James Madison, George Soros, and Feldstein-Horioka: Disfavored Creditor Groups and Government Debt [*]

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Abstract

This paper examines the effect of reduced transaction costs in the trading of assets on the ability of governments to issue debt. We examine a model with two types of creditors, favored and disfavored. Governments are more inclined to default if a large proportion of their debt is held by the disfavored group. For example, the fledgling U.S. government paid soldiers in the U.S. with Pierce's notes, many of which were later bought by US Revolutionary War speculators at steep discounts. In an international context, governments may care more about the welfare of domestic creditors than foreign creditors. We show that reductions in transaction costs, for example due to greater international openness, that make it easier to sell debt to the disfavored creditors can increase the likelihood of default, raising the cost of credit, and reducing welfare. Multiple equilibria may exist if disfavored creditors are less risk averse than favored ones. Even without transaction costs, home bias in placement of government debt may persist, because with default risk the return on government debt is correlated with the tax burden required to pay the debt. Asset inequality may reduce this home bias, and by increasing foreign ownership, increase incentives for default.

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1. Introduction

> "To do what he (Alexander Hamilton) knew to be right was apparently to take sides with the wealthy against the poor, to champion the speculative profiteer against the poverty-stricken veterans of the Revolution who had parted with their evidences of indebtedness for a mere pittance and were now filled with rage at the thought that the purchases would reap a reward out of all proportion to the sums they had paid." *Leaders and Periods of American Finance* - Grayson p.65

Governments do not necessarily view all creditors equally. James Madison argued that the U.S. government had more responsibility for paying Revolutionary War soldiers who had been compensated with promissory notes than for paying speculators who had bought these notes at a discount. A future U. S. government may be more concerned with the impact of inflating away debt on domestic creditors' finances than with its impact on foreign creditors. This paper takes the possibility of such favoritism seriously and derives its implications for the ability of governments to issue debt.

Such a setting is arguably relevant both for the past of the U.S. debt markets, and for the future. First during the Revolutionary War, the United States government issued debt and promissory notes, known as Pierce's notes, to soldiers and merchants to purchase goods and services. As doubts arose as to the new government's ability to honor these obligations, these soldiers and merchants often sold their Pierce's notes at large discounts, sometimes as low as fifteen cents to the dollar. Wealthy speculators, both foreign and domestic, who were in better position to bear the risk and who were not liquidity constrained, purchased these instruments secondhand.

When the time came for repayment, a debate broke out between the founding fathers (Ferguson 1961). On one side, Alexander Hamilton and the Federalists advocated that the government should protect its future credibility and pay the debt to all current holders. Opposing them were James Madison, Daniel Webster, and Benjamin Rush, who argued that by paying the current holders the government would be enriching the wealthy speculators, some of them foreign, by taxing the very soldiers and merchants who had sacrificed their lives for the country. They preferred either outright default, or, at least, partial repudiation. The public was quick to side with the soldiers. A letter addressed to the Yeomanry of the US by "an American farmer" exclaimed, (Ferguson 1961)

> "Can it be thought reasonable or just that the assignee (current holder of the bond) should now be entitled to that which the assignor (original holder of the bond) honorably relinquished to the distressed state of the country? Must it not rather be regarded as the most atrocious act of iniquity and injustice that ever disgraced the annals of civil society, that, to secure the full payment of the debt to the assignee, a funding-system should take place by which the original creditors and their posterity will become the hewers of wood and the drawers of water to a foreign moneyed interest?" (Bolles 1894 p. 24)

More generally, many governments may have favor particular creditors. Governments presumably place greater value on the welfare of their citizens, to whom they are directly responsible and who elect them, than on foreigners. Thus, although governments may in some cases protect the rights of foreign creditors for instrumental reasons, they are more likely to value the welfare of citizens.

The possibility of such favoritism is indeed potentially relevant for the present and future of U.S. debt markets. In the last 3 decades, especially in the last 10 years, foreign holdings of U.S. treasury securities has substantially increased both in absolute terms and as a fraction of the total amount of public debt privately held.[1] There is not much consensus on the public debate about the consequences and actual importance of this fact.

Foreign ownership of sovereign debt is more broadly assuming increasing importance for rich countries. Many feel that transaction costs in the international trading of assets have been falling, due both to technological changes (such as the introduction of the internet) and to policy changes (such as the relaxation of rules limiting foreign investment by pension funds). In fact, the Feldstein and Horioka (1980) finding on the near absence of net capital flows among countries seems to be weakening (Feldstein and Bacchetta, 1989; Frankel, 1993). If this trend continues and transaction costs continue to fall, capital markets may someday become much more fully integrated.

To examine these instances where different creditor groups may exist, we consider a government which issues debt, but can later default. Default is costly. Default might be through inflation if the debt is denominated in domestic currency or it might come through outright repudiation which carries a reputation cost. There are two classes of potential creditors: favored creditors and disfavored creditors, to whom the government is more willing to default. We take the probability of default or, in the case of nominal debt, target inflation, to be an increasing function of the amount of debt held by disfavored creditors.

[1] In December 2006, the U.S. Treasury estimated that U$ 2.104 trillions of the public debt were held by foreign investors, while U$ 4.122 trillions was the total held by private investors.

We also assume that the government cannot selectively default only to one group. If a market exists so that resale of the debt cannot be controlled, it will not be possible to pay only one class of creditors: if the government announces, for instance, that it will not pay its debt obligations to foreign claimants, then foreign bondholders can just sell their bonds to domestic citizens. With a competitive market, foreign bondholders will receive from domestic buyers exactly the amount of debt repayment that a domestic bondholder can expect to receive from the government.

