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Inflation, Inequality and Social Conflict

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Abstract
This paper presents a political economy model of inflation as a result of social conflict. Agents are heterogeneous in terms of income. Agents' income levels determine their ability to hedge against the effects of inflation. The interaction of heterogeneous cash holdings and preferences over fiscal policy leads to conflict over how to finance government expenditure.

The model makes a number of predictions concerning which environments are conducive to the emergence of inflation. Inflation will tend to be higher in countries with higher inequality and with greater pro-rich bias in the political system. Conversely, the use of income tax will be higher in countries with lower inequality and less pro-rich bias. The model also predicts that although inequality and political bias will have an impact on the composition of revenue, it will have no effect on the overall level of government spending (assuming that spending is on public goods only). These results are largely confirmed by the empirical portion of the paper. The paper's novel features are its simplifications at the household level which allow for richer treatment of the income distribution and political process than in the related literature.

The paper also gives unequivocal comparative statics results under relatively undemanding assumptions.

JEL Classifications: D31 D72 E31 E50 E60 H20 H30
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1 Introduction

An emerging literature on the macroeconomic consequences of income inequality has identified a robust positive relationship between inequality and inflation (Bhattacharya et al. (2003); Albanesi (2002); Dolmas et al. (2000); Bulif (1998); Easterly and Fischer (1998); Beetsma and Van Der Ploeg (1996)).[1] This paper offers a political economy explanation for the relationship. It develops a model whose key features are the existence of elite bias in the political system and differing distributional consequences of the inflation tax and alternative tax instruments. The model is similar in spirit to several important recent theoretical contributions. However, simplifications at the household level allow a richer analysis of the political economy environment and a more general treatment of the income distribution than has been possible so far. It also gives rise to clear analytical results that facilitate explicit empirical testing of the theory. The empirical section of the paper lends relatively strong support to the model.

The model is motivated by a simple public finance problem: the financing of a public good via a linear income tax and/or seigniorage. Financial market imperfections mean that richer agents find the inflation tax easier to avoid, making it a regressive form of taxation.[2] The elite bias in the political system gives rise to what is essentially a weighted welfare maximisation problem, where agents' weight is increasing in income. The choice of income tax versus seigniorage and the level of government spending is then determined by the interaction of three competing motivations. The first is the standard public finance problem: to provide the efficient level of the public good via the optimal choice of taxation. The second motivation is an equity one: to provide a degree of consumption equalisation. This results from the concavity of agent's utility functions, and biases the policy-maker towards using income taxation, the more progressive form of taxation, to finance government expenditure. However, there is a third, political bias effect, that causes the policy-maker to favour policies more beneficial to richer groups in society. This can lead to positive seigniorage in equilibrium as the burden of taxation is shifted onto the less well-off.

The pro-rich bias is accentuated by increased income inequality, since greater income dispersion magnifies the disparity in political power. The model then predicts that societies

[1] Bhattacharya et al. (2003) actually identify an inverse-U shaped relationship, positive for all but extremely high values of inequality. Easterly and Fischer (1998) focus on the income share of the lowest 20% of the income distribution, rather than an inequality measure based on the entire distribution (such as the Gini coefficient). Note as well that some studies assume a causal relationship, and differ in the direction of causation, whereas others merely note the correlation.

[2] That seigniorage tends to be a regressive form of taxation, its incidence felt particularly harshly by poorer agents and the middle classes, is well documented (Easterly and Fischer (2001), Erosa and Ventura (2002), Kane and Morisett (1993)).

with more income inequality and where the pro-rich political bias is stronger will tend to suffer from higher inflation.

Although the model is in the tradition of a growing theoretical literature, its precepts may seem unconventional, particularly in light of earlier formal and informal explanations of inflation. The idea that inflation can emerge as a deliberate policy choice, rather than as a result of policy failure, fiscal mismanagement, adverse shocks or time inconsistency, requires some motivation. Similarly, the idea that inflationary policies might be related to 'pro-elite' political bias may also appear controversial, not least because in earlier models that approach the issue, it tends to be 'populists' – politicians of the 'left' – that are assumed to be more inflation-tolerant. This may arise either from a greater desire to offset output fluctuations, or from the need to finance higher public expenditure.[3]

The view that left-wing parties may be more averse to output fluctuations is certainly defendable. However, if the resulting inflationary bias is greater for the 'left-wing' party and hence more electorally damaging, this party might have the most to gain from a tougher anti-inflationary stance.[4] Distributional considerations reinforce this argument. The available evidence suggests that inflation is most harmful for those at the bottom and middle of the income distribution – the natural constituency of parties of the 'left'. Distributional effects become particularly salient when the issue is placed in a context of fiscal dominance of monetary policy, as in this paper. If money creation is fiscally motivated, its incidence and distributional dimension *relative to alternative tax instruments* becomes the critical question. An expenditure explanation – that inflation emerges as a result of increased government spending and the monetisation of the resultant fiscal deficit – requires that more progressive tax instruments are unavailable. Otherwise, why would a rational 'left-wing' government adopt a tax instrument that falls heaviest on its favoured constituency?

Because the model makes a number of quite strong assumptions which are central to its results, it is vulnerable to accusations that these results simply follow directly from the assumptions, with the model contributing few additional insights. However, I believe that the model delivers insights that are greater than the sum of its assumptions. Firstly, the key relationship is a subtle one: the *conditioning effect of political bias on the inequality-inflation relationship*. The model illustrates quite precisely the conditions under which the existence of pro-rich bias gives rise to the positive relationship between inflation and inequality. Es-

[3]For instance, the canonical Partisan Cycle model has two parties (Left (L) and Right (R)) competing for control over monetary policy, and assumes that the parties differ in the relative weight attached to inflation in their social loss functions. Party L places less weight on inflation and more weight on output fluctuations, resulting in a greater inflation bias (Persson and Tabellini (2000), pp 426-31).

[4]And party R (using the Partisan Cycle model's terminology) might gain by increasing the inflationary bias, thus increasing the cost of electing party L and boosting its own reelection chances. See Milesi-Ferretti (1994).

sentially, political influence must increase with income with a greater than unit elasticity, so that the distribution of political bias is more unequal than that of income and *becomes progressively more unequal, in relation to income, as income inequality increases*. Secondly, the political bias effect is only one effect, balanced by a competing motivation to equalise income generated by agents' concave utility. The model's contribution is its illustration of how these effects interact. Finally, both the assumption that political bias increases sharply with income and the assumption that inflation is regressive seem important for any political economy model relating to fiscal and monetary policy. Both relationships have received robust empirical support, as detailed below. Their implications for policy, analysed in this paper, also receive empirical backing.

The rest of the paper is organised as follows. Section two discusses the relevant theoretical and empirical literature. Section three presents the model of the economy. Section four solves for the first-best welfare-maximising solution, to provide a suitable benchmark. Section five introduces the political economy problem. It solves the Ramsey problem as a special case, providing a second benchmark. Finally, this section presents the full solution and undertakes some comparative statics analysis. Section six provides an empirical analysis of the relationships outlined in the theoretical portion of the paper. The empirical results are broadly supportive of the paper's theoretical arguments, although there are some interesting results that merit further research. Section seven concludes.

2 Related Literature

2.1 Theoretical Contributions

Traditional models of the cost of inflation – such as menu costs/shoe leather cost models and the new generation of dynamic sticky price models – have tended to place little emphasis on the distributional impact of price instability. Similarly, most of the 'political economy' literature on monetary policy-making focuses on time-inconsistency issues, or rests on ad-hoc assumptions over politicians' loss functions, rather than rigorously analysing the usual questions in the political economy literature relating to distributional conflicts.

However, recent years have seen the emergence of a body of literature whose authors have developed important theoretical insights into how distributional and political economy factors can influence inflation performance. Albanesi (2002) and Sturzenegger (1992) both adopt variants of the cash-credit goods model. Sturzenegger (1992) introduces a foreign currency explicitly, whilst Albanesi (2002) uses the standard Lucas and Stokey (1983) model, in which a subset of goods must be bought with cash, subject to a cash-in-advance constraint,

and the remainder can be purchased with a costly credit technology. Albanesi argues for – at least in part – a reverse pattern of causation running from inequality to inflation to motivate the relationship between the variables uncovered in her empirical work. Using a bargaining model to proxy for the political determination of policy, she shows that greater inequality heightens the political conflict over fiscal policy, leading to the adoption of inflationary financing.

Dolmas et al. (2000) use an overlapping generations framework, with a single tax (seigniorage) used to finance lump sum transfers. Beetsma and Van Der Ploeg (1996) take a similar position, arguing that inflation is essentially a progressive form of taxation since it reduces the value of public debt which is largely held by wealthier agents. In both papers higher inequality makes the median voter relatively less well-off, increasing the government's incentives to rely on inflationary finance. Bhattacharya et al. (2003) employ an overlapping generations model similar to that in this paper, and predict an inverse-U shaped relationship between inequality and seigniorage. Unlike the earlier two papers, they allow for substitution out of cash by richer agents, making seigniorage a regressive tax. Inflation initially increases in inequality but falls for very high levels of inequality due to a tax-base effect (basically a Laffer-curve argument). The possible weaknesses of this approach are twofold. Firstly, the treatment of the political economy dimension, based on discretising the policy choice and assuming a series of bilateral contests, is somewhat counterintuitive and does not match the approach taken elsewhere in the political economy literature. Secondly, the paper relies on simulation, making it difficult for the authors to pin down the processes driving their results.

Desai et al. (2003) argue that inequality and the political system interact to drive inflation performance. In high inequality countries, more democracy leads to higher inflation as a result of populist attempts at redistribution. By contrast, in low inequality countries, the main problem is parasitic governing elites that create inflation to transfer resources to themselves. In this environment more political competition will reduce inflation.

