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Fiscal Progressivity and the Time Consistency of Monetary Policy

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Abstract

This paper studies how progressive fiscal policy influences the conduct of monetary policy in a tractable heterogeneous agent economies. A priori, progressive labor taxation is undesirable because it generates costly distortions. Nonetheless, it is an effective instrument to mitigate the inflation bias of monetary policy because it achieves a redistributive purpose. I analyze this commitment channel of progressive labor taxes through the lens of political conflicts. When agents vote on monetary and fiscal instruments, progressivity is decisive in curbing the inflation bias because it generates distributional conflicts: lower-productivity agents support higher labor taxes to preserve the consumption value of money holding and shift the burden of policy distortions to higher-productivity agents. Anticipating the reduction in inflation, agents unanimously desire to adopt a progressive fiscal system.

Keywords: *Monetary-Fiscal Policy, Progressive Labor Income Taxes, Inflation Bias, Time Consistency, Political Economy, Heterogeneous Agents.*

JEL classification: E02, E42, E52, E61, E62.

1 Introduction

Monetary policy decisions have distributional consequences on income and wealth, but it is usually argued that a central bank should not be responsible for addressing them. Fiscal policy, though, with the appropriate set of targeted instruments, should take care of these redistributive consequences. This idea is, for instance, promoted by a former Chair of the Federal Reserve:

> *"Policies designed to affect the distribution of wealth and income are, appropriately, the province of elected officials, not the Fed (...) Monetary policy is a blunt tool which certainly affects the*

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distribution of income and wealth (...) Other types of policies are better suited to addressing legitimate concerns about inequality." (Bernanke - 2015)

This paper proposes a model with heterogeneous agents to investigate how monetary policy, fiscal policy and inequality are dynamically intertwined. In contrast to the views that promote a separation of objectives and instruments, the present analysis shows how fiscal policy, with its capacity to tailor the incidence of taxes, contributes to the support of efficient monetary decisions.

Specifically, monetary policy suffers from time-inconsistency, as identified by Kydland and Prescott (1977) and Calvo (1978). Nominal quantities (interest rates, money holding) are sensitive to expectations, however policies are implemented once expectations are locked in. This intertemporal conflict gives rise to an *inflation bias* which generates welfare losses. Several institutional arrangements have been proposed to address this issue.[1] This paper studies a novel one, namely the commitment channel of progressive fiscal policy.

The analysis is conducted in a stylized environment that highlights the time inconsistency of monetary decisions and the influence of fiscal progressivity on the inflation bias. I present a nominal economy with overlapping-generation agents, where within-generation heterogeneity stems from differences in productivity. The government finances an exogenous level of public good by taxing labor income or increasing the supply of currency. The labor tax plan is captured by two parameters: level and progressivity. As in Farhi (2010) or Ferriere (2015), fiscal progressivity is subject to *tax inertia*: it needs time to be adjusted, and therefore is set prior to the *level* of taxes to be collected.[2] Importantly, progressive labor taxes introduce both redistribution across taxpayers and productive efficiency concerns. The analysis distinguishes these two dimensions and shows that the commitment channel of progressive labor taxes is effective in mitigating the inflation bias only if policymakers are concerned about the distribution of consumption.

Consider first the policy choices of a benevolent policymaker without distributional concerns.[3] Under commitment, the optimal policy mix features no progressivity and a balanced taxation of labor income and money holding. This plan uniformly spreads tax distortions over time and population. Under a lack of commitment, real money holdings are pre-determined to policy decisions, hence there is the temptation to rely predominantly on the inflation tax. The equilibrium outcome then is characterized by a classic inflation bias and welfare losses: agents anticipate policymakers' willingness to resort to the inflation tax and reduce their demand for money accordingly. In both cases, progressivity is not desirable because it generates only costly labor supply distortions.

To study the influence of distributional conflicts on the relative stance of monetary and fiscal instruments, I consider a two-stage political game. Under *tax-inertia*, the progressivity of fiscal policy is determined in the first stage, i.e., one period prior to tax collection. The second stage takes place contemporaneously to the provision of the public good: majority voting determines the relative mix of inflation and labor taxes, given the progressivity of labor taxes and the distribution of money holding across the population.

[1] Many contributions have analyzed how to overcome the time inconsistency of optimal plans through a reputation mechanism, a trigger strategy, or the appropriate management of debt maturity.

[2] *Tax inertia* refers to the idea that the legislative process for fiscal policy is complex and some structural elements of the tax code, e.g. progressivity, requires more time to be adjusted. Appendix A provides empirical elements supporting this assumption: despite regular adjustments in tax codes, countries are characterized by time invariant redistributive structures.

[3] The absence of redistributive concerns stems from individual linear utility of consumption, as explained in Section 2.

The voting protocol highlights how progressive labor taxes shape strategic preferences. With proportional labor taxes (no progressivity), agents unanimously support the inflation tax, in order to collect revenue from the inelastic tax base. With progressive labor taxation, redistributive conflicts emerge. Lower-productivity agents favor higher labor taxes to preserve the consumption value of their money holding and shift the burden of distortionary taxation to higher-productivity agents. These agents stand on the receiving end of the *tax-shifting* effect and vote for relatively more inflationary policies, so as to minimize the personal exposure to distortionary taxation.[4] Under a progressive tax plan, the decisive voter favors positive labor taxes, in order to exploit the *tax-shifting* effect, thereby reducing the magnitude of the inflation tax.

At the first stage of the game, agents form preferences about progressive labor taxation, anticipating the outcome of the vote and the associated policy mix. They weigh the disincentive effect of progressivity and their exposure to labor taxes against the beneficial effect of curbing the inflation tax. The central result of the analysis is the unanimous support for a strictly positive level of labor tax progressivity. Indeed, despite different exposure to labor taxes, progressive labor taxes provide valuable *dynamic incentives* to all by reducing the inflation bias.

Overall, this paper provides an analytical characterization of the commitment channel of progressive fiscal policy on individual preferences for the monetary-fiscal policy mix. The structure of the analysis disentangles efficiency considerations from distributive concerns. The analysis identifies the beneficial *dynamic incentives* provided by progressive labor income taxes against the inflation bias of monetary policy. These results are derived in a stylized environment, to isolate the distinctive forces that influence the conduct of monetary policy under progressive fiscal policy. A final section presents a numerical extension with incomplete markets and idiosyncratic productivity risk, to highlight how the commitment channel interacts with a classic insurance channel of progressive fiscal policy.

Literature. This paper studies the credibility problem of monetary decisions in an environment with fiscal policy and heterogeneous agents. Albanesi (2007) provides a link between income inequality and inflation as the outcome of a distributional conflict underlying monetary policy choices. The present analysis further emphasizes that the incidence of fiscal policy, captured by the progressivity of labor income taxes, is critical to understand monetary policy outcomes.

A related analysis is led by Farhi, Sleet, Werning, and Yeltekin (2012) in the context of capital taxation with imperfect commitment. Progressive capital taxation emerges as an optimal choice because it contains the build-up of inequalities and the temptation to reduce them with a capital levy. By contrast, monetary decisions subject to similar time inconsistency problems cannot be made progressive or targeted. The present analysis focuses alternatively on progressive labor taxes. It identifies a commitment channel of progressive fiscal policy to constrain discretionary monetary decisions and support efficient dynamic policy plans. This channel is distinct from the insurance channel of progressive income taxes originally studied by Conesa and Krueger (2006) and Heathcote, Storesletten, and Violante (2017).

Finally, there is a growing literature studying monetary policy in heterogeneous agents economies, e.g.

[4]Rich agents' relative preferences for inflationary policies is documented in Easterly and Fischer (2001) and extensively studied in Albanesi (2007). The present analysis relates the progressivity of the tax system to individual preferences for inflation.

Auclert (2019), Kaplan, Moll, and Violante (2018) and Gornemann, Kuester, and Nakajima (2021). This literature highlights how the effects of monetary decisions depend on the conduct of fiscal policy. Indeed, fiscal policy ultimately determines how, in response to changes in monetary policy, resources are redistributed to agents with different marginal propensity to consume. The present analysis stresses additionally that appropriate fiscal policy can curb the time inconsistency of monetary policy and implement dynamically an appropriate policy mix.

The rest of the paper is organized as follows. Section 2 describes the analytical environment. Section 3 characterizes efficient policy choices implemented by a benevolent policymaker with and without commitment. Section 4 then develops a political game to highlight the implications of distributional conflicts over policy choices. Section 5 develops a numerical extension with idiosyncratic risk and incomplete markets to generalize result and study the interplay of the commitment channel with the partial insurance provided by progressive labor taxes. Section 6 concludes. An Appendix presents additional materials related to the analysis and an Online Appendix reports mathematical proofs of lemmas.

2 Economic Environment

Consider an overlapping generation economy with heterogeneous agents. Time is discrete and infinite, prices are flexible. The environment is designed to highlight the incidence of fiscal and monetary decisions and the influence of fiscal progressivity on the time inconsistency of monetary policy.

2.1 Environment

2.1.1 Private Economy

Every period, a continuum of mass 1 of agents is born and lives two periods. Agents differ in lifetime labor productivity z, distributed on the compact set $[z_l, z_h]$, with $0 < z_l < z_h \leq 1$. The cumulative distribution function is noted $F(z)$.

Agents supply labor n_y and save when young, supply labor n_o and consume c_o when old. This structure introduces an explicit motive for saving without resorting to additional frictions. Because the consumption good is perishable, there is a nominal asset available for storing wealth: fiat money.[5] Production is linear and preferences are linear-quadratic.[6] Labor supply decisions solve:

$$\max_{n_y, n_o, c_o} \; c_o - \frac{n_o^2}{2} - \frac{n_y^2}{2}, \tag{1}$$

[5]It is in effect very similar to the *"morning - afternoon"* structure developed in Chari and Kehoe (1990). These elements reflect a stylized version of a life-cycle model with an asset demand choice, while abstracting from intertemporal substitution in consumption, which is not central to the analysis. Appendix B.3 discusses generalization of results to the availability of additional assets.

[6]Curvature in the utility function would capture either a desire for consumption smoothing, for insurance or for redistribution. In the absence of the two former effects, the present analysis neatly disentangles policy choices with and without redistributive concerns, as is made clear in Sections 3 and 4. Section 5 discusses the generalization of results to utility functions with curvature, idiosyncratic productivity risk and incomplete markets.

subject to young and old age budget constraints:

$$m = zn_y, \tag{2}$$

$$c_o = zn_0 - \lambda(zn_o)^{1+\alpha} + m\tilde{\pi}'. \tag{3}$$

In youth, agents supply labor n_y and save labor income $y_y = zn_y$ with money, whose real value is noted m. In old age, agents supply labor n_o, produce output $y_o = zn_o$ and pay labor taxes $\tau(y_o) = \lambda(y_o)^{1+\alpha}$. By printing money, the government collects seigniorage revenue, which is a tax on money holding. The real value of money net of inflation writes $m\tilde{\pi}$, where $\tilde{\pi}$ is the **inverse** gross inflation rate: a low value of $\tilde{\pi}$ corresponds to a high inflation rate. The expected inverse inflation rate is noted $\tilde{\pi}^e$.

The labor income tax schedule $\tau(y) = \lambda y^{1+\alpha}$ is parametrized by progressivity $\alpha \geq 0$ and level $\lambda \geq 0$. Formally, a tax plan is progressive if marginal rates are higher than average taxes at all level of income: $\frac{\partial\tau(y)/\partial y}{\tau(y)/y} = 1 + \alpha$.[7] When $\alpha = 0$, the tax plan implements a flat tax rate λ, and for any $\alpha > 0$, the tax plan is progressive. Note that these fiscal plans do not generate positive transfers, i.e., $\tau(y) \geq 0$, for all $y > 0$. This property allows to focus on redistributive conflicts between labor income tax and seigniorage and not on the redistributive conflicts driven by labor taxation.[8]

The solution to individuals' optimization problem is straightforward: the following expressions characterize agent z production decisions in youth and old, $y_y(z, \pi^e) = zn_y(z, \pi^e)$ and $y_o(z, \alpha, \lambda) = zn_o(z, \alpha, \lambda)$:

$$y_y(z, \pi^e) = z^2\tilde{\pi}^e \qquad\qquad y_o(z, \alpha, \lambda) = z^2\Big[1 - \frac{\partial\tau(y_o)}{\partial y_o}\Big]. \tag{4}$$

These decisions are driven by real returns to work, defined as the product of individual productivity z and marginal tax rates. In particular, high anticipated inflation (i.e., low $\tilde{\pi}^e$) induces agents to reduce labor supply and money demand when young. The same logic applies to old age production decisions subject to labor income taxation.

