives for inflation. I analyze the change in the inflation tax rate between 1975–89 and 1990–2004 for a cross section of countries. To capture the interaction effect I include on the right hand side a measure of initial income inequality interacted with the change in elite bias over the period.

Political change can occur endogenously. To overcome this identification problem I focus on a specific time period for which there is evidence of an exogenous political "shock." The late 1980s and early 1990s witnessed a widespread and lasting wave of democratic reform (reduction in elite bias) that has been characterized as democracy's "third wave" (Huntingdon, 1991; Jaggers and Gurr, 1995). Its likely cause, or at least a significant contributory factor, was the end of the Cold War – I present evidence to support this hypothesis. This account also suggests an instrumental variables (IV) identification strategy: to use Cold War relationships as instruments for democratization.

Section IV outlines the empirical strategy and results. I employ both a difference-in-differences (DD) methodology, with democratization modeled as an exogenous "treatment" whose impact can differ between high and low inequality countries, and an instrumental-variables (IV) approach that additionally employs Cold War alliance information to isolate the exogenous component of democratization. I find robust support for the predicted interaction effect using both techniques.

Anticipating these results, Table 1 presents some initial evidence. It shows the mean fall in the inflation tax rate for 83 countries grouped into four categories depending on both their initial level of income inequality and whether they experienced democratization over the period.[3] Inflation fell most in high inequality countries that democratized: the interaction effect has the hypothesized sign and is statistically and quantitatively significant, as shown in the table's bottom right-hand cell.[4]

Table 1. Mean Percentage Change in the Average Inflation Tax Rate, 1975-89 to 1990-2004

	Low Inequality [1]	High Inequality [2]	Δ [2] - [1]
No Fall in Bias [A]	-4.8**	-3.6*	1.2
	(1.9)	(2.1)	(2.8)
Fall in Bias [B]	2.6	-9.0***	-11.6**
	(3.5)	(2.4)	(4.2)
Δ [B] – [A]	7.4*	-5.4*	-12.7**
	(3.9)	(3.2)	(5.1)

[3] The categorical variables (inequality and decline in bias) are defined as above or below the mean value. The number of countries in each category (reading left to right and top to bottom) is 31, 24, 9 and 19, respectively. Robust standard errors in parentheses. The data are decribed in more detail in Section IV.

[4] On the other hand, the model predicts that inflation should fall in low inequality democratizing countries, albeit by less than in high inequality countries, but the estimated effect is positive (bottom left-hand cell).

This paper contributes to several related strands of the literature. It complements four recent papers that have sought to explain the positive correlation between inflation and inequality. Albanesi (2002) and Bhattacharya et al. (2003) model inflation as regressive by allowing substitution out of cash subject to a fixed cost. They demonstrate via simulation under specific income distributions that inflation generally increases in income inequality. Dolmas et al. (2000) and Beetsma and Van DerPloeg (1996) obtain analytical results; however, inflation is modeled as progressive. In both papers higher inequality makes the pivotal (median) voter poorer and therefore prefer higher inflation.[5] All four papers present cross-country evidence supportive of their models.[6]

Recent work has focused specifically on the interaction between inequality, politics, and inflation. Desai et al. (2003; 2005) argue that in high inequality countries more democracy leads to higher inflation as a result of populist attempts at redistribution, while in low inequality countries parasitic governing elites create inflation – so that greater political competition should reduce it. This account relies on inequality having no effect on the political power of elite groups and "populists" having no access to more progressive tax instruments.[7]

I also draw on an empirical literature which analyzes the distributional impact of inflation in order to motivate the modeling of inflation as a regressive tax. Kane and Morisett (1993) identify at least three channels by which inflation can affect the distribution of income: (i) a balance sheet channel (agents face differential access to inflation-proof assets and liabilities); (ii) a real wage channel (inflation shifts the wage profile); and (iii) a fiscal channel (taxes and transfers are inadequately indexed so that inflation redistributes between net tax-payers and net benefit-recipients). The authors analyze Brazilian data and find that high inflation redistributed income from the poor – who suffered real wage erosion – and the middle class – who suffered the erosion of cash assets – to the rich.

Ferreira and Litchfield (1999) also analyze Brazilian data, and find some time-series evidence of inflation leading to higher inequality. Cardoso (1992) explores inflation and inequality in several Latin American countries and supports Kane and Morisett's view that inflation's impact on the poor is primarily through its effect on real wages while the middle class pays the inflation tax. Erosa and Ventura (2002) also argue that the inflation tax is regressive, focusing on the impact of unequal access to inflation-proof assets. Their analysis of U.S. data shows that poorer agents are more reliant on cash holdings as a proportion of

[5] The same argument, that greater income inequality increases the median voter's preferred rate of taxation, has been used to motivate the empirical finding linking higher inequality to lower growth (see, for instance, Alesina and Rodrik, 1994).

[6] A number of other empirical studies have analyzed the relationship between inflation and the income distribution (Romer and Romer, 1998; Bulir, 1998; Easterly and Fischer, 2001; Datt and Ravallion, 2002; and Epaulard, 2003; among others). The consensus in the literature is well captured by the IMF (1996): "high average inflation and high variability of inflation increase income inequality significantly."

[7] In fact, seigniorage revenues generally make only a negligible contribution to total government revenue: Click (1998) demonstrates that even countries experiencing persistent high inflation have rarely derived more than 20 percent of their revenue from this source. Click also demonstrates that cross–country differences in seigniorage rates are not driven by differences in government spending. This supports the "revenue switching" account of the current paper but not the "populist spending" account offered elsewhere.

their aggregate wealth, making them more exposed to the inflation tax. Luttmer's (1999) analysis of U.S. households' asset holdings uncovers a significant fixed cost of accessing inflation-hedging assets as a barrier to entry for the poor. Mulligan and Sala-i-Martin (1996) also identify a fixed cost of financial market participation using U.S. micro data, so that wealthier agents are more likely to hold inflation-proof assets.

A second means of assessing the distributional impact of inflation is to measure which groups in society are more inflation averse (Easterly and Fischer (2001), Fischer and Huizinga (1982), Scheve (2003; 2004)). Higher inflation aversion among poorer groups would suggest that inflation is regressive. The balance of evidence from cross-country studies suggests that poorer groups are more inflation averse, except when they are confronted with an explicit Phillips curve trade-off and unemployment concerns dominate.[8]

Lastly, this paper follows recent work in modeling elite bias in the political system. Benabou (2000 and 2005) presents variants on the Downs (median voter) model with elite bias and discusses comprehensive evidence of the influence of income on political activity and influence.[9] For instance, Benabou (2005) quotes a study of political responsiveness of U.S. senators, which finds that senators' responsiveness to the views of their constituents (as deduced from survey data) increases markedly with constituents' income. Similarly, Besley et al. (2005) uncover evidence that elite bias in gubernatorial elections affected policy outcomes in the southern states of the United States before civil rights era reforms. Crowe (2005) demonstrates that the correlation between redistributive policies (income tax progressivity) and preferences for redistribution of various income groups in member countries of the Organization for Economic Cooperation and Development is strongest for the preferences of the richest.[10]

II. Household Optimization

The model employs an overlapping generations (OLG) framework. Time is discrete. A cohort of households i, distributed on the unit interval with unit mass, is born each period. Each household lives for two periods. Each household in cohort t (born in period t) receives a positive endowment of the consumption good, y_t^i, in period t; y_t^i is drawn from a time-invariant distribution $F(y^i)$ over $\left[y^{\min}, y^{\max}\right]$, where $F(y^i)$ is continuous and differentiable and $E[y^i] = 1$.

[8] Scheve (2003; 2004) analyzes the Phillips Curve trade-off and finds that poorer respondents are less likely to prioritize low inflation. However, he argues that their higher unemployment risk (not their relative exposure to the inflation tax) likely explains this. Easterly and Fischer (2001) ignore this trade-off and find that poorer respondents are more inflation averse. Shiller (1996) conducts surveys in three countries to ascertain *why* people dislike inflation, and finds that inflation is seen as "unfair" because it arbitrarily redistributes income.

[9] Desai et al. (2003) adopt the same specification.

[10] Theories of political representation that ignore income biases (such as the simple median voter model) predict a positive relationship between inequality and redistributive policy, whereas, as Benabou (2005) notes, the opposite relationship appears to hold in the data (while Crowe (2005) shows that average *preferences* for redistribution do increase with inequality). The observed negative cross-country correlation between inequality and redistribution is predicted by income-weighted voting models.

Households consume only in the second period of their life (i.e. period $t+1$ for cohort t), but endowments are perishable. Hence some transactions technology is necessary to allow the intertemporal and intergenerational transfer of endowments. There are two inherently valueless assets in the economy to facilitate this exchange: cash m (whose supply is controlled by the government) and a second asset d in fixed (nominal) supply.[11] This second asset can be thought of as an inflation shelter (the model can also be thought of as a model of endogenous partial dollarization). The price of each asset in terms of goods is determined endogenously. There is no uncertainty.

The household maximizes its utility subject to its budget constraint:[12]

$$\begin{aligned}
\max_{z_t^i} U^i &= \ln c_t^i + \alpha \ln g_t && (1)\\
\text{s.t. } c_t^i + \tau_t \left(y_t^i - D_t^i \lambda\right) &= \frac{m_t^i}{p_{t+1}} + \frac{d_t^i}{q_{t+1}} && (2)\\
&= \left[\frac{p_t}{p_{t+1}}\left(1 - z_t^i\right) y_t^i + \frac{q_t}{q_{t+1}}\left(z_t^i y_t^i - D_t^i \lambda\right)\right]
\end{aligned}$$

where z_t^i denotes the share of saving via the inflation shelter and the dichotomous variable $D_t^i (= 1$ if $z_t^i > 0$ and 0 otherwise) indicates whether the household holds *any* savings in the inflation shelter. The empirical literature on portfolio choice has persuasively argued for the existence of fixed costs of participation in markets for non-cash financial assets. This is captured by the (real) fixed cost of operating in the market for the second asset, denoted $\lambda \in [0,1]$, payable if $D_t^i = 1$.[13] Prices of the consumption good in terms of cash and the second asset are denoted p and q, respectively: households sell their endowment at period t prices but purchase consumption goods at period $t+1$ prices. The "old" also consume a public good g which is funded out of taxation and seigniorage revenue and produced by the government using a linear (one-for-one) technology. Explicit taxation is in the form of a linear income tax τ payable by the "old." Households implement their asset-holding strategies based on anticipated policies (there is no uncertainty over policy).