In this environment, favored creditors who sell some of the asset to disfavored creditors increase the amount of debt held by the disfavored group and reduce the value of the asset to all creditors (e.g., by increasing the probability of default or by increasing target inflation). This reduction in asset value is miniscule, so individuals will not internalize this effect, and holdings will be determined by portfolio diversification considerations. Assuming that the return on government debt is stochastic and imperfectly correlated with other assets, portfolio considerations will make it individually optimal for disfavored creditors to hold some government debt, even though all creditors bear an uncompensated reduction in asset value as a result of sales to disfavored creditors. In a rational expectations equilibrium, creditors will account *ex ante* for these sales when making their portfolio decisions, and the government will have to pay more for credit. Thus, we find the counterintuitive result that by enlarging the pool of possible creditors to include disfavored citizens, the government obtains less favorable terms of credit.

When willingness to bear risk increases with wealth, there may be multiple equilibria. We present a model in which disfavored creditors have greater wealth (and

hence lower risk aversion) than favored creditors. Because the disfavored creditors are more willing to bear risk, and the government is more likely to default the greater is the amount held by the disfavored creditors, there may be two equilibira. There may be a favored ownership equilibrium, in which all debt is held by the favored group and the default risk and cost of credit are therefore low. There may also be a disfavored ownership equilibrium, in which disfavored creditors hold some positive proportion of government debt, and the default risk and cost of credit are correspondingly higher.

If domestic creditors are favored over foreign creditors, this model suggests that domestic citizens will be more likely to own government debt even in the absence of any transaction costs. This is because the real return on government debt and the real tax burden are negatively correlated, since default on the debt reduces the tax burden required to pay the debt. Consequently, if all favored domestic agents are identical, we find that in our model, all debt is held by domestic citizens. In the more realistic case in which domestic agents are heterogeneous, and the tax burden of individual domestic agents is not proportional to their holdings of government debt, optimal portfolio selection requires foreigners to hold some government debt. The ratio of assets to tax burden varies across individuals since assets tend to be more concentrated than income, and taxes tend to be levied primarily on income. Because the government's default decisions is based on its amount of foreign indebtedness, our model suggests that, holding constant the tax schedule, greater asset inequality leads to greater foreign ownership of debt, and thus to inflationary default. This may be relevant to Latin America.

Related Literature

The problem of time inconsistency in fiscal and monetary policy is well-developed in the literature. In particular, many have noted that a government with nominal liabilities to foreign claimants may have an incentive to pursue an inflationary monetary policy to redistribute wealth from foreign to domestic citizens; this time-inconsistency problem may make it difficult for the government to issue nominal debt and offers a rationale for foreign-currency-denominated debt (Calvo, 1978; Kydland and Prescott, 1977; Persson et al., 1987; Bohn, 1990a; Bohn, 1991). Of course, this problem is not eliminated by issuing foreign-currency debt if that debt, too, can be repudiated. Our paper considers how the time-inconsistency problem discussed by these authors changes as frictions in international financial markets are reduced.

Drazen (1998) presents a political model of the allocation of debt among domestic and foreign creditors, in which the repayment decision varies with the identity of the creditor. In his model, unlike ours, governments have control over whether debt is held domestically or abroad, and they can selectively repudiate one class of its obligations (i.e., domestic or foreign). This paper considers a non-segmented market for sovereign debt in which domestic and foreign creditors can trade government claims and in which, therefore, there is no possibility of selective default.

Although our model is described in terms of sovereign debt, the analysis may have implications for a broader range of situations. For instance, Shiller (1995) promotes the creation of securities to insure against risk in national income. As Obstfeld and Rogoff (1996) point out, the desirability of such securities is undermined by the moral hazard this insurance would generate. Likewise, Calvo (2000) offers a model which shows that it may be optimal, in terms of *ex ante* domestic welfare, not to have a market

for insurance against national income risk. Our paper differs from Calvo's in examining sovereign debt markets, rather than markets for insurance against discontinuation of reform. We also derive implications of secondary sovereign debt markets for home bias, consider the welfare consequences of different degrees of friction in international debt markets, and show the possibility of multiple equilibria in the placement of sovereign debt.

The remainder of this paper is organized as follows. In Section 2 we present a partial equilibrium model of government debt in a context of international finance, where favored and disfavored creditors are respectively domestic and foreign creditors. We find that reductions in transactions costs can worsen the price of government debt. In section 3 we extend this result to a general equilibrium setting and show that reductions in transaction costs can reduce overall social welfare. We also find that home bias can persist even in the absence of transaction costs. In section 4, we present a simple example based on the history of the American Revolutionary War debt. Based on our previous results, we explain how the government's terms of credit and social welfare may decline as speculators disfavored by the government become able to purchase government bonds. We also discuss the potential implications of our analysis to the present and future of the U.S. Debt markets. In section 5, we show that there may be multiple equilibria if disfavored creditors are less risk averse than favored creditors. In our remarks in Section 6, we describe a model of exchange-rate risk to motivate the denomination of debt in domestic currency, and to match the empirical observation that some governments seem at least as willing to inflate away domestically denominated debt as to default outright on debt denominated in foreign currency. Section 7 concludes.

