Commitment versus Discretion
in a Political Economy Model of
Fiscal and Monetary Policy Interaction

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Job Market Paper

Abstract Price commitment results in lower welfare. I explore the consequences of price commitment by pairing an independent monetary authority issuing nominal bonds with a fiscal authority whose decisions are microfounded by a political economy model. Without price commitment, nominal bonds are backed by a new endogenous form of commitment and can be used for tax smoothing. With price commitment, nominal bonds can be used for tax smoothing and wasteful spending. Price commitment eliminates monetary control over fiscal decisions. The results show that the combination of a politically distorted fiscal authority and an independent monetary authority with nominal bonds and without price commitment is the solution to a constrained mechanism design problem that overcomes time inconsistency and results in the highest welfare.

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1 Introduction

The papers of Kydland and Prescott (1977) and Barro and Gordon (1983) find that price commitment results in higher welfare in models with benevolent fiscal and monetary authorities and nominal bonds. I find the opposite: price commitment leads to lower welfare. I change the assumption of a benevolent fiscal authority by microfounding the fiscal authority with a political economy model. Without monetary control, the politically distorted fiscal authority is free to spend with impunity leading to waste.

Standard models with benevolent fiscal and monetary authorities show welfare gains from price commitment due to the time inconsistency problem of nominal debt. A benevolent monetary authority will inflate away the real value of nominal debt at the start of every period to allow the benevolent fiscal authority to set taxes to their minimum. Anticipating this inflation, consumers won’t hold bonds whose real value will evaporate. Price commitment turns nominal bonds into indexed bonds, eliminating the benevolent monetary authority’s incentive to inflate. The benevolent fiscal authority is then able to increase welfare by using bonds to smooth taxes as shown in Barro (1979).

With benevolent fiscal and monetary authorities, the fiscal authority is unable to issue nominal bonds without price commitment. The benefit of price commitment is stark: no bonds without price commitment versus a benevolent optimal amount of bonds with price commitment. I show in this paper that a politically distorted fiscal authority is able to issue nominal debt without price commitment. The benefit of price commitment in this situation is not as stark: bonds for tax smoothing without price commitment versus bonds for tax smoothing and wasteful spending with price commitment. The benefit must be weighed against the cost: price commitment increases wasteful spending which lowers welfare by allowing a politically distorted fiscal authority to issue more bonds that will eventually require higher taxes to pay off.

In the course of proving the new result for price commitment, this paper gives new answers to two additional questions of monetary policy: why do we have nominal debt, and why is it desirable to have an independent central bank. The analysis shows that

1These papers deal with the time inconsistency problem of nominal debt in models with a Phillips curve rather than directly through the government’s budget constraint. The time inconsistency problem is identical.
nominal debt provides a method for an independent monetary authority to discipline a politically distorted fiscal authority. In return, the politically distorted fiscal authority solves the time inconsistency of nominal debt by anchoring expectations that prevent the monetary authority from monetizing the debt.

Advanced economies are typified by the pairing of a politically distorted fiscal authority and an independent monetary authority. This paper shows that such a pair is efficient. It can be viewed as the result of a constrained mechanism design problem to overcome time inconsistency while limiting any possible political distortion.

I use the political economy model of Battaglini and Coate (2008) to microfound fiscal decisions. Under this model, the government tries to maximize the utility of a subset of the citizens instead of maximizing the utility of the society as a whole. A politically distorted fiscal authority will, when it has enough revenue, spend on private transfers to its coalition rather than on public goods.

An independent monetary authority knows that inflating away the real value of nominal debt will give the politically distorted fiscal authority the freedom to spend revenue on private transfers instead of public goods. Maintaining a positive level of nominal debt constrains wasteful spending, but if debt is too high it requires high distortionary taxes to pay off. Thus a form of endogenous price commitment arises: the independent monetary authority will inflate away some of the debt so that taxes will be lower. It won’t inflate away all of the nominal debt because if it did so the politically distorted fiscal authority would spend the new revenue on wasteful transfers.

Endogenous commitment allows the independent monetary authority to control the spending decisions of the politically distorted fiscal authority. This commitment has two beneficial effects: it alleviates time inconsistency and it limits the power of the political distortion. The pairing of a politically distorted fiscal authority and an independent monetary authority is able to issue nominal bonds which will increase overall welfare when the bonds are used for tax smoothing.

If control of the monetary authority is captured by the politically distorted fiscal authority the economy will be subject to the time inconsistency problem as before. The government won’t be able to issue any nominal debt. Thus central bank independence is key to separate the (benevolent) goals of the monetary authority from the (politically distorted) goals of the fiscal authority.

Forcing the central bank to commit to a price level in advance increases the amount
of nominal bonds that can be issued. This extra revenue will be spent at the discretion of the politically distorted fiscal authority. The benefits of the extra revenue will not outweigh the future increases in taxes that will be necessary to pay off the bonds. Welfare will be lower because of these tax increases.

A monetary union such as the European Union is another form of monetary and fiscal interaction. My paper predicts that a union of homogenous countries can make previously non-trustworthy central banks trustworthy. Countries in such a union will be able to sustain nominal bonds with the same endogenous commitment described previously.

Trouble arises when the monetary union is composed of heterogenous countries. For example, countries heterogenous in size. If the central bank cares only about the large countries in the union, the small countries will act as if they have price commitment. This explains the behavior of Greece. It took advantage of the Eurozone by issuing bonds to fund transfers to the governing coalition. When bad shock hit, Greece had to tax at a punitive rate to fund its previous profligacy.

Central bank independence leads to endogenous commitment. In the terminology of Fischer (1995) this independence is both instrument independence, the monetary authority uniquely controls the price level, and goal independence, the benevolent goal of an independent monetary authority diverges from the goal of a politically distorted fiscal authority. The divergence enables an independent, benevolent monetary authority to better fulfill its objectives than if both it and the fiscal authority were benevolent. The non-optimality of coordination is similar to the benefits Rogoff (1985b) finds a conservative central banker provides to an economy by reducing inflation expectations.

The rest of the paper provides the model and specific comparisons of fiscal policy and price commitment. I review the relevant literature on the subject. Then, following the analysis above, I first show utility with self-interested fiscal policy can be higher than with benevolent fiscal policy. This is due to the availability of bonds for tax-smoothing purposes. Second, price level commitment by the monetary authority is equivalent to issuing real debt. A benevolent fiscal authority can now use bonds to smooth taxes while a self-interested fiscal authority can issue more bonds to fund larger direct transfers. In the former, society is better off, in the latter it is not. Third, I analyze how endogenous commitment and price level commitment respond to technology shocks. Fourth, I show that the results are identical in an infinite
period version of the model. Fifth, I analyze the case of monetary unions. Sixth, I look at how inverting the timing of fiscal and monetary decisions allows a version of the Fiscal Theory of the Price Level (FTPL). Seventh, I examine robustness of the results to adding a cash-in-advance constraint and thus costs to inflation. And finally, I conclude.

2 Literature Review

The benefit of government debt as a way to smooth taxation is originally seen in Barro (1979). Debt provides an intertemporal link between good times and bad times and allows tax rates to remain constant despite variable economic conditions. This will be the positive use of bonds in this model. The revenue raised from bonds will be available for tax smoothing, as well as other more wasteful uses.

Time inconsistency prevents the use of nominal bonds. It is examined in Kydland and Prescott (1977). Time inconsistency specifically of joint monetary and fiscal policy is investigated in Lucas and Stokey (1983) and Barro and Gordon (1983). These papers show that the lump-sum nature of the inflation tax strictly dominates any other revenue generating tax instrument. This creates the incentive for the monetary authority to inflate and with it the time inconsistency problem. I duplicate this result before the introduction of a political distortion. After its introduction, the time inconsistency problem is partially solved.

The benefit of price level commitment as a method of overcoming time inconsistency is investigated in numerous papers. A good overview of results is found in Chari et al. (1991). Price level commitment is in the form of a Ramsey plan: the central bank can choose the price level for all periods in advance ignoring time inconsistency. Price level commitment is shown to increase utility by supporting bonds to smooth taxes. While this is still a use of bond revenue, I show that price level commitment can lead to decreased utility by leading to wasteful spending by the fiscal authority. More bonds requires higher taxes in the future and thus lower overall utility.

Overcoming time inconsistency without explicit exogenous commitment is investigated for various functional forms of utility in Albanesi et al. (2001), Alvarez et al. (2004), and Díaz-Giménez et al. (2008). These papers balance the direct utility costs of inflation with the budget benefits. Persson et al. (1987) starts a literature that uses the term structure of nominal debt to the same effect. I mitigate time inconsis-
tency in a new way founded in the differing goals of monetary and fiscal policy. Time inconsistency still dominates until the utility functions of the two are separated.

The idea that differing utility functions can result in an overall better outcome is the mechanism in Rogoff (1985a). He investigates how differing utility functions can be beneficial in an international context. Countries can cooperate by matching monetary policy moves and hence holding exchange rates constant. This gives a greater incentive to inflate which figures into consumers’ expectations of inflation and leads to actual inflation. If the countries compete, monetary policy is constrained because the negative effects of exchange rate fluctuations dominate gains from inflation. I use a similar dynamic between utility functions to mitigate time inconsistency albeit between monetary and fiscal authorities rather than countries. The basic point that cooperation leads to worse outcomes is similar to the results I obtain.

For monetary unions, Chari and Kehoe (2008) analyze behavior where the individual members attempt to maximize utility functions that are separate, and different, from the utility function of the entire union. This leads to suboptimal outcomes without methods for disciplining members. My paper differs by explicitly microfounding fiscal and monetary decisions, through studying a single country rather than a monetary union, and by the tools available to the fiscal authority.

Martin (2011) investigates what microfounding money in the method of Lagos and Wright (2005) does to price level commitment. He finds that price level commitment no longer has significant effects. I use the cashless limit where money doesn’t appear directly. A version with money and a cash-in-advance constraint as in Lucas and Stokey (1987) is explored as an extension but the results don’t change significantly.

Another analysis of monetary policy is found in Rogoff (1985b). This work sees the advantage in monetary policy having a different utility function from the consumer. By making the central banker more inflation averse than consumers, consumers limit their inflation expectations. An overview of the benefits of a conservative central banker is found in Fischer (1995). Adam and Billi (2008) present a more modern model with independent fiscal and monetary policies built around a conservative central banker. I don’t rely on a conservative central banker (which is equivalent to a form of price commitment). I microfounded the split in utility functions between the monetary and fiscal sides of the economy. The difference is not from exogenous preferences (as with a more conservative central banker) but directly from the effect of political distortion on fiscal policy. Having distinct utility functions for monetary and
fiscal policies provides a similar benefit in limiting consumers’ inflation expectations.

The fiscal policy model used in my paper, and its political distortion, is adapted from a series of papers Battaglini and Coate (2008), and Battaglini et al. (2008). They use an infinite period model with a political distortion from Baron and Ferejohn (1989) in which a subgroup of citizens controls fiscal policy. There is no monetary policy. They show that this model results in debt dynamics that match the broad outlines of modern U.S debt dynamics.