Given the dynamic nature of the model, I define welfare functions $V_h(\cdot)$ at each age $h \in \{y, o\}$. When old, given real money holding m, an agent of type z exposed to a tax plan (α, λ) and inverse inflation rate $\tilde{\pi}$ derives utility according to:

$$V_o(z, m, \alpha, \lambda, \tilde{\pi}) = y_o(z, \alpha, \lambda) - \lambda y_o(z, \alpha, \lambda)^{1+\alpha} - \frac{\big(y_o(z, \alpha, \lambda)/z\big)^2}{2} + m\tilde{\pi}. \tag{5}$$

Similarly, for young type z agent, considering a labor tax plan (α, λ) and expected inflation rate $\tilde{\pi}^e$:

$$V_y(z, \alpha, \lambda, \tilde{\pi}^e) = y_o(z, \alpha, \lambda) - \lambda y_o(z, \alpha, \lambda)^{1+\alpha} - \frac{\big(y_o(z, \alpha, \lambda)/z\big)^2}{2} + y_y(z, \tilde{\pi}^e)\tilde{\pi}^e - \frac{\big(y_y(z, \tilde{\pi}^e)/z\big)^2}{2}. \tag{6}$$

The difference between these expressions outlines the credibility problem of policy plans. When young,

[7] This definition of progressivity is standard, and similar approaches are being adopted by Benabou (2002), Heathcote, Storesletten, and Violante (2017) or Holter, Krueger, and Stepanchuk (2019). Note that for any $\alpha \in [-1, 0]$, the tax plan is *regressive*. I do not consider this parameter space because it does not arise as a candidate policy choice in the analysis.

[8] The seminal analysis of Meltzer and Richard (1981) studies redistributive conflicts induced by progressive labor taxation.

agents internalize the disincentive effect of inflation on labor supply, whereas when old, real money holding m is predetermined and inflation operates as a non-distortionary tax, by contrast to labor taxation. As the analysis is conducted in a deterministic environment, expectations reflect future policy choice $\tilde{\pi}^e = \tilde{\pi}$.[9]

Note that the distribution of real money holding in the population is non-degenerate. Formally, from (2) and (4), individual demand for money of young agents writes:

$$m(z, \tilde{\pi}^e) = z^2 \tilde{\pi}^e. \tag{7}$$

In old age, individual money holdings is given by the following distribution:

$$\phi\big(z, \Phi\big) = \frac{z^2}{E\big(z^2\big)} \Phi, \tag{8}$$

where Φ is aggregate real money holding. Importantly, money demand (7) is sensitive to expected policy choice, while money holding (8) of old agents is inelastic.

2.1.2 Government

Every period, the government finances a real and exogenous level of public good g, by collecting labor income taxes on old agents or by printing money. The real budget constraint of the government writes:

$$\int_z \lambda y_o(z, \alpha, \lambda)^{1+\alpha} dF(z) + \frac{\Delta M}{P} = g, \tag{9}$$

where the first term reflects labor income taxes, ΔM is the change in total money supply M, and P is the price level. The structure imposes within-generation budget constraint, so as to neatly focus on intragenerational conflicts and the dynamic determinants of the relative tax mix.[10]

The change in the elasticity of money holding over time is the essence of the time inconsistency of monetary decisions. Still, the choice of taxes affects the distribution of wealth and consumption across agents. This dimension is potentially magnified in the presence of progressive income taxation $\alpha \geq 0$.

2.2 Progressive Tax Plans

Note $t(z, \alpha, \lambda)$, the labor *tax function* for an agent of type z, and $T(\alpha, \lambda)$ the *aggregate tax function*, defined as the *tax plan* evaluated at the production decision (4):

$$t(z, \alpha, \lambda) = \lambda y_o(z, \alpha, \lambda)^{1+\alpha} \qquad\qquad T(\alpha, \lambda) = \int_z t(z, \alpha, \lambda) dF(z). \tag{10}$$

In the absence of progressivity i.e., when the tax plan implements a flat tax rate, the Laffer curve properties of labor tax functions (10) are well known.[11] This property extends to the individual and aggregate

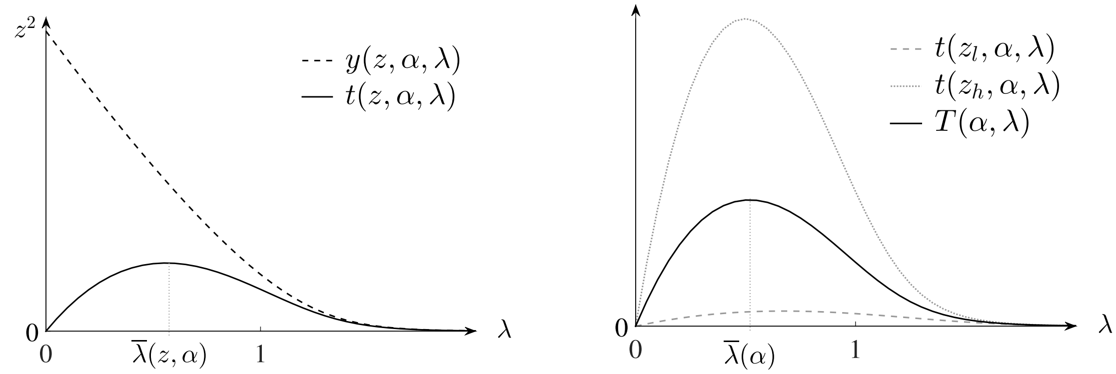
[9] In a stochastic environment, these expressions would be modified to account for the realization of an exogenous shock and the expectations over the shock from a young agent's perspective. Generalization of the results to idiosyncratic productivity shocks is discussed in Section 5.

[10] Appendix B.1 discusses how results generalize to environments with additional intergenerational conflicts over policy choices.

[11] The Laffer curve shape of tax functions reflects the classic competing *behavioral response* and the *mechanical effects* of raising

tax functions for positive level of progressivity $\alpha > 0$. Figure 1 represents the production function (4), the individual and aggregate tax functions (10) under a tax plan (α, λ). In particular, individual tax functions reach of maximum at $\bar{\lambda}(z, \alpha) = \frac{1}{2(1+\alpha)(\frac{z^2}{2})^\alpha}$. By analogy, the peak of the aggregate tax function is labeled $\bar{\lambda}(\alpha)$.[12]

Figure 1: Production and Tax Functions with Progressivity ($\alpha > 0$)



(a) Individual Production and Tax Functions (b) Aggregate Tax Function

The left panel represents the production decision and tax function for an agent of type z when the tax plan features progressive labor taxes, i.e., $\alpha > 0$. Online Appendix 2 formally shows that individual tax functions are single peaked, strictly concave on the upward slopping part and increasing in productivity z. The right panel outlines how tax functions aggregate over the population.

Importantly, as in Werning (2007), introducing progressive labor taxes $\alpha > 0$ generates costly distortions. To highlight this point, consider a **static** labor taxation program: for a given level of taxes to be collected, progressivity is only costly, because it increases marginal tax rates, labor supply distortions and weighs on individual and aggregate welfare. This is formalized in the following lemma.

Lemma 1. *Consider the static problem of financing a public good using labor taxes only. Both in homogeneous ($z_l = z_h$) and heterogeneous agent economies ($z_l < z_h$), the optimal plan prescribes no progressivity, i.e.,* $\alpha = 0$.

Proof. See Online Appendix 3. ∎

2.3 Assumptions

The following assumptions are used to characterize policy outcomes. The first imposes a restriction on the distribution of productivity, with the usual property that the mean agent has higher productivity than the median one.

Assumption 1. *Let* $z_m = F^{-1}(\frac{1}{2})$ *be the median productivity level. It satisfies:*

$$z_m \leq E(z). \quad \textbf{(A.1)}$$

taxes. If $\alpha = 0$, the individual tax function writes $t(z, 0, \lambda) = z^2(1-\lambda)\lambda$ and the aggregate tax function $T(0, \lambda) = E(z^2)(1-\lambda)\lambda$. These functions are strictly concave, positive for $\lambda \in [0, 1]$ and reach a global maximum at $\lambda = 1/2$.

[12]These elements are formally established in Online Appendix 2.

As government expenses play no particular role in this environment, I impose the following upper limit on g to guarantee the existence of interior solutions to taxation programs.[13]

Assumption 2. *g is non stochastic and satisfies:*

$$0 < g < \frac{E(z^2)}{4}. \tag{\textbf{A.2}}$$

More importantly, fiscal choices (α, λ) are constrained by the presence of *tax inertia* in fiscal progressivity α, as in Farhi (2010) or Ferriere (2015). *Tax inertia* refers to the idea that some structural elements of the tax code requires more time to be adjusted. This concept is particularly relevant for dimensions related to the incidence of fiscal policy.[14]

Assumption 3. *Fiscal progressivity α is set one period prior to tax collection.* (**A.3**)

In other words, the progressivity of the labor tax plan in place for a given cohort of old agents is required to be set in young age. It is predetermined to the choice of the monetary-fiscal policy mix.

2.4 Equilibrium Definition

All economic outcomes are characterized as *Stationary Rational Expectation Equilibrium* (SREE). Accordingly, we need to define the relevant state variables, market clearing conditions and the link between money printing rate σ, inflation $\tilde{\pi}$ and seigniorage $\frac{\Delta M}{P}$.

The state vector is noted $\mathcal{S} = (\Phi_{-1}, \alpha)$: Φ_{-1} refers to aggregate money holding of old agents, from which the whole distribution of money holding derives using (8). Further, consistently with Assumption 3, the progressivity parameter α of the labor tax plan is predetermined to policy decisions.

The condition for money market clearing requires that $\Phi(\mathcal{S})$, aggregate money demand, matches the supply of money:

$$\Phi(\mathcal{S}) = \int m(z, \mathcal{S}) dF(z) = \frac{M(\mathcal{S})}{P(\mathcal{S})} \qquad \forall \mathcal{S}, \tag{11}$$

where $P(\mathcal{S})$ is the state dependent money price of goods and $M(\mathcal{S})$ the nominal stock of money. Using this expression, the inverse gross inflation rate writes:

$$\tilde{\pi}(\mathcal{S}) = \frac{P(\mathcal{S}_{-1})}{P(\mathcal{S})} = \frac{\Phi(\mathcal{S})}{\Phi(\mathcal{S}_{-1})} \frac{1}{1 + \sigma(\mathcal{S})}. \tag{12}$$

Using these expresssions, the government budget constraint (9) rewrites:

$$\int_z t\big(z, \alpha, \lambda(\mathcal{S})\big) dF(z) + \Phi(S) \frac{\sigma(S)}{1 + \sigma(S)} = g. \tag{13}$$

[13] This restriction ensures there are enough resources in the economy in any circumstance to finance the public good. It is derived under the scenario of no labor taxation and top of seigniorage Laffer curve, as in Persson and Tabellini (1994).

[14] In particular, this assumption is motivated by empirical elements presented in Appendix A that document a relatively time-invariant country specific component in fiscal redistribution.

These expressions imply a one-to-one mapping between the rate of money creation $\sigma(\mathcal{S})$ and the realized inverse inflation $\tilde{\pi}(\mathcal{S})$.[15] Accordingly, the equilibrium definition is stated with the government setting the inverse inflation rate $\tilde{\pi}(\mathcal{S})$.