2.2 Empirical Contributions

2.2.1 Distributional effects of inflation

Kane and Morisett (1993) identify at least four channels by which inflation can affect the distribution of income. Agents tend to face differential access to anti-inflation hedging tools – such as foreign-currency denominated or interest-bearing assets. Inflation also shifts the wage profile as differential bargaining strength or access to indexed wages results in differential rates of real wage erosion. A third channel is heterogeneity with respect to liabilities

– some groups have access to subsidised loans whose nominal interest rates may fail to fully reflect inflationary pressures. Finally, fiscal drag – the Tanzi-Olivera effect – reduces the real value of non- or inadequately indexed taxes and transfers, redistributing from net tax-payers to net benefit-recipients.

Kane and Morisett analyse 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 balances – to the rich, worsening the country's already highly skewed distribution of income. Ferreira and Litchfield (1999) also analyse Brazilian data, and find some time-series evidence of inflation leading to higher inequality. Cardoso (1992) supports Kane and Morisett's view that inflation's impact on the poor is primarily through its effect on real wages – a result of imperfect indexation – whereas it is the middle class that pays the inflation tax on cash balances.

Some papers have combined empirical analysis with a more rigorous theoretical approach, using a cash-credit goods framework – with an increasing returns element to the credit technology – to argue that the inflation tax is regressive. This corresponds to the 'hedging' channel outlined by Kane and Morisett. Erosa and Ventura (2002) analyse US data, showing that poorer agents are more reliant on cash holdings as a proportion of their aggregate wealth, making them more exposed to the inflation tax.[5] Calibrating a monetary growth model based on a cash-credit goods framework, they show that the welfare and redistributive effects of allowing for this agent heterogeneity are significant.

A parallel research question asks which groups in society are more inflation averse. Higher inflation-aversion amongst poorer groups would suggest that inflation is regressive in character. Fischer and Huizinga (1982) use US survey data from the 1970s to analyse how factors such as income and political affiliation affect relative preferences over inflation and unemployment. They find that for the US, simple analysis of sample means suggests the rich are more likely to rate inflation as more important than unemployment, but regression analysis does not uncover a statistically significant income effect. Scheve (2002) analyses UK survey data from 1995, and finds that although holders of nominal assets are more inflation averse (as one would expect), there is not a significant income effect on inflation-aversion. However, Easterly and Fischer (1998) analyse international survey data which asks respondents to rate which of a range of possible domestic problems they feel to be of greatest concern. They find that the probability of nominating inflation as of high concern is higher for poorer and less educated respondents.

Shiller (1996) presents survey data from the US, Germany and Brazil in an attempt

[5]Mulligan and Sala-i-Martin [32] report similar findings from the 1989 US Survey of Consumer Finances. Wealthier and older agents are more likely to hold interest-bearing assets.

to answer a related question: *Why* do people dislike inflation? He finds that the traditional economist's answer – with a focus on menu costs and the like – is not generally held amongst the population as a whole. Non-economists tend to view inflation as 'unfair' because it arbitrarily redistributes income. This indicates that for the public at large – if not for economists – the redistributive impact of inflation is central.

2.2.2 Inflation and Inequality: cross-sectional studies

Romer and Romer (1998) use a cross-sectional framework to analyse the effect of macroeconomic policies on the distribution of income. They find that macroeconomic stability and low inflation are associated with improved well-being of the poor over the long-run. Bulif (1998) also uses a cross-sectional approach, regressing gini coefficients on a number of explanatory variables, including a quadratic expression in income (to test the Kuznets hypothesis) and dummies for hyperinflation, high inflation, low moderate inflation and very low inflation. He finds that higher inflation is associated with more inequality, although the result seems to exhibit a degree of non-monotonicity. In particular, hyperinflationary countries have higher inequality than other countries but at lower levels of inflation the relationship is not so clear-cut. Earlier work by the same author (Bulif and Gulde, 1995) based on a panel of developing and industrial countries also uncovered a positive relationship between inflation and inequality. Easterly and Fischer (1998) use cross-country data and find that higher inflation is associated with the lower 20% of the income distribution having a smaller share of total income, lower minimum wage rates in relative terms, and higher rates of poverty. An IMF (1996) survey of global inflationary trends found that 'high average inflation and high variability of inflation increase income inequality significantly.'

Other authors analyse the link between inflation and poverty. Datt and Ravallion (2002) analyse panel data from Indian states and find that regional differences in the inflation rate contribute positively to poverty. Conversely, Epaulard (2003) studies a cross-section of almost 100 growth and downturn episodes in developing countries and finds that very high inflation increases the responsiveness of poverty to economic slowdowns, but inflation has no direct effect on poverty.

Albanesi (2002) also adopts a cash-credit goods model, and presents evidence of a cross-country correlation between inflation and inequality in support of the positive relationship predicted by her theoretical work. Dolmas et al. (2000) and Beetsma and Van Der Ploeg (1996) present empirical evidence of a positive relationship between inflation and inequality, which they take to support their model linking inflation to populism. Dolmas et al. (2000) controls for measures of central bank independence. However, in neither case does the data

allow an explicit test of the political channel hypothesised.[6] In fact the evidence presented in section six below, covering a wider range of countries, suggests that inflation is highest in autocracies, which contradicts the papers' hypothesis linking inflation to populism. Furthermore, the balance of evidence in the literature, as discussed above, suggests that inflation is regressive (certainly compared to alternative means of finance). This undermines the validity of modelling the inflation tax as a progressive form of taxation. It also makes these papers' results vulnerable to the addition of alternative tax instruments, such as a linear income tax. Bhattacharya et al.'s (2003) prediction of an inverse-U shaped relationship between inequality and seigniorage is supported by the empirical evidence presented in their paper.

Cukierman et al. (1992) focus on political conflict and instability – which one would expect to be linked with inequality other things being equal – rather than on inequality per se. They argue that political instability leads policy-makers to hold off from fiscal reforms for electoral reasons, leading to a greater reliance on inflationary financing. They find some cross-sectional evidence to support this hypothesis. However, Click (1998) finds that seigniorage is explained by the differential costs of different methods of taxation and by the institutional set-up governing the central bank, but the measures of political instability in Cukierman et al. are not significant once these other factors are controlled for. Desai et al. (2003) present some empirical support for their model based on inequality conditioning the relationship between inflation and democracy.

3 The Model

3.1 Demographics, Technology and the Household Problem

The model employs a simplified overlapping generations framework, similar in spirit to that in Bhattacharya et al. (2003) but greatly simplified to allow for analytical solutions and to facilitate a fuller treatment of the income distribution and the political environment.

Each household lives for two periods, with one cohort born each period. In the first period the household receives an endowment of the consumption good, y^i. Consumption takes place in the second period, but the good is assumed to be perishable and is destroyed after one period. Hence some transactions technology is necessary to allow the 'young' to transfer their endowment to the 'old' in exchange for purchasing power the following

[6] One could also criticise the econometric analysis of the latter paper for its relatively small sample size (23 democracies), its reliance on the exclusion of an awkward outlier (Israel) for its results, and the limited number of controls employed.

period. There are two assets in the economy to facilitate this exchange: cash (whose supply is controlled by the government) and a second asset in fixed supply.[7] This second asset can be thought of as a real asset, a foreign currency or an indexed asset. Essentially it is an inflation shelter.

Agents are heterogeneous in their labour endowment. The endowment is given by:

$$\begin{aligned} y^i &\sim \left(1, \sigma^2\right) && (1)\\ y^i &\geq 0 && (2)\\ \text{with cdf } F(y);\ f\left(y^i = 0\right) &= f\left(y^i \to \infty\right) = 0 && \\ \frac{\partial}{\partial \sigma^2} \int_0^{\widetilde{y}} y f(y)\, dy &\leq 0 \ \forall \widetilde{y} && (3) \end{aligned}$$

Inequality (3) states that increases in the variance of the income distribution from, say, σ_0^2 to $\sigma_1^2 \geq \sigma_0^2$ delivers a distribution $F_1(y)$ that second order stochastically dominates the initial distribution $F_0(y)$.

Households face a utility cost of operating in the market for the second asset, denoted κ^i.[8] This cost is assumed to fall with y^i:

$$\begin{aligned} \kappa^i &= \kappa(y) \geq 0 && (4)\\ &> 0 \text{ for } y \text{ finite} && (5)\\ \frac{\partial \kappa}{\partial y} &\leq 0 && (6) \end{aligned}$$

The empirical and theoretical work on portfolio choice has posited the existence of fixed costs of participation in markets for non-cash financial assets. Luttmer (1999) analyses US data on asset holdings and argues that the lower bound on the cost is 3% of monthly per capita consumption. Mulligan and Sala-i-Martin (1996) argue that the fixed cost varies across agents due to individual-specific characteristics, including age, education and financial wealth. These characteristics in turn affect income. The simple inverse relationship between the cost of financial diversification and income employed here can be thought of as a reduced form of a more complex model of portfolio choice.

[7] The value of each asset depends on the availability of goods supplied by agents in the following period who wish to exchange for the asset, so that - for instance - the value of the asset falls if fewer goods are available for purchase (the price of the goods in terms of the asset increases).

[8] Households will not substitute their endowment for a mixture of both assets, because the cost of accessing the market for the second asset is a fixed cost that does not vary in the value of the fixed asset held. Hence, a corner solution is always chosen.

Utility is given by:

$$U^i = \ln c^i + \alpha \ln g - \kappa^i D^i \tag{7}$$

$$D^i = \begin{cases} 1 \text{ if agent exchanges endowment for the second asset;} \\ 0 \text{ if exchange is for cash} \end{cases} \tag{8}$$

In addition to consuming the private good, agents also consume a public good g which is funded out of taxation and seigniorage revenue. The log utility formulation is necessary for expositional simplicity. Explicit taxation is in the form of a linear income tax τ which is paid out of consumption goods immediately prior to consumption.

The nominal value of assets received in exchange for the endowment is given by:

$$a_t^i = d_t^i + m_t^i = \left[D^i q_t + \left(1 - D^i\right) p_t\right] y^i \tag{9}$$

where p and q are the prices of goods in terms of cash and the second asset respectively (alternatively, the inverse of the assets' prices, taking the consumption good as the numeraire), and m and d are nominal holdings of cash and the second asset by the household following production.