Bohn (1988) explains the role of nominal debt as a hedging device against unexpected shocks. In a recession the government would like to increase spending but would prefer not to raise taxes. Inflation provides real revenues without the distorting effects of taxes. This explains the time inconsistency problem as one of balancing the benefit of hedging against the cost of inflation. Nominal bonds allow hedging but they lead to inflation. My paper endogenizes this result by endogenizing bond choices. Nominal debt is used because it affords the monetary authority limited control over the fiscal authority. This restricts the extent to which the political distortion affects fiscal choices.

The idea that fiscal and monetary policy interact through the government budget constraint is found in Sargent and Wallace (1981). To make the budget constraint hold, the fiscal authority can force the hand of the monetary authority to inflate away bonds or the monetary authority can force the fiscal side to increase revenues. The dynamic is magnified in my paper. The choices of fiscal policy are not static; the amount of spending is a function of debt and current conditions. Monetary choices will constrain the fiscal side by limiting its budget constraint through price level manipulations.

A considerable amount of study of monetary and fiscal interactions has centered on the Fiscal Theory of the Price Level as seen in Leeper (1991). It proposes that the fiscal authority can set the price level by changing the present value of expected future tax revenue and thus how much money consumers expect to be repaid for their bonds. For an overview see Bassetto (2008) or Christiano and Fitzgerald (2000). The default timing I examine, monetary policy setting the price level before the fiscal authority sets tax revenue is roughly analogous to Leeper’s active monetary, passive fiscal regime. I explore the other possibility, fiscal policy moving before monetary policy, in an extension and find that a full Fiscal Theory of the Price Level requires an explicit fiscal commitment as in Schmitt-Grohé and Uribe (2000).
3 The Model

I layout the basic model in two periods to emphasize the intuition. I extend to infinite periods in a later section to show that the main results still hold. Nominal government debt, when sustainable, links the two periods. Fiscal policy consists of setting taxes, expenditure on a public good, direct transfers to citizens, and bond issuance. A real shock hits at the beginning of the second period that determines wages (and the distortion due to taxes). Monetary policy sets the price level in the second period after first period fiscal decisions but before second period fiscal decisions. I investigate changing this timing in a later section. All debt must be paid off in the second period; default is not possible.

To minimize and simplify notation, I set the number of bonds in the first period to 0 and normalize the price level in the first period to 1. I reserve $P$ to denote the monetary authority’s choice of the price level at the start of the second period and $B$ to be the choice of the number bonds issued by the fiscal authority in the first period.

3.1 Consumers

There are $n$ identical consumers, indexed by $i$ when necessary. A consumer’s per period utility function is

$$u(c, g, l) = c + A \frac{g^{1-\sigma}}{1-\sigma} - \frac{l^{1+1/\epsilon}}{\epsilon + 1}$$

and they seek to maximize $U = u(c_1, g_1, l_1) + u(c_2, g_2, l_2)$ where $c$ is a consumption good, $g$ is government spending on a public good, $l$ is labor, and the discount rate $\beta$ has been implicitly set to one. The parameter $\epsilon > 0$ is the Frisch elasticity of labor and $\sigma > 0$ measures the curvature of utility from the public good.

A representative consumer $i$ faces two budget constraints

$$c_1 + qB_n \leq w_1l_1(1-\tau_1) + T_{1,i},$$
$$c_2 \leq w_2l_2(1-\tau_2) + \frac{B_n}{P} + T_{2,i}.$$

In the first period the consumer can consume $c_1$ and purchase nominal bonds $B_n = \frac{B_n}{n}$ at price $q$. Each consumer in the economy holds $B_n$ bonds, $B = nB_n$ is the total amount of bonds the government issues. The consumer’s income consists of labor
income at wage $w$ that is taxed by the government at distortionary tax rate $0 \leq \tau_1 \leq 1$ and direct transfers $T_{1,i} > 0$ from the government. The price level in the first period is normalized to 1 so is not visible in the budget constraint. The second period is identical except new bonds cannot be purchased while old bonds are repaid at the second period price level $P$.

Combining these I derive the equilibrium bond price

$$q = E_w \left[ \frac{1}{P} \right]$$

where the expectation is over realizations of the wage $w_2$ in the second period.

A consumer’s utility is defined entirely by the government’s choices of taxation $\tau$ and public good spending $g$. The simplified indirect utility function is

$$W(\tau, g) = \frac{\epsilon^\tau (w(1-\tau))^{\tau+1}}{\epsilon + 1} + A \frac{g^{1-\sigma}}{1 - \sigma}$$

### 3.2 Firms

The representative firm has a linear production technology

$$z = wl$$

used to produce an intermediate good $z$ at wage $w$ with labor $l$. At the beginning of the second period a technology shock hits the economy such that wages $w_2 \in \{w_l, w_h\}$ where $w_l < w_h$. The probability that $w_2 = w_l$ is $p$, the probability that $w_2 = w_h$ is $1 - p$.

The intermediate good $z$ is split costlessly between the consumption good $c$ and the public good $g$ such that

$$c + g = z.$$

This defines the per period resource constraint

$$c + g \leq wl.$$
3.3 Government

The government controls fiscal policy. Raising revenue is possible via a distortionary labor tax $\tau$ and selling nominal bonds $B$ in the first period. A positive bond level $B$ means the government is in debt hence owes money to consumers in the second period. Revenue can be spent on a public good $g$ that benefits all $n$ citizens or on strictly positive transfer payments $T_{t,i}$ that benefit individuals. In the second period the revenue raised via taxation must be sufficient to cover bond payments of $\frac{B}{P}$.

The budget constraints are

$$g_1 + \sum_i T_{1,i} \leq \text{Rev}(\tau_1) + qB,$$  

(1)

$$g_2 + \sum_i T_{2,i} + \frac{B}{P} \leq \text{Rev}(\tau_2),$$  

(2)

where

$$\text{Rev}(\tau) = n\tau w (\epsilon w (1 - \tau))^\epsilon$$

is the total tax revenue raised by the distortionary labor tax on all $n$ consumers.

3.3.1 Self-Interested Fiscal Policy

When indicated, fiscal policy decisions will be made by a subgroup of the citizenry interested in maximizing their own utilities. I term this self-interested fiscal policy to contrast it from the choices of benevolent fiscal policy which attempts to maximize the utility of all citizens.

Following the political system laid out in Battaglini and Coate (2008) who extend the political economy model of Baron and Ferejohn (1989), citizens vote each period to decide that period’s fiscal policy $\{\tau, g, B, T_i\}$. The power to propose a choice of fiscal policy is randomly assigned to one citizen. A proposal is enacted if $m < n$ citizens vote for it. If a proposal fails, the power to propose is randomly assigned to a different citizen. There can be a maximum of $T$ proposal rounds after which a dictator is appointed.

I focus without loss of generality on proposals that are accepted in each round; thus we can examine only the first proposal. In order for this to happen, the proposal must make the members of the $m$ coalition as well off as the expectation of the next proposal. The expectation arises from the random assignment of proposal powers.
and thus the randomness of being included in the next proposer’s \( m \) coalition. In practical terms, proposers will select fiscal instruments to maximize the utility of the \( m \) citizens in the coalition without care for non-coalition citizens. This is in contrast to benevolent choices which can be thought of as the case where \( m = n \).

A fiscal policy proposal defines the fiscal policy for a single period. The next period a new proposer is randomly selected and the process begins anew. Fiscal policy commitment over periods is impossible. Weakening the requirement that a new proposer is chosen between periods has little effect on the outcome; it can in fact increase aggregate utility.

### 3.4 Monetary Policy

Monetary policy attempts to maximize societal welfare by choosing the Pareto Optimal second period price level \( P \). This is costless inflation. A version of the model with two consumer goods and a cash-in-advance constraint to introduce costs to inflation is examined in Section 8.

### 3.5 Timing

The model utilizes timing akin to a Stackelberg game with the monetary authority as leader and the government as follower. The monetary authority chooses \( P \) at the beginning of the second period: after consumer and government choices in the first period and the realization of the technology shock but prior to those choices in the second period. Thus monetary policy controls the real value of government debt which is equivalent to second period consumer wealth. An alternative timing with the government as the leader and the monetary authority as the follower is investigated in Section 7.

### 3.6 Equilibrium Definition

An equilibrium in the model consists of choices by the consumer, government, and monetary authority. The consumer chooses labor and consumption \( \{l_1, l_2, c_1, c_2\} \) in the first and second period. The government chooses fiscal instruments: taxes, spending on the public good, transfers, and bonds in the first period \( \{\tau_1, \tau_2, g_1, g_2, \{T_1\}_1^n, \{T_2\}_1^n, B\} \). The monetary authority chooses the price level in the second period \( P \).
Consumer choices of labor and consumption \(\{l, c\}\), are defined by the government’s choice of taxes and spending on the public good \(\tau, g\) through the indirect utility function \(W(\tau, g)\). I simplify the equilibrium description by describing only choices by the government and monetary authority. To shorten the description I write the government’s problem once for both benevolent and self-interested government. Let \(j \in \{n, m\}\). If \(j = n\) then the welfare function is that of a benevolent government. If \(j = m\) then the welfare function is that of a self-interested government.

I describe the equilibrium beginning in the second period and working backwards in order to emphasize the information sets and provide intuition to the solution method used in the paper.

- The second period government, given fiscal instruments from the first period \(\{\tau_1, g_1, \{T_1\}_1^n, B\}\), the realization of the technology shock and the monetary authority’s choice of price level \(P\), chooses \(\{\tau_2, g_2, \{T_2\}_1^n\}\) to maximize

\[
W(\tau_2, g_2) + \sum_{i} T_{2,i} \quad \text{s.t.} \quad g_2 + \frac{B}{P} + \sum_{i} T_{2,i} \leq \text{Rev}(\tau_2)
\]

- In the second period, given fiscal instruments from the first period \(\{\tau_1, g_1, \{T_1\}_1^n, B\}\) and the realization of the technology shock, the monetary authority chooses price level \(P\) to maximize second period welfare

\[
W(\tau_2, g_2) + \sum_{i} T_{2,i} \quad \text{s.t.} \quad g_2 + \frac{B}{P} + \sum_{i} T_{2,i} \leq \text{Rev}(\tau_2)
\]

- The first period government chooses \(\{\tau_1, g_1, \{T_1\}_1^n, B\}\) to maximize

\[
W(\tau_1, g_1) + \sum_{i} T_{2,i} + E [W(\tau_2, g_2) + \sum_{i} T_{2,i}] \quad \text{s.t.} \quad g_1 + \sum_{i} T_{1,i} \leq \text{Rev}(\tau_1) + qB
\]

\[
g_2 + \frac{B}{P} + \sum_{i} T_{2,i} \leq \text{Rev}(\tau_2)
\]
• The government’s expectation of the price level as a function of bonds and the technology shock is equal to the monetary authority’s choices hence

\[
\frac{1}{P} = E_w \left[ \frac{1}{\bar{P}} \right]
\]

There may be a continuum of bond amounts \( B \) that result in the same bond revenue \( qB \). Issuing bonds above a level can result in the expected price level increasing to perfectly offset the amount of revenue the new bonds would gain. For example: \( B = 1, E[P] = 1 \) and hence \( q = 1 \) raises \( qB = 1 \) revenue which is the same as \( B = 2, E[P] = 2 \) and \( q = \frac{1}{2} \). Two equilibriums with identical bond revenue will be identical with regards to all other variables. To simplify discussion I assume the government issues the minimum amount of bonds necessary for a given level of revenue.