The household's budget constraint can be rewritten as:

$$\begin{aligned}
c_t^i &= y_t^i\left(1 - z_t^i\right)\left(1 - \tau_t - \widehat{\pi}_t\right) + \left(z_t^i y_t^i - D_t^i \lambda\right)\left(1 - \tau_t - \widehat{q}_t\right) && (3)\\
\text{where } \frac{p_t}{p_{t+1}} &\equiv 1 - \frac{\pi_t}{\pi_t + 1} \equiv 1 - \widehat{\pi}_t\\
\frac{q_t}{q_{t+1}} &\equiv 1 - \widehat{q}_t
\end{aligned}$$

[11] The second asset need not be in fixed supply; it is sufficient that the aggregate supply is not a choice variable for the authorities or for individual agents in the economy.

[12] The log utility formulation is adopted to aid tractability. All time subscripts refer to the period in which the cohort in question was born, except those for prices, which refer to the current period.

[13] For expositional purposes, it is assumed that the fixed cost is tax-deductible: i.e., the tax base for the income tax is the endowment net of the cost of financial market participation.

This formulation makes explicit the "tax rates" $\widehat{q}_t$ and $\widehat{\pi}_t$ due to changes in asset prices ($\widehat{\pi}_t$ is the inflation tax). I assume that both assets are traded in equilibrium as long as it is individually rational for households to trade in both assets given that others do. As is generally the case with OLG models, there are degenerate equilibria where either one or both assets are not traded because they are not expected to be accepted in trade; it is easy to demonstrate that the equilibrium in which both assets are potentially traded is consistent with rational expectations, and I focus on this, the most interesting, equilibrium. The solution to the household's problem is then given by:

$$\begin{aligned} z_t^i &= 1 \text{ iff } y_t^i > \widehat{y}_t;\ 0 \text{ otherwise}; \\ \text{where } \widehat{y}_t &\equiv \frac{\gamma_t \lambda}{\gamma_t - 1} \text{ and } \gamma_t \equiv \frac{(1-\tau_t-\widehat{q}_t)}{(1-\tau_t-\widehat{\pi}_t)} \end{aligned} \tag{4}$$

Households adopt corner solutions for z_t^i as a result of the fixed cost λ, holding only the second asset if their endowment is above the critical value $\widehat{y}_t$ and otherwise holding only cash. The Appendix describes the equilibrium in greater detail. The key equations are the optimal asset holding decision (4) and the following equations giving, respectively, an expression for aggregate real balances and the government's budget constraint:

$$\widehat{m}_t \equiv \frac{m_t}{p_t} = \int_i y_t^i \left(1 - z_t^i\right) di = \int_{i \mid y_t^i \leq \widehat{y}_t} y_t^i di \tag{5}$$

$$g_t = \tau_t \left(1 - \left(1 - \widehat{F}_t\right) \lambda\right) + \widehat{m}_{t+1} - \widehat{m}_t + \widehat{\pi}_t \widehat{m}_t \tag{6}$$

$$\text{where } \widehat{F}_t \equiv \int_i \left(1 - D_t^i\right) di \text{ gives the measure of cash-holders.}$$

Note that the government's seigniorage revenues are derived from increases in the demand for money ($\widehat{m}_{t+1} - \widehat{m}_t$) and from taxing real balances ($\widehat{\pi}_t \widehat{m}_t$). Households anticipate the relative tax rates on consumption via each asset (as captured by the policy parameter γ_t): $\frac{\partial \widehat{m}_t}{\partial \gamma_t} \leq 0$.

III. Political Optimization

This section describes the political economy environment and also analyzes the Ramsey problem – a benign policymaker choosing optimal (welfare maximizing) policies in a decentralized setting – since it is easily incorporated as a special case.

A. The Model

I adopt the probabilistic voting model originally due to Lindbeck and Weibull (1987), as formulated by Persson and Tabellini (2000).[14] Policymakers are elected for one period, and

[14] The probabilistic voting model enjoys several advantages over alternative models (such as the Downs (1957) median voter model), including tractability, realism, and applicability to multidimensional policy environments.

choose a level of government expenditure g_t, a single income tax rate τ_t, and the inflation tax rate $\widehat{\pi}_t$, subject to a balanced budget constraint. Policymakers derive utility only from being elected, and therefore adopt a policy vector $G_t \equiv \{g_t, \tau_t, \widehat{\pi}_t\}$ to maximize their probability of being elected. There are two policymakers $J \in \{A, B\}$ seeking election, and the electoral rule is majority voting.

Timing is as follows: cohort t is born in period t and trades its endowment with agents of cohort $t-1$ (and possibly the monetary authorities) at period t prices. Asset choice is based on the (perfectly) anticipated policies G_t and is given by equation (4).[15] In period $t+1$, with agents' asset holdings predetermined, cohort t votes for one of the two candidates proposing a policy platform G_t^J. Cohort t (and possibly the monetary authorities) then trades with cohort $t+1$ in the asset markets, obtaining consumption goods at period $t+1$ prices. The government then implements its policy platform. Finally, cohort t consumes public and private goods and then dies, the winning political candidate leaves office, and period $t+1$ comes to an end with cohort $t+1$ still holding assets to trade with cohort $t+2$...

Each candidate maximizes his probability of winning the election, which is equivalent to maximizing a weighted social welfare function subject to the government budget constraint. The solution is given formally for candidate A (but candidate B's problem is symmetric). Each candidate takes as given the distribution of cash-holders and non-cash-holders and the choice of the other candidate.

I make a critical assumption that agents differ in their political "weight" w_t^i, where this weight is assumed to be non-decreasing in agents' income. This reduced-form formulation is designed to match the evidence of unequal political influence discussed in the introduction. Later I assume a specific functional form for the relationship between agents' income and their political weight in order to arrive at analytical results.

The benefit of the probabilistic voting model is that the policymaker's objective function is smooth, because of the addition of noise in agents' voting functions. If this noise is distributed iid uniform for all agents, then A's probability of winning is simply given as:[16]

$$p_t^A = \frac{1}{2} + \int_i w_t^i \left[U^i\left(G_t^A\right) - U^i\left(G_t^B\right)\right] di \tag{7}$$

Candidate A maximizes (7) with respect to G_t, subject to the government balanced budget constraint (6).[17] Denote the total political weight of cash- and non-cash-holding agents as,

[15] Policy is perfectly anticipated because the only uncertainty in the model is over which candidate wins. However, both candidates adopt the same policy program in equilibrium, so that there is no uncertainty over policy.

[16] See Persson and Tabellini (2000).

[17] Recall that D_t^i and hence $\widehat{m}_t$ are predetermined; $\widehat{m}_{t+1}$ is determined by expected (with perfect foresight) period $t+1$ policies to which the policymaker cannot commit.

respectively, W_0 and W_1; cash-holders make up a fraction $\widehat{F}_t$ of the total population:

$$W_0 \equiv \int_{i|y_t^i \leq \widehat{y}_t} w_t^i di; W_1 \equiv \int_{i|y_t^i > \widehat{y}_t} w_t^i di$$

Hence:

Proposition 1 *If there exists an internal solution to the political economy problem, then it is characterized by:*

$$\gamma_t\left(\widehat{y}_t\right) = \frac{W_1 \widehat{m}_t}{W_0 \left(1 - \widehat{m}_t - \left(1 - \widehat{F}_t\right)\lambda\right)} \tag{8}$$

Proof. This follows from the three first order conditions (FOCs), for $\widehat{\pi}_t$, τ_t and g_t, that define the solution to the policymaker's problem:[18]

$$\frac{1}{1-\tau_t-\widehat{\pi}_t} W_0 - \phi_{0t}\widehat{m}_t = 0 \ [\widehat{\pi}_t] \tag{9}$$

$$\frac{1}{1-\tau_t-\widehat{\pi}_t} W_0 + \frac{1}{1-\tau_t-\widehat{q}_t} W_1 - \phi_{0t}\left(1-\left(1-\widehat{F}_t\right)\lambda\right) = 0 \ [\tau_t] \tag{10}$$

$$\frac{\alpha}{g_t}\left(W_0+W_1\right) - \phi_{0t} = 0 \ [g_t] \tag{11}$$

Combining (9) – (10) then gives (8). ■

Note that a corner solution with $\{\gamma_t \leq 1; z_t^i = 0 \forall i\}$ is always an equilibrium. It is consistent with political optimization because when all agents hold cash any value of $\widehat{\pi}_t = g_t - \tau_t$ is consistent with political optimization, including $\widehat{\pi}_t \leq \widehat{q}_t$ ($\gamma_t \leq 1$). However, this equilibrium is not plausible if another exists.[19] I therefore assume that if an alternative equilibrium with an internal solution (8) exists then the equilibrium $\{\gamma_t \leq 1; z_t^i = 0 \forall i\}$ is not played.

B. A Special Case: The Ramsey Problem

In our model with iid noise terms in the voting rule, the Ramsey problem is equivalent to the general political economy problem with equal household weights: $w_t^i = w \ \forall i$.

[18] Note that the second order conditions for $\widehat{\pi}$, τ and g hold: the assumption of log utility combined with the linearity of the government budget constraint ensures that the relevant convexities are present. The Lagrange multiplier associated with the budget constraint is given by ϕ_{0t}.

[19] This is because a small deviation from equilibrium behavior by a policymaker such that $\widehat{\pi}_t > \widehat{q}_t$ (which would leave the policymaker indifferent) would make some agents' asset holding choices suboptimal. If agents anticipate this deviation and some substitute out of cash, then the corner solution is no longer optimal for the policymaker. This equilibrium is therefore not plausible if an alternative equilibrium that is invulnerable to this kind of "trembling hand" criticism does exist.

Proposition 2 *The Ramsey Equilibrium has a non-positive inflation tax rate and all agents hold cash.*

Proof. By contradiction. Assume that $\gamma > 1$. Then from (4) some households substitute out of cash: an interior solution will obtain. However, from (8):

$$\gamma\left(\widehat{y}_t\right) = \frac{1-\widehat{F}_t}{\widehat{F}_t} \frac{\widehat{m}_t}{\left(1-\widehat{m}_t-\left(1-\widehat{F}_t\right)\lambda\right)} \leq 1 \tag{12}$$

Hence $\gamma > 1$ is inconsistent with optimality. All agents therefore hold cash in *every* period: hence $\widehat{q} = 0$ and $\widehat{\pi} \leq 0$. ■

The rationale for this is simple. Absent political economy considerations, the policymaker faces a standard trade-off between efficiency (optimal public good provision) and equity (consumption equalization). Since seigniorage is the more regressive of the two tax instruments, it worsens the trade-off and is therefore not utilized in equilibrium.[20]

C. Political Economy Solution

The intuition behind (8) is straightforward. The concavity of the utility function makes the policymaker disinclined to use seigniorage, since it worsens inequality. The left hand side of the equation, which captures this cost, increases with $\widehat{\pi}$. However, the political economy channel makes the policymaker more inclined to use seigniorage for the same reason. The right hand side captures this benefit: it increases with the relative weight of non-cash-holders and cash-holders, $\left(\frac{W_1}{W_0}\right)$, adjusted by the relative marginal tax revenues associated with taxing each group $\left(\frac{\widehat{m}}{\left(1-\widehat{m}-\left(1-\widehat{F}\right)\lambda\right)}\right)$.