Consumption is at period $t+1$ prices. Hence, the household budget constraint is given by:

$$c^i + \tau_t y^i = \frac{d_t^i}{q_{t+1}} + \frac{m_t^i}{p_{t+1}} = \left[D^i \frac{q_t}{q_{t+1}} + \left(1 - D^i\right) \frac{p_t}{p_{t+1}}\right] y^i \tag{10}$$

The time subscripts on the prices reflect the fact that agents receive their endowment one period before consuming themselves. The sole consumption decision for the household is which asset to hold, which comes down to a choice of $D^i \in [0,1]$:

$$D^i \in [0,1] = \arg\max U^i = \ln c^i + \alpha \ln g_t - \kappa^i D^i \tag{11}$$

$$s.t.$$

$$c^i + \tau_t y^i = \frac{m_t^i}{p_{t+1}} + \frac{d_t^i}{q_{t+1}} = \left[D^i \frac{q_t}{q_{t+1}} + \left(1 - D^i\right) \frac{p_t}{p_{t+1}}\right] y^i \tag{12}$$

Which yields the solution:

$$D^i = 0 \text{ if } \kappa^i > \ln\left[\frac{q_t}{q_{t+1}} - \tau_t\right] - \ln\left[\frac{p_t}{p_{t+1}} - \tau_t\right] = \ln\left[\frac{\frac{q_t}{q_{t+1}} - \tau_t}{\frac{p_t}{p_{t+1}} - \tau_t}\right], \ 1 \text{ otherwise} \tag{13}$$

Note that in the foregoing discussion and in what follows, all time subscripts refer to the period in which the cohort producing or consuming was born, except prices, which refer to the current period.

3.2 General Equilibrium

General Equilibrium is defined by the optimal asset-holding decision for each household, based on beliefs about the evolution of prices p and q, market clearing conditions for cash, the second asset, and goods, and budget constraints for each household and the government:

$$c^i + \tau_t y^i = \frac{m_t^i}{p_{t+1}} + \frac{d_t^i}{q_{t+1}} = \left[D^i \frac{q_t}{q_{t+1}} + \left(1 - D^i\right) \frac{p_t}{p_{t+1}} \right] y^i, \forall i \quad (14)$$

$$D_t^i = 0 \text{ if } \kappa^i > \ln \left[\frac{\frac{q_t}{q_{t+1}} - \tau_t}{\frac{p_t}{p_{t+1}} - \tau_t} \right], \text{ 1 otherwise}, \forall i \quad (15)$$

$$q_t \int_i y^i D_t^i f\left(y^i\right) di = d_t \equiv d \quad (16)$$

$$p_t \int_i y^i \left(1 - D_t^i\right) f\left(y^i\right) di = m_t \quad (17)$$

$$\int_i c_t^i f\left(y^i\right) di + g_t = \int_i y^i f\left(y^i\right) di \equiv 1 \quad (18)$$

$$g_t = \tau_t + \frac{m_{t+1} - m_t}{p_{t+1}} \quad (19)$$

The first equation (14) above gives the household budget constraint. Equation (15) gives the optimal choice for each household in terms of exchanging its endowment for cash or the second asset. Equations (16) and (17) equate supply and demand for the second asset and cash respectively (market clearing conditions for the asset market). In these equations the terms $d_t\,(=d)$ and m_t without superscripts represent aggregate quantities.

Equation (18) gives market clearing conditions in the goods market. Note that the equations denote general equilibrium for period $t+1$, when the cohort born in period t consumes public and private goods and is taxed. Hence, total consumption by cohort t is equal to the total endowment of the period $t+1$ cohort (1 by assumption). The final equation (19) gives the government balanced budget constraint. It shows that the public good must be funded out of tax revenue and seigniorage.

4 Planner Problem

The planner problem provides us with a benchmark against which to judge the political economy outcome derived in the following section. The planner is constrained by the economy's resource constraint but not by the constraints imposed by individual behaviour, since all allocations can be imposed centrally by assumption. The planner problem can therefore

be expressed as:

$$\max_{c_t^i, D_t^i, g_t} W_t = \int_i \left[\ln c_t^i + \alpha \ln g_t - \kappa^i D_t^i\right] f\left(y^i\right) di \tag{20}$$

$$s.t.$$

$$\int_i c_t^i f\left(y^i\right) di + g_t = 1 \ [\phi_{0t}] \tag{21}$$

The sole constraint is the economy-wide resource constraint: that total cohort t public and private consumption is equal to total cohort $t+1$ endowment, which is equal to unity by construction.

First order conditions are given by:

$$\frac{1}{c_t^i} = \phi_{0t} \ \left[c_t^i\right] \tag{22}$$

$$\frac{\alpha}{g_t} = \phi_{0t} \ [g_t] \tag{23}$$

Hence, all agents consume the same level of private consumption:

$$c_t^i = \overline{c}, \forall i, t \tag{24}$$

Since consumption is equalised via transfers, the authorities can circumvent the equity-efficiency trade-off. Substituting into the economy-wide resource constraint gives the optimal (efficient) level of the public good:

$$g_t = \overline{g} = 1 - \overline{c} \tag{25}$$

Hence:

$$\overline{c} = \frac{1}{1+\alpha} \tag{26}$$

$$\overline{g} = \frac{\alpha}{1+\alpha} \tag{27}$$

Differentiating with respect to D_t^i yields:

$$\frac{\partial W_t}{\partial D_t^i} = -\kappa^i < 0 \tag{28}$$

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

Note that **the choice of seigniorage versus income tax is orthogonal to the planner**

problem because all redistributive effects on private consumption can be offset by individual taxes and transfers.

5 Political Economy Equilibrium

The political economy environment of the economy is introduced in this section. I also analyse the Ramsey problem here – a benign policy-maker choosing optimal welfare-maximising policies in a decentralised setting – since it is easily incorporated as a special case of the political economy game. The first subsection outlines the political economy environment. The second analyses the Ramsey solution, whilst the third analyses the general solution.

Before describing the political economy problem in detail, I introduce some further notation. Dividing by the relevant price level, real balances and the real stock of the second asset can be expressed as:

$$\widehat{m}_t \equiv \frac{m_t}{p_t} = \int_i y^i \left(1 - D_t^i\right) f\left(y^i\right) di \tag{29}$$

$$\widehat{d}_t \equiv \frac{d_t}{q_t} = \int_i y^i D_t^i f\left(y^i\right) di = 1 - \widehat{m}_t \tag{30}$$

Note that, from the second-order stochastic dominance assumption on the income distribution,

$$\frac{\partial\left(1 - \widehat{m}\right)}{\partial\sigma^2} \geq 0 \tag{31}$$

I also introduce the following notation for price level inflation, measured in terms of the 'inflation tax':

$$\frac{p_t}{p_{t+1}} \equiv \frac{p_t}{p_t\left(\pi_t + 1\right)} = 1 - \frac{\pi_t}{\pi_t + 1} \equiv 1 - \widehat{\pi}_t \tag{32}$$

$$\frac{q_t}{q_{t+1}} \equiv 1 - \widehat{q}_t \tag{33}$$

Finally, I define a variable γ_t that summarises the policy stance in terms of τ_t and price changes:

$$\gamma_t = \frac{1 - \widehat{q}_t - \tau_t}{1 - \widehat{\pi}_t - \tau_t} \tag{34}$$

Substituting this into the decision rule for D_t^i yields the following:

$$\begin{aligned} D_t^i &= 0 \text{ if } \kappa^i > \ln \gamma_t, 1 \text{ otherwise} && (35) \\ i.e. \text{ if } y &< \widehat{y} \equiv \kappa^{-1}\left(\ln \gamma_t\right), 1 \text{ otherwise} && (36) \\ \frac{\partial \widehat{y}}{\partial \gamma_t} &\leq 0 && (37) \end{aligned}$$

5.1 Political Economy Environment

I adopt the probabilistic voting model originally due to Lindbeck and Weibull (1987). I adopt the formulation of Persson and Tabellini (2000). The usefulness of the probabilistic voting model over alternative models (such as the simple Downes-Hotelling median voter theory) is its additional tractability, as the introduction of uncertainty in the voting function removes the non-continuities associated with the earlier median-voter models. This greater tractability is particularly important when agent heterogeneity makes the political economy environment more complex.

It also introduces a greater degree of realism to the model, as in reality votes over party platforms are determined not only by the particular issue or issues under analysis, but by a variety of other issues. One way of dealing with this is to label extraneous factors as 'ideology' and model preferences over this factor as essentially random, as in the probabilistic voting model. Finally, the model has the additional advantage that it can easily be applied to multidimensional contests, such as the one analysed here. By contrast, the median voter model can only be generalised to multidimensional problems if they can be rendered essentially unidimensional by making simplifying assumptions about how policies map into voters' preferences.

5.1.1 The Probablistic Voting Model

Policy-makers are elected for one period, and choose a level of government expenditure g_t, a single income tax rate τ_t, and an expansion in the money supply $(m_{t+1} - m_t)$. The latter is equivalent to choosing a rate of inflation π_t or more conveniently a rate of the inflation tax (seigniorage) $\widehat{\pi}_t$. Policy-makers derive utility only from being elected, and therefore adopt a policy vector $G_t \equiv \{g_t, \tau_t, \widehat{\pi}_t\}$ to maximise their probability of being elected.[9] There are two policy-makers seeking election, and the electoral rule is simple majority voting. For simplicity, it is assumed that policy positions are announced and the election occurs after

[9] Although the set of policy instruments includes three separate instruments, the government balanced-budget constaint implies that only two can be independent.

agents have made their asset-holding choices. That is, only the 'old' vote, with the vote taking place at the start of their second period of life.