4 Results

The main result of the paper explains why price level commitment by a monetary authority in the presence of a self-interested fiscal authority results in lower welfare. First I show that the presence of a self-interested monetary authority means a positive amount of nominal bonds is possible. Then I show the main result, that adding price level commitment to the model results in lower welfare. Finally, I show that the pairing of a benevolent monetary authority and self-interested fiscal authority with nominal bonds as observed in modern advanced economies is welfare maximizing.

For clarity I restrict the parameter space so that without bonds there would be transfers in both periods no matter the realization of wage \( w_2 \in \{w_l, w_h\} \). The restriction has the effect of making the optimal amount of bonds strictly positive. I provide the main intuition for my result here. The formal proofs are shown in the appendix.

**Proposition 1**  
A benevolent monetary authority with a self-interested fiscal authority is able to support nominal bonds.

Self-interested fiscal policy mitigates time inconsistency. Debt acts as a constraint on the choices of the fiscal authority. When real debt is high enough the fiscal authority is unable to finance any direct transfers. In the eyes of the monetary
authority these transfers are not Pareto improving as there is no overall gain to redistributing revenue in this fashion (although the individuals in the self-interested fiscal planner’s coalition do benefit).

The optimal action by the monetary authority is to increase the price level to decrease debt as long as this means taxes decrease and not that transfers increase. Put another way, the monetary authority will threaten to inflate if too many bonds are issued, otherwise it will keep the price level stable. Bonds will have a positive return so they will be bought in the first period.

The result is in contrast with the standard result that nominal bonds cannot exist with benevolent monetary and benevolent fiscal authorities due to the time inconsistency problem. Monetary policy will eliminate all real debt in the second period by setting the price level $P = \infty$ in order to minimize the distortionary tax. In the first period no citizen will buy soon to be worthless bonds.

**Proposition 2** Price level commitment by a monetary authority with a self-interested fiscal authority and nominal bonds results in lower welfare than discretionary monetary policy.

The result endogenizes the insight of Bohn (1988). Inflation makes nominal bonds somewhat state contingent. A government benefits from the budget freedom provided by the state contingency. Discretionary monetary policy with a self-interested fiscal authority suffers from some time inconsistency but allows for state contingency. The benefit of price commitment is that it eliminates time inconsistency. The cost is that it eliminates state contingency. The latter can outweigh the former.

In more detail, the intuition is that price level commitment by the monetary authority leads the self-interested fiscal authority to issue too many bonds. These bonds will be used for tax smoothing and wasteful transfers. If there is a bad shock $w_2 = w_l$ the monetary authority will be unable to inflate away the real value of those bonds. Repayment will require high distortionary taxes.

With discretionary monetary policy some nominal bonds can be supported by a form of endogenous commitment arising from the interaction of the benevolent monetary authority and self-interested fiscal authority. These bonds will be used for tax smoothing. If there is a bad shock $w_2 = w_l$ the monetary authority will be able to inflate away the real value of the bonds. Repayment will require low distortionary taxes.
If there is a good shock $w_2 = w_h$ both types of monetary policy lead to the same, low, tax rate in the second period. The amount of revenue spent on transfers in the first period will be lower with discretionary policy. Thus the welfare comparison only involves comparing tax rates in the second period following a bad shock. Tax rates are higher with price level commitment hence utility is lower.

**Why Nominal Bonds**  
Price level commitment turns nominal bonds into real bonds. The preceding comparison shows welfare is higher with nominal rather than real bonds. It presupposes that nominal bonds are the only intertemporal savings instrument available. Taking one step back, it’s necessary to explain why nominal bonds will exist instead of real bonds.

There are two ways to justify nominal bonds. As shown by Proposition 2 welfare is higher with nominal bonds. If citizens in an original position, before the first period coalition is chosen, were able to vote on nominal or real bonds they would choose nominal.

The second way is to assign responsibility for choosing real or nominal bonds to the monetary authority. The fiscal authority chooses the amount of bonds, but the type is chosen by the monetary side. The monetary authority seeks to maximize overall utility which is is higher under nominal bonds. Hence it will insist on nominal instead of real.

### 4.1 Optimal Design of Monetary, Fiscal Structure

The monetary and fiscal structure of most modern advanced economies looks similar. A government that is subject to a form of elections controls fiscal policy. A central bank independent from the voting process is tasked with controlling the price level. The vast majority of government debt is nominal. I argue that this setup is efficient at smoothing taxes via debt and limiting transfers.

**Proposition 3** *The pairing of a self-interested fiscal authority and an independent monetary authority with nominal bonds and without price commitment is the solution to a constrained mechanism design problem that results in the highest welfare.*

The mechanism design problem is to choose the structure of the economy to maximize welfare. This can be viewed as a constitutional design problem. There
are two possibilities for the fiscal authority: benevolent or self-interested. There are
two possibilities for the monetary authority: captured or independent. There are two
possibilities for bonds: real (equivalent to price commitment) or nominal.

Amongst the possible combinations, the two equivalent welfare maximizing choices
are a benevolent fiscal authority and real bonds. (Real bonds mean control of the
monetary authority is irrelevant since the authority has no choices to make.) I ignore
this combination. Dictatorships do not issue real bonds in the real world possibly
due to the inability to make real contracts enforceable across regimes. Additionally,
it’s very hard to find a benevolent dictator.

Constraining choice to the other six possibilities, choosing a self-interested fiscal
authority, an independent monetary authority, and nominal bonds is optimal. This
is the set up explored in Proposition 2. I briefly describe and compare the other
combinations to this one below.

1. Benevolent Fiscal, Benevolent Monetary, Nominal Bonds: This combination is
   unable to support any nominal bonds due to the time inconsistency problem.
   There will be no tax smoothing.

2. Benevolent Fiscal, Captured Monetary, Nominal Bonds: This combination is
   unable to support any nominal bonds due to the time inconsistency problem.
   There will be no tax smoothing.

3. Self-Interested Fiscal, Benevolent Monetary, Real Bonds: This combination is
   explored in Proposition 2 and shown to result in lower welfare than if it featured
   nominal bonds.

4. Self-Interested Fiscal, Captured Monetary, Real Bonds: Real bonds mean con-
   trol of the monetary authority is irrelevant. Hence it’s identical to the combi-
   nation above.

5. Self-Interested Fiscal, Captured Monetary, Nominal Bonds: This combination
   is unable to support any nominal bonds due to the time inconsistency problem.
   There will be no tax smoothing.

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2 A captured monetary authority is one controlled by the same political process as a self-interested
fiscal authority. Namely it tries to maximize the utility of m out of n consumers. For simplicity,
and without loss of generality, define a captured monetary authority to share the same coalition as
the self-interested fiscal authority if both are present.
Since the choice featuring a self-interested fiscal authority and an independent monetary authority with nominal bonds is welfare maximizing, it’s natural we observe it in the real world. As with the choice to use nominal bonds, citizens in an original position would choose this structure; possibly by embedding it in the constitution of the state.

5 Infinite Periods

I extend the model to infinite periods to show that it does not change the results. To do so, I eliminate the constraint that bonds must be paid off entirely in the second period. I add a discount factor $0 < \beta < 1$ so that

$$U = \sum_{t=0}^{\infty} \beta^t u(c_t, l_t)$$

The monetary authority faces the identical single period optimization problem as before

$$W(\tau, g) + \sum_i T_i$$

s.t.

$$g + \frac{B}{P} + \sum_i T_i \leq \text{Rev}(\tau) + qB'$$

I can write the problem of the fiscal authority in recursive formulation as

$$V(B; P(B)) = \max_{\tau, g, T_i, B'} \left[ W(\tau, g) + \sum_i T_i \right] + \beta E_w [V(B'; P'(B'))]$$

s.t. $g + \frac{B}{P} + \sum_i T_i \leq \text{Rev}(\tau) + qB'$

where $j = n$ for a benevolent fiscal authority, $j = m$ for a self-interested fiscal authority and $P(B)$ is the price level chosen by the monetary authority.

It’s important to recognize that this maximization problem is almost identical in first order conditions to the first period in the two period model. The difference is that the budget constraint requires $B$ bonds to be paid off rather than 0. Issuing an additional bond requires higher taxes in the future to pay off. Infinitely lived consumers internalize this cost. The consumers in the government’s coalition will gain
from the transfers the bonds enable and lose from the future taxes. The consumers outside the coalition will lose from the additional taxes.

**Proposition 4** Proposition 2 holds identically with infinite periods as it did with two periods.

The intuition is the same as in the two period case, repeated infinitely. If the monetary authority utilizes price level commitment a self-interested fiscal authority will issue too many bonds each period. When there is a bad realization \( w = w_I \) of the technology shock distortionary taxes will be set very high.

## 6 Monetary Unions

I discuss the benefits and costs of a monetary union. I describe the theoretical results and draw analogy to specifics of the European Union and the experience of Greece. The model explains Greece’s actions and current predicament as the rational actions of a small open economy in a monetary union of large countries.

A monetary union consists of a single monetary authority and multiple fiscal authorities. In the Eurozone the European Central Bank acts as the sole monetary authority for all Eurozone countries. Each country has its own independent, elected, government that controls fiscal policy.

Countries have incentive to join a monetary union because of the benefits of an independent monetary authority compared to a captured monetary authority. For institutional or expectational reasons a country may find it difficult to insulate its sovereign monetary authority. Joining a monetary union is a way of reifying commitment to an independent monetary authority.

**Proposition 5** If countries in a monetary union are homogenous, each sovereign fiscal authority acts identical to the behavior of a fiscal authority with a sovereign benevolent monetary authority.

Prior to joining the Euro, Greece suffered from the view that its central bank was less than independent. This led investors to demand high interest rates on its sovereign debt due to fears of Greece inflating away the real value of the debt. After joining interest rates on Greek debt fell to near German levels.
Proposition 5 holds for a monetary union composed of homogenous countries. It does not reflect what has happened in the Eurozone. Greece is not equivalent to Germany or France. Homogeneity ensures that the central bank will respond equally to the behavior of all countries. The ECB did not and has not done so.

**Proposition 6** A small country in a monetary union with larger countries behaves as if it had price commitment.

The main requirement of Proposition 6 is that the central bank not respond to the actions of the small country. If this is the case the small country acts as if it has price level commitment. As shown in Proposition 2 this means the governing coalition will issue debt solely to spend on transfers to itself. When a bad shock hits the country will be required to raise taxes to punitive levels.

The consequences match what has happened with Greece. Greece issued Euro denominated debt that appeared nominal. It wasn’t: the ECB wouldn’t change the price level to keep the Greek fiscal authority in line. During the good times Greece was able to repay the debt while keeping tax rates low. When the financial crisis struck Greece was unable to use inflation to erase some of its debt. It had to raise taxes significantly to pay back the debt.

This outcome was foreseen by the designers of the Eurozone. Fiscal rules constrain the choices of fiscal authorities. The Maastricht Treaty had fiscal rules built into it to constrain budget deficits and debt issuance. The fiscal rules were ignored by all member countries large and small.