2. International Public Finance and the Basic Model

In this section we present a partial equilibrium model of government debt to show that enlarging the pool of disfavored creditors can worsen the government's terms of trade if the government's cost of default is sufficiently low.

An important context where the distinction between favored and disfavored creditor groups may arise is in the market for international debt. Domestic governments issue debt obligations that are often purchased by foreign investors. Domestic governments may tend to value the utility of their own citizens more than that of foreign investors. As foreign investors become an even more significant creditor group through a worldwide decline in international transaction costs, a government's preference toward domestic creditors may have important ramifications.

There is historical evidence that the repayment decisions of sovereign debtors are conditioned on the identity of their creditors. For instance, speculative attacks against the French franc in the 1920s have been blamed on expectations that the government would try to inflate away its foreign debt obligation from World War I (Krugman, 1997).

Consider the following two-period partial equilibrium model. A government wishes to raise money in the first period in order to invest in some public good which generates utility for domestic (favored) citizens in the second period. The government has two default technologies available to it: outright default and inflation. We assume that if the government's debt obligation exceeds D unities, it cannot credibly commit not to default outright, and so it is limited to issuing D units of debt.[2] Thus the government issues D units of debt at the market price p per unit.

[2] We discuss further how to relax this assumption , allowing the government to endogenously choose how much nominal debt to issue. Admittedly, under this rationale, the government's debt limit should be D in

The government issues debt to both domestic and foreign creditors. Domestic creditors are favored and foreign ones are disfavored. In the first period, the government issues D units of debt; each unit of debt pays 1 (in nominal terms) in the second period. Domestic and foreign creditors make a portfolio decision in the first period to divide their wealth between the two available assets: government debt, and a safe asset which pays 1 (in real terms) in the second period. Creditors can purchase debt directly and then can also trade among themselves. In the second period, the government sets a target inflation rate to reduce the real value of its debt repayment; actual inflation, which is stochastic, is realized; and the government pays off its debt.

In this economy, there are transaction costs associated with trading debt. We have in mind here asymmetric transaction costs which might affect foreign creditors but not domestic ones. For instance, the secondary market for sovereign debt may be frictionless for trades among domestic creditors, yet may involve logistical transaction costs or legal restrictions when foreign citizens purchase government bonds from domestic creditors. Alternatively, there might be important information, relevant for investment decisions on domestic bonds, which is more costly to be obtained for foreigners. We let transaction costs on the foreign ownership of government debt be indexed by C , so that for each unit invested by foreign creditors on government debt, they incur an additional cost of C. Domestic creditors do not incur any additional cost while investing in the risky asset.[3]

It is worth noting that under rational expectations, equilibrium asset allocations and price will be the same whether the government places its debt domestically and then trade

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real terms. However, for tractability, we assume here that the government is limited to issuing a fixed amount of debt in nominal terms.

[3] None of the results presented changes if we assume instead that foreign creditors earn only a fraction λ on the return from domestic debt.

occurs between domestic and foreign creditors, or the government places its debt on an international market. In the former case, domestic creditors correctly anticipate the amount of debt that foreign creditors will want to hold and the price at which the debt will trade; the government will place all of its debt domestically at that price, and then domestic creditors will sell the correctly anticipated quantity to foreign creditors. In the latter case (which corresponds to our model) domestic and foreign creditors initially purchase the equilibrium allocations of debt at the equilibrium price, and there is no further trade among the creditors. In either case, rational expectations guarantees that the placement price and secondary market price of debt will be identical.

There is a continuum of identical domestic and foreign creditors (i.e., with identical wealth and preferences) of measure n_d and n_f. Domestic citizens and foreign creditors have constant absolute risk aversion preferences, defined over wealth *w*, given by $u(w) = e^{-rw}$. The coefficient of absolute risk aversion, *r*, is common to both groups of creditors. We set the wealth endowment of all creditors to 1.[4] Let Γ_f and Γ_d denote the aggregate quantity of debt held by disfavored and favored creditors, respectively, at the beginning of period 2.

Let π denote the inflation rate (i.e., the ratio of the change in prices to period 1 prices). Then $\tau \equiv \frac{\pi}{1+\pi}$ represents the fraction of the real value of wealth eroded by inflation, and $1-\tau$ is the ratio of real to nominal value of wealth in the second period. In

[4] This is not a normalization. Rather, we are free to fix the creditors' endowment at any level as long as the creditors' optimal portfolio decisions are interior in equilibrium.. With CARA preferences and interior portfolio decisions , there are no wealth effects, so the creditors' portfolio decision of how much to invest in the risky asset is independent of their wealth endowment. Furthermore, all wealth not invested in debt is held as a safe asset, so that the comparative statics on welfare are unaffected by choice of initial endowment. Hence, all results are invariant with respect to the endowment of the creditors.

the second period, the government sets some target τ_e (and hence an implicit target inflation rate π_e). The value of realized τ is stochastic; it is normally distributed with mean τ_e and variance σ^2.[5] We require that inflation be stochastic so that government debt is, indeed, a risky asset, and that there is a non-trivial asset allocation problem faced by the agent. Since the equilibrium concept here is a rational expectations equilibrium, if $\sigma^2 = 0$, creditors will correctly anticipate the government inflation decision in period 1, and the equilibrium price of debt will be set equal to the real value of 1 unit of wealth in period 2. Government debt would then be a safe asset, offering the same return as the other asset in the economy, and there would be no portfolio decision to make.