In addition to their utility derived from consuming public and private goods, agents have some intrinsic bias towards one or other of the candidates, which is uncorrelated with other aspects of their individual characteristics, notably their income. The bias has two components, an individual-specific bias and an economy-wide bias, both of which vary over time. If the two candidates are denoted $\{A, B\}$, then the biases are denoted as a bias in favour of candidate B, so that a negative value implies a bias towards candidate A. The individual-specific bias is denoted ε^i, whilst the economy-wide bias is denoted δ. ε^i is uniformly distributed as:

$$\varepsilon^i \sim U\left[-\frac{1}{2\phi}, \frac{1}{2\phi}\right] \tag{38}$$

I make a critical assumption that agents differ in their political 'weight' w^i, where the weight is increasing monotonically in income. This reduced-form formulation is designed to account for the observed greater political participation by richer agents (see Benabou, 2000 and 2003 for similar models and comprehensive evidence of the influence of income on political activity and influence)[10]. It can be rationalised by introducing lobbying (see Persson and Tabellini, 2000) or by simply making richer agents more likely to vote, or by making the variance of the noise in agents' voting rules vary inversely with income.

Formally, I assume that agents' weight maps into income monotonically, with the rela-

[10]Benabou (2003) quotes a startling study of political responsiveness of US senators, which finds that senators' responsiveness to the views of their constituents (as deduced from survey data) is between 3 and 15 times higher for voters in the 75th percentile than for those in the 25th percentile. The responsiveness to views of voters in the 99th percentile is 2-3 times higher still. And this is in a mature representative democracy. As he points out, in poorer countries 'there is also extensive vote-buying, clientism, intimidation and the like, which are likely to result in even more bias.'

tionship indexed by a 'pro-rich bias' term $\theta \geq 0$ such that:

$$w^i = w\left(y^i, \theta\right) \geq w^{\min}, \frac{w^{\min}}{y^{\min}} > 0 \tag{39}$$

$$\frac{\partial w\left(y^i\right)}{\partial y^i} \geq 0 \tag{40}$$

$$E\left(w^i\right) = 1 \tag{41}$$

$$w^i = y^i \text{ for } \theta = 0 \tag{42}$$

$$\frac{\partial\left(1-A\right)}{\partial\theta} \geq 0 \tag{43}$$

$$\frac{1}{\left(1-\widehat{m}\right)}\frac{\partial\left(1-\widehat{m}\right)}{\partial\sigma^2} \leq \frac{1}{\left(1-A\right)}\frac{\partial\left(1-A\right)}{\partial\sigma^2} \tag{44}$$

$$\text{where } \widehat{m} = \int_0^{\widehat{y}} yf\left(y\right)dy \text{ and } A \equiv \int_0^{\widehat{y}} w\left(y\right)f\left(y\right)dy \tag{45}$$

Hence the political weight is monotonically increasing with income (yielding **greater political influence to agents higher up the income scale)**. Since $w^i = y^i$ for $\theta = 0$ and $\frac{\partial A}{\partial\theta} \leq 0$, the distribution of weights second-order stochastically dominates income.[11]

Finally, note that the elasticity of the *income* of non-cash-holders (or their real holdings of the non-cash asset) with respect to the inequality parameter is assumed to be lower than the elasticity of their *weighted mass* with respect to the same parameter (Equation (44)). This condition essentially says that the degree to which the distribution of weights second-order stochastically dominates the distribution of income is increasing in inequality. This assumption is critical to the result that increasing inequality leads to greater seigniorage. It ensures that greater income inequality generates a decrease in the effective inflation-averse electorate that outweighs the reduction in the tax base of the inflation tax.[12]

The economy-wide random bias towards candidate B distributed as:

[11]The assumption that the distribution of weights second-order stochastic dominates the distribution of income is necessary to generate interesting results. This is because the log-linear specification for utility implies that $\frac{\partial U}{\partial C}$, the marginal utility of consumption, equals $\frac{1}{C}$. When the weights are distributed with less inequality than income, the lobbying effect is insufficient to outweigh the utility-equalisation effect implied by the diminishing marginal utility associated with log utility. If utility had a linear specification, then any positive relation between income and political weight would be sufficient to overcome the utility-equalisation effect, because marginal utilities would already be equal across agents (equal to unity) by assumption. For relatively low levels of bias (i.e. if $\theta < 0$ were assumed), $A \geq \widehat{m}$; that is, the distribution of weights is second-order stochastically dominated by the distribution of income. In this case there is no incentive to create inflation (in this simple model) and no marginal effect from increasing σ^2 or θ.

[12]This assumption essentially requires that the weighting function $w\left(y^i, \theta\right)$ should be sufficiently elastic with respect to income.

$$\delta \sim U\left[-\frac{1}{2\psi}, \frac{1}{2\psi}\right] \tag{46}$$

Voter i prefers candidate A if:

$$U^i\left(G_t^A\right) > U^i\left(G_t^B\right) + \varepsilon_t^i + \delta \tag{47}$$

Therefore, an agent of type i is a swing voter (indifferent between the two candidates) if:

$$\varepsilon_t^i = U^i\left(G_t^A\right) - U^i\left(G_t^B\right) - \delta \tag{48}$$

Candidate A's probability of winning is therefore given as:

$$p_t^A = \frac{1}{2} + \int_i w^i f\left(y^i\right)\left[U^i\left(G_t^A\right) - U^i\left(G_t^B\right)\right] di \tag{49}$$

5.1.2 Timing

The timing of key events 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) for either cash or the second asset, at period t prices. In period $t+1$, with agents' asset holdings predetermined, agents (from cohort t only) vote for one of two candidates proposing a policy platform G. Agents of cohort t and the monetary authorities then trade with cohort $t+1$ in the asset markets, obtaining consumption goods in exchange for their assets at period $t+1$ prices.[13] Government then implements its policy platform, collecting income tax revenues in the form of consumption goods from agents in cohort t and producing the public good from the consumption goods obtained in income tax and in exchange for seigniorage (i.e. collected from agents in cohort t via the inflation tax). Finally, agents in cohort t consume public and private goods and then die, 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 $t+2$ for the latter cohort's endowments.

5.1.3 Solving the Model

Each candidate maximises his probability of winning the election, which is equivalent to maximising a weighted social welfare function subject to the government budget constraint.

[13] Because each agent consumes in one period only, there is no intertemporal consumption choice and hence no rate of time preference and no interest rate (this is why the Friedman rule is not optimal).

The solution is given formally for candidate A but as discussed above candidate B faces a symmetrical problem and arrives at the same policy solution.

Formally, candidate A's problem is given by:

$$\begin{aligned}
\max_{G_t^A} p_t^A &= \frac{1}{2} + \int_i w^i f\left(y^i\right)\left[U^i\left(G_t^A\right) - U^i\left(G_t^B\right)\right] di && (50)\\
& s.t. \\
G_t^A &\equiv \{g_t, \tau_t, \widehat{\pi}_t\} && (51)\\
U^i &\equiv \ln c_t^i + \alpha \ln g_t - \kappa^i D_t^i, \forall i && (52)\\
g_t &= \tau_t + \widehat{m}_{t+1} - \widehat{m}_t\left(1 - \widehat{\pi}_t\right) \ \ [\phi_{0t}] && (53)\\
c_t^i &= \left[\left(1 - \widehat{q}_t - \tau_t\right) D^i + \left(1 - \widehat{\pi}_t - \tau_t\right)\left(1 - D^i\right)\right] y^i, \forall i && (54)\\
D_t^i &= 0 \text{ if } y < \widehat{y} \equiv \kappa^{-1}\left(\ln \gamma_t\right), 1 \text{ otherwise}, \forall i && (55)
\end{aligned}$$

The solution to this policy problem is derived from three first order conditions, one each for $\widehat{\pi}_t$, τ_t and g_t. The three conditions are given below.

$$\frac{1}{1 - \tau_t - \widehat{\pi}_t} \int_0^{\widehat{y}} w^i f\left(y^i\right) - \phi_{0t}\widehat{m}_t = 0 \ [\widehat{\pi}] \quad (56)$$

$$\frac{1}{1 - \tau_t - \widehat{\pi}_t} \int_0^{\widehat{y}} w^i f\left(y^i\right) + \frac{1}{1 - \tau_t - \widehat{q}_t} \int_{\widehat{y}}^{\infty} w^i f\left(y^i\right) - \phi_{0t} = 0 \ [\tau] \quad (57)$$

$$\frac{\alpha}{g_t} - \phi_{0t} = 0 \ [g] \quad (58)$$

The first two first order conditions can be combined as:

$$\frac{1}{\widehat{m}_t} \int_0^{\widehat{y}} w^i f\left(y^i\right) = \int_0^{\widehat{y}} w^i f\left(y^i\right) + \frac{1}{\gamma_t} \int_{\widehat{y}}^{\infty} w^i f\left(y^i\right) \quad (59)$$

This assumes that both financing instruments are used in equilibrium and that the marginal costs are therefore equal at the margin. Hence we arrive at the following implicit solution for γ_t:

$$\gamma_t = \frac{1 - A}{A} \frac{\widehat{m}}{1 - \widehat{m}} \geq 1 \quad (60)$$

Assuming that this solution is unique, then the solution for γ_t has to be time invariant. Hence, agents' production sector decisions are also time invariant, which implies that q_t is

constant and $\widehat{q}_t = 0, \forall t$. This implies that:

$$\gamma = \frac{1-\tau}{1-\tau-\widehat{\pi}} \geq 1 \tag{61}$$

5.2 Ramsey Solution

The Ramsey problem is to maximise aggregate welfare through the optimal choice of instruments available to the policy-maker and subject to all the behavioural constraints imposed by equilibrium behaviour on the part of the private sector. The Ramsey solution can be thought of as the solution to the probabilistic model without the pro-rich bias that enters into the policy-maker's objective function. This is because, absent this bias, the policy-maker simply maximises aggregate welfare. In other words, the Ramsey solution equals the general solution with $w^i = 1 \; \forall i$.

The key characteristic of the Ramsey solution is that there is **no seigniorage in equilibrium**. To see this, note that if $w^i = 1 \; \forall i$ then:

$$\gamma = \frac{1-F\left(\widehat{y}\right)}{F\left(\widehat{y}\right)} \frac{\widehat{m}}{1-\widehat{m}} \leq 1 \tag{62}$$

With $\gamma \leq 1$, $F\left(\widehat{y}\right) = \widehat{m} = 1$ (all agents hold cash). Hence $\gamma = 1$ and $\widehat{\pi} = 0$. The rationale for this is simple. Absent political-economy considerations, the policy-maker faces a standard trade-off between efficiency (optimal public good provision) and equity (consumption-equalisation). Since seigniorage is the more regressive of the two tax instruments, it worsens the trade-off and is therefore not utilised in equilibrium.[14]

Note as well that the level of the public good g is equal to the first-best level. This is demonstrated in the following section for the general political economy solution (but obviously holds for the special case Ramsey solution as well).