### 7 Timing of Fiscal and Monetary Choices

The default choice of timing is the monetary authority moving prior to the fiscal authority in the second period. I call this monetary dominant timing to contrast it with what I analyze here: fiscal dominant timing means the fiscal authority moves first in the second period. In the language of a Stackelberg game, the new timing has the fiscal authority as the leader and the monetary authority as the follower. This timing is similar to that discussed in Fiscal Theory of the Price Level literature as an active fiscal, passive monetary regime.

I keep the model identical but invert the timing of decisions in the second period. The fiscal authority now moves first in the second period, setting \( \{\tau_2, g_2, T_2, i\} \) and
subsequently the monetary authority sets $P$. The budget constraint of the government is

\[ \frac{B}{P} \leq \text{Rev}(\tau_2) - g_2 - \sum_i T_{2,i} \]

where the revenue left over after spending on the public good and transfers is spent repaying bonds. The monetary authority sets $P$ to clear the budget constraint.

The key difference between fiscal dominant and monetary dominant timing is that introducing the political distortion doesn’t create endogenous commitment. Bonds are impossible under both benevolent and self-interested fiscal policy.

**Proposition 7** No nominal bonds can be supported with fiscal dominant timing.

The source of time inconsistency here is identical to the usual case: inflation’s lump sum nature is preferred to distortionary taxation. Before it was the monetary authority preference for the inflation tax that led to time inconsistency, here the fiscal authority’s preference is the cause.

The monetary authority must choose $P$ to clear the government’s budget constraint. Knowing that it has this backstop, the fiscal authority won’t leave any tax revenue for bond repayment. Consumers know this and won’t hold bonds whose real value will be erased.

Proposition 7 emphasizes the importance of the choice of timing to the results. As shown in 3 monetary dominant timing leads to welfare maximized by a set up of monetary and fiscal authorities that resembles the real world. Fiscal dominant timing results in no bonds and does not resembles the real world.

A full version of the FTPL states that the fiscal authority can select a specific price level. Let the fiscal authority commit to a plan for both periods. The government in the first period will choose all first and second period quantities \( \{\tau_1, g_1, T_{1,i}, B, \tau_2, g_2, T_{2,i}\} \). Control of the fiscal authority is irrelevant; both benevolent and self-interested authorities may want bond revenue albeit for different purposes.

**Proposition 8** Under fiscal dominant timing, fiscal commitment in the first period to a choice of fiscal instruments in the second period allows fiscal policy to choose $P$. Equilibrium allocations other than $P$ will be identical to monetary dominant timing and price level commitment

By leaving some tax revenue left over in the second period to repay bonds, the fiscal authority can control the choice of $P$. The monetary authority will mechanically
choose $P$ to set the real value of debt equal to the amount dedicated to repayment. By committing in the first period to a certain amount of repayment and bonds, the fiscal authority can force the monetary authority’s actions in the second period.

8 Cash-In-Advance Constraint

A cash-in-advance constraint introduces utility costs to inflation. The constraint governs a nominally priced consumption good $c_m$ available only in the second period (since there are no possible cash holdings in the first period). Highlighting only the differences with the standard model, I add the cash-in-advance constraint that $Pc_m = M$. The monetary authority now chooses $P$ and $M$. I ignore the possibilities of seignorage. The representative firm’s output in the second period is now split between the normal consumption good, the new nominal consumption good, and the government’s public good

$$c_2 + c_m + g_2 \leq w_2 l_2$$

The consumer’s second period utility function is

$$u_2(c_2, c_m, g_2, l_2) = c_2 + \frac{c_m^{1-\gamma} - 1}{1-\gamma} + A \frac{g_2^{1-\sigma}}{1-\sigma} - \frac{l_2^{1+1/\epsilon}}{\epsilon + 1}$$

subject to budget constraint

$$c_1 + qB_n + M_n \leq w_1 l_1 (1 - \tau_1) + T_{1,i},$$

$$c_2 \leq w_2 l_2 (1 - \tau_2) + \frac{B_n}{P} + T_{2,i}.$$  

and the cash-in-advance constraint in the second period

$$c_m \leq \frac{M_n}{P}$$

where $M_n$ is an individual citizen’s money holdings and $M$ the total amount. The new money good has decreasing marginal utility that begins above one. This ensures that for any price level it is optimal for consumers to hold money to purchase some of the good. If the consumer’s wealth is high enough, the consumer will purchase both goods: eventually the curvature of utility pushes the marginal utility below one and
the remainder of the consumer’s wealth is spent on the linear in utility good. We assume we are in this region.

The new indirect utility function in the second period is

\[ W(\tau_2, g_2, P) = \frac{\epsilon (w_2(1 - \tau_2))^{\epsilon+1}}{\epsilon + 1} + \frac{M^e(1-\gamma)}{1-\gamma} - 1 + A \frac{g_2^{1-\sigma}}{1-\sigma} \]

Raising the price level has three effects on the consumer. As before, it lowers wealth by decreasing the real amount the government must repay to the consumer. This also allows the government to lower taxes correspondingly. The new effect is a shift in the consumption bundle away from the money good.

**Proposition 9** Adding a cash-in-advance constraint doesn’t change any comparisons from the standard model.

Adding utility costs to inflation doesn’t change the comparisons of the model. It does enlarge the region where self-interested fiscal policy behaves identically to benevolent fiscal policy. The time inconsistency problem for benevolent policy is lessened because the monetary authority won’t increase the price level without bound, but the same effect also aids self-interested fiscal policy.

## 9 Conclusion

Price commitment is a dangerous thing. Monetary policy keeps fiscal policy in line; the power to commit is the power for the fiscal authority to ignore monetary constraints. Counterintuitively, giving the monetary authority new power lessens its power over the fiscal authority to the detriment of overall welfare.

This paper shows that monetary policy benefits from distorted fiscal policy. Without an explicit commitment mechanism, nominal bonds are possible if fiscal policy is self-interested. Although the utility functions of the monetary and fiscal authorities will differ, the result is better for the monetary authority’s goal of maximizing welfare than when they are identical.

The source of endogenous commitment, a desire of the monetary authority to avoid what it views as waste, also provides the justification for nominal bonds. Real bonds, as in the case of price level commitment, allow a self-interested fiscal authority
to act without constraint. If the power to choose the type of bonds is vested in either the monetary authority or citizens, they will choose nominal bonds.

Without an independent monetary authority this structure collapses. Control of both fiscal and monetary policy doesn’t provide control over the expectations of citizens. The time inconsistency problem returns and nominal bonds are impossible. It’s in everyone’s interest for the monetary authority to be independent from the fiscal authority.

The structure of modern economies, where fiscal decisions are controlled by a political entity and monetary decisions by an independent non-political body with nominal bonds and without price commitment, is the efficient choice. It allows some bonds to be issued, but not so many that the political distortion is able to distort optimal policy. All other combinations lead to either too high taxes or no tax smoothing.

References


A Appendix

For brevity, proofs of the propositions in the text are located here.

A.1 Proofs of Proposition 1

The proofs of both Proposition 1 and Proposition 2 rely on similar model buildup. The proofs will differ only at the end. I solve backwards from the second period to analyze the fiscal and monetary choices made conditional on an incoming debt level of $B$. After solving the optimal second period policies for every $B$, I analyze behavior in the first period with these choices in mind. Optimal decisions by the monetary authority in the second period will constrain the possible choices of $B$ in the first period.

A.1.1 The Second Period of the Standard Model

In the second period the amount of incoming bonds is $B$. I analyze monetary policy’s choice of $P$ as a function of $B$.

**Benevolent Fiscal Policy**  Benevolent fiscal policy attempts to maximize the utility of all citizens. Since citizens are identical in all respects, transfers, if they exist, will be identically distributed. Revenue will always have a positive use so the budget constraint will hold with equality. The problem is to

$$\max_{\tau_2, g_2} w(\tau_2, g_2) + \frac{\sum_i T_{2,i}}{n}$$

s.t. $\text{Rev}(\tau_2) = g_2 + \frac{B}{P} + \sum_i T_{2,i}$

The first order condition of this problem is

$$nA g_2^{\sigma} = \frac{1 - \tau_2}{1 - \tau_2(1 + \epsilon)}. \quad (3)$$

This says that the marginal benefit of an additional unit of public good spending must be equal to the marginal cost of raising the revenue necessary to fund that spending via the distortionary labor tax. The right hand side measures the increasing cost of raising revenues. As the utility cost of raising revenue is strictly greater than 1, and
the utility gain from a direct transfer is 1, we can rule out any transfers. Hence the
government budget constraint holds as \( g_2 = \text{Rev}(\tau_2) - \frac{B}{P} \) and we can find optimal
quantities from
\[
A(nw\tau_2(\epsilon w(1 - \tau_2))^\epsilon - \frac{B}{P}) = \frac{1 - \tau_2}{1 - \tau_2(1 + \epsilon)}.
\]
Since the benefit of the first marginal unit of public good spending is infinity, it will
always be optimal to raise more revenues than necessary solely to pay off bonds \( \frac{B}{P} \).
Another way of stating this is that \( \tau \) is strictly positive for \( \frac{B}{P} \geq 0 \). We can also use
this equation to find derivatives: \( \frac{\partial \tau_2}{\partial B} \geq 0 \), \( \frac{\partial g_2}{\partial B} \leq 0 \). Intuitively, an increase in bonds
will require an increase in taxes to pay them off and an increase in bonds means less
money is available for public good spending since that money will be diverted to bond
repayments.

The monetary authority’s problem is to choose \( P \) to maximize
\[
v(P) = \max_{\tau_2, g_2} \left[ w(\tau_2, g_2) + \frac{\sum T_{2,i}}{n} \right].
\]

Claim 1  The first order condition of this problem is
\[
v'(P) = \left[ \frac{\epsilon \tau_2(B)}{1 - \tau_2(B)(1 + \epsilon)} \right] \frac{B_n}{P^2}.
\]

Proof.

Let \( P_0 \) be the choice of \( P \) that optimizes the value function
\[
v(P) = w(\tau_2, g_2) + \sum_{n} T_{2,i}
\]
\[
= \frac{\epsilon (w_2(1 - \tau_2))^\epsilon}{\epsilon + 1} + A \frac{g_2^{1-\sigma}}{1 - \sigma} + \frac{B_n}{P} + \frac{\sum T_{2,i}}{n}
\]
I will build a non-optimal function \( \phi(P) \) that coincides with \( v(P) \) at the optimal \( P_0 \)
but is less elsewhere (and strictly concave). This will fulfill the conditions of Theorem
4.10 of [Stokey et al. (1989)] stating that the derivative of \( \phi(P) \) is equal to that of \( v(P) \)
at the optimal \( P_0 \).