Definition 1. *A Stationary Rational Expectations Equilibrium (SREE) is given by:*

1. *Production and savings decisions of private agents* $\big(y_y(z,\mathcal{S}), y_o(z,\mathcal{S}), m(z,\mathcal{S})\big)$*, solve* (1) *subject to budget constraints* (2) *and* (3)*, given monetary and fiscal choices* $\big(\alpha(\mathcal{S}), \lambda(\mathcal{S}), \tilde{\pi}(\mathcal{S})\big)$*, for all* $\mathcal{S}$*.*
2. *A collective choice mechanism determines* $\big(\alpha(\mathcal{S}), \lambda(\mathcal{S}), \tilde{\pi}(\mathcal{S})\big)$ *subject to the government budget constraint* (13) *and tax inertia in progressivity* α*, for all* $\mathcal{S}$*.*
3. *All markets clear (good, money), for all* $\mathcal{S}$*.*

Item 2 of the equilibrium definition refers to a generic collective choice mechanism. Sections 3 and 4 contrast two different choice mechanisms, in order to understand the determinants of policy choices with and without distributional concerns.

The following lemma establishes the existence of stationary decisions for any set of policy parameters $\big(\alpha, \lambda, \tilde{\pi}\big)$ that satisfies the government budget constraint (9). This intermediate result allows to focus on the determinants and properties of the policy mix, and save on elements related to the existence of equilibria.

Lemma 2. *Let* $\big(\alpha, \lambda, \tilde{\pi}\big) \in \big\{0, [0,1], [0,1]\big\} \times \big\{\mathbb{R}_+^*, \mathbb{R}, [0,1]\big\}$ *be a set of time-invariant policy choices that satisfies the government budget constraint. For any* $\big(\alpha, \lambda, \tilde{\pi}\big)$ *in this set, there is a stationary rate of money creation, inflation expectations and policy decisions of private agents consistent with individual optimization and market clearing conditions.*

Proof. See Online Appendix 4. ∎

3 Productive Efficiency under Benevolent Policymaker

Which policy mix $(\lambda, \tilde{\pi})$ is implemented by a benevolent policymaker, when there is *inertia* in tax progressivity? What is the desirable level of progressivity then?

The policy mix is derived both under commitment and policy discretion. Importantly, because individual utility is linear-quadratic and the objective function utilitarian, there is no concern for the distribution of consumption. Hence, these benchmarks establish whether progressivity can mitigate the welfare consequences of taxation when the policymaker has an exclusive focus on productive efficiency.

First, consider policy choices under **commitment**: a policymaker sets $(\lambda^c, \alpha^c, \tilde{\pi}^c)$ one period prior to implementation, and inflation expectations reflect these choices, i.e., $\tilde{\pi}^e = \tilde{\pi}^c$. Accounting for equilibrium

[15] Indeed, $\Phi(\mathcal{S}_{-1}) = \Phi_{-1}$, i.e., aggregate real money holding of current old agents, is predetermined. Further, money demand of current young $\Phi(\mathcal{S})$, is, as verified below, independent of the current rate of money creation $\sigma(\mathcal{S})$. In other words, the demand for money of young agents is not sensitive to contemporaneous policy choices, only to the rate of progressivity that applies next period. Also, embedded in (**??**) is an interaction between expected inflation, that determines the aggregate demand for money $\Phi(\mathcal{S}_{-1})$, and realized inflation. This can give rise to a seigniorage Laffer curve and indeterminacy in money demand. The present analysis abstracts from this complication and assumes private agents' expectations of inflation lie on the upward sloping part of the seigniorage Laffer curve.

money demand, revenue obtained from seigniorage is $\frac{\Delta M}{P(\mathcal{S})} = E(z^2)\tilde{\pi}^c(1-\tilde{\pi}^c)$, and the government budget constraint (13) reads:

$$\int_z t(z, \alpha^c, \lambda^c) dF(z) + E(z^2)\tilde{\pi}^c(1-\tilde{\pi}^c) = g. \tag{14}$$

Accordingly, under commitment, a benevolent policymaker solves:

$$\max_{\alpha,\lambda,\tilde{\pi}} \int_z V_y(z, \alpha, \lambda, \tilde{\pi}) dF(z), \tag{15}$$

subject to the government budget constraint (14), the individual demand for money (7), production decisions (4), and non-negativity constraints $\alpha \geq 0$, $\lambda \geq 0$, $\tilde{\pi} \geq 0$.

Under a lack of commitment, a regime called **discretion**, the policymaker no longer internalizes how choices influence inflation expectations and money demand. It decides sequentially on the policy mix $\big(\lambda^d(\mathcal{S}), \tilde{\pi}^d(\mathcal{S})\big)$, given aggregate real money holding Φ and labor tax progressivity $\alpha^d \geq 0$. Given the generational incidence of policy choices, contemporaneous discretionary decisions influence only the welfare of current old agents. Formally, given $\mathcal{S} = (\Phi, \alpha^d)$, the policymaker under discretion solves:

$$\max_{\lambda,\tilde{\pi}} \int_z V_o\big(z, \phi_{-1}, \alpha^d, \lambda, \tilde{\pi}\big) dF(z), \tag{16}$$

subject to the government budget constraint (9), the distribution of money holding (8), the production decisions (4), and non-negativity constraints $\lambda \geq 0$, $\tilde{\pi} \geq 0$.

The following proposition characterizes equilibrium policy choices under commitment and discretion. It highlights the credibility problem of monetary policy and the non-desirability of progressive labor taxes.

Proposition 1. *Under assumptions* (**A.1**) *to* (**A.3**)*, there is a SREE where a utilitarian policymaker chooses the following policy plans:*

i. Policy choices under commitment are: $\alpha^c = 0$, $\lambda^c = 1 - \tilde{\pi}^c$.

ii. Policy choices under discretion are: $\tilde{\pi}^d > 0$, $\lambda^d = 0$, *for any* $\alpha^d \geq 0$.

Lifetime welfare for any agent z *is lower under discretion than under commitment.*

Proof. The existence of SREE under both regimes derives from Lemma 2.

i. By Lemma 1, we can rule out $\alpha^c > 0$ because for any level of labor taxes raised, welfare is higher with no progressivity. Policy solves (15) subject to (14), (7), (4) and $\alpha^c = 0$. This problem is symmetric in the choice variables λ and $1 - \tilde{\pi}$. Accordingly, any interior solution to this program, guaranteed by (**A.2**), satisfies $\lambda^c = 1 - \tilde{\pi}^c$.

ii. Under discretion, real money holding is predetermined to tax decisions $\big(\lambda^d(\mathcal{S}), \tilde{\pi}^d(\mathcal{S})\big)$. The policymaker first collects revenue with seigniorage because it is not distortionary, and uses labor taxation only if necessary.[16] Formally, from the government budget constraint, if $\lambda^d = 0$ then $\sigma^d = \frac{g}{\Phi_{-1}\tilde{\pi}}$. Using (12), the resulting inverse inflation rate writes $\Pi(\mathcal{S}) = \frac{\Phi(\mathcal{S}) - g}{\Phi_{-1}}$, constrained to be non-negative. In this expression,

[16] Given aggregate real money holding $\Phi_{-1} \geq 0$, the government under discretion with $\alpha^d = 0$ solves:

$\Phi(\mathcal{S}) = \int_z m(z, \mathcal{S})dF(z)$ reflects inflation expectations of the young generation, which is unaffected by the current choice over the relative tax mix under discretion. Overall, $\tilde{\pi}^d(\mathcal{S}) = \max\{\Pi(\mathcal{S}), 0\}$ and $\lambda^d(\mathcal{S}) > 0$ if and only if $\tilde{\pi}^d(\mathcal{S}) = 0$. In equilibrium, the stationary aggregate demand for money satisfies $\Phi = \int_z z^2 \tilde{\pi}^d dF(z)$ where $\tilde{\pi}^d = \frac{\Phi - g}{\Phi}$. Assumption (**A.2**) guarantees the existence of a positive level of aggregate real money holding, so that the policy implemented relies exclusively on the inflation tax.

Finally, because the allocation under discretion is feasible under commitment, and no distributional considerations could contrast these plans, the lifetime welfare of any agent z is higher under commitment than under discretion. ∎

Under commitment, the policymaker wants to spread equally the burden of taxation across agents and over time: government revenue comes equally from labor taxes and seigniorage. This policy plan is time-inconsistent: as real money holdings are predetermined to tax choices, ex post inflation is beneficial because it operates much like a non-distortionary lump-sum tax. Accordingly, inflation is higher under discretion than under commitment: this is a classic illustration of the *inflation bias* under a lack of commitment. The welfare losses under discretion stem from the anticipation of inflationary policies and its negative effect on young agents' labor supply and money demand.

Progressivity in labor income tax is not desirable, neither to reduce the deadweight loss of taxation nor to mitigate the inflation bias under discretion. As seen in Lemma 1, progressivity raises marginal tax rates, hence labor supply distortions and welfare losses. Both under commitment and discretion, a benevolent policymaker interested only in minimizing distortions avoids progressive labor taxation. This result comes from the productive efficiency objective of the utilitarian planner. The next section investigates whether progressive labor taxation is desirable and effective in mitigating the inflation bias when distributive considerations are influencing policy choices.

4 Political Economy Analysis

This section develops a political economy to incorporate distributive concerns into the selection of policy instruments. In contrast to Section 3, pre-committing to progressivity is part of an optimal policy plan and mitigates the inflation bias. Progressive labor taxation plays a dual role. For a given level of labor taxes, it distributes the overall burden of taxation toward richer agents, hence contributing to reducing consumption inequality. As such, when policy reflects distributional conflicts, this *tax-shifting* effect balances the optimal policy mix away from excessive seigniorage.[17] From a life-cycle perspective, progressive labor taxation is supported unanimously by the population because it provides *dynamic incentives* against the inflation bias.

$\max_{\lambda,\sigma} \int_z V_o\big(z, \phi_{-1}, 0, \lambda, \tilde{\pi}\big)dF(z)$ subject to $E(z^2)(1-\lambda)\lambda + \sigma\Phi_{-1}\tilde{\pi} = g$, where $\phi_{-1} \equiv \phi(z, \Phi_{-1})$ is given by (8). One can show that the solution to this program gives $\lambda = 0$. For $\alpha^d > 0$, first recall from Lemma 1 that distortions are lower with no progressivity: if the government were to raise positive labor taxes with $\alpha^d > 0$, it would do as well for $\alpha^d = 0$.

[17] In other words, the political economy analysis generates policy plans that are qualitatively similar to those of a benevolent policymaker with explicit desire for redistribution. This is verified in Section 5.

4.1 The Decision Protocol

Policy is set through a two-stage political game, under *tax inertia* for progressivity. When young, agents decide the progressivity of labor taxes α^p that will prevail next period. When old, majority voting determines the mix of labor taxes and seigniorage.

The voting protocol reflects how individual preferences over tax policies are influenced by the level of fiscal progressivity. Intuitively, progressive fiscal policy would modify the willingness to rely exclusively on the inelastic seigniorage tax base (Proposition 1) if it generates sufficient distributive conflicts across the population. The political game considers that the choice of α^p in young age is set *behind a veil of ignorance*, but it reflects individual preferences and its effects on the outcome of the vote next period.

A politico-economic equilibrium is characterized by policy choices $(\alpha^p, \lambda^p, \tilde{\pi}^p)$ consistent with Definition 1 and the decision protocol described above. Because the decisions of young agents internalize their effects on the outcome of the vote, the game is analyzed backward.

4.2 Stage 2 - Vote over the Policy Mix

In old age, agents vote over the tax mix $(\lambda, \tilde{\pi})$ given the distribution of money holding and predetermined progressivity of labor income taxes. The protocol for majority voting is standard: two political candidates, only interested in being elected, offer a tax platform and commit to implement it once in office.[18] This choice protocol displays how progressive labor taxes shape policy conflicts across the population, which in turn influence the outcome of the vote over the monetary-fiscal policy mix.

4.2.1 Individual Ranking of Policy Alternatives and Outcome of the Vote

An agent of type z evaluates policy plans $(\lambda, \tilde{\pi})$ compatible with the government budget constraint (9), given labor income progressivity α and aggregate money holding Φ_{-1}. Note $\tilde{\pi}(\lambda, \alpha, \Phi_{-1})$, the inverse inflation rate required to satisfy the government budget constraint as a function of the level of labor taxes $\lambda \geq 0$. An agent of type z ranks policies $\big\{\lambda, \tilde{\pi}(\lambda, \alpha, \Phi_{-1})\big\}$ according to the following value function:

$$\tilde{V}_o(z, \Phi_{-1}, \alpha, \lambda) \equiv V_o\big(z, \phi(z, \Phi_{-1}), \alpha, \lambda, \tilde{\pi}(\cdot)\big). \tag{17}$$

The derivative of this function with respect to λ outlines the trade-offs involved when choosing the policy mix. Using the envelope conditions (4), it writes:

$$\frac{d\tilde{V}_o(z, \alpha, \Phi_{-1}, \lambda)}{d\lambda} = -\frac{\partial \tau(\cdot)}{\partial \lambda} + \phi(z, \Phi_{-1})\frac{d\tilde{\pi}(\cdot)}{d\lambda}, \tag{18}$$

where $\tau\big(y_o(z, \alpha, \lambda)\big) = \lambda y_o(z, \alpha, \lambda)^{1+\alpha}$.