5.3 General Political Economy Solution

The concavity of the utility function makes the policy-maker disinclined to use seigniorage, since it worsens inequality. However, the political economy environment makes the policy-maker more inclined to use seigniorage, since it transfers resources to his more favoured constituency, richer agents. Hence, the optimal mix of tax and seigniorage is that which balances these two effects. When seigniorage is low relative to total government expenditure,

[14] This result also supports the standard Ramsey tax argument: to tax inelastic factors. Since agents can substitute out of cash-holding (at a cost), cash-holding is tax-elastic. By contrast the tax base for the income tax is fixed.

the authorities can increase its use, transferring more resources to richer agents. However, as seigniorage increases and the consumption of better-off agents rises and that of poorer agents falls, the marginal utilities of the less well-off become weighted more heavily in the policy-maker's objective function. Hence, the political bias effect becomes less important relative to the redistribution effect. Eventually, the two effects counter-balance each other, giving the optimal mix of tax and seigniorage.

Hence, when $\theta \geq 0$:

$$\gamma = \frac{1-A}{A}\frac{\widehat{m}}{1-\widehat{m}} \geq 1 \tag{63}$$

5.3.1 Existence and Uniqueness of Political Economy Equilibrium

A solution for γ always exists for $\theta > 0$. To see this, re-arrange the first order conditions (56-57) to give an expression for the marginal costs and benefits of seigniorage:

$$h \equiv MC - MB = \gamma A\left(1-\widehat{m}\right) - (1-A)\,\widehat{m} \tag{64}$$

$$\frac{h}{F\left(\widehat{y}\right)\left(1-F\left(\widehat{y}\right)\right)} = \gamma\underline{w}\overline{y} - \underline{y}\overline{w} \tag{65}$$

where $\underline{w} \equiv E\left[w \mid y \leq \widehat{y}\right], \overline{w} \equiv E\left[w \mid y > \widehat{y}\right]$ and $\underline{y}, \overline{y}$ are similarly defined.

When $\gamma \to 1$, then $\underline{y} \to 1$, $\underline{w} \to 1$ (almost all agents are cash-holders) and $\overline{w} > \overline{y}$. Hence:

$$\frac{h}{F\left(\widehat{y}\right)\left(1-F\left(\widehat{y}\right)\right)} \to -\left(\overline{w}-\overline{y}\right) < 0 \tag{66}$$

Therefore, for γ close to 1, $MC - MB \leq 0$.

Now consider $\gamma \to \infty$. In this case, $\overline{y} \to 1$, $\overline{w} \to 1$ (almost all agents are non-cash-holders). Hence:

$$\frac{h}{F\left(\widehat{y}\right)\left(1-F\left(\widehat{y}\right)\right)} \to \gamma\underline{w} - \underline{y} > 0 \tag{67}$$

Therefore, for very high γ, $MC - MB \geq 0$. Since the expressions are continuous, at least one solution with $MC = MB$ must exist for $\gamma \in [1, \infty]$.

Moreover, since $MC \leq MB$ for $\gamma \to 1$ and $MC \geq MB$ for $\gamma \to \infty$, then at least one of the solutions also satisfies the second-order condition for the political economy maximisation problem ($\frac{\partial[MC-MB]}{\partial\gamma} > 0$). Simulations using various functional forms for $F\left(y\right), w\left(y, \theta, \sigma^2\right)$ and $\kappa\left(y\right)$ suggest that the FOCs do generally describe a unique solution. Figure 1 gives a graphical exposition of equilibrium that sheds more light on this issue. It plots the MC and MB functions, $\gamma A\left(1-\widehat{m}\right)$ and $(1-A)\,\widehat{m}$ respectively, against the cdf

$F\left(\widehat{y}\left(\gamma\right)\right)$.[15]

Although a unique solution to the FOC is not guaranteed for general functional forms, a restriction can be introduced to guarantee a unique solution. Re-arranging the two functions gives us $(MC = MB)$: $(\gamma - 1) = \frac{1}{1-\widehat{m}}\left(\frac{\widehat{m}}{A} - 1\right)$. A **sufficient condition** to guarantee a single crossing point is therefore that, for any value of $\gamma = \gamma^*$ satisfying the FOC:[16]

$$\frac{\partial}{\partial \widehat{y}}\left[\ln\left(\gamma - 1\right) \mid \gamma = \gamma^*\right] = \frac{\gamma^*}{\gamma^* - 1}\kappa'\left(\widehat{y}\right) \leq \frac{\partial}{\partial \widehat{y}} \ln\left(\frac{\widehat{m}}{A} - 1\right) \tag{68}$$

In other words, the function κ should have a sufficiently steep (negative) gradient and the ratio $\frac{\widehat{m}}{A}$ should not be too greatly affected by incremental changes in $\widehat{y}$ (requiring that both the underlying distribution $F\left(y\right)$ and the mapping $w\left(y;\theta\right)$ should be relatively smooth). For the rest of the paper I assume that this condition holds and that the FOCs therefore describe a unique solution for γ.[17]

5.3.2 Comparative Statics

The key comparative statics result is that $\frac{d\gamma}{d\sigma^2} > 0$. That is, as income inequality increases, the optimal mix of seigniorage versus income tax shifts towards the former. To show this formally, note that (using the implicit function theorem):

$$\gamma^* = \gamma \mid \left[h\left(\gamma\right) \equiv \gamma A\left(1 - \widehat{m}\right) - \left(1 - A\right)\widehat{m} = 0\right] \tag{69}$$

$$\Longrightarrow \frac{d\gamma^*}{d\sigma^2} = -\frac{\frac{\partial h\left(\gamma^*;\sigma^2\right)}{\partial \sigma^2}}{\frac{\partial h(\gamma^*;\sigma^2)}{\partial \gamma}} \tag{70}$$

[15] The specific functional forms used to generate the diagram are as follows: $y = 0.7 + 0.3\varepsilon$; $\varepsilon \sim \Lambda\left(1, e^2 - 1\right)$; $w = 3y - 2$; $\kappa = \frac{3}{y}$; where Λ denotes a log-normal distribution. See Aitchison and Brown (1957) for details of the calculations using the log-normal distribution. These functional forms meet the model's key assumptions.

[16] The other term in the (log-transformed) MB function, $-\ln\left(1 - \widehat{m}\right)$ has $\frac{\partial(-\ln(1-\widehat{m}))}{\partial \widehat{y}} = \frac{1}{1-\widehat{m}}\frac{\partial \widehat{m}}{\partial \widehat{y}} \geq 0$.

[17] This condition guarantees a unique local maximum. Even when there is more than one local maximum, the uniqueness of the global maximum is (virtually) guaranteed. However, in this case the comparative statics results, derived for the local maximum, could not automatically be interpreted as describing the global maximum as well.

From the second order condition for the maximisation problem, $\frac{\partial h\left(\gamma^{*};\sigma^{2}\right)}{\partial\gamma} > 0$. Hence, $\frac{d\gamma^{*}}{d\sigma^{2}} \geq 0$ if $\frac{\partial h\left(\gamma^{*};\sigma^{2}\right)}{\partial\sigma^{2}} \leq 0$. This condition does indeed hold in equilibrium:

$$\frac{\partial h\left(\gamma^{*};\sigma^{2}\right)}{\partial\sigma^{2}} = \frac{h\left(\gamma^{*};\sigma^{2}\right)+\widehat{m}}{A}\frac{\partial A}{\partial\sigma^{2}} - \frac{h\left(\gamma^{*};\sigma^{2}\right)+1-A}{1-\widehat{m}}\frac{\partial\widehat{m}}{\partial\sigma^{2}} \tag{71}$$

$$= \frac{\widehat{m}}{A}\frac{\partial A}{\partial\sigma^{2}} - \frac{1-A}{1-\widehat{m}}\frac{\partial\widehat{m}}{\partial\sigma^{2}} \tag{72}$$

$$= \begin{array}{c} -\frac{\widehat{m}(1-A)}{A}\left[\frac{1}{(1-A)}\frac{\partial(1-A)}{\partial\sigma^{2}} - \frac{1}{(1-\widehat{m})}\frac{\partial(1-\widehat{m})}{\partial\sigma^{2}}\right] \\ -\frac{(1-A)(\widehat{m}-A)}{A(1-\widehat{m})}\frac{\partial(1-\widehat{m})}{\partial\sigma^{2}} \end{array} \leq 0 \tag{73}$$

Hence:

Result 1(a): Inflation increases with income inequality

Result 2(a): Income tax decreases with income inequality

The rationale for these results is that higher inequality increases the relative weight of richer agents in the quasi-welfare maximisation problem resulting from the probabilistic voting set-up. This then tilts the policy-maker towards greater inflation finance and away from income tax as a source of revenue.