Choose \( P \) from a neighborhood of \( P_0 \). For notational simplicity let \( b = \frac{B}{P} \) and
\( b_0 = \frac{B}{P_0} \). Define
\[
g_2(b) = \text{Rev}(\tau_2(b_0)) - b
\]
which is the non-optimal amount of government spending while still fulfilling debt repayment obligations. The amount of transfers will be the residual

\[ \sum_i T_{2,i} = \text{Rev} (\tau_2(b_0)) - g_2(b) - b_0 \]

Define the non-optimal utility function to be

\[ \phi(P) = w(\tau_2(b_0), g_2(b)) + \sum_i T_{2,i} \]

\[ = \frac{\epsilon^\epsilon (w_2(1 - \tau_2(b_0)))^{\epsilon + 1}}{\epsilon + 1} + A \frac{g_2(b)^{1-\sigma}}{1-\sigma} + b_n + \frac{\text{Rev} (\tau_2(b_0)) - g_2(b) - b_0}{n} \]

Take the derivative to find

\[ \phi'(P) = -\frac{B_n}{P^2} + Ag \left( \frac{B}{P} \right)^{-\sigma} \left( \frac{B_n}{P^2} \right) \]

\[ = -\frac{B_n}{P^2} + \left[ \frac{1 - \tau \left( \frac{B}{P} \right)}{1 - \tau \left( \frac{B}{P} \right) (1 + \epsilon)} \right] \left( \frac{B_n}{P^2} \right) \]

\[ = \left[ \frac{\epsilon \tau \left( \frac{B}{P} \right)}{1 - \tau \left( \frac{B}{P} \right) (1 + \epsilon)} \right] \left( \frac{B_n}{P^2} \right) \]

where I’ve substituted in Equation 3, the first order condition of the fiscal authority. Taking the second derivative confirms the necessary conditions.

The derivative is strictly positive for positive values of \( B \). For any non-zero level of bonds, total utility is improved by increasing the price level. A higher price level has two effects: the government will repay less in real terms, lowering utility, but the distortionary tax rate will be correspondingly lower, raising utility. Since the utility cost of taxation is always greater than the revenue gained, it’s beneficial to increase the price level. This implies that

\[ P^* = \begin{cases} [1, \infty), & \text{if } B = 0. \\ \infty, & \text{if } B > 0. \end{cases} \]

the monetary authority voids the real value of any debt that exists at the start of the period. As noted before, taxation will still be positive in this case as public good spending will be positive. I don’t emphasize the indeterminacy of the price level in
the equilibrium \( B = 0 \) case. While a nice result, and common in the literature, it is strongly dependent on costless inflation.

**Self-Interested Fiscal Policy**  Self-interested fiscal policy acts to maximize the utility of the \( m \) members in the governing coalition. The representative coalition member differs from a non-coalition member only in the possibility of direct transfers; all other instruments are universal in effect. Thus the problem of the self-interested fiscal planner is to

\[
\max_{\tau_2, g_2} w(\tau_2, g_2) + \sum_i \frac{T_{2,i}}{m} \\
\text{s.t. } \text{Rev}(\tau_2) = g_2 + \frac{B}{P} + \sum_i T_{2,i}
\]

There are two cases: either there are transfers or there are no transfers. In the first case, this problem is identical to the problem of the benevolent fiscal planner and correspondingly has an identical first order solution. In the second case, we have first order conditions

\[
\frac{1}{m} = \frac{1-\tau_2^*}{1-\tau_2^*(1+\epsilon)} \\
\frac{1}{m} = Ag_2^{* - \sigma}
\]

The benefit of a marginal transfer is a constant \( \frac{1}{m} \). The first equation shows that the benefit of a marginal transfer is equal to the increasing cost of raising that additional unit of revenue via taxation. The second equation shows that the benefit from transfers should be equal to the benefit of public good spending. Due to the diminishing marginal returns on public good spending, it is eventually worthwhile for the coalition to improve its welfare via transfers rather than public good spending.

Now that we know what happens with transfers we need to determine when there are transfers. Notice that if there are transfers taxes and public good spending \( \tau_2^*, g_2^* \) are constant, pinned down by the marginal utility of transfers \( \frac{1}{m} \). This means that any excess revenue from tax \( \tau_2^* \) after public good spending \( g_2^* \) must go to covering the bonds that are due, and the remainder to transfers. The cutoff bond level such that
there is revenue left over to fund transfers is

\[ B_2^* = \text{Rev}(\tau_2^*) - g_2^*. \]

Below \( B_2^* \) the required bond repayments are small enough that there is revenue leftover for transfers. Above \( B_2^* \) the fixed tax rate, public good spending levels \( \tau_2^*, g_2^* \) do not leave enough money to cover bond repayments. There will be no transfers so the first order conditions of the benevolent fiscal planner govern choice of \( \tau_2, g_2 \).

**Theorem 2** The problem of the fiscal authority is equivalent to

\[
\max_{\tau_2, g_2, T_2, i} \left[ w(\tau_2, g_2) + \frac{\sum T_{2,i}}{n} \right] \\
\text{s.t. } \tau_2 \geq \tau_2^*, g_2 \leq g_2^*
\]

Note that this is identical to the problem with benevolent fiscal policy except that taxation and government spending become stuck at the values \( \tau_2^*, g_2^* \).

**Proof.** This follows from the bond cutoff \( B_2^* \). If bonds are below \( B_2^* \) the first order conditions set \( \{\tau_2^*, g_2^*\} \) and the excess revenue is transferred to the \( m \) coalition. With linear utility splitting 1 dollar of transfers amongst \( m \) citizens has the same overall utility effect as splitting 1 dollar amongst \( n \) citizens.

If bonds are above or equal to \( B_2^* \) our problem is identical to benevolent fiscal policy. At \( B_2^* \) our constraints just bind to \( \{\tau_2^*, g_2^*\} \). As shown previously, \( \frac{\partial \tau_2}{\partial B} \geq 0, \frac{\partial g_2}{\partial B} \leq 0 \) so for bonds above \( B_2^* \) we have \( \tau_2 \geq \tau_2^*, g_2 \leq g_2^* \).

The monetary authority’s goal is the same as before: maximize the utility of all citizens. This is equivalent to choosing \( P \) to maximize

\[
v_p(P) = \max_{\tau_2, g_2, T_2, i} \left[ w(\tau_2, g_2) + \frac{\sum T_{2,i}}{n} \right] \\
\text{s.t. } \tau_2 \geq \tau_2^*, g_2 \leq g_2^*
\]

The first order condition of this problem is

\[
v'(P) = \begin{cases} 
0, & \text{if } \frac{B}{P} < B_2^*. \\
\frac{\epsilon \tau_2(\frac{g}{P})}{1 - \tau_2(\frac{g}{P})(1+\epsilon)} \frac{B_n}{P}, & \text{if } \frac{B}{P} \geq B_2^*. 
\end{cases}
\]
Proof. Expand out the entire optimization problem

\[ v(P) = w(\tau_2, g_2) + \sum_{i} \frac{T_{2,i}}{n} \]

\[ = \frac{\epsilon^\epsilon (w_2(1-\tau_2)^{\epsilon+1}}{\epsilon + 1} + A \frac{g_2^{1-\sigma}}{1 - \sigma} + B_n \frac{1}{P} + \sum_{i} \frac{T_{2,i}}{n} \]

I begin with the case \( \frac{B}{P} < B_2^* \). In this case taxation and public good spending are pinned at \( \{\tau_2^*, g_2^*\} \). These define the level of transfers as the residual after public good spending and repaying bonds

\[ \sum_i T_{2,i} = \text{Rev}(\tau_2^*) - g_2^* - \frac{B}{P} \]

The optimization problem is then

\[ v(P) = \frac{\epsilon^\epsilon (w_2(1-\tau_2)^{\epsilon+1}}{\epsilon + 1} + A \frac{g_2^{1-\sigma}}{1 - \sigma} + B_n \frac{1}{P} + \frac{\text{Rev}(\tau_2^*) - g_2^* - \frac{B}{P}}{n} \]

Taking the derivative with respect to \( P \)

\[ v'(P) = -\frac{B_n}{P^2} + \frac{B_n}{P^2} \]

\[ = 0 \]

If \( \frac{B}{P} < B_2^* \) the problem is identical to that of benevolent fiscal policy. ■

If bonds are below \( B_2^* \) transfers are positive. Increasing \( P \) lowers the required bond repayment while taxes and government spending are constant at \( \tau_2^*, g_2^* \) and any extra revenue goes to transfers. Bonds are consumers’ wealth so the monetary authority is taking money from consumers which the fiscal authority then rebates via transfers to no net effect. Above \( B_2^* \) increasing \( P \) will affect \( \tau_2, g_2 \) by the social planner’s first order conditions and result in lower taxes and higher government spending.

The Pareto Optimal price level is the price level at which further increases have no net utility gain. Hence the optimal price level is

\[ P^* = \begin{cases} 1, & \text{if } B \leq B_2^*. \\ \frac{B}{B_2^*}, & \text{if } B > B_2^*. \end{cases} \]
If $B$ is too high, the monetary authority will shrink the real value of bonds to $B_2^*$ but no further.

**A.1.2 The First Period of the Standard Model**

In the first period the government and the citizens know how the monetary authority will set the price level $P$ as a function of the amount of bonds $B$. This will affect the price $q$ that citizens are willing to pay for bonds and thus how much money the government can raise.

**Benevolent Fiscal Policy** The benevolent fiscal policy problem is little changed from the second period problem. We now have the ability to select bonds $B$ which means one additional first order condition. The problem of the government is

$$\max_{\tau_1, g_1, B} \left[w(\tau_1, g_1) + \frac{\sum_i T_{1,i}}{n}\right] + v_s(P; B)$$

subject to

$$\text{Rev}(\tau_1) + qB = g_1 + \frac{\sum_i T_{1,i}}{n}$$

with first order conditions

$$nAg_1^{-\sigma} = \frac{1 - \tau_1}{1 - \tau_1(1 + \epsilon)} \quad (6)$$

$$-n \frac{\partial v(P|B)}{\partial B} = \frac{1 - \tau_1}{1 - \tau_1(1 + \epsilon)} \quad (7)$$

The new first order condition says that the government would like to smooth the distortionary tax rate across periods by using bonds to finance public good spending.

As shown previously, for any $B > 0, P = \infty$ and hence $q = 0$. Though the government would like to issue bonds this period, the monetary authority cannot commit to a finite price level next period that would allow any real return on those bonds. Thus $B = 0$ and the government is unable to smooth taxes. This is the classic case of time inconsistency.

**Definition 3** The equilibrium choices with benevolent fiscal policy are

- In the first period, the government chooses bonds $B = 0$. With this constraint, the government chooses optimal quantities $\tau_1, g_1, \sum_i T_{1,i}$ that solve its first order condition (6) and subject to the budget constraint (1). Consumers’ choice of
consumption and labor is defined by the government’s choices and they receive \( w(\tau_1, g_1) \) utility.

- In the second period, the monetary authority chooses price \( P = 1 \). The government chooses \( \tau_2, g_2, \sum_i T_{2,i} \) that solve its first order condition (3) subject to the budget constraint (2). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive \( w(\tau_2, g_2) \) utility.