To derive analytical results I provide a specific functional form for the weighting function. I assume that agents' political weights derive from their grouping together in endogenously determined factions in order to lobby policymakers. Agents with the same preferences over policy belong to the same faction and have equal weight (capturing the faction's per-member lobbying strength). I assume that this weight is non-decreasing in the faction's average income. Specifically, if the average income (after payment of λ for non-cash-holders) of agents in faction j is given as $\widetilde{y}^j$, then the weight of agents in this faction is given as:

$$w^j = \left(\widetilde{y}^j\right)^\theta ; \, \theta \geq 0$$

Agents' preferences over policy are determined solely by their cash-holding status. Hence:

$$w^i = \begin{cases} \left(\underline{y}\right)^\theta \; \forall \; y^i \leq \widehat{y} \\ \left(\overline{y}-\lambda\right)^\theta \; \forall \; y^i > \widehat{y} \end{cases} \tag{13}$$

[20] The overall tax rate is given by $\tau + \widehat{\pi} = g$, where g is equal to the first-best level. This is demonstrated in the following section for the general political economy solution.

where

$$\begin{aligned} \underline{y} &\equiv E\left[y^i \mid y^i \leq \widehat{y}_t\right] \\ \overline{y} &\equiv E\left[y^i \mid y^i > \widehat{y}_t\right] \end{aligned}$$

Equilibrium is then given by two equations in two endogenous variables $(\gamma_t, \widehat{y}_t)$: the optimal asset holding condition (14) characterizing the optimal strategy for households and the interior solution to the political economy problem (15) characterizing the optimal strategy for the political authorities.[21]

$$\gamma_t = \frac{\widehat{y}_t}{\widehat{y}_t - \lambda} \tag{14}$$

$$\gamma_t = \frac{\left(1-\widehat{F}_t\right)(\overline{y}-\lambda)^{\theta}}{\widehat{F}_t \underline{y}^{\theta}} \frac{\widehat{m}_t}{1-\widehat{m}_t-\left(1-\widehat{F}_t\right)\lambda} = \left(\frac{(\overline{y}-\lambda)}{\underline{y}}\right)^{\theta-1} \tag{15}$$

Existence and Uniqueness

Proposition 3 *Assume that $(y^{\max} - \lambda) > 1$. Then an equilibrium with $\gamma_t > 1$ exists if $\theta > 1$.*[22]

Proof. Rearrange equation (15) to give an expression proportional to the marginal costs and marginal benefits to the policymaker of increasing γ:

$$MC - MB \propto \gamma \underline{y}^{\theta-1} - (\overline{y} - \lambda)^{\theta-1} \tag{16}$$

From (14), $MC < MB$ for $\gamma \to 1$ $(\overline{y} = y^{\max})$ and $MC > MB$ for $\gamma \to \infty$ $(\widehat{y} = \lambda)$. By continuity, there must be some intermediate value of γ with $MC = MB$ and $\gamma_t > 1$. ■

Figure 1 presents this graphically. Simulations using various functional forms for $F(y)$ suggest that the FOCs generically describe a unique solution. I therefore assume in what follows that the solution is unique. Since $F(y)$ is time invariant, the solution must be stationary ($\widehat{q}_t = 0$). Hence:

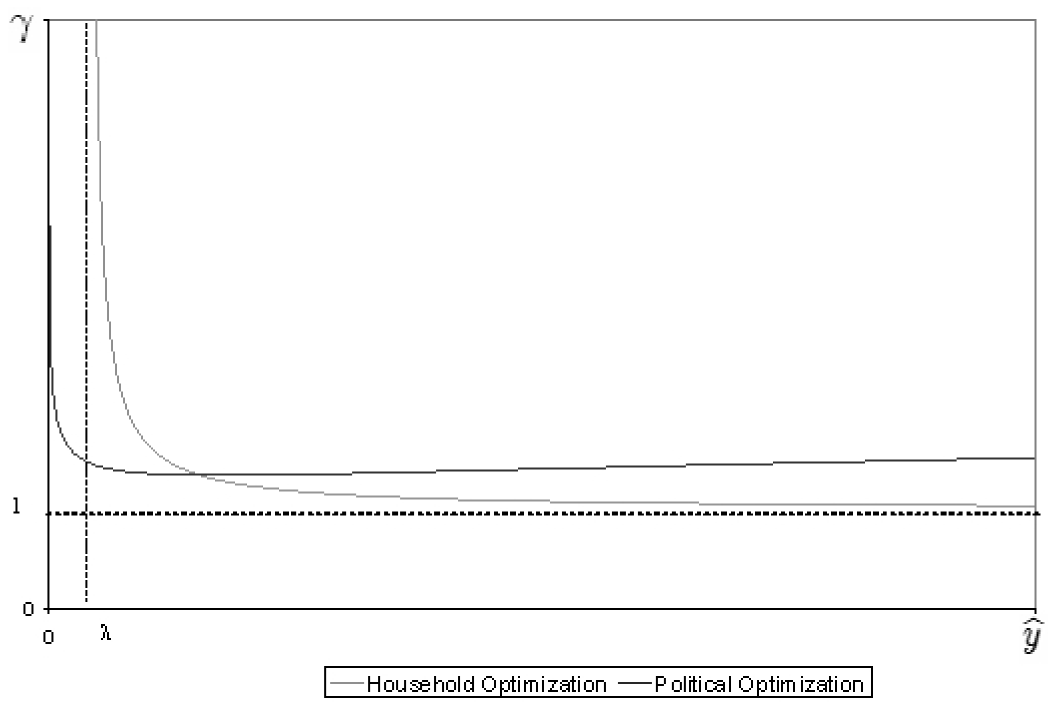
$$\gamma_t = \gamma = \frac{(1-\tau)}{(1-\tau-\widehat{\pi})} \forall t \tag{17}$$

Since $\theta > 1$ is a sufficient condition for an interior solution, I assume that it holds for the rest of the paper; and since an interior solution exists, I focus on this solution rather than the corner solution with $\gamma \leq 1$.

[21] Equation (15) is an implicit function in $\widehat{y}_t$ since $\overline{y}$ and $\underline{y}$ are functions of $\widehat{y}_t$.

[22] The first assumption will hold under any realistic support for y. When $\theta \leq 1$ then the corner solution $\gamma \leq 1$ is optimal for the policymaker. This is because when political weight increases less than one-for-one with income the negative tax base effect of taxing the better-off less heavily (by relying on seigniorage rather than income tax) outweighs the positive political effect of lowering taxation on the more favored constituency, so that seigniorage is never an optimal source of taxation.

Figure 1. Equilibrium



Comparative Statics

The key comparative statics result is the link between inequality and the policy parameter γ. To maintain generality, I have not parameterized the income distribution. I therefore demonstrate the effect in terms of Lorenz dominance.[23] To show that γ increases with inequality I first show that the political economy solution can be plotted as a series of "iso-γ" lines in the same parameter space (population share F, income share L) as Lorenz curves. Moreover, these lines mimic Lorenz curves, and increases in γ are associated with a downwards shift in the iso-γ line akin to the Lorenz dominance relationship. Hence, shifts in the income distribution from F_0 to F_1 (Lorenz dominated by F_0) will *generally* be associated with a shift to a lower iso-γ line: i.e. an increase in γ.[24]

[23] Assume two income distributions $F_0(y)$ and $F_1(y)$. Then the statement that F_0 Lorenz dominates F_1 means that the Lorenz curve for F_1 is everywhere below that for F_0. This then implies that the Gini coefficient associated with F_1 is higher than that for F_0.

[24] Looking at equation (15) it is easy to see the intuition: under F_1, non-cash-holders will generally be richer ($\overline{y}$ increases) while cash-holders will be poorer ($\underline{y}$ falls). This increases the relative political weight of richer agents, biasing the policymaker towards greater inflation finance.

It is demonstrated in the Appendix that this relationship holds *for certain* given some undemanding conditions on the income distribution (and that these conditions hold in the case of a specific and widely used distribution, namely the lognormal). Hence:

Proposition 4 *Comparing two income distributions F_0 and F_1, where F_1 is Lorenz dominated by F_0 and both distributions belong to a class of distributions governed by the additional assumptions given in the Appendix, then $\widehat{\gamma}(F_1) > \widehat{\gamma}(F_0)$.*

Proof. Rewriting equation (15) in terms of the cdf $F(y)$ and the Lorenz function $L(F)$ (noting that $\underline{y} = \frac{L(\widehat{F})}{\widehat{F}}$ and similarly that $\overline{y} = \frac{1-L(\widehat{F})}{1-\widehat{F}}$) and re-arranging to give a function in L, F space gives:

$$\begin{aligned} \widehat{L}\left(\widehat{F};\widehat{\gamma},\lambda\right) &= \frac{\widehat{F}(1-\lambda)+\lambda\widehat{F}^2}{\widehat{\gamma}-(\widehat{\gamma}-1)\widehat{F}} \\ \text{where } \widehat{\gamma} &\equiv \gamma^{\frac{1}{\theta-1}} \geq 1 \end{aligned} \tag{18}$$

To see that these iso-γ lines in (F, L) space mimic Lorenz curves, note that $\widehat{L}(0) = 0$, $\widehat{L}(1) = 1$, $\frac{\partial \widehat{L}}{\partial \widehat{F}} \geq 0$, $\frac{\partial^2 \widehat{L}}{\partial \widehat{F}^2} \geq 0$. Moreover:

$$\frac{\partial \widehat{L}}{\partial \widehat{\gamma}} = -\frac{\left(\widehat{F}(1-\lambda)+\lambda\widehat{F}^2\right)\left(1-\widehat{F}\right)}{\left(\widehat{\gamma}-\widehat{F}(\widehat{\gamma}-1)\right)^2} \leq 0 \tag{19}$$

This is illustrated in Figure 2. The Appendix outlines sufficient conditions (essentially some undemanding restrictions on the shape of the income distribution) such that, for a given value of $\widehat{y}$, comparing F_0 and F_1, $\widehat{\gamma}(\widehat{y}; F_1) > \widehat{\gamma}(\widehat{y}; F_0)$.