Next we consider the foreign creditors' portfolio decision. Let *p* denoted the market price of government debt. Let *q* denote the (stochastic) return on 1 unit of wealth for a given choice of portfolio $(\gamma, 1 - p\gamma)$, where γ is the quantity of government debt held, and $1 - p\gamma$ the quantity of safe asset. Then, for a creditor facing transaction costs equal to C,

$$q = (1 - p\gamma) + \gamma(1 - \tau) - C\gamma, \tag{1}$$

the sum of the real return on the safe asset and the real return (net of transaction costs) on government debt. By normality of τ, *q* is distributed normally with mean and variance

[5] Admittedly, the symmetric distribution of τ about its mean results in an asymmetric distribution of π. We stipulation the distribution of τ instead of π for analytical convenience. Since, in practice, π is bounded above -1, τ should be bounded below 1. In this model, τ has unbounded support, but we take σ^2 to be small, so that the probability of τ > 1 is likewise small.

$$\mu_q = 1 - p\gamma + \gamma(1-\tau_e) - C\gamma \tag{2}$$

$$\sigma_q^2 = \gamma^2\sigma^2. \tag{3}$$

Under normality of returns and CARA utility, the certainty equivalent of a unit of wealth invested in a portfolio $(\gamma, 1-p\gamma)$ is given by $\mu_q - \frac{r}{2}\sigma_q^2$, or

$$CE = 1 - p\gamma + \gamma(1-\tau_e) - C\gamma - \frac{r}{2}\gamma^2\sigma^2. \tag{4}$$

The maximization of (4) yields

$$\gamma_f(p,\tau_e) = \frac{1}{r\sigma^2}(1-\tau_e - p - C). \tag{5}$$

Domestic creditors' portfolio decision is the same as the foreigner's decision except for the absence of transaction costs. The expression above therefore implies that

$$\gamma_d(p,\tau_e) = \left[\frac{1-\tau_e - p}{r.\sigma^2}\right]. \tag{6}$$

Equations (5) and (6) should be intuitive. The next expected return from holding the government bond is given by $1-\tau_e - p$ for domestic agents and $1-\tau_e - p - C$ for foreigners.

In order to have the model fully specified, we need to model how the choice of τ_e is made in period 2. Inflation generates a cost to domestic agents given $\frac{1}{2}k(\tau_e^2 + \sigma^2)$. Note that this cost is increasing and convex in τ_e. While choosing the level

of expected inflation τ_e, the government faces a trade-off between defaulting on the debt held by foreigners Γ_f and increasing this cost.

The marginal redistribution from foreign creditors to domestic citizens induced by inflation by a marginal increase in one unit of inflation is Γ_f,. The marginal cost of this increase is given by $\tau_e.k$. We have not specified in this section the objective for the government, but this reasoning suggests that is reasonable to stipulate the choice of τ_e as given by $\tau_e = \Gamma_f / k$. In the next section this will become an optimal decision for the government, given a well specified objective.

Given the government's actions, we can derive the equilibrium. Aggregating individual demand schedules, we have that $\Gamma_f(p) = n_f \gamma_f(p)$ and $\Gamma_d(p) = n_d \gamma_d(p)$. In an interior equilibrium, where both domestic and foreign creditors hold debt, those demands can be determined from equations (5) and (6). In this case, the equilibrium demands can be determined from the condition $\Gamma_d(p) + \Gamma_f(p) = D$.

This leads to the following equilibrium demands for debt:

$$\Gamma^*_d = \pi_d.D + \pi_d.\left(\frac{n_f.C}{r.\sigma^2}\right), \qquad (7)$$

and

$$\Gamma^*_f = \pi_f.D - \pi_d.\left(\frac{n_f.C}{r.\sigma^2}\right), \qquad (8)$$

where $\pi_d = \frac{n_d}{n_d + n_f}$ and $\pi_f = \frac{n_f}{n_d + n_f}$.

The condition for the equilibrium to be interior can be expressed in a simple way. When the price of the debt is low enough, only domestic creditors will demand a positive amount of the debt. As this price reduces, when foreigners are sufficiently compensated for transaction costs, they start demanding some debt. The equilibrium will be interior if, at the price were foreigners are starting to demand a positive amount of debt, the domestic demand is smaller than D. This can be expressed as

$$\frac{C}{r.\sigma^2} < D. \qquad (9)$$

We will assume that this condition holds true. If this were not the case, our comparative static results would not be interesting, since transaction costs would not matter for any equilibrium outcome.

From the same conditions used above to calculate the equilibrium demands and given the government's decision rule $\tau_e = \Gamma_f / k$, we can obtain the equilibrium price for this equilibrium:

$$p^* = \left(1 - \frac{\Gamma^*_f}{k}\right) - \frac{r\sigma^2}{n_f + n_d}.D - C.\pi_f. \qquad (10)$$

From the expression above it should be clear the two effects from reductions in transaction costs C. The direct positive effect is a consequence of the fact that decreases in C increase the foreign demand for the debt, what enables higher prices to place all the debt in the market. However, there is also a negative indirect effect. When C reduces, the foreign ownership of the debt Γ^*_f will increase, what leads to a higher temptation for the government to inflate and a lower price.

When the cost from inflation is sufficiently low, the second effect will be more important and reductions in transaction costs will worsen the terms of trade. To see this, note that the above expression for p leads to

$$\frac{\partial p^*}{\partial C} = \left(\frac{\partial \Gamma^*_f}{\partial C} \right) . \frac{1}{k} - \pi_f = \pi_f . \frac{n_d}{r\sigma^2 k} - \pi_f \qquad (11)$$

This expression will be positive only if

$$k < \frac{n_d}{r\sigma^2}.$$

The above result can be summarized in the following proposition.