**Self-Interested Fiscal Policy** The ability to use bonds for the self-interested government could have positive or negative effects. The bonds could be used to smooth taxes across periods as in benevolent fiscal policy or to finance transfers. As discussed before, the self-interested fiscal policy problem when transfers are zero is identical to the problem with benevolent fiscal policy. If transfers are positive the first period self-interested fiscal planner’s problem is

\[
\max_{\tau_1, g_1, B} \left[ w(\tau_1, g_1) + \frac{\sum_i T_{1,i}}{q} \right] + v_p(P; B)
\]

s.t. \( \text{Rev}(\tau_1) + qB = g_1 + \frac{\sum_i T_{1,i}}{n} \)

with first order conditions

\[
1 = n \frac{1-\tau_1^*}{1-\tau_1^*(1+\epsilon)} \quad (8)
\]
\[
1 = A g_1^{*\sigma} \quad (9)
\]
\[
1 = -n \frac{\partial v(P|B^*)}{\partial B} \quad (10)
\]

where \( B^* \) is the optimal level of bonds issued in the first period. This new first order condition says that if the self-interested fiscal authority issues bonds to finance transfers, the marginal benefit must equal the marginal cost of paying off those bonds next period. From the point of view of a member of the current coalition there’s incentive to issue bonds for transfers today so there won’t be transfers tomorrow.

Corresponding to \( B_1^* \), there’s a first period cutoff level of bonds below which there are transfers and above which there are none. This cutoff is

\[
B_1^* = \text{Rev}(\tau_1^*) + B^* - g_1^*.
\]
Since our starting level of bonds is 0, there will be transfers if \( B_1^* > 0 \) and none if \( B_1^* \leq 0 \). Note that \( B^* \) will be constrained by equilibrium choices of \( P \).

We can now analyze the bond level chosen by self-interested fiscal policy. If there are no transfers, the problem of the self-interested fiscal authority in the first period is identical to the benevolent fiscal policy problem, but in the second period the monetary authority’s price function is different. Self-interested fiscal policy can issue bonds up to the level \( B_2^* \) without causing the monetary authority to increase the price level. If there are transfers the self-interested fiscal planner would issue \( B_1^* \) if \( P \) were constant. With the price function found previously, the self-interested planner will choose to issue \( \min\{B_1^*, B_2^*\} \). In fact, it will be the case that \( B_2^* \leq B_1^* \).

**Lemma 4** A self-interested fiscal planner with transfers will set \( B^* = B_2^* \).

**Proof.** As shown in the second period, if \( B^* > B_2^* \) the price level will be set to inflate away those bonds so there’s no gain in issuing them.

Assume \( B^* = B_1^* < B_2^* \). Then there will be transfers in both the first and second periods. When there are transfers, the first order condition with respect to bonds is

\[
\frac{1}{m} = -n \frac{\partial v(P|B^*)}{\partial B^*}.
\]

Since there are transfers, we can show the right hand side derivative is \( \frac{1}{n} \). Hence the first order condition will not hold and the fiscal authority can do better by issuing more debt. Intuitively this is a consequence of the random choice of coalition \( m \). For a member of the coalition, if \( B^* < B_2^* \), you know you can issue more bonds to direct additional transfers to yourself today but you don’t know if you will be able to do so tomorrow. Why leave money available to tomorrow’s coalition to use as transfers if you might not be a member of that coalition?

An analogous lemma deals with the situation with the situation without transfers.

**Lemma 5** A self-interested fiscal planner without transfers will set \( B = \max\{0, B_2^*\} \)

**Proof.** If \( B > B_2^* \) the price level in the second period will be set to inflate away those bonds so there’s no gain in issuing them. The model does not allow a negative level of bonds \( B < 0 \).
Assume $B \in [0, B^*_2]$. Then there will be transfers in the second period. When there are no transfers in the first period the first order condition is

$$-n \frac{\partial v(P|B)}{\partial B} = \frac{1 - \tau_1}{1 - \tau_1(1 + \epsilon)}$$

Since there are transfers in the second period the left hand side derivative is $\frac{1}{n}$ because increasing bonds only cuts transfers. Hence the left hand side is strictly less than one and the right hand side is strictly greater than one. Intuitively in this situation a unit of debt in the first period is used to lower first period taxes at the cost of decreased transfers in the second. Since taxes are distortionary while transfers have no net effect, this is a positive tradeoff.

We can now characterize the equilibrium with a self-interested fiscal authority.

**Definition 6** The equilibrium choices with self-interested fiscal policy are

- In the first period there are two situations: if there are transfers or not
  
  - If $B^*_1 \leq 0$ then $\sum_i T_{1,i} = 0$. The government’s choice of $\tau_1, g_1, B = \max\{0, B^*_2\}$ solves the first order condition of the benevolent fiscal authority (6) subject to the budget constraint (1). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_1, g_1)$ utility.
  
  - If $B^*_1 > 0$ then $\sum_i T_{1,i} > 0$. The government chooses $\tau^*_1, g^*_1, B = B^*_2$ to solve equations (8) and the remainder is used as transfers to satisfy the budget constraint (1). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau^*_1, g^*_1) + \sum_i T_{1,i}$ utility.

- In the second period, the monetary authority chooses price $P = 1$. The government chooses $\tau_2, g_2, \sum_i T_{2,i} = 0$ that solve the first order condition of the benevolent fiscal authority (3) subject to the budget constraint (2) which must now pay off any bonds. Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_2, g_2)$ utility.

Proposition 1 is now proved by comparing the equilibrium of benevolent fiscal policy in Definition 3 and self-interested fiscal policy in Definition 6.
If there are no transfers under self-interested fiscal policy the two fiscal optimization problems are identical as shown in Theorem 2. Bonds will be used solely to smooth taxation between periods. Under benevolent fiscal policy, no bonds are possible for this purpose. Under self-interested fiscal policy there will be $B^*_2$ bonds that can be used. These bonds will be used to smooth tax rates between periods and thus utility will be higher.

If there are transfers under self-interested fiscal policy, taxes and public good spending will be $\tau_1^*, g_1^*$. Taxes and public good spending would be lower except for the political distortion. $B^*_2$ bonds will be issued and some of that revenue will be used for transfers and some for tax smoothing. Since the level of debt in the second period will be $B^*_2$ the tax rate and public good spending in the second period will be $\tau_2^*, g_2^*$.

It is the extent to which any of this revenue is used for tax smoothing that determines the utility comparison. If the parameter values are such that a benevolent planner without bonds sets $\tau_1 < \tau_1^*$ and $\tau_2 < \tau_2^*$ then citizens are clearly better off under such a planner. If one of the benevolent planner’s tax rates is above the corresponding self-interested tax rate, then bonds will serve both to enable transfers and to smooth tax rates. The latter increases utility and could outweigh the utility loss from the higher tax rate. If both the benevolent planner’s tax rates are above the corresponding self-interested tax rates there won’t be transfers. This follows from the equivalence between self-interested and benevolent fiscal policy when there are no transfers in Theorem 2.

A.2 Proof of Proposition 2

Price level commitment eliminates the monetary authority’s actions in the second period. I first examine the consequences of technology shocks under endogenous commitment in the second period then look at both price level commitment and endogenous commitment in the first period. When necessary, let $p$ be the probability of the high realization $w_h$ and $1 - p$ be the probability of the low realization $w_l$.

A.2.1 Second Period under Endogenous Commitment

At the start of the second period the technology shock is realized $w_2 = w_l$ or $w_2 = w_h$. Subsequently the monetary authority chooses $P$ and then the fiscal authority chooses...
\(\tau_2, g_2, \sum_i T_i\) as in the static case.

With the structure already established in the proof of proposition \([\text{I}]\) we can lay out the actions of the monetary authority conditional wage realization \(w_l\) or \(w_h\). Notice that \(B^*_{2,l}\) is correspondingly lower than \(B^*_{2,h}\).

If \(w_2 = w_l\) then

\[
P^*_l = \begin{cases} 
1, & \text{if } B \leq B^*_{2,l} \\
\frac{B}{B^*_{2,l}}, & \text{if } B > B^*_{2,l}
\end{cases}
\]

and similarly if \(w_2 = w_h\) then

\[
P^*_h = \begin{cases} 
1, & \text{if } B \leq B^*_{2,h} \\
\frac{B}{B^*_{2,h}}, & \text{if } B > B^*_{2,h}
\end{cases}
\]

After the realization of the technology shock the model is identical to the static case.

**A.2.2 First Period**

**Endogenous Commitment** The self-interested fiscal authority in the first period faces the same first order condition with respect to bonds as before

\[
\frac{n}{m} = -n E \left[ \frac{\partial v(P|B)}{\partial B} \right] = \begin{cases} 
0, & \text{if } B < B^*_{2,l} \\
\frac{n}{m}, & \text{if } B \geq B^*_{2,l}
\end{cases}
\]

The self-interested fiscal authority will issue \(B^*_{2,h}\) bonds although this will not equal the amount of revenue raised since \(E[P] > 1\). There is positive revenue from issuing up to \(B^*_{2,h}\) bonds. After that the price level rises one for one with the amount of bonds issued. In the case of a high realization of \(w_2\) the second period there will be no transfers and taxes will be at the endogenous boundary \(\tau^*_2, h\). If there is a low realization, the monetary authority will inflate away the bonds to the level \(B^*_{2,l}\) and taxes will be at the endogenous boundary \(\tau^*_2, l\).

**Definition 7** The equilibrium choices with self-interested fiscal policy and a technology shock are
• The government chooses $\tau_1^*, g_1^*, B = B_{2,h}^*$ to solve equations $\Box$ and the remainder is used as transfers to satisfy the budget constraint $\Box$. Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_1^*, g_1^*) + \sum \frac{T_{1,i}}{n}$ utility.

• In the second period there are two possibilities
  
  – If the low wage is realized in the second period, the monetary authority chooses price $P = P_l$. The government chooses $\tau_{2,l}, g_{2,l}^*, \sum_i T_{2,l,i} = 0$ that solve the first order condition of the benevolent fiscal authority $\Box$ subject to the budget constraint $\Box$, which must now pay off any bonds. Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_{2,l}^*, g_{2,l}^*)$ utility.

  – If the high wage is realized in the second period, the monetary authority chooses price $P = 1$. The government chooses $\tau_{2,h}, g_{2,h}^*, \sum_i T_{2,h,i} = 0$ that solve the first order condition of the benevolent fiscal authority $\Box$ subject to the budget constraint $\Box$, which must now pay off any bonds. Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_{2,h}^*, g_{2,h}^*)$ utility.

**Price Level Commitment**  The first order condition with respect to bonds is

$$\frac{n}{m} = -n E \left[ \frac{\partial v(P = 1|B)}{\partial B} \right]$$

$$= \begin{cases} 
0, & \text{if } B < B_{2,l}^* \\
\frac{p^n m}{(1-p) \left( \frac{1-\tau_{2,l}(B)}{1-\tau_{2,l}(B)(1+\epsilon)} \right)}, & \text{if } B_{2,l}^* < B < B_{2,h}^*
\end{cases}$$

$$= \begin{cases} 
\frac{1-\tau_{2,l}(B)}{1-\tau_{2,l}(B)(1+\epsilon)}, & \text{if } B \geq B_{2,h}^*
\end{cases}$$

If bonds are between $B_{2,l}^*$ and $B_{2,h}^*$ there is a $p$ chance the good shock hits and there are transfers and a $(1-p)$ chance the bad shock hits and the fiscal authority will raise taxes to pay off the bonds. The self-interested fiscal authority with price commitment will issue a level of bonds in this region, call it $\bar{B}$. The amount of revenue raised will be identical to the amount of revenue the self-interested fiscal authority with endogenous commitment raised although the number of bonds will be lower.
Definition 8  The equilibrium choices with self-interested fiscal policy and a technology shock with price commitment are

- The government chooses $\tau_1^*, g_1^*, B = \bar{B}$ to solve equations (8) and the remainder is used as transfers to satisfy the budget constraint (1). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_1^*, g_1^*) + \sum_i T_{1,i}$ utility.