Hence, plotting (14) and (15) in $\gamma, \widehat{y}$ space, downwards shifts in the Lorenz curve shift the latter function upwards since they are associated with movement to a "Lorenz-dominated" iso-γ line, leading to a higher value for γ in equilibrium (Figure 3). ■

I can also demonstrate the following propositions:

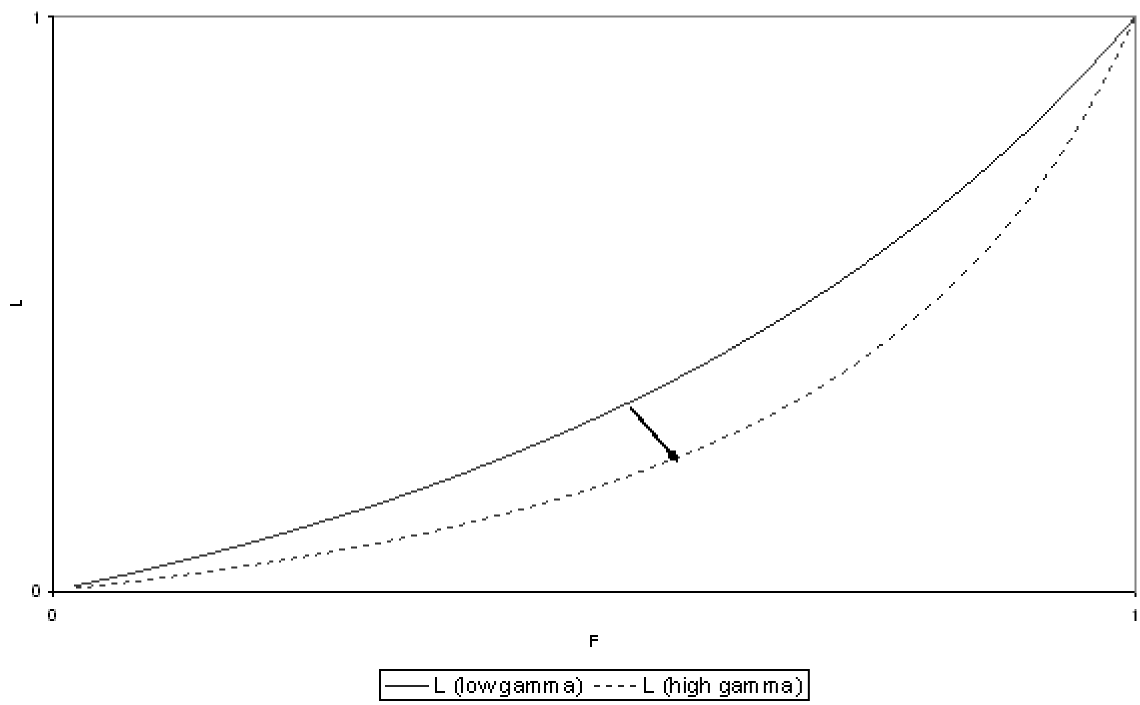
Proposition 5 *The optimal policy γ is increasing in θ*

Proof. This follows from (15):

$$\frac{\partial \gamma}{\partial \theta} = \frac{\partial}{\partial \theta}\left(\frac{(\overline{y}-\lambda)}{\underline{y}}\right)^{\theta-1} = \widehat{\gamma}^{\theta-1}\ln\widehat{\gamma} \geq 0 \tag{20}$$

■

Figure 2. Iso-Gamma Lines in (F, L) Space



Proposition 6 *Greater income inequality increases the responsiveness of inflation to political bias: Comparing two income distributions F_0 and F_1, where F_1 is Lorenz-dominated by F_0 and both distributions belong to a class of distributions governed by the additional assumptions given in the Appendix, then $\frac{\partial\gamma}{\partial\theta}(F_1) > \frac{\partial\gamma}{\partial\theta}(F_0)$.*

Proof. Differentiating (with respect to $\widehat{\gamma}$) the previous comparative statics result yields:

$$\frac{\partial^2\gamma}{\partial\theta\partial\widehat{\gamma}} = \widehat{\gamma}^{\theta-2}\left\{(\theta-1)\ln\widehat{\gamma}+1\right\} \geq 0 \tag{21}$$

Proposition 6 then follows from the fact that $\widehat{\gamma}(F_1) > \widehat{\gamma}(F_0)$ (Proposition 4). ■

This result – that the effects of political bias and income inequality are complementary and have a multiplicative impact on inflation – is the most interesting from an empirical point of view, because it offers an explicit test of the hypothesized political economy channel linking inflation and inequality. This is the paper's empirical focus.

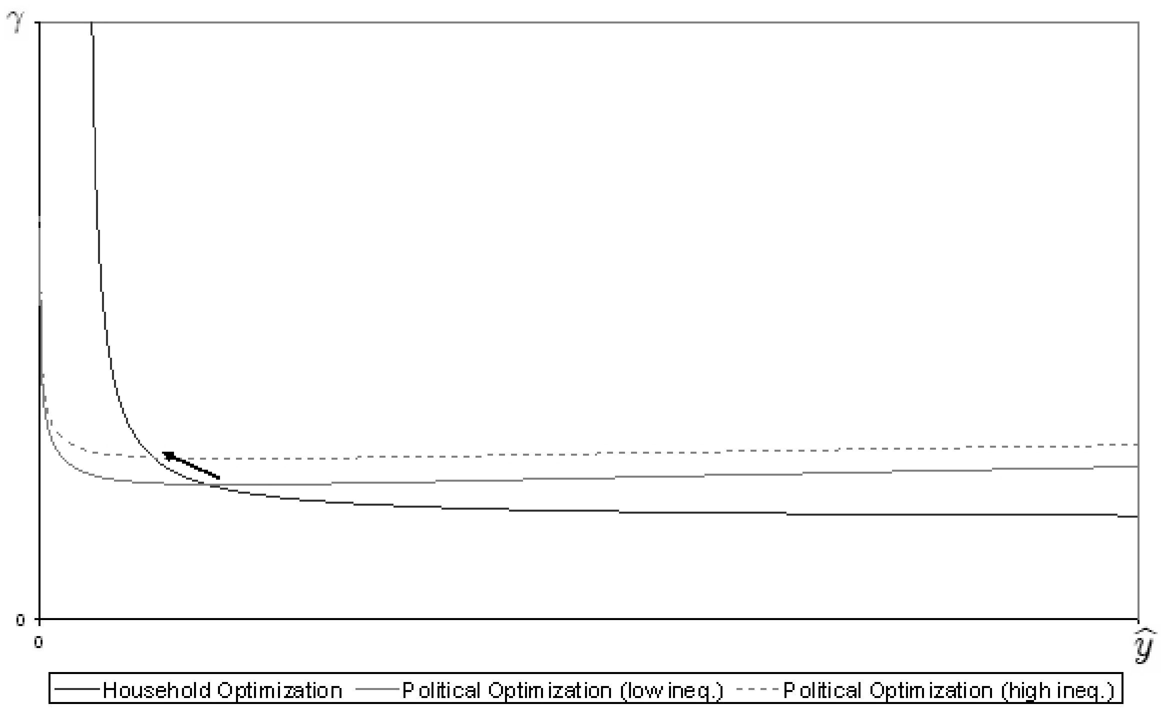
Proposition 7 *Changes in the income distribution and in θ have no effect on government spending g as a fraction of output net of asset market participation costs.*

Proof. This follows from the three FOCs for the policymaker's problem (9) – (11) and the government budget constraint (6). Substitution yields:

$$\frac{g}{\left[1-\left(1-\widehat{F}\right)\lambda\right]}=\frac{\alpha}{1+\alpha} \tag{22}$$

Clearly the ratio on the left hand side depends only on the relative importance of the public good in agents' utility function, α.[25] Note as well that government spending is equal to the First Best level if all agents hold cash (see Appendix). ■

Figure 3. Comparative Statics



IV. Empirical Analysis

A. Methodology

Using cross-country macroeconomic data for hypothesis testing is plagued by a number of well known identification problems caused by endogeneity and the presence of omitted

[25]This result is included merely to illustrate the mechanics of the model. It arises from the assumption of additive separability and log-utility in the utility function with respect to private good and public good consumption, a simplifying assumption of the model which is not central to the analysis.

variables.[26] This paper's identification strategy is based on "difference in differences" (DD) and instrumental variables (IV) methodologies.[27] "Difference in differences" techniques rely on the random assignment of a "treatment" across observations in order to identify its effect. If the assignment is exogenous and random, then comparing the change in the dependent variable for observations receiving the "treatment" to different degrees will provide a consistent estimate of its effect.[28] IV estimation extends this logic by identifying exogenous factors (instruments) that explain the assignment of the "treatment." As Besley and Case (2000) note, the method of identification – finding a source of exogenous change – is essentially the same under both techniques.

The marked change in the evolution of world politics since the late 1980s is central to my identification strategy. Since the late 1980s the political systems of many countries have become more democratic (Huntingdon, 1991; Jaggers and Gurr, 1995). Figure 4 illustrates this change, plotting the distribution of countries witnessing an increase (or decrease) in their "democracy score" (see Jaggers and Gurr, 1995) between 1960 and 2000. This step-change has occurred in a sufficiently diverse group of countries to suggest that some external (exogenous) shock was a major contributing factor.

The most significant international event that occurred around this time was the end of the Cold War. Historians have argued for a causal relationship. For instance, Simensen (1999) notes that "the end of the Cold War and the fall of the Soviet Union drastically weakened economic and military support for [largely non–democratic] Marxist regimes... The Americans, on their side, reduced their support of authoritarian regimes that had been their allies during the Cold War."[29] This explanation is neither necessary nor sufficient to account for democratization in all cases. For example, democratization in some Latin American and Asian countries clearly predated the end of the Cold War. However, even in these countries, the Cold War's cessation "accelerated the process" of reform. According to this interpretation, autocratic governments aligned to either side during the Cold War were most likely to democratize in the late 1980s and early 1990s.

This hypothesis is supported by Table 2, which divides countries into three groups ("pro–Soviet," "unaligned" or "anti–Soviet") according to a measure of their Cold War relationship with the Soviet Union, and gives the mean level of democratization between

[26] One method of overcoming these problems is to use panel techniques, which can control for time-invariant country effects (such as in Desai et al., 2003; 2005). Unfortunately, the long lags involved in the key relationships investigated here would severely limit the time dimensionality of any panel. In addition, our measure of income inequality is available only intermittently for most countries, implying an unbalanced panel with many missing observations.