Proposition 1 A *reduction in transaction costs worsens the government's terms of credit if and only if the cost of inflation is sufficiently low* ($\frac{dp^*}{dC} > 0$ *if and only if* $k < \frac{n_d}{r\sigma^2}$)

Proof. See the text above.

3. General Equilibrium Model

The model from the previous section left open the use of the resources raised by the government in the first period, the source of funds available for the government to repay its debt, as well as the explicit objective of the government while making the decision of how much to inflate. In this section we extend the previous model into a general equilibrium setting which explicitly addresses those issues. We show that, if the government's cost of default is sufficiently low, increasing the pool of disfavored

creditors not only can reduce the government's terms of credit but also reduce domestic social welfare. In an international finance context, we also find that home bias can persist even in the absence of transaction costs.

As before, the government wishes to raise money in the first period in order to invest in some public good which generates utility for domestic (favored) citizens in the second period and can only issues D units of debt at the market price p per unit. The public good enters into the domestic citizens' utility as an increasing function of the amount of investment ($p.D$) made. In the second period, the government levies taxes (of nominal value D) to pay off the debt.

The domestic population is now divided into two groups, whom we label rich and poor. Domestic wealth is owned by the rich, and only the rich act as domestic creditors. The poor do not invest in government bonds. In particular, the poor have some fixed endowment, immune to inflation, in the second period. For instance, this endowment might be agricultural output or wage income. We set the poor's wealth equal to 0 and their size equal to 1.[6] We assume that the poor do not act as creditors, because (for instance) the transaction costs are too high, or because they face informational, liquidity, or capital market constraints. In the second period, the government divides the tax burden between the two groups, levying a tax of h (exogenously determined in nominal terms) on the rich and 1-h on the poor.

The existence of a group (the poor) that does not act as a creditor is important in our framework for a simple reason. As we shall see below, domestic agents now have an additional incentive to hold domestic bonds to insure themselves against future taxes and,

[6] The results are invariant with respect to choice of the poor's endowment and size, so we set them respectively equal to zero and one, for convenience.

in the absence of such group, all domestic debt would be held by domestic creditors in equilibrium.

Except for this heterogeneity among domestic agents, we have the exact same set up as before. The government issues debt to a continuum of rich domestic creditors and foreign creditors of measure n_d and n_f, with identical wealth and preferences. Rich domestic creditors are favored and foreign ones are disfavored.

. The portfolio decision of domestic creditors remains the same as before, given by equation (5). However, domestic creditors' portfolio decision now must take into account the effect of taxes and inflation when maximizing their certainty equivalent. Domestic creditors collectively face a real tax burden of $hD(1-\tau)$, which is distributed normally with mean $h.D(1-\tau_e)$ and variance $h^2.D.^2\sigma^2$.

For a domestic individual portfolio defined by investment in γ_d units of debt, let *q* denote the normally distributed return, net of taxes:

$$q = 1 - p\gamma_d + \left(\gamma_d - \frac{hD}{n_d}\right)(1-\tau). \tag{12}$$

The mean and variance of the net return on a portfolio $(\gamma_d, 1-p\gamma_d)$ are therefore given by

$$\mu_q = 1 - p\gamma_d + \left(\gamma_d - \frac{hD}{n_d}\right)(1-\tau_e) \tag{13}$$

$$\sigma_q^2 = \left(\gamma_d - \frac{hD}{n_d}\right)^2 \sigma^2. \tag{14}$$

This implies that rich domestic creditors have the following maximization problem according to their certainty equivalence given from equations (13) and (14):

$$\gamma_d\ (p,\tau_e) = \arg\max_\gamma 1 - p\gamma + \left(\gamma - \frac{hD}{n_d}\right)(1-\tau_e) - \frac{r}{2}\left(\gamma - \frac{hD}{n_d}\right)^2 \sigma^2, \qquad (15)$$

which gives

$$\gamma_d(p,\tau_e) = \frac{hD}{n_d} + \left[\frac{1-\tau_e - p}{r.\sigma^2}\right]. \qquad (16)$$

In the absence of expected returns, domestic creditors have a motive for holding debt, because this enables them to insure themselves against future taxes. More precisely, in the absence of non-zero expected returns from holding the risky debt , each domestic agent would hold as much debt as much he or she is exposed to taxes (hD/n_d in equation (16)), achieving fully insurance.

In order to solve for the full equilibrium, we must first examine the government's problem . Specifically, let $v_1(p)$ and $\frac{1}{2}k_1(\tau_e^2 + \sigma^2)$ denote, in wealth equivalent units, the public good benefit and inflationary burden in the welfare of the rich, and $v_2(p)$ and $\frac{1}{2}k_2(\tau_e^2 + \sigma^2)$ the public good benefit and inflationary burden in the welfare of the poor. Recall that the poor collectively face a real tax burden of $(1-h)D(1-\tau)$, which is distributed normally with mean $(1-h)D(1-\tau_e)$ and variance $(1-h)^2.D^2.\sigma^2$.