- The monetary authority sets $P = 1$. In the second period there are two possibilities
  - If the low wage is realized in the second period, the fiscal authority chooses $\tau_{2,l}(\bar{B}), g_{2,l}^*(\bar{B}), \sum_i T_{2,l,i} = 0$ that solve the first order condition of the benevolent fiscal authority (3) subject to the budget constraint (2) which must now pay off any bonds. Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_{2,l}(\bar{B}), g_{2,l}(\bar{B}))$ utility.
  - If the high wage is realized in the second period, the fiscal authority chooses $\tau_{2,h}^*, g_{2,h}^*, \sum_i T_{2,h,i} = 0$ that solve the first order condition of the benevolent fiscal authority (3) subject to the budget constraint (2) which must now pay off any bonds. Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_{2,h}^*, g_{2,h}^*)$ utility.

Proposition 2 is proved by noting that allocations are identical in the first period and in the second period on a high realization of the technology shock. In the case of a bad realization the tax rate with endogenous commitment is $\tau_{2,l}^*$ while the tax rate with price commitment is $\tau_{2,l}(\bar{B})$ which is strictly greater and hence utility strictly lower.

A.3 Proof of Proposition 3

The only situation that hasn’t yet been examined involves a captured monetary authority. If the fiscal authority is benevolent, the optimal price setting of a captured monetary authority is the same and results follow identically. If the fiscal authority is self-interested, the derivative of the self-interested monetary authority’s value
function with respect to $P$ is

$$v'(P) = \begin{cases} 
\frac{B_B}{P^2}, & \text{if } \frac{B}{P} < B^*_2, \\
\left[1 - \frac{\epsilon \tau_2(B)}{1 - \tau_2(B)(1 + \epsilon)}\right] B_B, & \text{if } \frac{B}{P} \geq B^*_2. 
\end{cases}$$

The case $\frac{B}{P} < B^*_2$ arises from the equivalence of government debt and transfers in a consumer’s budget constraint: both are wealth. Receiving a transfer is identical to holding government debt. Increasing the price level decreases nominal government debt. The total decrease in debt will equal the total increase in transfers.

Independent monetary policy weighed this increase averaged across all $n$ consumers compared to the decrease in debt and saw it had no effect. (See Proof A.1.1; the comparable derivative was 0 in this region, equivalent to $m = n$ above.) For captured monetary policy, those transfers aren’t averaged. Increasing the price level decreases the amount the government has to repay everyone while increasing the transfers to just the coalition. It is in effect a lump sum tax on all to fund direct transfers for the coalition.

The derivative is always positive so there’s always a benefit to increasing the price level,

$$P = \begin{cases} 
[1, \infty), & \text{if } B = 0, \\
\infty, & \text{if } B > 0. 
\end{cases}$$

Because of the expectation of the price level there will be no bonds in the first period. This is a new situation: there are no bonds but transfers are still possible.

**Definition 9** The equilibrium choices with self-interested fiscal policy and captured monetary policy are

- **In the first period** the government chooses bonds $B = 0$. With this constraint there are two situations: if there are transfers or not

  - If $B^*_1 \leq 0$ then $\sum_i T_{1,i} = 0$. The government’s choice of $\tau_1, g_1$ solves the first order condition of the benevolent fiscal authority subject to the budget constraint. Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_1, g_1)$ utility.

  - If $B^*_1 > 0$ then $\sum_i T_{1,i} > 0$. The government chooses $\tau^*_1, g^*_1$ to solve equations and the remainder is used as transfers to satisfy the budget con-
Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_1^*, g_1^*) + \frac{\sum_i T_1, i}{n}$ utility.

- In the second period, the monetary authority chooses price $P = 1$. With this constraint there are two situations: if there are transfers or not
  
  - If $B_2^* \leq 0$ then $\sum_i T_{2,i} = 0$. The government’s choice of $\tau_2, g_2$ solves the first order condition of the benevolent fiscal authority (3) subject to the budget constraint (2). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_2, g_2)$ utility.
  
  - If $B_2^* > 0$ then $\sum_i T_{2,i} > 0$. The government chooses $\tau_2^*, g_2^*$ to solve equations (4) and the remainder is used as transfers to satisfy the budget constraint (2). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_2^*, g_2^*) + \frac{\sum_i T_{2,i}}{n}$ utility.

The other new situation is the pairing of benevolent fiscal policy with captured monetary policy. Since bonds are impossible and the fiscal authority is benevolent, this is equivalent to the benevolent fiscal policy, benevolent monetary policy case.

**Definition 10** The equilibrium choices with benevolent fiscal policy and captured monetary policy are

- In the first period, the government chooses bonds $B = 0$. With this constraint, the government chooses optimal quantities $\tau_1, g_1, \sum_i T_{1,i}$ that solve its first order condition (6) and subject to the budget constraint (1). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_1, g_1)$ utility.

- In the second period, the monetary authority chooses price $P = 1$. The government chooses $\tau_2, g_2, \sum_i T_{2,i}$ that solve its first order condition (3) subject to the budget constraint (2). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_2, g_2)$ utility.

**A.4 Proof of Proposition 4**

The analysis of first order conditions and the monetary authority’s best responses has already been explicated in detail in the preceding proofs. This follows the proofs in
Battaglini and Coate (2008) and Battaglini et al. (2008) which go into more detail. The case of indexed debt is identical to Battaglini and Coate (2008). The case of nominal debt changes the first order condition with regard to debt from Battaglini et al. (2008) but is otherwise similar.

I begin by describing the characteristics of the infinite period equilibrium.

A.4.1 Benevolent Fiscal Policy

As shown in Battaglini et al. (2008), the benevolent fiscal authority will attempt to accumulate enough bonds to fund spending on the public good while setting the tax rate to zero. Define this Samuelson level of public debt to be

\[ x = -\frac{(nA)\sigma}{1/\beta - 1}. \]

As shown previously, a benevolent fiscal authority is unable to issue bonds due to time inconsistency. There is an asymmetry though with regards to accumulating bonds. On entering a period with negative bond holdings \( B \), the monetary authority will decrease the price level in order to increase the value of those bonds to \( x \). The full price reaction function is

\[ P^* = \begin{cases} \frac{x}{\theta}, & \text{if } B < 0 \\ [1, \infty), & \text{if } B = 0 \\ \infty, & \text{if } B > 0. \end{cases} \]

Thus while a benevolent fiscal authority is unable to issue any bonds due to time inconsistency, the authority can accumulate bonds but most do so all at once. The tax rate in the period when the bonds are accumulated is going to be exceedingly high, and thus exceedingly distortionary, in order to raise the revenue to buy the bonds. In return, taxes will be zero for all future periods.

Depending on the discount rate \( \beta \) and the size of technology shocks to \( w \) (how well off a period is) a benevolent fiscal authority may never be able to accumulate any bonds. A larger discount rate \( \beta \) means the benefit from zero future taxes will be larger. A larger technology shock \( w \) means that the high tax rate required in the accumulating period will be less distortionary, lowering the cost.
A.4.2 Self-Interested Fiscal Policy

The behavior of a self-interested fiscal authority is identical to the two period case. The bond cutoff is

\[ B_c^* = \text{Rev}(\tau^*) + B^* - g^*. \]

As shown previously, at the beginning of every period the monetary authority will use the price level \( P \) to set the amount of nominal bonds to \( B_c^* \). Hence the self-interested authority will be constrained to use \( B_c^* \) bonds. I assume that \( B_c^* \) is strictly positive for all periods to ensure that manipulation of \( P \) can match \( B_c^* \) since setting \( P \) cannot change a positive level of bonds to a negative one.

A.5 Proof of Proposition 5 and Proposition 6

A.5.1 The Second Period in the Monetary Union Model

Assume there are two homogenous countries denoted with subscripts \( a \) and \( b \). Without repeating the same analysis, I define the important terms. \( B_2^* \) was the cutoff level of bonds below which a self-interested fiscal planner had positive transfers. We now have two such cutoffs: \( B_{2,a}^* \) and \( B_{2,b}^* \). Without loss of generality assume \( B_{2,a}^* \leq B_{2,b}^* \).

The monetary authority will set the price level to eliminate as many taxes as possible. The problem is essentially a double of the old problem

\[
v(P) = \max_{\tau_{2,a}, g_{2,a}, T_{2,a,i}} \left[ w(\tau_{2,a}, g_{2,a}) + \frac{\sum T_{2,a,i}}{n} \right] + \max_{\tau_{2,b}, g_{2,b}, T_{2,b,i}} \left[ w(\tau_{2,b}, g_{2,b}) + \frac{\sum T_{2,b,i}}{n} \right]
\]

s.t. \( \tau_{2,a} \geq \tau_{2,a}^*, g_{2,a} \leq g_{2,a}^*, \tau_{2,b} \geq \tau_{2,b}^*, g_{2,b} \leq g_{2,b}^* \)

The monetary authority’s actions are governed by

\[
v'(P) = \begin{cases} 
0, & \text{if } \frac{B_{2,a}}{P} < B_{a}^*, \frac{B_{2,b}}{P} < B_{b}^* \\
\frac{\epsilon_a \tau_{2,a}(B_{2,a})}{1-\tau_{2,a}(B_{2,a})(1+\epsilon_a)} \frac{B_{n,2,a}}{P^2}, & \text{if } \frac{B_{2,a}}{P} \geq B_{2,a}^*, \frac{B_{2,b}}{P} < B_{2,b}^* \\
\frac{\epsilon_b \tau_{2,b}(B_{2,b})}{1-\tau_{2,b}(B_{2,b})(1+\epsilon_b)} \frac{B_{n,2,b}}{P^2}, & \text{if } \frac{B_{2,a}}{P} < B_{2,a}^*, \frac{B_{2,b}}{P} \geq B_{2,b}^* \\
\frac{\epsilon_a \tau_{2,a}(B_{2,a})}{1-\tau_{2,a}(B_{2,a})(1+\epsilon_a)} \frac{B_{n,2,a}}{P^2} + \frac{\epsilon_b \tau_{2,b}(B_{2,b})}{1-\tau_{2,b}(B_{2,b})(1+\epsilon_b)} \frac{B_{n,2,b}}{P^2}, & \text{if } \frac{B_{2,a}}{P} \geq B_{2,a}^*, \frac{B_{2,b}}{P} \geq B_{2,b}^* 
\end{cases}
\]

The derivative shows that if bonds are above both cutoffs \( B_{2,a}^* \) and \( B_{2,b}^* \) increasing the
price level decreases taxes in both countries. If only one country is above its cutoff, increasing the price level decreases taxes in that country while transfers will increase in the other. If we’re below both cutoffs, increasing the price level results in increased transfers and stable taxes in both countries. Since increasing transfers in this manner has no net benefit nor cost, the derivative is positive in all regions except the latter.