The two terms in (18) reflect the costs and benefits to agent z of increasing the level of labor taxes. Positive labor taxation is distortionary and costly: this is captured by the marginal tax rate term $\frac{\partial \tau(\cdot)}{\partial \lambda}$. On the other hand, an increase in labor taxes decreases the magnitude of the inflation tax and preserves money

[18] For detailed references, see for instance Persson and Tabellini (2002), Chapters 2 and 3.

holding as a source of consumption.[19] This effect is captured by the marginal consumption benefit from real money holding $m(z) = \phi(z, \Phi_{-1})$, net of the change in inflation $\frac{d\tilde{\pi}(\cdot)}{d\lambda}$. This last term captures the strategic dimension embedded in the evaluation of policy alternatives. Indeed, use (12) and (13) to derive $\frac{d\tilde{\pi}(\cdot)}{d\lambda}$, and rewrite the former expression as:

$$\frac{d\tilde{V}_o(z, \alpha, \Phi_{-1}, \lambda)}{d\lambda} = \underbrace{-\frac{\partial \tau(\cdot)}{\partial \lambda}}_{\text{tax distortions}} + \underbrace{\frac{z^2}{E(z^2)} \frac{dT(\alpha, \lambda)}{d\lambda}}_{\text{tax shifting}}. \tag{19}$$

This expression makes clear the shape of agent z value function is not sensitive to Φ_{-1}, $\tilde{\pi}$ or g. The willingness of type z agent to raise labor taxes is tied to the distributional consequences generated by different level of progressivity α.[20] This is the *tax-shifting* effect.

The following Lemma derives two essential results to characterize the outcome of the vote. First, the ranking of policy alternatives is monotone: this is the so-called *single-peaked* property of the value function (17). The lemma further characterizes the dependence of individual bliss policies on progressivity.

Lemma 3. *Individual preferences over policy choices are single-peaked, with bliss policy choice noted* $\lambda^p(z, \alpha)$.

i. When $\alpha = 0$, *all agents share the same bliss policy:* $\lambda^p(z, 0) = 0$.

ii. For $\alpha > 0$, *agents disagree over the policy mix and individual bliss policies are ordered by productivity type. Formally, there is a productivity cut-off* $\bar{z}(\alpha) = \left[\frac{E\left(z^{2(1+\alpha)}\right)}{E(z^2)}\right]^{\frac{1}{2\alpha}}$, *with* $z_l < \bar{z}(\alpha) < z_h$, *such that:*

- *For all* $z < \bar{z}(\alpha)$, $\lambda^p(z, \alpha)$ *is positive and strictly decreasing in* z, *and* $\lim_{z_l \to 0} \lambda^p(z_l, \alpha) = \bar{\lambda}(\alpha)$.
- *For all* $z \geq \bar{z}(\alpha)$, $\lambda^p(z, \alpha) = 0$.

Proof. See Online Appendix 5. ∎

Lemma 3 establishes two key elements. First, progressivity is critical to generate redistributive conflicts within a generation. Second, individual bliss policies are ordered by productivity type z.

In the absence of progressivity, $\alpha = 0$, agents vote unanimously to rely exclusively on the inflation tax.[21] Yet with progressive labor taxation, this unanimity no longer holds. Figure 2 provides a graphical illustration of bliss policies $\lambda^p(z, \alpha)$ when $\alpha > 0$. The lower individual productivity, the higher the support for labor taxation, because it collects relatively more taxes on higher-productivity agents, at low individual costs. This is the *tax-shifting* effect induced by progressivity. Similarly, high-productivity agents support inflationary policies. The population is split in two, according to the cut-off value $\bar{z}(\alpha)$. Any agent with productivity $z > \bar{z}(\alpha)$ would not support positive labor taxes. Interestingly, when the productivity z_l of

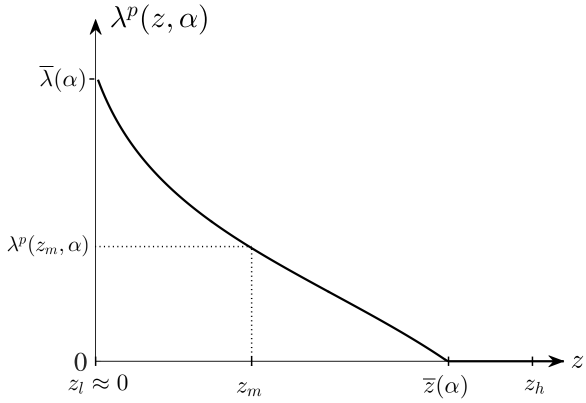
[19] Again, the analysis stresses that the relevant levels of labor tax lie on the upward sloping part of the Laffer curve, so that $\frac{d\tilde{\pi}(\cdot)}{d\lambda} < 0$. Whenever λ lies on the downward sloping part of the aggregate Laffer curve, i.e., $\lambda \geq \bar{\lambda}(\alpha)$, then $\frac{d\tilde{V}_o(\cdot)}{d\lambda} < 0$. See equation (19).

[20] Still, the level of inflation needed to clear the government budget constraint does depend on the seigniorage tax base Φ_{-1} or level of public good g.

[21] This result is stronger than the outcome of the optimal policy plan under discretion (Proposition 1). Indeed, not only aggregate productive efficiency prescribes the exclusive use of the inflation tax, but agents unanimously support seigniorage to take advantage of the inelastic tax base.

the least productive agents is very small, the associated bliss policy is the top of the aggregate Laffer curve $\bar{\lambda}(\alpha)$.[22]

Figure 2: Individual Bliss Policies - Stage 2 Vote ($\alpha > 0$)



This figure represents bliss policies as a function of productivity z. The lower productivity, the higher the desire for labor taxation. In turn, the associated level of inflation is increasing in z: higher-productivity agents internalize they would bear the largest share of labor taxes, hence they favor more inflationary policies. As bliss policies are ordered by productivity type, the median productivity agent z_m is the decisive voter.

Altogether, these results provide a characterization of the outcome of the vote $\left\{\lambda^p(\alpha, \Phi_{-1}), \tilde{\pi}^p(\alpha, \Phi_{-1})\right\}$.

Proposition 2. *Majority voting selects a unique policy mix. The decisive voter is the median productivity agent, so that* $\lambda^p(\alpha, \Phi_{-1}) = \lambda^p(z_m, \alpha)$*, with the following characteristics:*

- *For* $\alpha = 0$*, the implemented policy relies exclusively on the inflation tax:* $\lambda^p(\alpha, \Phi_{-1}) = 0$.
- *For any* $\alpha > 0$*, the policy implements positive labor taxes* $\lambda^p(\alpha, \Phi_{-1}) > 0$*, possibly complemented with the inflation tax.*

Proof. The assumption of permanent lifetime productivity ensures individual type z and real money holding $\phi(z, M)$ are perfectly correlated, i.e., that agents differ *de facto* only along one dimension. Moreover, because preferences are single-peaked over a unidimensional policy space, majority voting induces a unique Condorcet winner. The outcome of the vote is the bliss policy of the median voter. Because bliss policies are ranked by productivity type (Lemma 3), the decisive voter is the median-productivity agent.

Lemma 3 establishes that whenever the labor tax plan is not progressive ($\alpha = 0$), then agents unanimously vote for no labor taxes. For any $\alpha > 0$, using Jensen inequality:

$$\frac{E\big(z^{2(1+\alpha)}\big)}{E(z^2)^{1+\alpha}} \geq 1 \Rightarrow \bar{z}(\alpha)^{2\alpha} \geq E(z^2)^{\alpha} \Rightarrow \bar{z}(\alpha)^2 \geq E(z^2), \tag{20}$$

and by the definition of the variance $E(z^2) = V(z^2) + E(z)^2$, one gets:

$$\bar{z}(\alpha) > E(z) \geq z_m, \tag{21}$$

[22] When $z_l \approx 0$ and $\alpha > 0$, the average labor tax rate tends to 0 for any λ, while the average tax rate implied by inflation is strictly positive.

where the last inequality comes from (**A.1**). For any $\alpha > 0$, the median-productivity agent z_m is below the cut-off value $\bar{z}(\alpha)$ and supports positive labor taxes. ∎

Without labor income tax progressivity, agents vote unanimously against labor taxes, because associated labor supply distortions systematically outweigh the benefits of collecting proportional labor taxes over the whole population. When $\alpha > 0$, the outcome of the vote is one of positive labor taxes: the *tax-shifting* effect is strong enough that the median agent does want to raise positive labor taxes. Overall, any level of progressivity $\alpha > 0$ contributes to curb the inflation tax.

4.2.2 Influence of Fiscal Progressivity on the Policy Mix

Proposition 2 has established that majority voting implements positive labor taxes if and only if the labor tax plan is progressive. It is essential then to characterize the implied aggregate labor tax function $T(\alpha, \lambda^p(\alpha, \Phi_{-1}))$, and conversely, how the inflation tax is sensitive to labor income tax progressivity α.[23]

Lemma 4. *The aggregate tax function $T(\alpha, \lambda^p(\alpha, \Phi_{-1}))$ is positive for all $\alpha \geq 0$, admits a global maximum, and eventually converges to 0 as the level of progressivity gets to infinity.*

Proof. See Online Appendix 6. ∎

Figure 3 represents the breakdown of government revenues induced by majority voting as a function of α. As the median-productivity agent is decisive, it is important to understand how his willingness to raise labor taxes is modified when α increases. As is clear now, when $\alpha = 0$, no labor tax is collected. A positive level of progressivity induces the median agent to rely on the *tax-shifting* effect and raise labor taxes. As the level of progressivity increases further, increasing labor supply distortions leads to a decrease in the total amount of labor taxes collected. Note that these curves should not be read as standard Laffer curve. Indeed, as shown next section, individuals have favorite level of progressivity that lies on both the upward and downward sloping part of these curves.

4.3 Stage 1 - The Determinants of Fiscal Progressivity

The previous section shows that the tax mix $\{\lambda^p(\cdot), \tilde{\pi}^p(\cdot)\}$ implemented under majority voting features positive labor taxes if and only if $\alpha > 0$. Yet, progressivity is costly per se (Lemma 1) and has significant distributional consequences (Proposition 2). This section investigates whether young agents would support to pre-commit to positive progressivity, and so to benefit from the expected reduction in inflation.

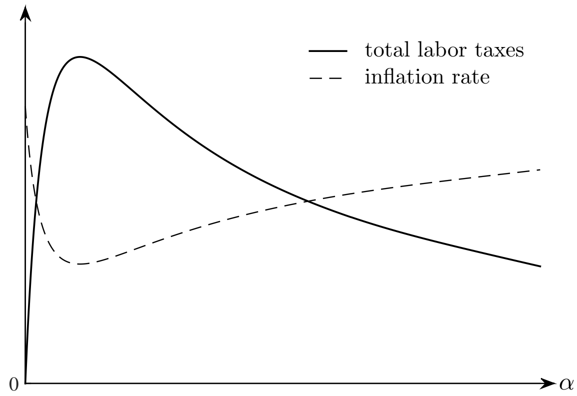
Young agents decide on progressivity behind a *veil of ignorance*, i.e., before agents learn their individual productivity z.[24] To establish $\alpha^p > 0$ in equilibrium, I first study individual preferences over progressivity. The value function of a young agent with productivity z satisfies:

$$\tilde{V}_y(z, \alpha) \equiv V_y(z, \alpha, \lambda^p, \pi^p), \tag{22}$$

[23] Formally, $T(\alpha, \lambda^p(\alpha, \Phi_{-1}))$ is the aggregate labor tax function (10) evaluated at the vote outcome $\lambda^p(\alpha, \Phi_{-1}) = \lambda^p(z_m, \alpha)$.