Similarly, increasing the political bias (by increasing θ) also increases relative use of the inflation tax:

$$\frac{\partial h\left(\gamma^{*};\theta\right)}{\partial\theta} = \frac{h\left(\gamma^{*};\theta\right)+\widehat{m}}{A}\frac{\partial A}{\partial\theta} \tag{74}$$

$$= \frac{\widehat{m}}{A}\frac{\partial A}{\partial\theta} \leq 0 \tag{75}$$

$$\Longrightarrow \frac{d\gamma^{*}}{d\theta} = -\frac{\frac{\partial h(\gamma^{*};\theta)}{\partial\theta}}{\frac{\partial h(\gamma^{*};\theta)}{\partial\theta}} \geq 0 \tag{76}$$

Hence:

Result 1(b): Inflation increases with the pro-rich bias

Result 2(b): Income tax decreases with the pro-rich bias

5.3.3 Effect on Government Spending

Changing inequality and pro-rich bias have no effect on government spending in this model. This is a result of the log-linear additively separable utility specification and the fact that all spending is in the form of a public good. Essentially, distributional considerations matter for the composition of taxation and its incidence but not for aggregate revenue or expenditure. To see this formally, rewrite the three FOCs (the FOC for τ has been simplified using the

first FOC):

$$\frac{1}{1-\tau-\widehat{\pi}}\frac{A}{\widehat{m}} = \phi_0\ [\widehat{\pi}] \tag{77}$$

$$\frac{1}{1-\tau}\frac{1-A}{1-\widehat{m}} = \phi_0\ [\tau] \tag{78}$$

$$\frac{\alpha}{g} = \phi_0\ [g] \tag{79}$$

Substituting the government budget constraint (53) and the third FOC (79) into the first two FOCs (77-78) yields:

$$A = \phi_0 \left[1-(1-\widehat{m})\,\widehat{\pi}\right]\widehat{m} - \alpha\widehat{m} \tag{80}$$

$$1-A = \phi_0 \left[1+\widehat{m}\widehat{\pi}\right](1-\widehat{m}) - \alpha\,(1-\widehat{m}) \tag{81}$$

Combining (80-81) then gives us:

$$1 = \phi_0 - \alpha \tag{82}$$

which implies that $\phi_0 = 1+\alpha$, a constant, and hence that $g = \frac{\alpha}{1+\alpha}$, the first-best level of government spending. Hence:

Result 3: Government final expenditure is unrelated to both **(a)** inequality; and **(b)** pro-rich bias.

Note that this result is due to the assumption of additive separability in the utility function with respect to private good and public good consumption. This is a simplifying assumption of the model and is not central to the analysis; in this sense result 3 is not central to the paper. However, if the inequality and bias terms are found to affect tax and seigniorage choices then the test of result 3 is essentially *a check that the model's emphasis on the revenue side rather than the expenditure side is correct*.

6 Empirical Analysis

This empirical section tests the central results derived in the theoretical portion of the paper:

1. Higher seigniorage results from:
   (a) greater income inequality; and
   (b) greater pro-rich bias in policy-making;

2. Higher income tax revenue results from:

   (a) less income inequality; and

   (b) less pro-rich bias in policy-making;

3. Government final expenditure (excluding transfers) is unrelated to both:

   (a) income inequality; and

   (b) pro-rich bias.

The results are strongly supportive of propositions 1(a) and 1(b). Result 3 (a) is strongly supported, and there is reasonably strong support for Result 3 (b). There is some evidence supporting Results 2(a) and 2(b), although the evidence is not robust to specification or sample. The first section describes the methodology employed and the data used. The second section discusses the results of the empirical analysis, and the third section offers a brief discussion.

6.1 Methodology and Data

This paper analyses inflation as the result of a political conflict over financing public expenditure. The key linkages are between the government budget constraint and seigniorage, and between money creation and inflation. Both linkages should be conceived as long term phenomena. In the short run, the gap between expenditure and tax revenue can be made up by borrowing; recourse to seigniorage is not necessary until the costs of borrowing outweigh the benefits, which may not occur until a substantial degree of borrowing has occurred. Similarly, although Friedman's assertion concerning inflation's monetary genesis is not to be doubted, the short run relationship between the money supply and inflation is notoriously difficult to pin down (except during hyperinflationary periods).

Hence, I have taken the long run as the appropriate time frame for analysis. This precludes the use of a panel approach to the problem, and I therefore adopt a simple cross-section framework. Data availability makes the 1981-2000 period the most fruitful for analysis.

I obtain data from a range of sources. Inequality data is obtained from the UNU/WIDER World Income Inequality Database (WIID) in the form of Gini coefficients.[18] The quality of the observations and the survey method is coded in the data: I use only the highest quality

[18]The starting point for the database (contributing to around half the total observations) is the more widely-used Deininger and Squire (World Bank, 1997) dataset (used, for instance, in Bhattacharya et al. (2003)).

data where the sample used is representative of the country's full population, and adjust observations to take into account the survey method (gross versus net and income versus expenditure).[19] The data is presented in annual format, although with a substantial number of missing observations for most countries. In order to maximise the number of observations, data are averaged over the period (i.e. data may be unavailable for the first year of the period, but available for subsequent years). To control for the endogeneity of income inequality I use a measure of inequality from the previous twenty-year period (similarly calculated) as an instrument and undertake Two-Stage Least Squares (2SLS).

There are several widely-used datasets of political institutions available to the researcher, which focus on both specific areas of difference (presidential vs parliamentary, 'left' vs 'right') as well as general indicators ('democracy' vs 'autocracy'). I attempt to exploit the wide range of information by using as my measure of 'pro rich bias,' $\widehat{\theta}$, a variable derived from as wide a range of sources as possible. Hence, I use factor analysis (principal factor method) to generate a single indicator from five separate variables taken from four datasets. Each component represents a measure of political participation or competition.[20] This is based on the assumption that when political participation is limited, the poor are the first to be shut out from the political process.[21] The model suggests that the political bias term plays a role when it is high ($\theta > 0$). If the political bias is below this threshold (so that agents' political influence is increasing in income, but less than proportionately, so that the distribution of income second order stochastically dominates the distribution of political influence), then there is no effect. Hence, I allow for different slopes for high and low values for the derived measure.[22] I also allow for differential effects of inequality depending on whether the bias term is high or low, for the same reason.

I find that two other variables from the various datasets can be significant as controls. These are a 'Left-wing executive' indicator from the World Bank Database of Political In-

[19]The appropriate adjustment is calculated by regressing the high quality observations on dummy variables for Expenditure vs. Income and Gross vs. Net measures, interacted with a dummy for Industrial vs. Developing/Transition economies to proxy for the substantial structural differences between tax and transfer systems between the two groups of countries. This gives an estimate of the average difference between Gini coefficients based on the different measurement techniques, which is unbiased as long as the choice of methodology for the inequality survey is exogenous.

[20]The five variables are 'Index of Electoral Competitiveness (executive elections)' from the World Bank's Database of Political Institutions (DPI); 'Political Participation' and 'Freedom of Association' from the Cingranelli-Richards (CIRI) Human Rights Database; 'Competitiveness of Political Participation' from the Polity IV (P4) database, and the 'Political Freedom' indicator from Freedom House. Each component variable is averaged over the period before being combined using factor analysis. Correlation between the five variables for the 53-country sample varies from 66% to 92%.

[21]The most obvious example is property or income restrictions on the franchise, although other, less explicit, mechanisms are also likely to be present.

[22]The derived measure $\widehat{\theta}$ is divided according to $\widehat{\theta} \gtrless 0$. This bifurcation occurs around the 72nd percentile in the 53-country sample.

stitutions and a measure of regime instability derived from a measure of 'Durability' taken from the Polity IV dataset.[23]

The dependent variables are the average of the "inflation tax" transform ($\widehat{\pi}$) over the period (the average of the annual rates, taken from the IMF's *International Financial Statistics*) and the average ratios of income tax revenue and government final consumption spending to GDP (both taken from the World Bank's *World Development Indicators*). I also include a number of other control variables, including dummies for industrial countries, former Eastern Block countries and South American countries, measures of trade openness and real (PPP) GDP per capita taken from the Penn World Tables (PWT 6.1), and a measure of urbanisation (% of the population living in urban areas, taken from the World Bank *World Development Indicators)*. These controls are taken for the first year of the period to denote initial conditions.

Because the sample size is relatively small, I have attempted to conserve degrees of freedom by limiting the controls in the preferred specifications. In these regressions, controls have been chosen optimally according to two rules:

1. All controls should be individually statistically significant at the 10% level or above;
2. Within the class of specifications meeting requirement 1, the preferred specification is that which minimises the Root Mean Squared Error (RMSE).

Once the set of controls has been arrived at, I test for the equality of slope and intercept coefficients for the $\widehat{\theta}$ high and $\widehat{\theta}$ low groups. When the hypothesis that coefficients are equal cannot be rejected (at the 10% level) I present results with equality imposed, to increase the model's degrees of freedom and improve the efficiency of the parameter estimates. I also present regression results with the full range of controls for robustness purposes (again, I test for equality of coefficients and impose it when the evidence is supportive).

6.2 Results

The Results are presented in Tables 1-3 in the Appendix. In each Table, the first three columns show results from the preferred specification. The last three regressions include the

[23]The latter variable is a dummy variable which takes on a value of 1 if the existing political system has substantially changed in the last 10 years. This variable is derived from the 'Durable' variable in the Polity IV dataset which measures the number of years since the last significant change in the political system, defined as an absolute change of more than 3 points in the 'Polity' variable which codes countries on a -10 to +10 (autocratic to democratic) scale. The instability dummy then takes a value of 1 if 'Durable'$<$10, implying that the existing system is less than 10 years old, and 0 otherwise. This variable is taken from the first year of the period; the other variable is a period average.

full range of control variables. Within each group of three regressions, the first is for the largest available sample; the second has only Developing and Transition economies, whilst the third regression drops only former Communist countries in Eastern Europe.

The results in Table 1 are strongly supportive of **Result 1(a)**. The coefficient on the gini coefficient is positive, as predicted, and statistically significant in all six specifications. There is some evidence that the slope may be lower for observations with high values for the bias term, which contradicts the hypothesis; however, the difference between the slopes is only statistically significant for the developing/transition economies subsample.[24] The results are also supportive of **Result 1(b)**: in each specification the coefficient on $\widehat{\theta}$ for high values of $\widehat{\theta}$ has the predicted positive sign, and is also statistically significant. The caveat to this result is that in one specification the intercept is higher for countries with low values of $\widehat{\theta}$, implying a non-monotonic relationship.[25]

Table 2 presents the results with respect to **Results 2(a)-(b)**. Here the results are not particularly strong. The predicted negative relationship between the Gini coefficient and income tax revenues is confirmed by only two specifications, and in neither case is the result robust to including the full range of controls. The negative relationship between the bias term and income tax is similarly confirmed by only two specifications (in one case the relationship is non-linear), and again is not robust to the choice of controls in either case. Only in one specification and sample (column one) are both coefficients significantly negative. The evidence generally points to there being no difference in the relationships between high-bias and low-bias observations.