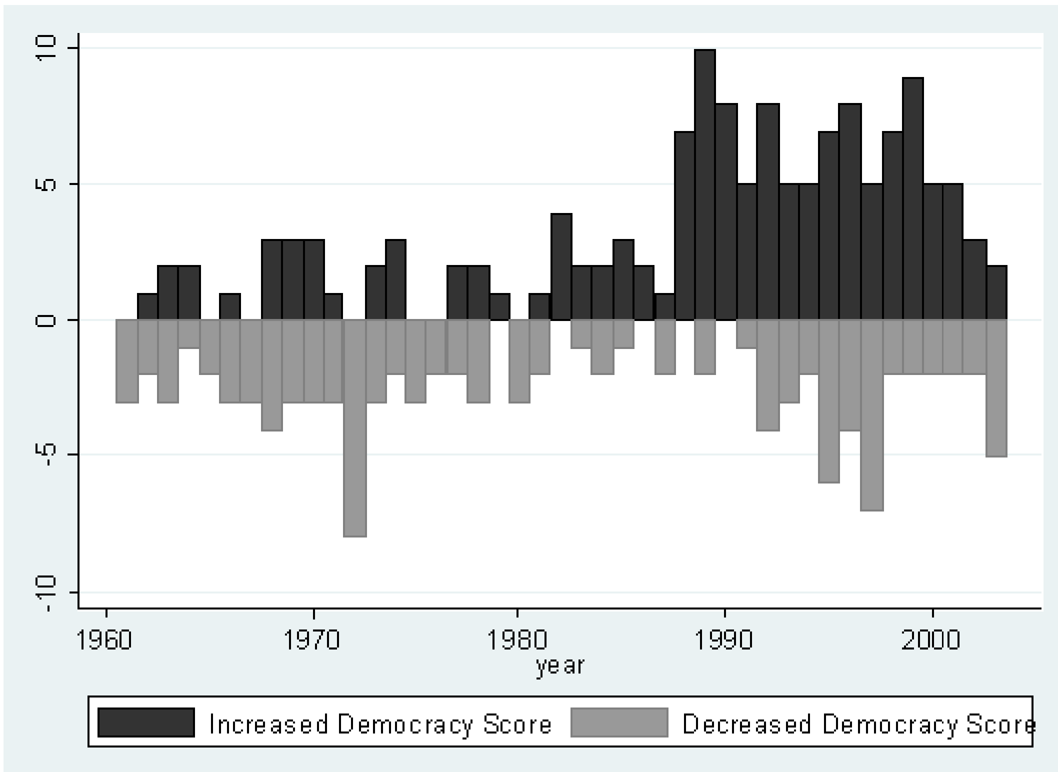
[27] See Besley and Case (2000) for a discussion and comparison of these methodologies.

[28] Because it is based on first differences, DD analysis also removes the effect of other (non-time-varying) variables that may be correlated with the level of the dependent variable.

[29] Soviet support for allied autocracies and repression of dissent is well known. Western support for anti–communist autocracies is also well documented (see Blum, 2003).

1975-89 and 1990-2004 for each group.[30] All groups democratize on average but the effect is most pronounced for the "aligned" countries (on either "side"). This differential effect is statistically significant once one controls for the initial level of democracy to account for mean reversion (column II).

Figure 4. Number of Countries with Increased or Decreased Democracy Score



For DD estimation, this pattern supports the view that the wave of democratization in the late 1980s and early 1990s resulted from the end of the Cold War rather than merely from country-specific factors, and can therefore be modeled as an exogenous "treatment." For IV estimation, the pattern suggests a choice of instruments with which to identify the exogenous component of the political change.

[30] To measure democracy I use the "democracy score" scaled to lie between 0 and 1. To measure countries' Cold War orientation I use Tucker's (1999) measure S of the similarity between the "alliance portfolio" of each country (measured over 1975–1984) and the Soviet Union. The country with the lowest S score in the sample is the United States; those with the highest scores are Bulgaria, Hungary, Poland and Romania. Countries are then divided into three equal–sized categories. Standard errors are in parentheses.

Table 2. Mean Democratization: Countries Grouped by Cold War Relationship with USSR

Mean Democratization μ	I Unconditional Mean	II Conditional Mean
"pro-Soviet" group: μ_P	.203***	.00997
	(.0497)	(.0523)
"unaligned" group: μ_U	.136***	$-$.129**
	(.0444)	(.0565)
"anti-Soviet" group: μ_A	.227***	.0213
	(.0456)	(.0507)
(Initial Democracy)		$-$.360***
		(.0568)
$\mu_P - \mu_U$	.0667	.139**
	(.0667)	(.0581)
$\mu_A - \mu_U$	.0901	.150***
	(.0637)	(.0553)
OLS R^2	.322	.509
Observations	110	110

Difference-in-Differences Estimation

Inflation has trended downwards since the late 1980s (IMF, 1996). Proposition 6 tells us that the inflation tax should have fallen most in high inequality countries which experienced the greatest shift away from elite dominance in politics. The change in the inflation tax transform between the periods before and after democracy's "third wave," $\Delta\widehat{\pi}$, is our dependent variable. The change in the political environment ($\Delta Bias$) then constitutes the "treatment," whose effects will vary depending on the country's initial level of inequality ($Ineq$). I estimate the following DD regression:

$$\Delta\widehat{\pi} = \beta_0 + \beta_1 Ineq + \beta_2 \Delta Bias + \beta_3 Ineq \times \Delta Bias + \beta_4 X + \varepsilon \tag{23}$$

where X is a set of exogenous controls. Proposition 6 predicts that $\beta_3 > 0$.

Instrumental Variables Estimation

Table 2 motivates our choice of instruments for the change in bias $\Delta Bias$. Democratization is assumed to be most likely in "aligned" non–democratic countries. Hence:

$$\begin{aligned} \Delta Bias &= \gamma_0 + \gamma_1 D_{B\geq 0.5} + \gamma_2 S_{SOV} + \gamma_3 \left(S_{SOV}\right)^2 \\ &\quad + \gamma_4 D_{B\geq 0.5} \times S_{SOV} + \gamma_5 D_{B\geq 0.5} \times \left(S_{SOV}\right)^2 + \eta_1 \end{aligned} \tag{24}$$

where $D_{B\geq 0.5}$ is an indicator variable that takes the value of 1 when the initial level of political bias is high (≥ 0.5) and 0 otherwise, and S_{SOV} is the Signorino and Ritter (1999) measure of similarity of alliance portfolio between the country in question and the Soviet

Union (entered quadratically to capture Cold War "alignment" with either side).[31] It is assumed (and confirmed by the data) that $\gamma_4 > 0$ and $\gamma_5 < 0$, and that $\gamma_2 = \gamma_3 = 0$.[32] The interaction term $Ineq \times \Delta Bias$ is treated as a separate endogenous regressor. The full instrument set for both endogenous regressors therefore includes the five excluded instruments above as well as the same five instruments interacted with initial inequality $Ineq$ (as instruments for the interaction term). I treat initial inequality as exogenous (at least in the narrow sense of being uncorrelated with the error term in equation 23).

B. Data

I treat the spread of democracy worldwide since the late 1980s as a natural experiment and estimate changes in the inflation tax rate as a function of interactions between the initial level of inequality and the change in elite bias. The two time periods are the late 1970s/1980s (1975-1989) and 1990s-2000s (1990-2004).

Inequality data is obtained from the UNU/WIDER World Income Inequality Database (WIID; v2.0) in the form of Gini coefficients.[33] The quality of the observations and the survey method is coded in the data: I use the top three quality categories and adjust observations to take into account the survey method (gross versus net income, income versus expenditure, monetary versus full income, etc.).[34]

I make the assumption (as elsewhere in the literature) that autocratic governments exhibit greater elite bias than democratic governments. Measures of democracy can be used as proxies for (an absence of) elite bias. I therefore use a widely utilized measure of democracy, the "democracy score" from the Polity IV dataset, normalized to lie between zero and one and then subtracted from one, to provide a proxy for elite bias.[35]

The dependent variable is the change in the average inflation tax rate ($\widehat{\pi}$) between the two period (averages of annual rates, taken from the IMF's *International Financial Statistics*). For robustness purposes I also include a number of control variables. These include dummies for advanced countries, Latin American countries, and Eastern European

[31] The first stage regressions also include initial income inequality, as well as the exogenous controls X where these enter into the second stage.

[32] Regressing $\Delta Bias$ on the five excluded instruments for the 83 countries in the sample, estimates of γ_2 and γ_3 are statistically insignificant, while estimates of γ_4 and γ_5 carry the predicted signs and are statistically significant at the 0.1 percent level.

[33] Version 1.0 of the database has been widely used (see, e.g., Desai et al., 2003, 2005). Version 2.0 has been substantially revised to include new data and to exclude problematic observations in the original dataset, leaving fewer observations.

[34] I adjust the data by regressing observations on methodology and country dummies to estimate the average difference between Gini coefficients resulting from the use of the different measurement techniques (identified using countries where more than one technique is employed). Where top quality ($quality = 1$) data are available for a particular country and time period, only these observations are used to estimate the period average. Where $quality < i, i \in \{2, 3\}$ data are unavailable but $quality = i$ data are available, only these observations are used.

[35] Mulligan et al. (2004) is one of several leading empirical studies that makes extensive use of the Polity IV 'democracy score' variable.

countries, to control for concerns that these atypical countries may be driving the results.[36] Tucker (1999) provides the Cold War alliance data (the excluded instruments for IV estimation), Signorino and Ritter's (1999) measure S of bilateral similarity of alliance portfolios for the country in question and the Soviet Union. Table 3 gives summary statistics for the sample of 83 countries.

Table 3. Descriptive Statistics

	Observations	Mean	Standard Deviation	Min.	Max.
$\Delta\widehat{\pi}$	83	$-.0462$	.107	$-.526$	.296
Inequality	83	42.2	9.69	22.9	64.2
Δ Bias	83	$-.193$	.271	$-.985$	.167
Openness	82	61.1	41.0	11.0	301
Δ Openness	82	5.99	28.2	-77.6	124
Urbanization	82	53.7	23.6	5.3	100
Real PC GDP	82	7,945	7,376	494	26,458
Industrialized	83	.241	.430	0	1
E. Europe	83	.0361	.188	0	1
L. America	83	.229	.423	0	1
S_{SOV}	83	.718	.116	.403	.919
$D_{B\geq 0.5}$	83	.566	.499	0	1

C. Results

DD Estimates

Table 4 presents results for various specifications of the DD regression (23).[37] Column I presents results without controls. The coefficient β_3 is positive and statistically significant at the 5 percent level, confirming the interaction effect reported in Table 1. Column II presents results including control variables: the coefficient on β_3 remains positive and statistically significant at the 5 percent level. Note that the country dummies are not

[36] Latin American countries arguably exhibited many of the features of the model during the 1970s and 1980s: entering the Latin America dummy ensures that the results are not driven wholly by these countries. The dummies for Eastern European and Industrial countries control for the opposite problem: that the model does not adequately describe the situation in these countries, either because they were already democries prior to 1989 (industrial countries) or because democratization occured with other fundamental changes (Eastern Europe). I also include a measure of urbanization (taken from the World Bank's *World Development Indicators*) and measures of trade openness and real (PPP) GDP per capita taken from the Penn World Tables (PWT 6.1). The last three controls are taken for the first year of the second period (1990) to denote initial conditions (I also enter the change in openness, which is found to significantly affect inflation performance).