[24] In the political literature, the veil of ignorance refers to a choice mechanism where parties involved in the decision process do not know about their particular abilities, tastes and position within the social order of society.

Figure 3: Government Revenue as a Function of Progressivity under Majority Voting



This figure represents the tax mix implemented under majority voting as a function of progressivity α. The plain line represents $T\big(\alpha, \lambda^p(\alpha, \Phi_{-1})\big)$, the aggregate level of labor taxes. The dashed line represents the inflation rate needed to meet the government budget constraint. These curves do not read as Laffer curves but rather reveal the trade-offs faced by the decisive voter. When $\alpha = 0$, unanimity for the inflation tax gives rise to high inflation and no labor taxes. When α increases, the median agent supports higher labor taxes, up to a point where labor supply distortions become too costly to raise more labor taxes. In the limit, no labor taxes are collected.

where $\lambda^p \equiv \lambda^p(\alpha, \Phi_{-1})$ and $\tilde{\pi}^p \equiv \pi^p(\alpha, \Phi_{-1})$ is the policy mix implemented next period under majority voting (Proposition 2). Φ_{-1} is next period aggregate seigniorage tax base, formed contemporaneously as the sum of individual demand for money. From (7) and (8), it satisfies:

$$\Phi_{-1} = E(z^2)\tilde{\pi}^p(\alpha, \Phi_{-1}). \tag{23}$$

Value function (22) has two components: the demand for asset in youth is influenced by expected inflation, whereas production in old age is distorted by the labor income tax plan. The derivative of (22) w.r.t. α outlines variation in welfare for an agent with productivity z. Using the envelope conditions (4):

$$\frac{d\tilde{V}_y(z,\alpha)}{d\alpha} = -\underbrace{\frac{\partial \tau(\cdot)}{\partial \alpha} - \frac{\partial \tau(\cdot)}{\partial \lambda}\frac{d\lambda^p(\cdot)}{d\alpha}}_{\text{labor income tax}} + \underbrace{y_y(\cdot)\frac{d\tilde{\pi}^p(\cdot)}{d\alpha}}_{\text{inflation tax}}. \tag{24}$$

The first two terms reflect the welfare losses associated with progressive labor taxes: the direct disincentive effect of progressivity and the overall distortions induced by labor taxes. The magnitude of the latter depends on the relative position of agent z within the productivity distribution, i.e., its exposure to the *tax-shifting* effect identified in Section 4.2. The third term is the marginal cost of inflation: the influence of α on the inflation tax precisely captures the dynamic implications of progressivity to balance the policy mix away from excessive inflation.

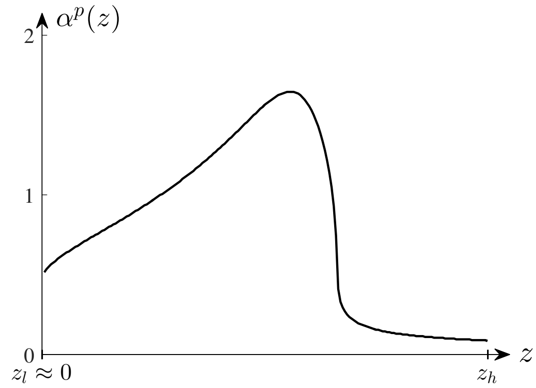
To understand how progressivity operates, consider the limit case $\alpha \approx 0$. The decisive voter next period implements a policy mix relying essentially on inflation. An increase in α would then decrease inflation and mitigate its adverse effects on young agents' labor supply and money demand. In effect, progressivity contributes to balance inevitable welfare losses over the life cycle: every young agent z supports a strictly positive level of progressivity, as it provides appropriate *dynamic incentives* to curb the excessive inflationary policies.

Lemma 5. *Any agent $z \in [z_l, z_h]$ would favor a strictly positive level of progressivity, i.e., for all z, $\alpha^p(z) > 0$.*

Proof. See Online Appendix 7. ∎

Figure 4 outlines that agents' favorite choice of progressivity $\alpha^p(z)$ is not monotonic in z. Indeed, individuals weigh their individual exposure to labor taxation, the deadweight loss associated with progressivity and the reduction in inflation. For the least productive agents $z_l \approx 0$, the marginal tax rate is 0 for any $\lambda \geq 0$ whenever $\alpha > 0$. Therefore, this agent would favor a level of progressivity that maximizes total labor taxes collected.[25] An agent with a low $z > z_l$ would then support a higher level of progressivity, to further exploit the *tax-shifting* effect while minimizing its individual exposure to labor taxes. An agent with a higher z would support a lower level of progressivity because it internalizes it would bear a large welfare cost associated to labor taxes. The highest-productivity agent z_h would favor progressivity just enough to balance distortions induced by inflation and labor taxes. Overall, agent z's favorite level of progressivity weighs *tax-shifting*, *distortions* from progressivity and *dynamic incentives* to curb inflation. The latter dominates at low level of progressivity for every agent z.

Figure 4: Individual Choice of Progressivity - Stage 1



This figure plots young agents' favorite choice of α. The non-monotonicity of $\alpha^p(z)$ stems from the interplay between *tax-shifting*, *distortions* from progressivity and *dynamic incentives* to curb inflation. When $z_l \approx 0$, $\alpha^p(z_l)$ maximizes labor tax revenue next period. At lower values of z, an agent would select a higher α to take benefit of *tax-shifting*. Higher productivity agents choose a lower value of α because they internalize the support of the largest burden of labor taxes.

The choice protocol described in Section 4.1 specifies that progressivity is set behind a *veil of ignorance*, namely before agents learn their productivity parameter z. The selected level of progressivity α^p is the solution to the following program:

$$\max_{\alpha} \int_z \tilde{V}_y(z, \alpha) dF(z), \tag{25}$$

where policy choices $\lambda^p(\cdot)$ and $\tilde{\pi}^p(\cdot)$ are the outcome of majority voting next period. The following proposition follows naturally from Lemma 5.

[25] Recall that with $\alpha > 0$, the average tax rate writes $\frac{\tau(\cdot)}{y_o(\cdot)} = \lambda y_o(\cdot)^{\alpha}$. Agent $z_l \approx 0$ would pick α that maximizes $T\big(\alpha, \lambda^p(\alpha)\big)$, the peak of the aggregate labor income tax function. See Figure 3.

Proposition 3. *If labor income tax progressivity is set behind a 'veil of ignorance', then* $\alpha^p > 0$.

Proof. Note $W(\alpha) \equiv \int_z \tilde{V}_1(z, \alpha) dF(z)$ the welfare criterion. Applying Lemma 5, we naturally have $W'(0) > 0$, so that the optimal level of progressivity is not zero. Because when α gets very large no labor taxes are effectively collected (see Lemma 4), and α^p is finite. ∎

Overall, the political analysis stresses how progressive labor taxation generates distributional conflicts that are effective in mitigating excessive inflation. Recall from Proposition 1 that a benevolent policymaker with commitment and without distributional concern would set $\alpha = 0$ and optimally equalize distortions and welfare losses across the population and over time. Here, without commitment and with distributional conflicts - reflected by the majority voting protocol, progressive labor taxation allows policy to implement a similar allocation, in the sense that the inflation bias is contained and the burden of policy distortions is distributed more evenly over time.

Finally, note that for a given generation, life-time welfare is higher under the conflictual political decision protocol than under benevolent discretionary policymaking (Proposition 1). Indeed, the choice of progressivity under both decision processes satisfies the same welfare criterion (25). In addition, the political protocol could set the same policy instruments (no progressivity, maximum inflation bias) but selects instead policy with progressive labor taxes to reduce the inflation bias: redistributive conflicts motivate the introduction of progressive labor taxes that enhance lifetime welfare under a lack of commitment.

5 Commitment and Insurance Channels of Progressivity

The analysis has been conducted so far in a stylized environment, to isolate the distinctive forces that determine the commitment channel of progressivity against discretionary monetary policy. The literature emphasizes usually the role played by progressive fiscal policy as partial insurance against idiosyncratic productivity risk, e.g., Conesa and Krueger (2006) and Heathcote, Storesletten, and Violante (2017). This section introduces incomplete markets and idiosyncratic productivity risk to study the interplay of these channels. The analysis highlights that progressive fiscal policy enhances welfare, through a reduction in the inflation bias and a decrease in the cross section inequality of consumption.

5.1 Adjustments to the model

The environment is in all respects similar to the one introduced in Section 2, at the exception of the following additional elements.[26] First, agents are exposed between young and old age to idiosyncratic productivity shocks, that satisfy the following process:

$$\log(z_o) = (1 - \rho)\log(\bar{z}) + \rho \log(z_y) + \varepsilon, \tag{26}$$

where $\varepsilon \sim \mathcal{N}(0, \sigma_\varepsilon^2)$. This feature generates a non-trivial joint distribution of labor productivity and nominal wealth, reflected by the cumulative distribution function $F(z_o, z_y)$ over old-age population. Individual

[26] An exhaustive presentation is available in Appendix 5, including formal definitions of policy regimes.

preferences are modified to account for risk aversion and plausible behavioral reactions to policy decisions:

$$\beta E_{z_o|z_y}\left[\frac{c_o^{1-\sigma}}{1-\sigma}-\chi\frac{n_o^{1+\frac{1}{\kappa}}}{1+\frac{1}{\kappa}}\right]-\chi\frac{n_y^{1+\frac{1}{\kappa}}}{1+\frac{1}{\kappa}}, \tag{27}$$

where κ is the commonly defined Frisch elasticity of labor supply, and χ pins down the disutility of labor. Under this specification, young age money demand is motivated by wealth accumulation and insurance against productivity shocks. Finally, the government budget constraint features a lump-sum transfer t:

$$t+g=\lambda\int_{z_o,z_y}\left(z_o n_o(z_o,z_y)\right)^{1+\alpha}dF(z_o,z_y)+(1-\tilde{\pi})\int_{z_o,z_y}\phi(z_0,z_y)dF(z_o,z_y) \tag{28}$$

where $n_o(z_o,z_y)$ and $\phi(z_o,z_y)$ are the endogenous labor supply and money holding of individuals with productivity history z_y, z_o.

5.2 Numerical Solution and Results

To generate plausible behavioral reactions to taxes, the model is calibrated to match standard moments for the U.S. economy, when policy choices are made by a benevolent policymaker under a lack of commitment. Table 1 reports numerical parameters and moments.

Table 1: Calibration

Parameter		**Value**	**Source / Target**
Preferences			
β	discount factor	0.96	Annual frequency
σ	coefficient risk aversion	2	Fixed
χ	disutility labor	10.36	Average hours worked = 1/3
κ	Frisch elasticity	0.72	Chetty and al. (2011)
Productivity			
$\bar{z}$	average productivity	1	Normalization
ρ	persistence	0.96	Conesa and Krueger (2006)
σ_ϵ	variance	0.169	U.S. Market GINI = 0.48
Government			
α	progressivity	0.499	U.S. After Tax GINI = 0.36
g	pure governement expenses	0.11	U.S. public consumption = 15%
t	pure governement tranfers	0.05	U.S. public transfer = 7%

Given the parsimonious OLG structure of the model, the numerical solution delivers exact policy functions, both for private agents and the government. Table 2 reports steady-state outcomes, under commitment and discretion, for different values of fiscal progressivity α. It also reports economic outcome when the fiscal-monetary policy mix is decided under majority voting.