Finally, Table 3 presents tests of **Results 3(a)-(b)**. For **Result 3(a)** all specifications confirm that inequality has no effect on expenditure, as predicted. However, with respect to **Result 3(b)**, the political bias term does affect expenditure in the preferred specification, with a non-monotonic (U-shaped) relationship. The significance of the relationship is not robust when the full range of controls is introduced or a different sample is used (although the positive effect from high values of bias is maintained in one other regression).

[24] For the developing/transition economy sub-sample, increasing inequality appears to be associated with higher inflation for low-bias countries, but has no statistically significant effect for high-bias countries. This result could be seen as supportive of the hypothesis advanced by Desai et al (2002), that inequality interacts with the degree of democracy, so that inflationary pressures are more pronounced in low inequality countries with autocratic regimes and high inequality countries with democratic regimes.

[25] On the other hand, the intercept is lower for these countries when a different sample is used (column 2), although this is difficult to interpret as the slopes for the gini coefficient are also allowed to differ in this specification, so that some of the difference in intercept may be due to this.

6.3 Discussion

The results uncovered in Tables 1-3 are quantitatively as well as qualitatively significant. According to the preferred specification and sample (first column of results, corresponding to parsimonious controls and the full sample), the inequality measure has a quantitatively significant positive effect on inflation. The range of the inequality parameter (gini coefficient) in the 53-country sample is 22% to 54%. Given the coefficient estimate of .0089, the estimated effect of increasing inequality from the lowest inequality observation to the highest would be to add an additional 0.29 to the inflation tax transform. If inflation were initially at zero, this would translate into an increase in the inflation rate to around 41%. Similarly, increasing the political bias term $\widehat{\theta}$ from 0 to its maximum value (1.43) shifts the inflation rate from zero to 21%. Reducing the political bias term from 0 to its minimum value (-1.20) also raises the inflation rate, to 13%, due to the intercept term. However, this intercept term is not statistically significant in most specifications.

Using the same specification and sample (minus one country due to data availability constraints), shifting from the lowest to the highest gini coefficient reduces income tax revenues (as a % of GDP) by six percentage points. The negative relationship between the bias term and income tax revenues appears to be monotonic. Moving from the lowest value for $\widehat{\theta}$ (-1.20) to the highest value (1.43) reduces income tax revenues (as a % of GDP) by five percentage points. These effects are statistically significant in the preferred specification and sample; however, the significance level is not maintained across different specifications and samples.

Finally, inequality appears to have no effect on government consumption (as a % of GDP), as predicted by the theory. However, there does appear to be a U-shaped relationship between $\widehat{\theta}$ and government consumption. In the preferred specification and sample, moving from $\widehat{\theta} = 0$ to either of its extreme values is estimated to increase the government consumption/ GDP ratio by around six-seven percentage points. This effect is unique to this sample and specification (although in one other regression the positive effect for higher values of the bias term is maintained). Other results suggest no relationship, in line with the model's predictions.

The apparent non-monotonicity in the relationship between political bias and the inflation tax transform (uncovered in column 1 of Table 1) requires further analysis. It appears that inflation is higher for low levels of bias, then drops at $\widehat{\theta} = 0$ before increasing in $\widehat{\theta}$ for higher levels of bias. One explanation could be that at low levels of bias the core conflict is not between cash-holders and non cash-holders, but between poorer recipients of government programmes (who are insulated, to an extent, from all forms of taxation) and middle class tax-payers who are more concerned with the level of taxation than the choice of tax

instrument. Hence, increasing the level of bias might primarily increase middle-class representation, reducing the level of government spending and the share of income taken in both income tax and seigniorage. This could explain the downwards-sloping relationship between government consumption expenditure and the bias term for low levels of bias uncovered in Table 3, columns 1 and 3, and why income tax revenues fall as the bias term increases for low levels of bias in particular (Table 2, columns 1 and 3). A more complex model of the political process and public finance environment, incorporating targeted fiscal transfers or local public goods, could capture these relationships.

7 Conclusions

This paper presents a model to account for a stylised fact noted in a number of studies: that more unequal societies tend to face higher inflation. The model uses a simplified overlapping generations framework to capture the essential features of a cash economy with politically-motivated monetary expansions. Consumption is subject to a one-period delay. Agents have a choice of two financial assets to allow for trade with their neighbouring cohorts: cash (subject to the inflation tax) and a second asset which can be thought of as an indexed asset, a real asset or a foreign currency asset. The ability to substitute from cash to the second asset is assumed to be correlated with income.

This then generates the feature that seigniorage is a more regressive form of taxation than income tax, matching arguments made elsewhere in the literature. Introducing an electorally-motivated policy-maker and a political environment subject to a pro-elite bias, the model predicts that higher inequality and greater bias both lead to greater recourse to seigniorage compared to income tax in equilibrium. The result with respect to the political bias is obvious, the result with respect to inequality perhaps less so. Note that positive seigniorage is the result of the political process alone: pure welfare-maximisation implies zero seigniorage (as shown by the solution to the Ramsey problem).

The model's strengths lie in its simplifications at the household level. These allow for analytical solutions and greater realism in both the income distribution and the political environment, compared to the related literature, notably Albanesi (2002) and Bhattacharya et al. (2003). Although the model is micro-founded and agents are fully rational, the treatment of the household could be strengthened. But the purpose of this paper is to analyse economy-wide political phenomena, and a realistic treatment of political processes and the income distribution is more important than attention to micro-foundations. Analytical solutions and unequivocal comparative statics results are other significant advantages of this approach.

The model's predictions are brought to the data and are broadly supported for the limited (53 country) cross-section dictated by data availability constraints. Overall, the model's predictions with respect to inflation (**R1(a)** and **R1(b)**) receive robust support. The hypothesised negative effect of both inequality and political bias on income tax revenues (**R2(a)** and **R3(b)**) is supported in the preferred specification, but the results are not robust to the addition of other controls or across all samples. The prediction of no relationship between inequality or political bias and government consumption (**R3(a)** and **R3(b)**) is supported, although there is some limited and non-robust evidence suggesting a U-shaped relationship between the bias term and government consumption.

Possible extensions to the model include the analysis of dynamics (although the analysis of dynamic political economy models is highly complex – see for instance Krusell and Rios-Rull (1999), Krusell (2002) and Hassler et al. (2003)), and further empirical work to analyse the predicted relationships. A panel data approach to the problem would be a desirable next step. However, data availability constraints – particularly due to the long-run nature of the relationships under analysis and the limited availability of good inequality series – make useful panel analysis difficult.

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Table 1: 2SLS Regressions with Inflation Tax Transform [$\pi/(1+\pi)$] (1981-2000 average) as DV

	Preferred Specification			Full Controls		
	Full Sample	Dev/Trans Economies	Excluding E. Europe	Full Sample	Dev/Trans Economies[†]	Excluding E. Europe
Gini (G)	**.00891*** **		**.00921*** **	**.00862*** **		**.00885*** **
	(.00251)		**(.00254)**	**(.00252)**		**(.00254)**
G×d		**.00182**			**.00336**	
		(.00300)			**(.00337)**	
G×(1-d)		**.0124*** **			**.0115** **	
		(.00376)			**(.00459)**	
Bias (B)						
B×d	**.120*** **	**.0700** **	**.119*** **	**.129*** **	**.109** **	**.129*** **
	(.0345)	**(.0325)**	**(.0349)**	**(.0408)**	**(.0424)**	**(.0406)**
B×(1-d)	**-.0562**	**-.00772**	**-.0560**	**-.0627**	**-.0580**	**-.0632**
	(.0714)	**(.0670)**	**(.0716)**	**(.0739)**	**(.0813)**	**(.0748)**
d = I(B>0)	**-.108***	**.342** **	**-.109**	**-.101**	**.217**	**-.102**
	(.0640)	**(.150)**	**(.0648)**	**(.0677)**	**(.202)**	**(.0680)**
Left				.0485	.0704	.0486
				(.0354)	(.0598)	(.0354)
Unstable				.0399	.0253	.0410
				(.0330)	(.0478)	(.0332)
Indust	-.108**		-.106**	-.137**		-.141**
	(.0483)		(.0485)	(.0653)		(.00660)
E. Eur	.268***			.246***	.0897	
	(.0703)			(.0756)	(.0923)	
S. America	.106**		.105**	.0794	.0610	.0822
	(.0500)		(.0499)	(.0494)	(.0585)	(.0494)
Openness	-.000637	-.00198***	-.000589	-.000665	-.00141**	-.000598
	(.000408)	(.000578)	(.000403)	(.000426)	(.000623)	(.000428)
Urbanisation		.00218***		.000999	.000555	-.000848
		(.000763)		(.000916)	(.00192)	(.000942)
Real PC				.000000330	.0000105	.00000120
GDP				(.00000547)	(.0000134)	(.00000563)
Constant	-.144	-.291**	-.157*	-.217**	-.299*	-.227**
	(.0893)	(.132)	(.0911)	(.0975)	(.153)	(.0991)
R^2	.60	.53	.58	.65	.62	.63
F-Statistic	8.49***	3.20**	8.02***	6.85***	3.14***	6.77***
Observations	53	35	51	53	35	51
F_0 (G)	2.11	5.36**	1.71	1.82	2.02	1.39
F_1 (B)	4.35**	3.52*	4.41**	3.00*	2.75	3.17*
F_2 (G, B, d)	5.53***	3.29**	5.32***	4.43***	4.85***	4.20**
B = 0: %ile	72	58	74	72	58	74

Gini (1981-2000) instrumented by Gini (1961-80).
SEs reported are robust.
Controls in 'Preferred Specification' regressions selected using following criteria:

(1) Create set of regression equations where all included controls are individually significant at the 10% level;
(2) Select from among these equations the equation that minimises the root mean square error (RMSE).

'Full Controls' regression results also shown as a robustness check.
Significance level of individual regressors and of the overall equation denoted by ***:1%; **:5%; *:10%.