[37] The Breusch-Pagan (B–P) test for heteroskedasticity rejects the null hypothesis of constant variance for some specifications. Robust standard errors are therefore reported (in this and subsequent tables). Significance levels are denoted by $\{1 \text{ percent}: ^{***}; 5 \text{ percent}: ^{**}; 10 \text{ percent}: ^{*}\}$.

statistically significant.[38] Dropping the country dummies (column III) provides sharper results: the measured interaction effect is significant at the 0.1 percent level.

Table 4. DD Regression Results

	I	II	III	IV	V	VI
Inequality	.000343 (.00102)	−.000240 (.00130)	−.000594 (.00104)	.00180 (.00110)	−.000248 (.00107)	.0000786 (.00165)
Δ Bias	−.389*** (.145)	−.538** (.238)	−.308*** (.0689)	−.384*** (.0751)	−.447** (.207)	−.419*** (.129)
Ineq.×Δ Bias	.00860** (.00337)	.0112** (.00460)	.00644*** (.00172)	.00790*** (.00193)	.00925** (.00389)	.00872*** (.00280)
Openness		.00130*** (.000449)	.00108*** .000357)	.000464 (.000307)	.00110*** (.000370)	.00136*** (.000471)
Δ Openness		−.00118** (.000551)	−.00101** (.000486)	−.000832** (.000357)	−.00106** (.000519)	−.000887* (.000524)
Urbanization		−.00225** (.000873)	−.00202** (.000970)	−.00116 (.000773)	−.00203** (.000974)	−.00142 (.00116)
Real PC GDP÷10^6		2.29 (2.89)	4.13 (2.40)	4.11** (2.06)	4.50* (2.48)	−5.25 (6.83)
Industrialized		.0601 (.0719)				
E. Europe		−.0854 (.0926)				
L. America		.0356 (.0374)				
1975-89				.114*** (.0211)		
β_0	−.0629* (.0369)	−.0382 (.0782)	−.0133 (.0589)	−.126** (.0566)	−.0322 (.0721)	−.0542 (.00780)
R^2	.109	.294	.274	.287	.260	.313
F Statistic	2.58*	4.29***	6.16***	6.96***	3.49***	4.13***
B–P χ^2 (1) (p–level)	.843	.000	.000	.133	.000	.000
Observations	83	81	81	134	79	61
Sample	Full	Full	Full	75-89 & 90-04	Excluding E. Europe	Excluding Industrialized

As a robustness check, I ascertain that the results are not unique to the time period chosen (although focusing on this time period is preferred because it overcomes some identification problems). Column IV maintains the same specification but extends the sample to two time periods (1975-89, as well as 1990-2004). Again, the coefficient retains its sign and statistical significance.[39] Finally, columns V and VI present results for two subsets of the original sample (excluding Eastern Europe and industrial countries, respectively). The coefficient β_3 remains positive and is statistically significant at either the 5 percent level or the 1 percent level. Note though that the coefficient β_2 is negative and statistically significant in all specifications, contradicting proposition 5.

IV Estimates

Table 5 reports the IV results. Columns I – III replicate the first three columns of Table 4. Estimation is via two stage least squares (2SLS) using the set of excluded instruments

[38] The p-value associated with a test of their joint significance is 0.66.

[39] The "before" comparator period for 1975-89 is 1960-74. Note though that, apart from biases associated with potentially endogenous policy change in the first period, these results are likely biased due to MA(1) serial correlation in the error term from taking first differences.

discussed above. The estimated interaction effect carries the predicted sign and is statistically significant at the 5 percent level when no controls are entered (column I), and at the 1 percent level when the controls other than the country group dummies are entered (column III), but is not statistically significant when the country group controls are added (column II).[40] Diagnostic tests suggest that the instruments meet conditions for identification: relevance and exogeneity.[41]

Table 5. IV Regression Results

	I	II	III	IV	V	VI
Inequality	.00180	.000324	.000466	.00218	.000359	.000978
	(.00137)	(.00165)	(.00128)	(.00163)	(.00180)	(.00150)
Δ Bias	−.513***	−.377	−.341***	−.541***	−.257	−.364***
	(.190)	(.361)	(.0963)	(.204)	(.472)	(.113)
Ineq.×Δ Bias	.0130**	.0102	.00918***	.0141**	.00868	.0105**
	(.00529)	(.00703)	(.00336)	(.00602)	(.00875)	(.00417)
Openness		.00117***	.000976***		.00109**	.000935***
		(.000445)	.000336)		(.000483)	(.000349)
Δ Openness		−.00108**	−.000957**		−.00102*	−.000937*
		(.000537)	(.000475)		(.000579)	(.000494)
Urbanization		−.00226**	−.00193**		−.00225*	−.00189**
		(.000860)	(.000953)		(.000891)	(.000968)
Real PC GDP÷10^6		2.16	3.49		2.05	3.30
		(2.76)	(2.34)		(2.86)	(2.38)
Industrialized		.0461			.0373	
		(.0771)			(.0831)	
E. Europe		.0246			.0896	
		(.136)			(.192)	
L. America		.0396			.0402	
		(.0357)			(.0372)	
β_0	−.111**	−.0314	−.0133	−.123**	−.0184	−.0480
	(.0472)	(.0906)	(.0589)	(.0544)	(.103)	(.0663)
2nd Stage R^2	.224	.391	.385	.208	.343	.351
2nd Stage F Statistic	2.39*	8.59***	5.79***	2.36*	16.7***	4.45***
1st Stage F Statistics	24.6***	3.65***	9.51***	24.6***	3.65***	9.51***
	15.3***	4.02***	6.75***	15.3***	4.02***	6.75***
P–H χ^2 (p–value)	.920	.154	.294	.927	.208	.341
A–R χ^2 (10) (p–value)	.0162	.392	.0010	.0162	.392	.0010
IV Relevance (p–value)	.001	.001	.001	.001	.001	.001
C–D ($r = \{.10; .25\}$)	3.03	2.65	4.08	3.03	2.65	4.08
	(38.5; 11.7)	(38.5; 11.7)	(38.5; 11.7)	(3.68; 2.25)	(3.68; 2.25)	(3.68; 2.25)
Over–id. (p–value)	.429	.503	.529	.696	.421	.288
Observations	83	81	81	83	81	81
Technique	2SLS	2SLS	2SLS	LIML	LIML	LIML

[40] These country dummies are again neither individually nor jointly significant.

[41] Results from over-identification tests using Hansen's J statistic (I–III) or the Anderson-Rubin statistic (IV–VI), where instruments are exogenous under the null hypothesis, confirm that the instruments are exogenous (Table 5). Similarly, the test of identification/ instrument relevance (Anderson canonical correlations LR test; where instruments are not relevant under the null hypothesis) suggests that the model is identified.

Stock and Yogo's (2002) test for weak instruments (based on the Cragg-Donald (C–D) statistic) indicates that the instruments may be weak.[42] However, the Anderson-Rubin (A-R) test of the significance of the coefficients on the endogenous regressors (β_2, β_3) is robust to weak instruments (Stock et al., 2002). According to this test, β_2 and β_3 are jointly significantly different from zero in specifications I and III. As a further robustness check I use a Limited Information Maximum Likelihood (LIML) estimator, which delivers more reliable inference if instruments are weak (Stock et al., 2002).[43] The results, reported in columns IV–VI, are very similar to those derived under 2SLS.[44] The coefficient β_2 again carries the "wrong" sign and is generally statistically significant.

D. Discussion

Table 6 reports further robustness checks with respect to the DD estimates, testing whether the use of relatively poor-quality inequality data (coded 2 or 3 in the WIID dataset) biases the results.[45] Columns I-III employ the simple DD specification while columns IV-VI include controls (except country group dummies). In each case the first column maintains the most liberal quality criterion (*quality* ≤ 3) while the second and third employ progressively stricter criteria. Raising the quality threshold reduces the sample size (particularly for developing countries). The point estimate for β_3 remains positive across specifications. Under the strictest quality criterion (columns III and VI) the estimate of β_3 is not statistically significant: this is likely a result of the reduction in sample size. However, results using the median quality threshold (columns II and IV) uphold the significance results of columns I and IV, respectively. Hence, the strategy of trading off reduced data quality against increased sample size does not seem to have unduly biased the results towards finding significant results.

The results are quantitatively significant. This is most readily illustrated using Table 1. Comparing two "low inequality" countries where one experiences a significant fall in

[42] Weak (i.e., only moderately relevant) instruments will lead to bias, even if the instruments are relevant (Stock et al., 2002). Weak instruments could cast doubt on the DD estimates as well as the IV estimates, since the identification strategy — using the end of the Cold War to isolate the exogenous component of political change — is essentially the same in both cases. Stock and Yogo (2002) propose formal tests for weak instruments using the C–D statistic and tabulate critical values. I reproduce two critical values, for $r \in \{.10; .25\}$, for the test of the null that a "5 percent significance test" will have an actual rejection rate of at least r percent. The C–D statistic therefore provides evidence of weak instruments in models I – III. This test requires that the residuals are homoskedastic: I therefore also report the Pagan–Hall (P–H) test statistic. The error term appears to be homoskedastic. In any case, robust standard errors are always reported.

[43] Stock and Yogo (2002) also present critical values for their weak instruments test under LIML: these are significantly lower than under 2SLS, since LIML is more robust to weak instruments.

[44] Moreover, comparing the C–D statistic against Stock and Yogo's critical values for LIML, there is little or no evidence of weak instruments leading to serious inference problems under this alternative estimation procedure.

[45] The WIID quality ratings refer to the degree to which the coverage or methodology of the original survey that generated the gini coefficient in question is either problematic or unknown. For observations with a *quality* rating of 1, both quality and coverage are known and of acceptable quality. For ratings of 2 or 3, respectively, one or both are unknown or of questionable quality.

political bias and one does not, the former sees a *greater rise* (or smaller fall) in $\widehat{\pi}$ of around 7 percent; whereas comparing two "high inequality" countries, the differential is in the other direction. The net differential effect is around 13 percent between high and low inequality countries. If initial inflation were equal in all countries and set at a level so that inflation in the "treated" high inequality country fell to zero, the inflation differential between high and low inequality treated countries would be around 15 percentage points. If initial inflation were higher, the effect would be more pronounced.