Numerical results isolate the insurance channel of progressive labor taxes, highlight the time inconsistency of monetary policy, and the effectiveness of progressive fiscal policy to curb welfare losses under monetary discretion. Columns 1 and 2 presents equilibrium outcomes under commitment: progressive labor taxes provides insurance against idiosyncratic shocks, hence increase welfare and decrease the dispersion of con-

Table 2: Equilibrium Policy Regimes

	Commitment		**Discretion**		**Majority Voting**	
	(1)	(2)	(3)	(4)	(5)	(6)
Progressivity α	0	0.499	0	0.499	0	0.499
Lifetime Welfare	1 (n)	1.008	0.729	1.003	0.729	0.996
Dispersion Welfare	1 (n)	0.951	2.271	1.019	2.271	1.069
Inflationary finance	0.507	0.575	0	0.706	0	0.780
Gini coef. pre-tax income	0.49	0.466	0.486	0.475	0.486	0.478
Gini coef. after-tax income	0.417	0.355	0.431	0.389	0.431	0.403
Effective progressivity	0.169	0.255	0.131	0.198	0.131	0.173
Average hours worked	0.339	0.332	0.257	0.333	0.257	0.333
Output	0.741	0.727	0.562	0.73	0.562	0.729
Gini coef. wealth	0.496	0.522	NaN	0.518	NaN	0.519
Gini coef. consumption	0.441	0.418	0.431	0.425	0.431	0.429

(n): normalization.

sumption. Column 3 presents outcome under a lack of commitment without progressive labor taxes: the incentives to rely on inflationary finance generates a collapse of money demand, a decrease in average welfare and a sharp increase in the dispersion of welfare. In contrast, discretionary policy choices with fiscal progressivity $\alpha > 0$ contains the inflation bias and provide valuable insurance against productivity shocks (column 4). If policy choices were instead made under majority voting, the lack of fiscal progressivity generates an inflationary bias similar to policy discretion (columns 3 and 5). In contrast majority voting under fiscal progressivity yields an equilibrium outcome comparable to policy discretion with progressity (columns 4 and 6). These elements confirm the qualitative equivalence between policy choices by a planner with a concern for the distribution of consumption and the political majority voting protocol.[27]

Finally, as reported in Appendix C.3, the model is used to conduct sensitivity analyses related to the incomplete market nature of the economy and the policy-making environment. The more persistent and volatile idiosyncratic shocks are, the more effective progressive labor taxes are to limit the inflation bias. Similar conclusions apply to lower lump-sum transfers or policymakers' higher inequality aversion. In other words, the higher the need and desire to redistribute consumption, the more effective progressive fiscal policy is in containing the excesses of monetary discretion.

6 Conclusions

This paper studies how the design of progressive fiscal policy can address the time inconsistency of monetary policy. The political game stresses that progressive labor taxes generate redistributive conflicts that mitigate the inflation bias. In this context, progressive labor taxes are desirable, despite the distortionary costs they impose on the economy. Progressive labor taxes achieve several objectives: they reduce consumption dispersion, provide insurance against income risk and mitigate the credibility deficit of monetary policy.

[27] This equivalence motivated the structure of the analysis that distinguished efficiency (Section 3) and redistributive conflicts proxied by majority voting (Section 4).

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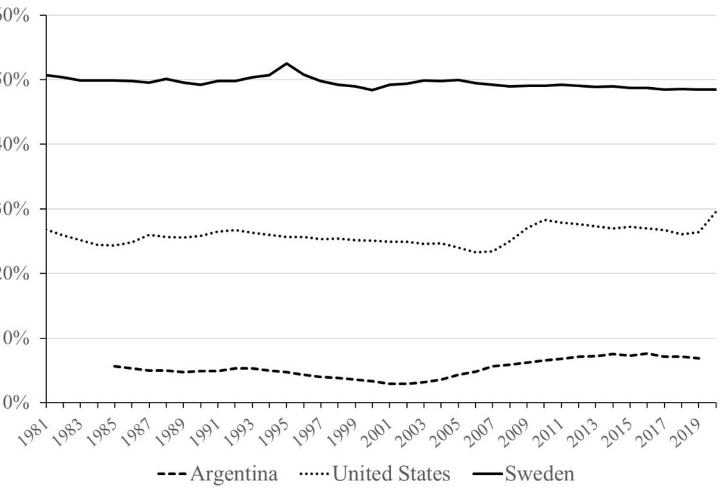
Appendix

A Inertia in redistributive fiscal structure

The Standardized World Income Inequality Database (SWIID) provides a panel dataset of fiscal redistribution across countires: it reports comparable estimates of inequality statistics, and associated measures of absolute redistribution (the difference between the market-income and net-income Gini indices) and relative redistribution (the percentage by which market-income inequality is reduced). These variables are used to measure the redistributive structure of fiscal policy P_{it}, in country i for year t: it accounts for the effect of fiscal taxes and social transfers on the absolute and relative reduction of income inequality.[28]

As suggested in Figure 5 for selected countries, there is a strong time-invariant country-specific dimension in fiscal redistribution. This intuition is confirmed in Table 3, which reports the share of variance in absolute and relative redistribution Y_{it} explained by a simple linear country fixed-effect model: $Y_{it} = \sum_{i=1}^{N} \beta_i C_i + \epsilon_{it}$. Country dummies $\{C_i\}$ can account for 98% of the total dispersion in relative redistribution, 97% when the sample is restricted to OECD countries. In contrast, similar regressions with market-income Gini as dependent variable yield adjusted R-squared of 85% for the whole sample and 75% when restricted to OECD countries. These results suggest that fiscal redistribution is a strong country-specific attribute, despite variations in market income inequality over time. This insight is motivating a central assumption of the modeling strategy, namely *tax-inertia* in fiscal progressivity, which is an essential component of redistributive policies.

Figure 5: Inertia in Redistributive Fiscal Structures



The figure represents the variable *relative redistribution* for selected countries. It is computed as the percentage change in market- and net-income Gini coefficients. It reflects the reduction in inequality induced by labor taxes and social transfers. Data: SWIID.

[28]For details about the SWIID and its construction, see Solt (2016).

Table 3: Adj. R2 for Country Fixed Effects Regressions

	All countries			OECD countries		
Sample years	1981 - 2021	1981 - 2001	2001 - 2021	1981 - 2021	1981 - 2001	2001 - 2021
Market income Gini	0.857	0.943	0.926	0.756	0.868	0.918
Relative redistribution	0.988	0.994	0.94	0.973	0.987	0.989
Absolute redistribution	0.974	0.987	0.991	0.938	0.970	0.978
# countries	70	70	70	38	38	38

The table reports the variance in market-income Gini and fiscal redistribution explained by country fixed effect: $\mathrm{Y}_{it} = \sum_{i=1}^{N} \beta_i C_i + \epsilon_{it}$. Data: SWIID.

B Robustness

This Appendix discusses how results generalize to the introduction of intergenerational heterogeneity, *ex-post* cost of inflation and richer asset structure.

B.1 Intergenerational heterogeneity

By construction, the analysis focuses on the effect of intragenerational conflicts on monetary and fiscal choices. This section discusses how results generalize if one accounts for multiple generations and intergenerational heterogeneity. Consider a generic distribution $(z_{ij}, m_{ij}) \sim \phi(i,j)$ of labor productivity z_{ij} and money holding m_{ij}, where j is the cohort to which agent i belongs. For instance, one could contemplate a stylized three cohorts life cycle profile presented in Table 4, that reflects intergenerational productivity and wealth heterogeneity.

Table 4: Illustrative life cycle heterogeneity

	generation j	productivity z_{ij}	nominal holding m_{ij}
young	1	low	low
middle age	2	high	medium
old	3	medium	high

The following developments build on the analysis presented in Section 4 and discusses how the introduction of intergenerational heterogeneity interacts with the *tax distortion* and *tax shifting* effects to shape redistributive conflicts, individual policy preferences and eventually economic outcomes.

Every period, an agent i that belongs to a cohort j, with productivity z_{ij} and nominal holding m_{ij} supply labor n_{ij}, consume c_{ij} and derive utility according to:

$$u(c_{ij}, n_{ij}) = c_{ij} - \frac{n_{ij}^2}{2}. \tag{B.1}$$

Her budget constraint is:

$$c_{ij} = z_{ij}n_{ij} - \lambda(z_{ij}n_{ij})^{1+\alpha} + m_{ij}\tilde{\pi} - m_{i,j+1}, \tag{B.2}$$

where $m_{i,j+1}$ is next period real money holding. When expressing preferences over policy intruments, all agents in this economy face a trade-off between distortionary labor taxes, with possible differing incidence if $\alpha > 0$, and collecting resources from the inelastic aggregate monetary tax base Φ_{-1} through the inflation tax. In addition, agents belonging to different cohorts now consider as well the relative exposure to labor taxes and inflationary finance, induced by relative differences in productivity z_{ij} and money holding m_{ij}. To illustrate this dimension, consider the following policy protocol. Every period, a vote takes place to choose a contemporaneous level of labor taxes λ and inflation tax $\tilde{\pi}$ given the level of fiscal progressivity $\alpha \geq 0$, to satisfy the government budget constraint:

$$\underbrace{\int_{i,j} \lambda(z_{ij}n_{ij})^{1+\alpha}\phi(i,j)dij}_{=T(\alpha,\lambda)} + \Phi_{-1}(1-\tilde{\pi}) = g, \tag{B.3}$$

where $\Phi_{-1} = \int_{i,j} m_{ij}\phi(i,j)dij$ is aggregate real money holding. Note that given the sequential nature of the vote, money demand $m_{i,j+1}$ is independent of current policy choices.[29] Accordingly, agents rank policy alternatives $\{\lambda, \tilde{\pi}\}$ according to value function (5), which depends on current productivity z_{ij}, individual m_{ij} and aggregate money holding Φ_{-1}:

$$V(z_{ij}, m_{ij}) = y(z_{ij}, \alpha, \lambda) - \lambda\big(y(z_{ij}, \alpha, \lambda)\big)^{1+\alpha} - \frac{\big(y(z_{ij}, \alpha, \lambda)/z_{ij}\big)^2}{2} + m_{ij}\tilde{\pi}, \tag{B.4}$$

where $y(z_{ij}, \alpha, \lambda) = z_{ij}n(z_{ij}, \alpha, \lambda)$ that satisfies (4) is the production decision of agent i, j exposed to fiscal plans (α, λ). The derivative of this function with respect to λ outlines individual exposure to policy trade-offs. Using the envelope condition, it writes:

$$\frac{dV(z_{ij}, m_{ij})}{d\lambda} = -\frac{\partial\tau(z_{ij}, \alpha, \lambda)}{\partial\lambda} - m_{ij}\frac{d\tilde{\pi}(\alpha, \lambda, \Phi_{-1})}{d\lambda}, \tag{B.5}$$

where $\tau(z_{ij}, \alpha, \lambda) = \lambda\big(y(z_{ij}, \alpha, \lambda)\big)^{1+\alpha}$. Introducing the government budget constraint:

$$\frac{dV(z_{ij}, m_{ij})}{d\lambda} = -\big(z_{ij}n(z_{ij}, \alpha, \lambda)\big)^{1+\alpha} + \frac{m_{ij}}{\Phi_{-1}}\frac{dT(\alpha, \lambda)}{d\lambda}. \tag{B.6}$$

As in (19), this expression highlights how *tax distortions* and *tax shifting* effects shape the policy preferences of agent i, j. In contrast though, the relative strength of these effects is now sensitive to the relative magnitude of productivity z_{ij} to nominal holdings m_{ij}:

- if $m_{ij} = \frac{z_{ij}^2}{E(z_{ij}^2)}\Phi_{-1}$ is proportional to z_{ij}^2 as in (8), then Lemma 4 applies: agent i, j supports labor taxes if and only if $\alpha > 0$ and $z_{ij} < \bar{z}(\alpha)$ where $\bar{z}(\alpha)$ is an endogenous cut-off of the productivity distribution z_{ij}.
- if instead $m_{ij} > \frac{z_{ij}^2}{E(z_{ij}^2)}\Phi_{-1}$, then agent i, j is relatively more exposed to inflationary finance, and would support relatively more labor income taxes. For instance, consider the case $\alpha = 0$, then the bliss level

[29] In other terms, the purpose of this section is to investigate the implications of a general distribution of productivity and nominal holding, not to rationalize a particular distribution.

of labor taxes λ^*_{ij} satisfies:

$$\frac{1-\lambda}{1-2\lambda} = \frac{m_{ij}}{z_{ij}^2}\frac{E(z_{ij}^2)}{\Phi_{-1}}. \tag{B.7}$$

Since the left hand side is increasing in $\lambda \in (0, 1/2)$, an increase in relative money holding $\frac{m_{ij}}{z_{ij}^2}$ is associated to an increase in the desire to raise labor income taxes. This effect works in addition to the implications of fiscal progressivity $\alpha > 0$ established in Lemma 4: a relatively low productivity level $z_{ij}^2/E(z_{ij}^2)$ increases the individual desire for labor income taxes.