The decision of the monetary authority is clear: set the price level to minimize taxes in both countries. As $B^*_{2,a}$ and $B^*_{2,b}$ are independent, this is an obligation to clear away the bonds from both countries until the laggard hits its cutoff. The monetary authority can’t simply set $P$ to match the lower cutoff $B^*_{2,a}$. For example, if country $a$ issues just enough bonds to be at its cutoff, but country $b$ is above its own, the price level will be set such that $\frac{B_{2,b}}{P} = B^*_{2,b}$. Mathematically,

$$P^* = \begin{cases} 
1, & \text{if } B_{2,a} \leq B^*_{2,a} \text{ and } B_{2,b} \leq B^*_{2,b}, \\
\max \left[ \frac{B_{2,a}}{B^*_{2,a}}, \frac{B_{2,b}}{B^*_{2,b}} \right], & \text{if } B_{2,a} > B^*_{2,a} \text{ or } B_{2,b} > B^*_{2,b}
\end{cases}$$

A.5.2 The First Period in the Monetary Union Model

With the optimal $P$ in the second period as a function of bonds $B_{2,a}, B_{2,b}$ we can find equilibrium choices in the first period. Choices of bonds, and thus bonds prices $q_a, q_b$, are made simultaneously. The analysis is identical to the single country case. The optimal monetary authority responds to any attempt to issue bonds above a country’s cutoff by raising the price level to constrain the country’s debt.

**Definition 11**  
• In the first period either country can have transfers or not

- If $B^*_{1,a} \leq 0$ then $\sum_i T_{1,a,i} = 0$. The government’s choice of $\tau^*_{1,a}, g^*_{1,a}, B_a = \max\{0, B^*_{2,a}\}$ solves the first order condition of the benevolent fiscal authority (6) subject to the budget constraint (1). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau^*_{1,a}, g^*_{1,a})$ utility.

- If $B^*_{1,a} > 0$ then $\sum_i T_{1,a,i} > 0$. The government chooses $\tau^*_{1,a}, g^*_{1,a}, B_a = B^*_{2,a}$ to solve equations (8) and the remainder is used as transfers to satisfy the budget constraint (1). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau^*_{1,a}, g^*_{1,a}) + \sum_i \frac{T_{1,a,i}}{n}$ utility.
- If $B_{1,b}^* \leq 0$ then $\sum_i T_{1,b,i} = 0$. The government’s choice of $\tau_{1,b}, g_{1,b}, B_b = \max \{0, B_{2,b}^*\}$ solves the first order condition of the benevolent fiscal authority (6) subject to the budget constraint (1). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_{1,b}, g_{1,b})$ utility.

- If $B_{1,b}^* > 0$ then $\sum_i T_{1,b,i} > 0$. The government chooses $\tau_{1,b}^*, g_{1,b}^*, B_b = B_{2,b}^*$ to solve equations (8) and the remainder is used as transfers to satisfy the budget constraint (1). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_{1,b}^*, g_{1,b}^*) + \sum_i T_{1,b,i}/n$ utility.

In the second period, the monetary authority chooses price $P = 1$. The governments choose $\tau_{2,a}, g_{2,a}, \sum_i T_{2,a,i} = 0$ and $\tau_{2,b}, g_{2,b}, \sum_i T_{2,b,i} = 0$ that solve the first order condition of the benevolent fiscal authority (3) subject to the budget constraint (2) which must now pay off any bonds. Consumers’ choice of consumption and labor is defined by the government’s choices and they receive $w(\tau_{2,a}, g_{2,a})$ and $w(\tau_{2,b}, g_{2,b})$ utility.

Proposition 5 is proved by comparing the monetary-union equilibrium provided in Definition 11 with the equilibrium for self-interested fiscal policy provided in Definition 6. The case of heterogeneous countries in Proposition 6 is trivial.

### A.6 Proof of Proposition 7 and Proposition 8

#### A.6.1 The Second Period in the Fiscal Dominant Model

The final choice in the second period is that of the monetary authority. Fiscal policy has already set government spending and revenue, monetary policy must mechanically equalize the two. The choice of $P$ induced by the fiscal policy choices is

$$P = \begin{cases} 
\frac{B}{\text{Rev}(\tau_2) - g_2 - \sum_i T_{2,i}}, & \text{if } B > 0. \\
1, & \text{if } B = 0. \\
\infty, & \text{if } \text{Rev}(\tau_2) = g_2 - \sum_i T_{2,i}
\end{cases}$$

The government’s budget constraint will be satisfied at any level of revenue. The choices of fiscal policy are governed by the same first order conditions as our original
analysis: equation (3) in the case of benevolent fiscal policy or equation (4) for self-interested fiscal policy.

As a consequence of this, no revenue will be raised to repay bonds; that job will be left to monetary policy. Why pay bonds if it’s not required? Even ignoring the negative effects of raising revenue from the distortionary tax, repaying bonds is identical to direct transfers to all \( n \) citizens. A benevolent fiscal policy has no transfers, self-interested fiscal policy has transfers but only to its \( m \) coalition. In neither case will they utilize debt repayment as a way to increase utility.

### A.6.2 The First Period in the Fiscal Dominant Model

With the analysis of the second period complete it’s clear that no one will hold bonds since the real return on the bonds will be zero. The situation is identical to the original monetary dominant timing with a benevolent fiscal planner.

**Definition 12** The equilibrium choices with fiscal dominant timing under either a benevolent fiscal planner or a self-interested fiscal planner are

- **In the first period**, the government chooses bonds \( B = 0 \). With this constraint, the government chooses optimal quantities \( \tau_1, g_1, \sum_i T_{1,i} \) that solve its first order condition (6) and subject to the budget constraint (1). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive \( w(\tau_1, g_1) \) utility.

- **In the second period**, the monetary authority chooses price \( P = 1 \). The government chooses \( \tau_2, g_2, \sum_i T_{2,i} \) that solve its first order condition (3) subject to the budget constraint (2). Consumers’ choice of consumption and labor is defined by the government’s choices and they receive \( w(\tau_2, g_2) \) utility.

Proposition 7 is proved by comparing the equilibrium under fiscal dominant timing provided in Definition 12 with the equilibrium under monetary dominant timing and benevolent fiscal policy provided in Definition 3.

Proving Proposition 8 relies solely on the fiscal choice of \( \{\tau_1, g_1, T_{1,i}, B, \tau_2, g_2, T_{2,i}\} \). Clearly, not all choices are equilibria. If the fiscal authority attempts to issue more bonds than revenue dedicated to pay them back, the price \( q \) will rise to reflect the future rise in \( P \). This gives the fiscal authority the ability to choose any price level.
by choosing the amount $B$ of bonds. The government can still only raise first period revenue from bonds up to the amount of real revenue it dedicates to repayment in the second period.

**Definition 13** A choice of \{τ₁, g₁, T₁, i, B, τ₂, g₂, T₂ \} is an equilibrium if

- The real value of $B$ is equal to the amount set as repayment: $\frac{B}{B} = \text{Rev}(τ₂) − g₂ − \sum_i T₂_i$. This defines $P$ and hence price $q$.
- The government’s first period budget constraint \[(1)\] is satisfied by \{τ₁, g₁, T₁, i, B \} given the implied bond price $q$.
- The government’s second period budget constraint \[(2)\] is satisfied by \{τ₂, g₂, T₂, i, B \} given the implied price level $P$.

The fiscal authority can implicitly choose $P$ by choice of $B$ and the amount of repayment.

**A.7 Proof of Proposition 9**

**A.7.1 The Second Period in the Cash-In-Advance Model**

We enter the second period with a level $B$ of bonds and $M$ of money to purchase the cash good. The monetary authority will set $P$ in an attempt to maximize the utility of the representative consumer.

**Benevolent Fiscal Policy** The problem of the monetary authority is largely the same as before

$$v_s(P) = \max_{τ₂, g₂} \left[ w_m(τ₂, g₂, P) + \frac{\sum_i T₂_i}{n} \right].$$

where we have replaced the old indirect utility function $w$ with the new one $w_m$. The first order condition with respect to $P$ is

$$P^γ = \left[ \frac{ετ₂(B/P)}{1 − τ₂(B/P)(1 + ε)} \right] \frac{B_n}{M^{1-γ}} \quad (11)$$

This equation may have multiple roots although it simplifies to a single root in the log ($γ = 1$) case. Some roots may be less than one but we have ruled out deflation.
so these can be ignored. The set of optimal price levels is

\[ P_{m,s} = \begin{cases} 
1, & \text{if } B = 0 \\
\{P \text{ s.t. } P > 1\} & \text{if } B > 0 
\end{cases} \]

Generically the monetary authority is agnostic amongst these roots. A simple selection device would be for the monetary authority to choose the largest element in \( P^*_m \). This can be justified by a form of E stability as in \[ \text{Evans and Honkapohja} \ (1994) \]. If consumers expect a lower root to be chosen, the monetary authority will be able to choose the largest root to cause unexpected inflation and a real decline in bond value.

**Self-Interested Fiscal Policy** The monetary authority tries to maximize

\[
v_p(P) = \max_{\tau_2, g_2, T_2, i} \left[ w_m(\tau_2, g_2, P) + \frac{\sum T_2, i}{n} \right] \\
\text{s.t. } \tau_2 \geq \tau_2^*, g_2 \leq g_2^*
\]

The first order condition of this problem is

\[
v'_p(P) = \begin{cases} 
-M_n^{1-\gamma} P^{\gamma-2}, & \text{if } \frac{B}{P} < B_2^* \\
\left[ \frac{\epsilon \tau_2(n)}{1-\tau_2(n)(1+\epsilon)} \right] \frac{B_n}{P^2} - M_n^{1-\gamma} P^{\gamma-2}, & \text{if } \frac{B}{P} \geq B_2^*
\end{cases}
\]

Recall that \( B_2^* \) is the level of bonds above which increasing the price level decreases taxes and increases the public good and below which taxes and public good spending are constant while transfers increase. The new inflation cost applies to both situations. Hence the set of optimal price levels is

\[ P_{m,p} = \begin{cases} 
\{1\}, & \text{if } B \leq B_2^* \\
\{P \text{ s.t. } 1 < P \leq \frac{B}{B_2^*}\} & \text{if } B > B_2^*
\end{cases} \]

**A.7.2 The First Period in the Cash-In-Advance Model**

The equations for \( P^*_m \) and \( P^*_m \) now define their respective bond prices \( q \). The first order conditions look the same but the derivative term in the intertemporal first order condition for bonds hides the new inflation cost. The benefit of issuing bonds is their ability to smooth taxes, the cost is now both increased taxes in the second period
and the cost of losing money to buy the cash good.

**Lemma 14** \( P^*_{m,s} \geq P^*_{m,p} \) in strong set order.

**Proof.** For the region \( B \leq B^*_2 \), \( P^*_{m,p} \) is identically \( \{1\} \) while \( P^*_{m,s} \) contains \( \{1\} \) and also may contain larger elements. For the region \( B > B^*_2 \), \( P^*_{m,p} \) consists of all elements of \( P^*_{m,s} \) that are smaller than \( \frac{B}{B^*_2} \). This ensures that even without a price level selection device, Proposition 9 holds. Inflation is costly and will be weakly lower with self-interested fiscal policy. Hence more bonds can be held without cost and the comparisons follow directly.

For price level commitment the standard effects apply. As long as there is a positive level of bonds, a benevolent social planner will use those bonds solely for tax smoothing while a self-interested social planner can use some for wasteful transfers.