A result that contradicts the model is the positive impact on inflation from democratization in low inequality countries ($\beta_2 < 0$). This finding suggests that the model may be ignoring other effects which could cause democratization to induce higher inflation.[46] The conditioning impact of inequality on how political changes affect inflation is the model's most important prediction: hence the interaction effect (β_3) offers the best test of model. However, the result that $\beta_2 < 0$ merits further research.

Table 6. DD Regression: A Robustness Check

	I	II	III	IV	V	VI
Inequality	.000343	.000532	−.000379	−.000594	−.00120	−.00125
	(.00102)	(.000954)	(.00150)	(.00104)	(.00136)	(.00169)
Δ Bias	−.389***	−.272***	−.193	−.308***	−.237***	−.234**
	(.145)	(.0700)	(.113)	(.0689)	(.0632)	(.0843)
Ineq.×Δ Bias	.00860**	.00699***	.00400	.00644***	.00480**	.00347
	(.00337)	(.00205)	(.00374)	(.00172)	(.00200)	(.00376)
Openness				.00108***	.000765**	.000532
				.000357)	(.000349)	(.000434)
Δ Openness				−.00101**	−.000157	.000835
				(.000486)	(.000558)	(.00166)
Urbanization				−.00202**	−.00290***	−.00241*
				(.000970)	(.00106)	(.00126)
Real PC GDP÷10^6				4.13	4.96*	6.20
				(2.40)	(2.56)	(4.05)
β_0	−.0629*	−.0686*	−.0499	−.0133	.0596	.000732
	(.0369)	(.0343)	(.0443)	(.0589)	(.0619)	(.106)
R^2	.109	.0820	.104	.274	.417	.464
F Statistic	2.58*	5.56***	2.56*	6.16***	9.00***	18.83***
B–P χ^2 (1) (p–level)	.843	.0813	.389	.000	.000	.000
Observations	83	56	27	81	55	27
Quality Threshold	≤ 3	≤ 2	≤ 1	≤ 3	≤ 2	≤ 1

It is also worth noting that the results presented here differ from those in Desai et al. (2003; 2005). In these studies, inflation is higher in what one might term "high inequality, high democracy" and "low inequality, low democracy" countries; whereas in this paper it is "high inequality, low democracy" countries where inflation is likely to be highest. From a theoretical point of view, the difference arises from different assumptions about the relationship between political bias and inequality and the tax instruments available to policymakers. Econometrically, differences likely reflect different samples and estimation

[46] For instance, political and economic reform could occur together, the latter causing (at least initially) higher inflation as the economy adjusts. Alternatively, democratization could release suppressed demand for public spending, which might initially be financed via money creation until tax revenues adjust or spending pressures abate.

strategies.[47] The strategy followed in the current paper delivers robust and consistent estimates.[48] However, the contrasting results suggest that one should interpret estimated effects cautiously.

The proxy for relative political power or elite bias used in this paper – the "democracy score" from the Polity IV dataset – is arguably not ideally suited to its task. Obtaining better proxies for this type of variable should be a key objective for future research. More broadly, obtaining measures of political "fundamentals" that capture *de facto* as well as *de jure* notions of representation should be at the forefront of the research agenda in political economy.

V. Concluding Remarks

This paper presents a model to account for a stylized fact noted in a number of studies: that more unequal societies tend to experience higher inflation. The model's key prediction for empirical testing is that elite bias (autocracy) and inequality interact to create inflation. Hence, among countries swept up in "democracy's third wave" in the late 1980s, inflation should have fallen most in the most unequal societies.

This proposition is tested by using the widespread democratization of the period as an exogenous "treatment" and estimating a difference in differences equation linking changes in inflation to changes in elite bias, interacted with the initial level of inequality. This procedure helps to minimize several pervasive identification problems associated with using cross-country data. As a robustness check, the same equation is estimated via an instrumental variables (IV) methodology, using countries' position in the Cold War alliance network as an instrument for the change in elite bias, under the assumption that the end of the Cold War was the prime reason for the widespread democratization that occurred. Both empirical approaches yield significant results in support of the model. Moreover, diagnostic tests suggest that the Cold War alliance variables are good instruments. This lends support to both the IV and DD results, since the identification strategy is essentially the same in each case.

This paper contributes to a wider literature on institutions and economic outcomes. Its starting point is the belief that the effect of institutions depends on their social context, a view that is increasingly prevalent among political economists.[49] The model analyzes how

[47] Desai et al. employ a dynamic panel methodology, generally with country fixed effects and including a lagged dependent variable and other endogenous variables on the right hand side. As the authors acknowledge, their OLS and Fixed Effects results will be biased and inconsistent, particularly with a limited time dimension (Baltagi, 2001; p. 130). They present further results obtained using variants of the Arrelano-Bond (consistent) GMM estimator which confirm their overall findings. However, these require the use of lagged variables as instruments which further reduces the panel's already limited time dimensionality.

[48] An additional strength of the empirical strategy followed in this chapter is the use of longer time periods to capture inherent lags, which should reduce the white noise in the inequality series and also solves the problem of over-rejection in significance tests due to serial correlation in panel DD estimation (see Bertrand et al., 2004).

[49] For instance, Besley et al., 2005, argue that "interactions with social and historical preconditions" can account for "the heterogeneous performance of political institutions."

one political institution (the relative political influence of different social classes) can interact with an aspect of the socioeconomic environment (the distribution of income) to drive policy outcomes. The empirical results strongly support the predicted interaction effect. In the context of elite bias in the political system, higher income inequality creates a more skewed distribution of political power. This in turn leads to policies more beneficial to the elite, including a regressive shift in tax incidence through higher seigniorage. This result supports a more general conclusion. Democratic and open institutions may be harder to achieve in economically divided societies; however, it is in these societies that they likely deliver the greatest benefits.

I. Equilibrium

Equilibrium for the economy (with exogenous policies) is defined by the optimal asset-holding strategy for each household $\{D_t^i\}$ (26) and a set of prices $\{p_t, q_t\}$ such that market clearing conditions for cash (28), the second asset (27), and goods (29), and budget constraints for each household (25) and the government (30) hold in each period t:[50]

$$\begin{aligned}
c_t^i &= y_t^i \left(1-\tau_t-\widehat{\pi}_t\right)\left(1-D_t^i\right) \\
&\quad + \left(y_t^i-\lambda\right)\left(1-\tau_t-\widehat{q}_t\right) D_t^i, \quad \forall i, t && (25)\\
D_t^i &= 1 \text{ iff } y_t^i > \widehat{y}_t,\ 0 \text{ otherwise}, \forall i, t && (26)\\
\widehat{y}_t &\equiv \frac{\lambda \gamma_t}{\gamma_t - 1} \\
q_t \int_i \left(y_t^i - \lambda\right) D_t^i di &= d_t \equiv d, \forall t && (27)\\
p_t \int_i y_t^i \left(1-D_t^i\right) di &= m_t, \forall t && (28)\\
\int_i c_t^i di + g_t &= \int_i \left(y_{t+1}^i - D_{t+1}^i \lambda\right) di \equiv 1-\left(1-F\left(\widehat{y}_{t+1}\right)\right)\lambda, \forall t && (29)\\
g_t &= \tau_t \int_i \left(y_t^i - D_t^i \lambda\right) di + \frac{m_{t+1}-m_t}{p_{t+1}} && (30)\\
&= \tau_t \left(1-\left(1-F\left(\widehat{y}_t\right)\right)\lambda\right) + \frac{m_{t+1}}{p_{t+1}} - \frac{m_t}{p_t} + \frac{m_t}{p_t}\widehat{\pi}_t, \forall t
\end{aligned}$$

Equilibria exist where either or both of the assets are not expected to be accepted in trade, and therefore have no value (ratifying these expectations). In these cases the relevant prices p_t or q_t will equal ∞. I focus on equilibria where both assets are traded as long as it is individually rational for agents to hold them, given that they expect them to be accepted in trade by the subsequent cohort.

[50] Substitution among the budget constraints and market clearing conditions demonstrates that Walras's Law holds.

II. First Best Allocation

The planner's problem can be expressed as:

$$\max_{c_t^i, D_t^i, g_t} W_t = \int_i \left[\ln c_t^i + \alpha \ln g_t\right] di \tag{31}$$

$$s.t.$$

$$\int_i c_t^i di + g_t = 1 - \lambda \int_i D_{t+1}^i di \;\; [\phi_{0t}] \tag{32}$$

The sole constraint is the economy-wide resource constraint: that total cohort t public and private consumption is equal to the total cohort $t+1$ endowment ($\equiv 1$) minus the cohort $t+1$ dissipated cost of participation in the market for d.[51] Differentiation with respect to D_{t+1}^i yields:

$$\frac{\partial W_t}{\partial D_{t+1}^i} = -\lambda \phi_{0t} < 0 \tag{33}$$

which implies that $D_t^i = 0, \forall i, t$.

Hence:

$$\overline{c}_t = \overline{c} = \frac{1}{1+\alpha} \tag{34}$$

$$g_t = \overline{g} = \frac{\alpha}{1+\alpha} \tag{35}$$

[51] The planner problem is not set up as an intertemporal problem because there is no technology for transfering resources across generations (other than via the one-period delay between receiving the endowment and consumption).