Overall, individual preferences for the monetary fiscal policy mix under inter- and intragenerational conflicts reflects three distinctive forces: the attractiveness of collecting resources from the inelastic money tax base, the tax shifting effect when $\alpha > 0$ and the relative nominal exposure m_{ij}/z_{ij}^2.

To illustrate possible implications, consider the stylized life-cycle distribution presented in Table 4 with $\alpha > 0$: the young supports labor taxes to benefit from tax-shifting at the expense of the middle age and the old, the middle age are leaning toward inflationary finance to preserve their earning potential, while the old reject inflationary finance to preserve the real value of nominal holding, hence support labor taxes. Importantly, the commitment channel of progressive labor taxes is still operative through the tax shifting effect.

B.2 Ex post Costs of Inflation

The model includes costs of *ex ante* inflation through the effect of expected inflation on young agents' money demand. Moreover, "unanticipated" inflation creates both costs and benefits. The benefits are at the heart of the mechanism studied in this paper: "unanticipated" inflation reduces distortionary labor taxes and thus increases output and consumption. The costs arise from the taxation of money holding.

The literature has proposed possible additional costs of inflation: price dispersion, consumption distortions or bracket creep are prominent examples. Consider the following additional term to individual agents' value functions:

$$\mathcal{C}(z, \tilde{\pi}) = \psi(z)\frac{(1-\tilde{\pi})^2}{2}, \tag{B.8}$$

where $\psi(z)$ captures a possible agent specific component. Note that if $\psi(z)$ is type-invariant, then the cost of inflation falls equally on all agents, independent of their productivity or money holding.

This additional feature does not substantively change the characterization of policy plans absent concerns for redistribution (Section 3, Proposition 1). First, the individual demand for money (7) and the relative distribution across the population (8) is not affected by the introduction of this term. Second, the policymaker is not interested in the distribution of the cost of inflation (B.8) across the population, only its average $\Psi = \int_z \psi(z)dF(z)$. Both under commitment or discretion, if labor taxes are raised, efficiency prescribes no progressivity, and there is an inflation bias under policy discretion.[30] The relative share of inflation tax to

[30] The same logic as in Lemma 1 applies. By contradiction, suppose labor income taxes are progressive. Then one can keep the total level of fiscal revenue unchanged and increase welfare by setting $\alpha = 0$.

labor income tax revenue is decreasing in Ψ though.

How do these additional costs of inflation modify the political economy analysis of Section 4? Key is to understand the influence of these additional costs (B.8) on the redistributive conflicts induced by progressive labor taxes across the population. Formally, equation (18) that characterizes bliss policies $\lambda^p(z, \Phi_{-1})$ reads:

$$\frac{d\tilde{V}_o(z, \alpha, \Phi_{-1}, \lambda)}{d\lambda} = -\frac{\partial \tau(\cdot)}{\partial \lambda} + \left[\phi(z, \Phi_{-1}) + \psi(z)\big(1 - \tilde{\pi}(\cdot)\big)\right] \frac{d\tilde{\pi}(\cdot)}{d\lambda}, \tag{B.9}$$

where $\tilde{\pi}(\cdot)$ is the inflation rate associated with a money printing rate σ that clears the government budget constraint given $\big(\lambda, \alpha, \Phi_{-1}\big)$. This expression provides a decomposition of the sensitivity of value functions to labor taxes into *distortions* vs. *tax-shifting* effects, as in (19). The presence of additional costs of inflation actually mitigates the willingness to rely on the inflation tax, but it does not change the strategic conflicts induced by progressive labor taxes. For instance, if $\psi(z)$ is proportional to relative money holding, then the decreased appetite for the inflation tax is constant across the population.[31] If the cost is constant across the population, then generating inflation is relatively more costly for low productivity agents, which reinforces the *tax-shifting* effect discussed in Lemma 3. Accordingly, young agents that choose progressivity behind a veil of ignorance value the reduction in the inflation bias provided by progressive labor taxes.

Overall, the presence of additional costs of inflation restrains the inflation bias, but both the *tax-shifting* effect redistributing consumption across the population and the beneficial *dynamic incentives* are still operative.

B.3 Asset Structure

In the model, only money is available as a store of value, whereas, arguably, households have access to greater range of assets. Whether this feature is a relevant approximation requires to assess if indeed low income households are more exposed to inflation.

Albanesi (2007) reviews evidence that supports this intuition: the cross-sectional distribution of currency holdings and transaction patterns by income level, as well as survey evidence on the perceived costs of inflation, strongly suggest that low income households are more exposed to inflation. In other terms, these elements support the view that the rich are better able to protect themselves against the effects of inflation than the poor. In particular, relatively richer agents are more likely to have access to financial instruments that hedge against inflation, while the portfolios of the poor are likely to have a larger share of cash.

This heterogeneity can be captured in the present framework with the introduction of a fixed cost to participating to asset markets and investing in real securities, such as stocks. As in Camous and Cooper (2019), such a feature sorts agents in two groups: rich agents pay the costs and invest in securities providing a hedge against inflation, while poor agents hold money and are exposed to the inflation tax. This sorting strengthens the structure of policy conflicts studied in Section 4, since inflation hurts money holders at the lower end of the income distribution. The unanimity for progressive labor taxes would hold if all agents were exposed to the credibility problem of monetary policy.

[31] Suppose $\psi(z) = \frac{z^2}{E(z^2)}c$, then (B.9) rewrites: $\frac{d\tilde{V}_o(\cdot)}{d\lambda} = -\frac{\partial \tau(\cdot)}{\partial \lambda} + \frac{z^2}{E(z^2)}\left[\Phi_{-1} + \big(1 - \tilde{\pi}(\cdot)\big)c\right]\frac{d\tilde{\pi}(\cdot)}{d\lambda}$, so that variation in inflation modifies uniformly the welfare effect of *tax-shifting* across the population.

Overall, an environment with a richer asset structure would deliver similar results because all nominal assets except money provide a hedge against average inflation. A diversified portfolio would then only reduce the relative exposure of rich agents to anticipated inflation in equilibrium, because it would be tilted toward these assets rather than cash.

C Numerical analysis

This appendix details the numerical analysis presented in Section 5. The monetary-fiscal environment is embedded in a standard incomplete market economy, where individual productivity is subject to idiosyncratic shocks.

The objective is twofold. First to verify that the political protocol is qualitatively equivalent to the policy choices of a benevolent policymaker with explicit redistributive concern. Second, if agents experience productivity shocks over their life cycle, are progressive labor taxes still desirable and effective in curbing the inflation bias?

This extension confirms the capacity of fiscal progressivity to curb the inflation bias, under a plausible calibration. As in Conesa and Krueger (2006), progressive labor tax plays a partial role of insurance against negative income shocks at the cost of tax distortions. The novelty of the analysis is to highlight that it contributes in addition to mitigate the welfare losses from monetary discretion. The numerical exercises show these losses have two sources, stemming from the standard aggregate inflation bias and an increase in the cross-section inequality of consumption.

C.1 Adjustments to the model

The environment is in all respect similar to the one introduced in Section 2, at the exception of the following modifications. First, agents are exposed to uninsurable productivity shocks. Productivity from young to old age evolves according to the following process:

$$\log(z_o) = (1-\rho)\log(\bar{z}) + \rho\log(z_y) + \epsilon, \tag{C.1}$$

where $\epsilon \sim \mathcal{N}(0, \sigma_\epsilon^2)$. This feature generates a non-trivial joint distribution of labor income and nominal wealth. Individual preferences are modified to account for uncertainty and to allow plausible behavioral reactions to policy decisions:

$$\beta E_{z_o|z_y}\left[\frac{c_o^{1-\sigma}}{1-\sigma} - \chi\frac{n_o^{1+\frac{1}{\kappa}}}{1+\frac{1}{\kappa}}\right] - \chi\frac{n_y^{1+\frac{1}{\kappa}}}{1+\frac{1}{\kappa}}, \tag{C.2}$$

where κ is the commonly defined Frisch elasticity of labor supply, and χ pins down the disutility of labor. Note $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$ and $g(n) = \chi\frac{n^{1+\frac{1}{\kappa}}}{1+\frac{1}{\kappa}}$. In this set up, young age labor supply is driven by two forces: wealth accumulation and insurance against future productivity shocks, i.e., a *precautionary motive* for saving.

Formally, labor supply functions are given by:

$$n_y(z_y, \lambda, \alpha, \tilde{\pi}) : \qquad z_y(1-\tilde{\pi}) \int_{z_o|z_y} u'(c_o) dF(z_o|z_y) - g'(n_y) = 0, \tag{C.3}$$

$$n_o(z_o, m, \lambda, \alpha, \tilde{\pi}) : \qquad z_o\big[1 - \lambda(1+\alpha)(z_o n_o)^{\alpha}\big] u'(c_o) - g'(n_o) = 0. \tag{C.4}$$

Finally, the government is running different social programs, captured by a lump-sum transfer t. The government budget constraint rewrites:

$$t + g = \lambda \int_{z_o, z_y} \big(z_o n_o(\cdot)\big)^{1+\alpha} dF(z_o, z_y) + (1-\tilde{\pi}) \int_{z_o, z_y} \phi(\cdot) dF(z_o, z_y) \tag{C.5}$$

A policymaker chooses policy instruments $(\lambda, \tilde{\pi})$ under commitment or discretion, taking progressivity α as given. The welfare objective is a steady-state measure of population's utility, as defined in Section 3.

Policy Plan under Commitment The benevolent policymaker maximizes the intertemporal welfare of a given generation:

$$\max_{\lambda, \tilde{\pi}} \int_{z_y} \beta \int_{z_o|z_y} \big(u(c_o) - g(n_o)\big) dF(z_o|z_y) - g(n_y) dF(z_y), \tag{C.6}$$

subject to individual policy functions (C.3), (C.4), and the government budget constraint:

$$\int_{z_y} \Big(\int_{z_o|z_y} \lambda \left(z_o n_o(\cdot)\right)^{1+\alpha} dF(z_o|z_y) + (1-\tilde{\pi}) z_y n_y(\cdot) \Big) dF(z_y) = g + t. \tag{C.7}$$

Policy Plan under Discretion Given $\mathcal{S} = \big(\{\phi(z_y, z_o)\}, \alpha\big)$, a benevolent policymaker under discretion solves:

$$\max_{\lambda, \tilde{\pi}} \int_{z_y} \int_{z_o|z_y} u(c_o) - g(n_o) dF(z_o|z_y) dF(z_y), \tag{C.8}$$

subject to C.4 and the government budget constraint:

$$\int_{z_o, z_y} \Big(\lambda \big(z_o n_o(\cdot)\big)^{1+\alpha} + (1-\tilde{\pi}) \phi(z_y, z_o) \Big) \, dF(z_o, z_y) = g + t. \tag{C.9}$$

An equilibrium is computed as a fixed point between stationary policy choices $(\lambda, \tilde{\pi})$ and the distribution of money holding $\{\phi(z_y, z_y)\}$ that reflects these policy choices. Individual money demand and the inflation rate lie on the upward sloping part of the seigniorage Laffer curve.

Policy Plan under Majority Voting Given $\mathcal{S} = \big(\{\phi(z_y, z_o)\}, \alpha\big)$, individual agents with productivity history z_y, z_o form preferences over a set of policy choice $(\lambda, \tilde{\pi})$ that satisfy the government budget constraint (C.9). Competing policy platforms are subject to electoral competition. The winning platform is the median voter bliss policy mix. An equilibrium is then a fixed point in the distribution $\{\phi(z_y, z_o)\}$, where individual money choices and aggregate real money balances are consistent with the policy platform that wins majority voting.

C.2 Calibration and Numerical Solution

Given the parsimonious nature of the model, the calibration is illustrative. Still, to generate plausible behavioral reactions to taxes, I calibrate the model according to standard practice for the U.S. economy, e.g., Conesa and Krueger (2006), Conesa, Kitao, and Krueger (2009), Holter, Krueger, and Stepanchuk (2019), Heathcote, Storesletten, and Violante (2017). Some parameters are directly specified while others are jointly chosen to match key statistics about inequality and redistribution.