The welfare of the rich is defined by the certainty equivalent

$$CE_1 = v_1(p) - \frac{k_1}{2}\left(\tau_e^2 + \sigma^2\right) + n_d\left(\mu_q - \frac{r}{2}\sigma_q^2\right), \tag{17}$$

where μ_q and σ_q^2 are defined by (13) and (14), and the welfare of the poor by the certainty equivalent

$$CE_2 = v_2(p) - \frac{k_2}{2}\left(\tau_e^2 + \sigma^2\right) - (1-h)D(1-\tau_e) - \frac{r}{2}(1-h)^2 D^2. \tag{18}$$

Thus, *ex ante* domestic social welfare (with equal weights given to rich and poor[7]) is given by the total certainty equivalent

$$TCE = v(p) - \frac{k}{2}\left(\tau_e^2 + \sigma^2\right) + n_d\left(\mu_q - \frac{r}{2}\sigma_q^2\right) - (1-h)D(1-\tau_e) - \frac{r}{2}(1-h)^2 D^2\sigma^2, \tag{19}$$

where $v = v_1 + v_2$, $k = k_1 + k_2$.

At the beginning of period 2, the government makes its target inflation decision to maximize *TCE*.[8] Because p and γ are determined in period 1, and h, n_d, and σ^2 are exogenously fixed, maximizing *TCE* with respect to τ_e is equivalent to maximizing

$$-\frac{k}{2}\left(\tau_e^2 + \sigma^2\right) + n_d\left(\gamma_d - \frac{hD}{n_d}\right)(1-\tau_e) - (1-h)D(1-\tau_e). \tag{20}$$

[7] The results which follow are suggestive of the results for arbitrary welfare weights; see further discussion in Appendix B.

[8] It is now clear that domestic creditors are favored *only* in the sense that their welfare, and not the welfare of foreigners, figures directly into the government's objective.

Recalling that $n_f \gamma_f + n_d \gamma_d \equiv \Gamma_f + \Gamma_d = D$, we conclude that (20) is maximized at $\tau_e = \Gamma_f / k$. This formalizes the intuition discussed in the last section.

Given the government's actions, we can follow the same steps as before and derive both the equilibrium demands for debt as well as the equilibrium price of one unit of nominal debt. This leads to the following equilibrium demands for debt:

$$\Gamma^*_d = \pi_d D + \pi_d . \left(\frac{n_f . C}{r . \sigma^2} \right) + (1 - \pi_d) . hD , \tag{21}$$

$$\Gamma^*_f = \pi_f D - \pi_d . \left(\frac{n_f . C}{r . \sigma^2} \right) - (1 - \pi_d) . hD , \tag{22}$$

where $\pi_d = \frac{n_d}{n_d + n_f}$ and $\pi_f = \frac{n_f}{n_d + n_f}$.

The condition as before for the equilibrium to be interior now becomes

$$\frac{C}{r . \sigma^2} < (1 - h) . D \tag{23}$$

Finally, the equilibrium price in equilibrium is given by:

$$p^* = \left(1 - \frac{\Gamma^*_f}{k} \right) - \frac{(1 - h)}{n_f + n_d} . Dr\sigma^2 - C . \pi_f . \tag{24}$$

This expression leads to

$$\frac{\partial p^*}{\partial C} = \left(\frac{\partial \Gamma^*_f}{\partial C} \right) . \frac{1}{k} - \pi_f = \pi_f . \frac{n_d}{r\sigma^2 k} - \pi_f . \tag{25}$$

Therefore we can replicate the result from Proposition 3 noticing again that when the cost from inflation is sufficiently low, the indirect effect from reducing transaction costs on the terms of trade will be more important, what will worsen the terms of trade.

Proposition 2 A *reduction in transaction costs worsens the government's terms of credit if and only if the cost of inflation is sufficiently low* ($\frac{dp^*}{dC} > 0$ *if and only if* $k < \frac{n_d}{r\sigma^2}$)

Proof. See the text above.

We note here the implications of (21) and (22) for home bias in this model. When C=0, the equilibrium quantity of debt held by domestic citizens are given by

$$\Gamma^*_d = \pi_d . D + (1 - \pi_d). hD \qquad (26)$$

Hence, when h = 0, the proportion of debt held by domestic creditors precisely equals their share of world wealth, as we would expect: domestic and foreign creditors have identical preferences and face the same portfolio decision, so their ownership share of any asset will equal their fraction of total population. However, as the tax burden h on domestic creditors increases, greater home bias is exhibited; indeed, when the government's repayment of debt is entirely financed by taxes on domestic creditors (h = 1), all debt is held by domestic creditors, no matter what the level of transaction costs (i.e., whatever the value of C). The reason is simple, the absence of domestic returns would be enough to clear the market with domestic agents (due to their insurance motives) and foreign creditors require some compensation (due to transaction costs) to

hold domestic debt. More generally, the same would happen if all domestic groups exposed to taxation could act as creditors.

We are not arguing that this is currently the main source of home bias, simply that even if the transaction costs and information asymmetries that account for home bias disappeared, home bias would persist.[9] Proposition 2 above establishes that when the cost of inflation *k* is low, so that the government's commitment not to default is not credible, reduction in transaction costs will worsen the government's terms of credit. However, further analysis is required to determine the welfare consequences of reduced transaction costs.