III. Sufficient Conditions for Proposition 4 to Hold

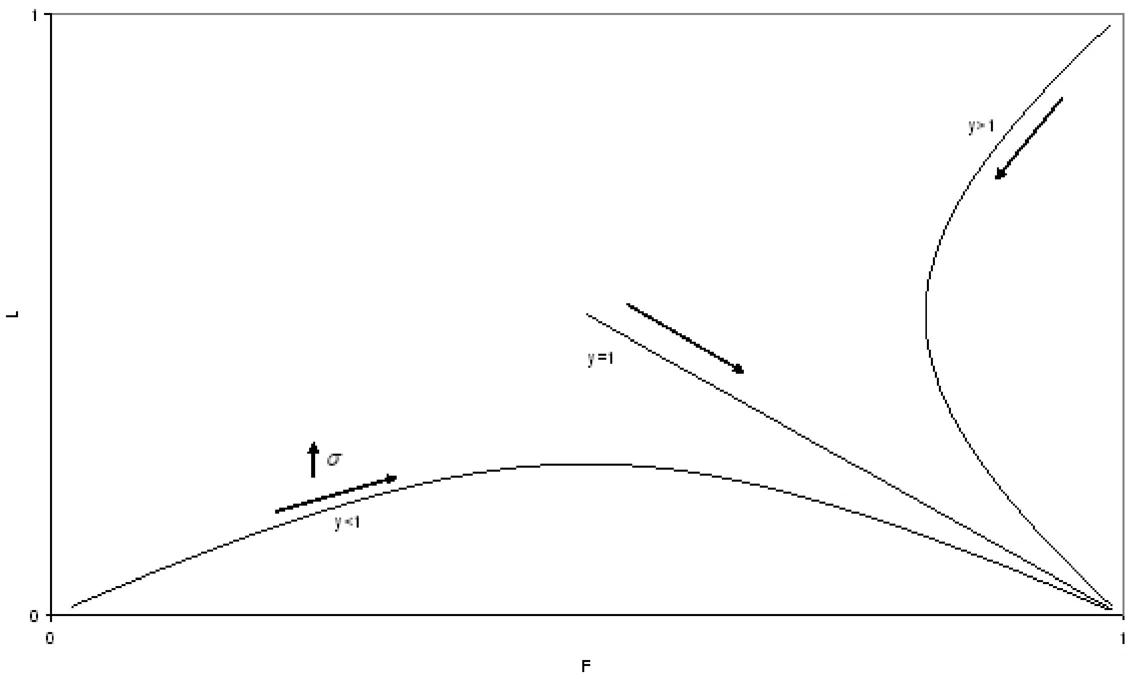
Assume that a class of income distributions F with associated Lorenz functions L and with mean income normalized to unity can be uniquely described by a parameter $\sigma \in [0,1]$. Specifically:

1. $F(\sigma_0)$ Lorenz Dominates $F(\sigma_1) \Leftrightarrow \sigma_0 < \sigma_1$
2.
   (a) $F(\widetilde{y} < 1; \sigma \to 0) = L(\widetilde{y} < 1; \sigma \to 0) = 0$
   (b) $F(\widetilde{y} = 1; \sigma \to 0) = L(\widetilde{y} = 1; \sigma \to 0) = \frac{1}{2}$
   (c) $F(\widetilde{y} > 1; \sigma \to 0) = L(\widetilde{y} > 1; \sigma \to 0) = 1$
3.
   (a) $F(\sigma = 1) = 1$
   (b) $L(\sigma = 1) = 0$
4. $L(\widetilde{y}; \sigma)$ and $F(\widetilde{y}; \sigma)$ are smooth and continuously differentiable in σ and $\widetilde{y}$
5.
   (a) $\left(\frac{\partial^2 L}{\partial F \partial \sigma} \mid \widetilde{y} < 1\right) < 0$
   (b) $\left(\frac{\partial L}{\partial F} \mid \widetilde{y} = 1\right) < 0$
   (c) $\left(\frac{\partial^2 L}{\partial F \partial \sigma} \mid \widetilde{y} > 1\right) > 0$; except for a discontinuity at the vertical (switch in slope from $+\infty \to -\infty$).

Assumption **1** above states that the parameter σ maps into Lorenz-dominance, in the same way that a cardinal utility measure maps into an ordinal preference relation (think of σ as "inequality"). Consider the following thought-experiment: plot in $(F, L(F))$ space the locus of points corresponding to a particular level of income $\widetilde{y}$ as σ increases from 0 to 1 (an iso-$\widetilde{y}$ line). Then Assumptions **2(a)-(c)** and **3(a)** and **(b)** dictate the start and end points of the line and Assumption **4** tells us that the line is smooth and continuously differentiable with respect to F and σ. Assumptions **5(a)-5(c)** impose restrictions on the slope of the line. They capture two competing effects of increasing inequality: changes in the numbers of the agents with income above or below a specific level, and changes in the average income of agents within either group. Assumption **5(a)** implies that for any low income level, as the income distribution becomes more unequal, initially the share of income held by those with income below this level increases as more agents hold below-mean incomes, but eventually, as more of those with incomes below this level have very low incomes, their income share falls even as their numbers continue to increase.

Similarly, assumption **5(c)** implies that for any income above the mean, as the income distribution becomes more unequal initially more agents have incomes above this level as more agents become relatively rich, but as income becomes concentrated in fewer hands the number of agents above this threshold falls although their share of total income continues to increase. Finally, assumption **5(b)** corresponds (loosely) to the middle class becoming increasingly small *and* poor as inequality increases. Essentially, assumptions **5(a)-(c)** simply impose some smoothness on the transition from one income distribution to another that is Lorenz-dominated by the first. Figure 1 provides an illustration.

Figure 1. Iso-y Lines in (F,L) Space

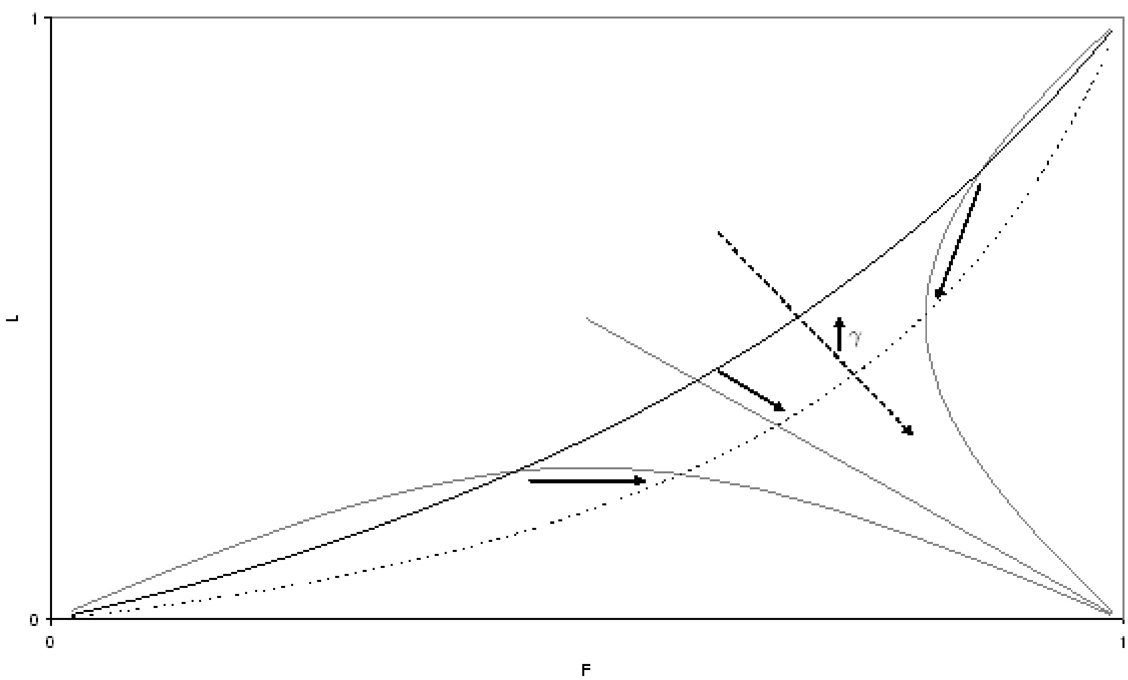


Proposition A1 Given these assumptions, Proposition 4 holds.

Proof. Plot the political economy solution (iso-γ line) in $(F, L(F))$ space, $\widehat{L}\left(\widehat{F};\widehat{\gamma},\lambda\right) = \frac{\widehat{F}(1-\lambda)+\lambda\widehat{F}^2}{\widehat{\gamma}-(\widehat{\gamma}-1)\widehat{F}}$ and consider any initial equilibrium point on this line, corresponding to a particular value of $\widehat{y} = \widehat{y}_0$ and of $\widehat{\gamma} = \widehat{\gamma}_0$ (and hence $\gamma = \gamma_0$). Consider the iso-$\widetilde{y}$ line corresponding to $\widetilde{y} = \widehat{y}_0$ passing through this point, corresponding to the initial income distribution described by $\sigma = \sigma_0$. Now consider the point on the iso-$\widetilde{y}$ line corresponding to $\sigma = \sigma_1 > \sigma_0$ (corresponding to an income distribution Lorenz-dominated by the original distribution). By the restrictions on the slope of the iso-$\widetilde{y}$ line imposed by assumptions 5(a)-5(c), this point must be below the original iso-γ line and hence, by (19), be on an iso-γ line corresponding to a higher level of γ for the given level of $\widehat{y} = \widehat{y}_0$. Hence, $\gamma = \left(\frac{(\overline{y}-\lambda)}{\underline{y}}\right)^{\theta-1}$ shifts upwards in $(\gamma, \widehat{y})$ space, implying a higher level for γ in equilibrium. ■

Figure 2 illustrates the preceding discussion.

Figure 2. Iso-y and Iso-Gamma Lines in (F,L) Space



Proposition A2 The Log-normal, a widely utilized approximation for real-world income distributions, conforms to Assumptions 1-5.

Proof. From Aitchison and Brown (1957), if mean income is normalized to unity, then $F = \Phi\left[\frac{\ln \widetilde{y}}{S} + \frac{S}{2}\right]$ and $L = \Phi\left[\frac{\ln \widetilde{y}}{S} - \frac{S}{2}\right]$; where $\Phi(z)$ is the standard normal distribution and S is the standard deviation of log income. Consider the monotonic transformation of S into $[0,1]$: $\sigma = 1 - \frac{1}{1+S}$. Then clearly Assumptions 1, 2(a)-(c), 3(a)-(b) and 4 hold.

Note that:

$$\frac{\partial F}{\partial S} = \frac{\partial F}{\partial z_F}\frac{\partial z_F}{\partial S} = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left[\frac{\ln \widetilde{y}}{S}+\frac{S}{2}\right]^2} \left[-\frac{\ln \widetilde{y}}{S^2} + \frac{1}{2}\right] \quad \text{(A1)}$$

$$\frac{\partial L}{\partial S} = \frac{\partial L}{\partial z_L}\frac{\partial z_L}{\partial S} = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left[\frac{\ln \widetilde{y}}{S}-\frac{S}{2}\right]^2} \left[-\frac{\ln \widetilde{y}}{S^2} - \frac{1}{2}\right] \quad \text{(A2)}$$

and hence:

$$\left(\frac{dL}{dF} \mid y = 1\right) = -\widetilde{y}\frac{\frac{S^2}{2} + \ln \widetilde{y}}{\frac{S^2}{2} - \ln \widetilde{y}} = -1 < 0 \tag{A3}$$

$$\left(\frac{\partial}{\partial S^2}\frac{dL}{dF}\right) = \frac{\widetilde{y} \ln \widetilde{y}}{\left(\frac{S^2}{2} - \ln \widetilde{y}\right)^2} \gtrless 0 \text{ as } \widetilde{y} \gtrless 1 \tag{A4}$$

$$\text{with discontinuity at vertical } (e^{\frac{S^2}{2}} = \widetilde{y}) \text{ for } \widetilde{y} > 1$$

which proves that Assumptions 5(a)-(c) also hold for the Log-normal. ■

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