[†] Test of joint significance F_2 rejects equality of coefficients, but individual significance tests for Gini and Bias do not reject equality of coefficients. Hence, unrestricted results reported.

Table 2: 2SLS Regressions with Income Tax Revenues [% GDP] (1981-2000 average) as DV

	Preferred Specification			Full Controls		
	Full Sample	Dev/Trans Economies	Excluding E. Europe	Full Sample	Dev/Trans Economies	Excluding E. Europe
Gini (G)	**-.00181***	**-.00212****	**-.00126**	**-.00118**	**-.00183**	**-.00116**
	(.000955)	**(.000838)**		**(.00131)**	**(.00126)**	**(.00129)**
G×d						
G×(1-d)						
Bias (B)	**-.0174****	**-.00491**		**-.0105**	**-.00319**	**-.0108**
	(.00669)	**(.00962)**		**(.0101)**	**(.0113)**	**(.0100)**
B×d			**-.0000273**			
			(.0197)			
B×(1-d)			**-.0400*****			
			(.0138)			
d = I(B>0)			**.00301**			
			(.0160)			
Left	-.0240*		-.0307*	-.0300	-.0207	-.0299*
	(.0138)		(.0154)	(.0134)	(.0162)	(.0162)
Unstable	-.0279**		-.0214**	-.0280**	-.0253*	-.0279**
	(.0103)		(.00937)	(.0119)	(.0130)	(.0119)
Indust				.0186		.0184
				(.0283)		(.0282)
E. Eur				.0143	-.0187	
				(.0211)	(.0282)	
S. America				-.0168	.00239	-.0166
				(.0243)	(.0244)	(.0243)
Openness				-.000155	-.000227	-.000150
				(.000163)	(.000207)	(.000167)
Urbanisation	.000694**		.000607**	.000865*	-.000460	.000853*
	(.000264)		(.000249)	(.000456)	(.000674)	(.000465)
Real PC		.00000754***		-.000000783	.0000114**	-.000000717
GDP		(.00000264)		(.00000235)	(.00000549)	(.00000240)
Constant	.103***	.0893**	.0714*	.0866*	.117**	.0858*
	(.0366)	(.0323)	(.0366)	(.0488)	(.0482)	(.0483)
R^2	.55	.38	.59	.61	.52	.60
F-Statistic	12.55***	5.13***	9.46***	16.53***	4.07***	10.2***
Observations	52	34	50	52	34	50
F_0 (G)	.004	.267	.571	.164	.0718	.187
F_1 (B)	1.14	1.08	3.02*	.643	1.44	.665
F_2 (G, B, d)	.745	.584	1.51	.255	1.08	.267
B = 0: %ile	73	60	75	73	60	75

All regressions contain the sample for Tables 1 and 3 excluding Tanzania.
Gini (1981-2000) instrumented by Gini (1961-80).
SEs reported are robust.
Controls in 'Preferred Specification' regressions selected using following criteria:

(1) Create set of regression equations where all included controls are individually significant at the 10% level;
(2) Select from among these equations the equation that minimises the root mean square error (RMSE).

'Full Controls' regression results also shown as a robustness check.
Significance level of individual regressors and of the overall equation denoted by ***:1%; **:5%; *:10%.

Table 3: 2SLS Regressions with Government Final Consumption [% GDP] (1981-2000 average) as DV

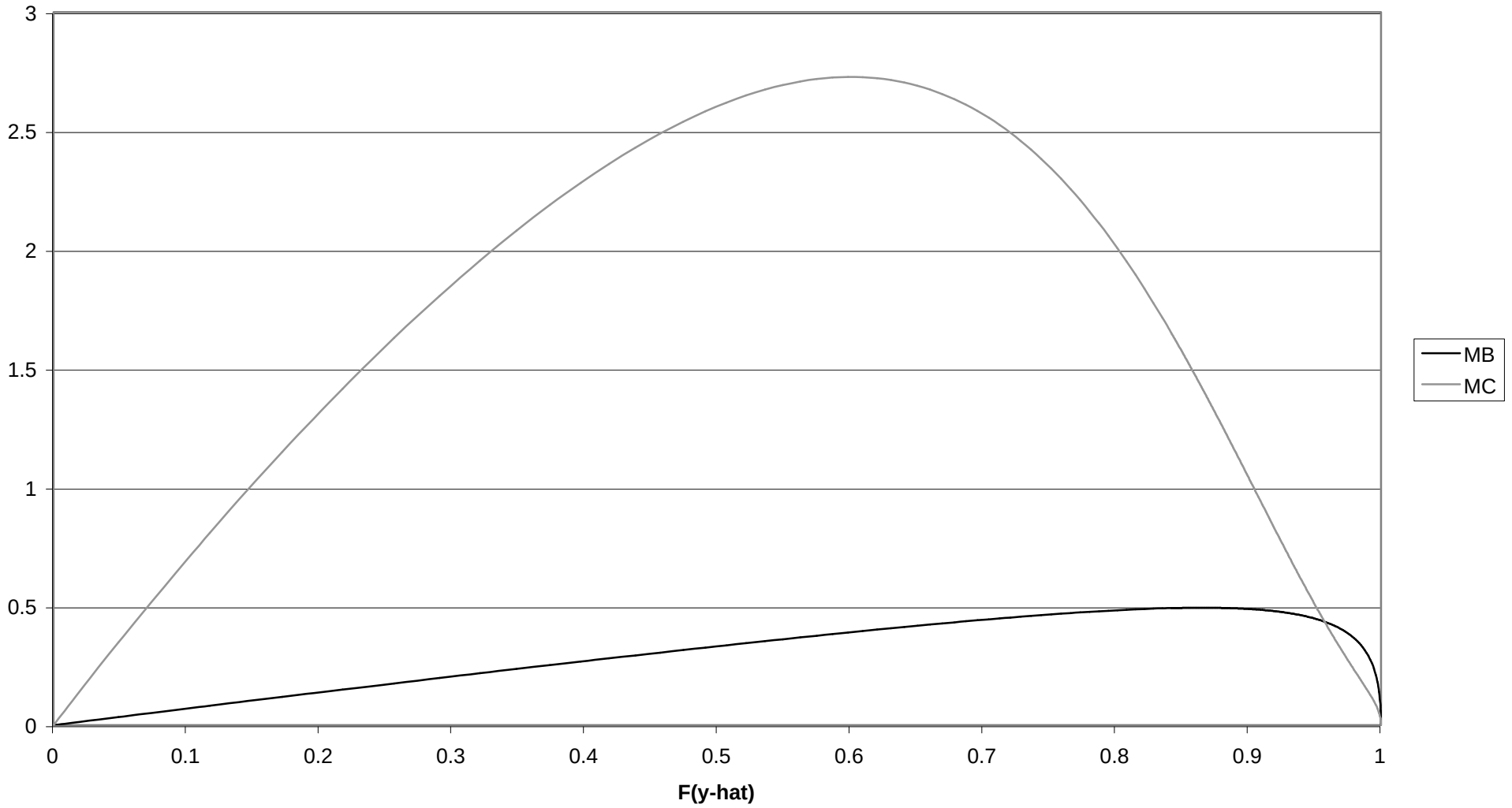
	Preferred Specification			Full Controls		
	Full Sample	Dev/Trans Economies	Excluding E. Europe	Full Sample	Dev/Trans Economies	Excluding E. Europe
Gini (G)	**.0000467**	**.000244**	**.000220**	**.000242**	**-.0000313**	**.000312**
	(.000920)	**(.000929)**	**(.00108)**	**(.00124)**	**(.00158)**	**(.00122)**
G×d						
G×(1-d)						
Bias (B)		**-.00195**		**.00131**	**.00543**	**.00115**
		(.0159)		**(.0124)**	**(.0119)**	**(.0123)**
B×d	**.0408***		**.0416***			
	(.0207)		**(.0241)**			
B×(1-d)	**-.0511****		**-.0217**			
	(.0197)		**(.0211)**			
d = I(B>0)	**-.00994**		**-.0222**			
	(.0190)		**(.0182)**			
Left				.0196	-.00214	.0196
				(.0201)	(.0228)	(.0199)
Unstable		-.0375**	-.0230**	-.0288**	-.0385**	-.0285**
		(.0159)	(.0110)	(.0140)	(.0186)	(.0140)
Indust				.0294		.0285
				(.0510)		(.0509)
E. Eur				-.0412	-.0578	
				(.0305)	(.0520)	
S. America	-.0359*			-.0271	-.0385	-.0263
	(.0182)			(.0294)	(.0326)	(.0294)
Openness				-.00000576	-.000373	.0000138
				(.000360)	(.000404)	(.000373)
Urbanisation	.00101**			.000903	.00104	.000859
	(.000414)			(.000576)	(.000962)	(000586)
Real PC			.00000458***	.000000205	.00000189	.000000460
GDP			(.00000163)	(.00000345)	(.0000102)	(.00000355)
Constant	.0627*	.137	.101**	.0901*	.121*	.0872
	(.0348)	(.0374)	(.0418)	(.0524)	(.0653)	(.0523)
R^2	.52	.14	.51	.52	.33	.51
F-Statistic	10.0***	2.10	10.1	6.89***	.870	7.56***
Observations	53	35	51	53	35	51
F_0 (G)	.0000295	.713	.0915	.114	.0167	.0571
F_1 (B)	11.60***	1.77	3.73*	1.03	1.50	1.10
F_2 (G, B, d)	4.35***	1.12	1.50	.995	.814	.979
B = 0: %ile	72	58	74	72	58	74

Gini (1981-2000) instrumented by Gini (1961-80).
SEs reported are robust.
Controls in 'Preferred Specification' regressions selected using following criteria:

(3) Create set of regression equations where all included controls are individually significant at the 10% level;
(4) Select from among these equations the equation that minimises the root mean square error (RMSE).

'Full Controls' regression results also shown as a robustness check.
Significance level of individual regressors and of the overall equation denoted by ***:1%; **:5%; *:10%.

Figure 1: Illustrative MC/MB Functions



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