Table 1 reports calibrated parameters and associated moments. The productivity process is discretized into a 7 state Markov chain using the method developed by Tauchen (1986). Calibrated parameters are derived from moments obtained when policy choices are made under discretion. Moments are standard, except for "effective progressivity". One needs to distinguish between the progressivity α of the tax schedule, and the empirical progressivity of taxes, which reflects both progressivity α and the behavioral response of agents. Following the definition in Heathcote, Storesletten, and Violante (2017) and Holter, Krueger, and Stepanchuk (2019), it is computed within the model as:

$$\int_{z_o,z_y} \frac{T'(y) - T(y)/y}{1 - T(y)/y} dF(z_o, z_y), \tag{C.10}$$

where $T(y) = \lambda y^{1+\alpha} - t$ and $y \equiv y(z_o, z_y, \alpha, \lambda, \tilde{\pi}, t)$. Overall, the calibration matches pretty well some key empirical statistics. It might overestimate the effective progressivity of the tax schedule, even though there is substantial uncertainty about its exact empirical value, due to the multidimensionality of tax codes.

With a parsimonious OLG structure, the algorithm delivers exact policy functions, both for private agents and the government. Table 2 reports steady-state outcomes, under commitment, discretion and majority voting, for different values of progressivity α.

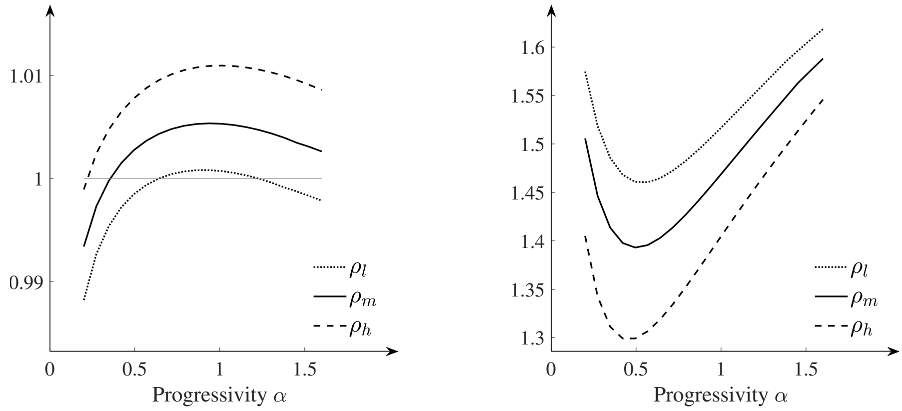
C.3 Incomplete markets, progressivity and inflation bias

How much *dynamic incentive* is provided by progressive labor taxes in an incomplete market economy? In an environment with non-trivial wealth-labor income distribution, the willingness to redistribute consumption depends on the underlying nature of idiosyncratic shocks. Similarly, the attractiveness of the seigniorage tax base depends on its size, i.e., on the strength of the precautionary motive for saving.

Figures 6 to 10 (and Table 5) reports comparative static exercises for selected parameters. The left panel represents welfare under discretion as a function of progressivity, relative to welfare under commitment with no progressivity. The right panel reports the intensity of the inflation bias, against a similar benchmark of commitment with no progressivity. These exercises cast light on the redistributive opportunity provided by progressive labor taxes to contain the inflation bias.

Persistence in individual productivity ρ is a key parameter that determines the joint distribution of income and wealth (Figure 6). The more persistent individual productivity is, the higher the wealth - labor income correlation. The induced inequality in consumption motivates the willingness of the government to

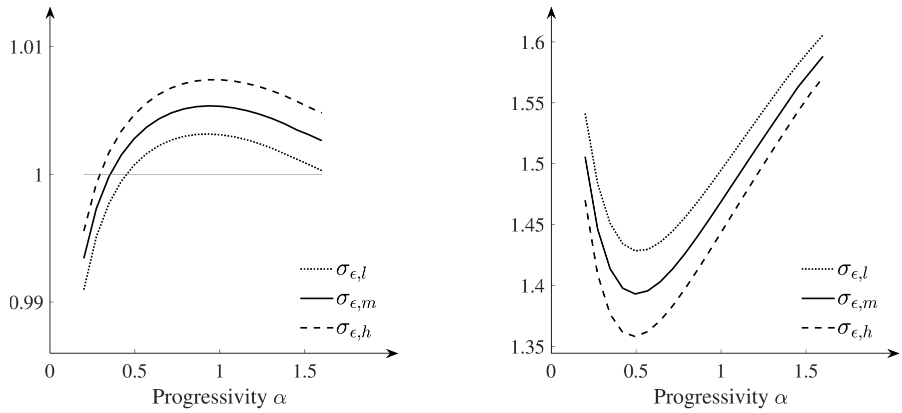
Figure 6: Comparative Static w.r.t. Persistence ρ



(a) Relative Welfare (b) Inflation Bias

$\rho_l = \rho \times 0.99 \; < \rho_m = \rho \; < \rho_h = \rho \times 1.1.$

Figure 7: Comparative Statics w.r.t. Variance σ_ϵ



(a) Relative Welfare (b) Inflation Bias

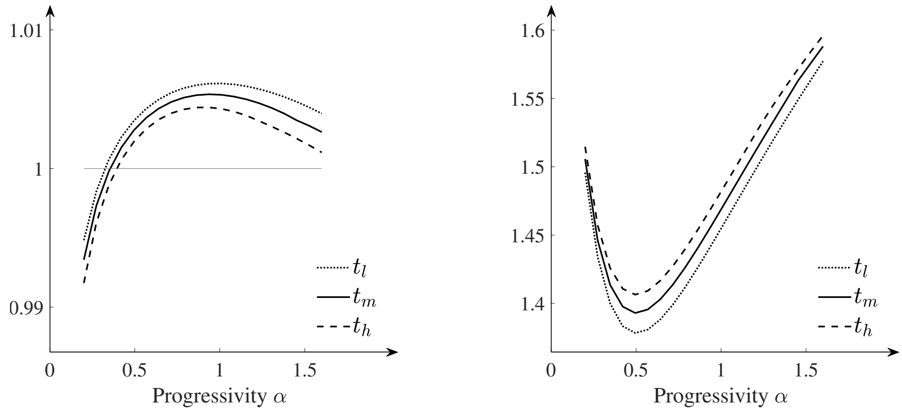
$\sigma_{\epsilon,l} = \sigma_\epsilon \times 0.95 \; < \sigma_{\epsilon,m} = \sigma_\epsilon \; < \sigma_{\epsilon,h} = \sigma_\epsilon \times 1.05.$

redistribute consumption, and hence to rely on labor income taxes to finance public spending and transfers. Further, lower individual risk curbs the precautionary motive for saving and the aggregate money tax base, which turns a less attractive source of public income.

Similar logic explains the influence of lump-sum transfers t (Figure 8) and discount factors β (Figure 10). Lump-sum transfers are redistributive per se, so that higher transfers reduce the willingness to rely on the labor income tax base, making it harder for progressivity to contain the inflation bias. The higher the discount factor, the higher the money tax base, hence the more effective are progressive labor taxes to enhance welfare and mitigate the inflation bias.

As established in Section 4.2, agents' heterogeneity is essential for positive labor taxes to be raised in equilibrium. Intuitively, the larger the inequality in individual productivity, the higher the willingness to redistribute, but also the more effective the *tax-shifting* effect is in collecting public resources. This intuition

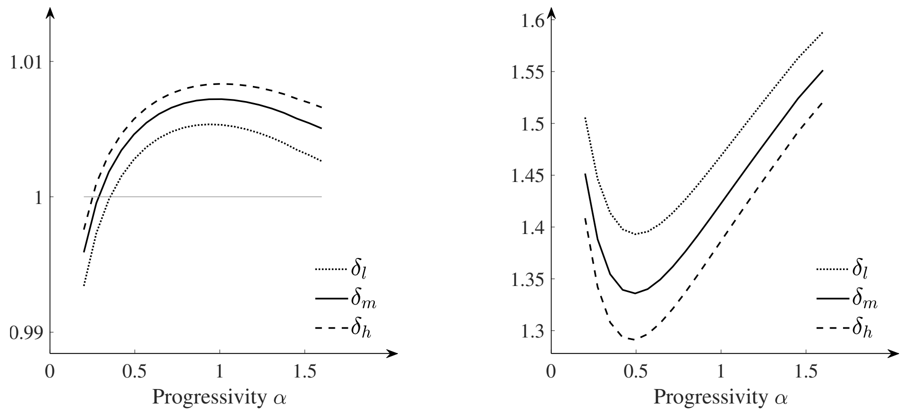
Figure 8: Comparative Statics w.r.t. Lump-sum Transfer t



(a) Relative Welfare (b) Inflation Bias

$t_l = t \times 0.9 \ < t_m = t \ < t_h = t \times 1.1$

Figure 9: Comparative Statics w.r.t. Inequality Aversion δ



(a) Relative Welfare (b) Inflation Bias

$\delta_l = 0 \ < \delta_m = 0.1 \ < \delta_h = 0.2$

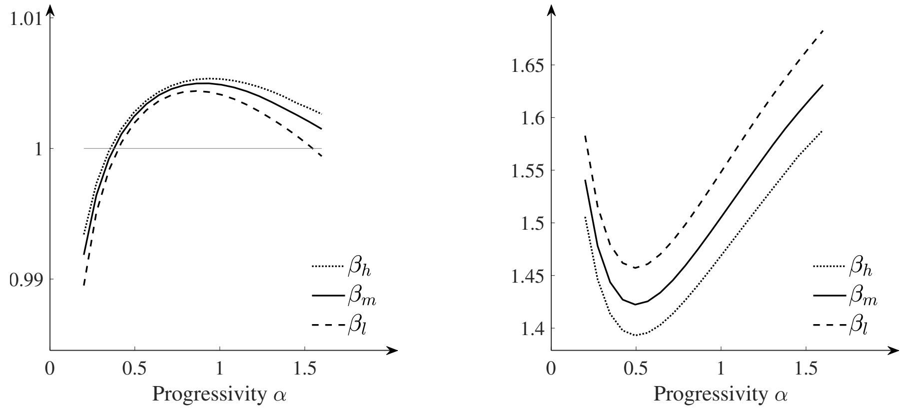
is confirmed in Figure 7, which contrasts performance for different variance in productivity innovation σ_ϵ. Larger dispersion in labor income leads to higher desire and effectiveness in raising labor taxes, hence mitigates the inflation bias and improves intertemporal welfare of the economy.

Finally, to confirm the role of the redistributive motive driving government's choices, Figure 9 contrasts three values of an inequality aversion parameter δ, which enters the program of the government as follow:

$$\max_{\lambda,\pi} E\big(V_o(\cdot)\big) - \delta V\big(V_o(\cdot)\big). \tag{C.11}$$

An increase in inequality aversion tilts policy choices toward labor taxes and further contribute to contain the inflation bias.

Figure 10: Comparative Statics w.r.t. Discount Factor β



(a) Relative Welfare

(b) Inflation Bias

$\beta_l = 0.76 \; < \beta_m = 0.86 \; < \beta_h = 0.96$

Table 5: Compartive Statics - Overview

(a) Idiosyncratic Productivity

	Calibrated economy	Persistence		Variance	
		ρ_l	ρ_h	$\sigma_{\epsilon,m}$	$\sigma_{\epsilon,h}$
α^*	0.944	0.904	1.003	0.923	0.965
Welfare	1.005	1.000	1.011	1.003	1.007
Dispersion	1.006	1.025	0.986	1.016	0.997
Share seign.	0.739	0.759	0.715	0.748	0.730

(b) Government Policy

	Calibrated economy	Lump-sum trans.		Ineq. aversion	
		t_l	t_h	δ_l	δ_h
α^*	0.944	0.984	0.904	0.980	1.011
Welfare	1.005	1.006	1.004	1.007	1.008
Dispersion	1.006	1.003	1.010	0.990	0.977
Share seign.	0.739	0.737	0.740	0.719	0.704

This table reports the numerical performance of the model at the optimal level of progressivity under different parameter values. The optimal level of progressivity is increasing when the underlying parameters call for a higher need or desire to redistribute consumption in the economy.