In what follows, all quantities are equilibrium quantities; asterisks are dropped for notational clarity. Recall that social welfare is defined by the total certainty equivalent in (19). We can rewrite this expression as:

$$TCE = \left[n_d + v(pD) - p.\Gamma_d - \Gamma_f.(1-\tau_e)\right] - \frac{k}{2}\left(\tau_e^2 + \sigma^2\right) -$$

$$- \pi_d \left(\gamma_q - \frac{hD}{n_d}\right)^2 . \frac{r\sigma^2}{2} - \frac{r}{2}.(1-h)^2 D^2.\sigma^2 \quad (27)$$

We are interested in the effect of decreasing C on equilibrium welfare, as given by *TCE** ≡ *TCE(p*).* As one can see from the expression above, there are three components of the domestic social welfare. First, the expected domestic return from the portfolio choice made between financing the public good and investing in the riskless asset, which is given by the first term in the expression above. Second, the cost due to

[9] We are implicitly interpreting the safe asset as a diversified portfolio of domestic and foreign assets.

inflationary distortions is the next term above. Finally, the cost due to the risk taken by the domestic citizens is the last term above.

When the transaction costs C change, there is an effect both on the price of the debt, the equilibrium inflation and the allocation of the debt between domestic and foreign creditors. The marginal effect of changing inflation for social welfare is zero, since the government determines inflation at a level that maximizes social welfare, i.e. at a point where this effect is equal to zero.

The change in the allocation of the debt has two effects. On one hand, is cheaper for the government to raise funds domestically, since there are commitment problems of repayment to outside creditors. On the other hand, this exposes more domestic citizens to the debt risk. In our model, those two effects cancel out.

Finally, the change in the terms of trade has an effect in the amount of public goods that the government is able to finance. This is the only important effect here. More precisely, from equation (27) we have that (see the appendix A for details):

$$\frac{\partial TCE^*}{\partial C} = \left(v'(p^* D)D - \Gamma_d^*\right)\frac{\partial p^*}{\partial C} \tag{28}$$

As long as the government only raises money to invest in the public good if that investment is worthwhile, we have that $v'(p^* D) - \Gamma_d^* / D > 0$. For the public project to be worthwhile, the marginal benefit from investment of an additional unit of wealth, $v'(p^*)$, must exceed 1, the marginal benefit from an additional unit of wealth. Since $\Gamma_d^* \leq D$, we have therefore established the following result:

Proposition 3 *Assuming that the public good is worthwhile, a reduction in transaction costs is welfare-enhancing if and only if the government's commitment not to inflate is sufficiently credible; i.e., if and only if the cost of inflation k exceeds* $n_d / r\sigma^2$.

Proof. See appendix A

We have assumed so far that if the government's debt obligation exceeds D, it cannot credibly commit not to default outright, what limited the government's ability to issuing D units of nominal debt. However, the results here presented can be extended if we relax this assumption. More precisely, suppose now that there is no such constraint for the government. Given C, there will be an optimal choice by the government of how much nominal debt to issue D*(C). Note that

$$\frac{dTCE(C, D^*(C))}{dC} = \frac{\partial TCE((C, D^*(C))}{\partial C}, \qquad (29)$$

given that the government chooses D* to maximize the TCE. Therefore, under the same conditions as in proposition 3, reductions in C will reduce domestic social welfare. However, the overall impact on the terms of trade will depend on the response of D*.

4. U.S. Debt Markets: Past, Present and Future

In the model presented last section, we analyzed how reducing transaction costs for the domestic government debt, in an international finance context, can impact both domestic government's terms of trade and domestic social welfare. The basic insight there presented can be arguably applied to a broad range of contexts, including the past, present and future of the U.S. debt markets.

Repayment of the American Revolutionary War debt was a very controversial issue in early America. The debate surrounding it was particularly acrimonious because it pitted soldiers and merchants against wealthy speculators. The soldiers and merchants to whom the debt was originally issued often sold the debts needing liquidity to buy basic goods or being unable to tolerate risk. Many felt that they were exploited by the wealthy who bought the debt at steep discounts. Thus, when it came time to repay, both the public and many politicians found it disagreeable to allow such exploitation to be rewarded.[10]

James Ferguson wrote in his history of early American public finance, *The Power of the Purse*:

> "Scores of newspaper articles denounced the present holders. They were said to have been loyalists or at least loyalists at heart, devoid of patriotism, and given to exploiting the public distress. They were portrayed as following soldiers to betray them with false information and buy their securities at a discount. Now that the fruits of a national union were to be distributed, it was cause for bitter complaint that the wicked were to be rewarded and the virtuous made hewers of wood and drawers of water. 'It is wished to sacrifice the *many* to a few… to make nobleman and nabobs of a few New York gentlemen, at the expense of all the farmers in the United States.' Benjamin Rush voiced the characteristic reply to all Federalist arguments about public credit and sanctity of contract when he wrote that a man who expected to get

[10] James Madison actually proposed a type of selective default. He wished to pay the current holders the current market value of the debt and to pay the original holders the par value minus the current market value. In this way, Madison would return to the original holders almost the entire value of the debt and give to the speculative secondary holders only what they roughly paid. Madison's plan was not adopted. His plan specifically contradicted the terms printed on the notes, (Perkins 1994), was difficult to implement practically since transaction records were not well recorded, (Stabile 1998) and was still a form of default.

> twenty shillings on the pound for securities bought for a tenth of that amount had a mind like a highway robber" (Ferguson 1961 p. 301)

In this example, it appears that the existence of the speculators as a sizeable creditor group jeopardized the possibility of repayment.

The arguments against paying the debts to speculators extended beyond not rewarding exploitation. The public realized that payment of the debt would have to come from taxes levied on the very soldiers and merchants who first sold their notes. Pelatiah Webster, author of *Political Essays on the Nature and Operation of Money, Public Finance, and Other Subjects* (1791), argued this point:

> "He charged that the government would not be paying patriotic citizens and soldiers who risked their money and lives in the Revolution but speculators, for it was 'a matter of public notoriety and general belief, that almost the whole of the widows, orphans, soldiers and other distressed public creditors have sold their certificates, which are now in the hands of speculators'… At the same time, the money to pay these obligations would come from taxes levied, in part, on those who had been forced to sell their certificates." (Anderson 1983 p. 47)

This issue became a particularly sensitive topic. In fact, Massachusetts, where Revolutionary War debt payment began before the federal government's plan, imposed high property and poll taxes to raise revenue. These policies led to large public demonstrations sometimes culminating in violence as in Shay's rebellion in 1786. (Anderson 1983)

In the same basic set up as before, suppose now that the two groups of potential creditors are soldiers and patriots (favored group), and speculators (disfavored group). Debt is first issued to the favored group. Soldiers, however, can choose to sell their notes to speculators at a transaction cost.

The main difference from before is that now taxes might be partially levied also on speculators. However, the main insights from last section remain the same. The existence of the group of speculators and their ability to hold the revolutionary war debt could worsen both the government's terms of trade and social welfare by worsening the government's ability to credibly repay.

More recently, the increasing importance of foreign holdings of U.S. treasury securities has been a topic of intense public debate. Both the total amount and the fraction of foreign holdings of U.S. federal debt have substantially increased since the seventies, reaching in 2005 more than 50% of all debt held by private investors. To the extent that the preferential treatment of domestic creditors can become a serious concern at some point, our analysis suggests a challenge for the continuation of this path by future U.S. governments.

5. Multiple Equilibria

In this section, we analyze how the ability of a disfavored group to purchase government debt can lead to multiple equilibria. More precisely, we show that when the assumption of CARA preferences is dropped, and agent's wealth is allowed to vary with their wealth, there may be multiple equilibria in the market for government debt.

We continue to consider a two-period model in which the government issues risky debt, at a market price p, to domestic and foreign creditors in the first period. For simplicity, we will assume now that the government can credibly issue only one unit of

dent. However, debt is *rea*l now, and pays out 1 in real terms in the second period; the government may also choose to default, in which case it repudiates its debt entirely and creditors earn zero return.

Risk-averse favored and disfavored creditors make a portfolio decision in the first period between the risky debt and a safe asset which pays 1 with certainty in the second period. The two groups of creditors could represent either the domestic and foreign creditors as in our international finance example or soldiers and speculators as in our revolutionary war debt example.

There are two important distinctions between those two groups of creditors. First, as before, disfavored creditors face transaction costs C on each unit of debt they hold. Second, disfavored creditors are less risk averse than favored creditors. This may occur, for instance, if we assume that agents' willingness to bear risk increases in their wealth, and that disfavored creditors have greater wealth than domestic creditors.

This last assumption is central and leads us to the multiple equilibria result. Since foreigners are willing to bear more risk than domestic creditors, and since greater foreign ownership makes the government debt more risky, there may be multiple equilibria in the market for government debt.

In order to capture that idea we assume that disfavored creditors have sufficient wealth that they act effectively risk neutral and we model the government default decision in a simple way. The government faces a cost of default k which is stochastic, and is realized only at the beginning of the second period, after creditors have made their portfolio decisions, but before the government makes its decision whether to default or repay.

Following the notation used in the international finance application, denote the demand for debt by favored and disfavored creditors respectively by Γ_d and Γ_f. The net benefit from default is the cost of servicing debt held by disfavored creditors (Γ_f) less the cost of default k. Hence, the government defaults if and only if $\Gamma_f - k \geq 0$.

For the distribution of k, we assume that with probability $\phi_{\max} < 1$, $k \in [0, F]$, where F is some constant less than 1. With probability $1 - \phi_{\max}$, there is a very high cost of default; in particular, k>1. This generates a period one probability of default $\phi(\Gamma_f)$ as a function of foreign ownership, where ϕ is just the cumulative distribution function of k. Under our assumptions, $\phi(0) = 0$, $\phi'(\Gamma_f) \geq 0$ and $\phi(\Gamma_f) = \phi_{\max} < 1$ for $\Gamma_f \in [F,1]$.

We are not being very specific about the incidence of taxes between favored and disfavored creditors. However, this is not crucial here. As it should become clear, everything that matters are conditions on the equilibrium demand for debt of favored and disfavored creditors.

This model can have at least two equilibria if domestic agents are sufficiently risk averse. First, there is an equilibrium in which all debt is held by favored creditors. $\Gamma_f = 0$ implies that the probability of default ϕ is zero, and that the government debt is therefore a safe asset. Since domestic creditors face no transaction costs, they will bid the price of debt up to its real return: $p^* = 1$.

At this price, domestic creditors are indifferent between government debt and the other asset (both of which are safe, offer the same return, and trade at the same price), but because of transaction costs, foreign creditors will hold no debt at this price. Hence, $\Gamma^*_f = 0$, $\Gamma^*_d = 1$, $p^* = 1$ is always an equilibrium.

Now suppose that favored creditors are sufficiently risk averse that if $p = 1 - \phi_{\max} - C$, and the probability of default is $\phi_{\max}$, then domestic creditors will demand $\Gamma_d(p, \phi_{\max}) = D < 1 - F$. In this case, there is a second equilibrium where disfavored creditors will hold a positive amount of debt and there will be a positive probability of default in equilibrium .

Suppose $\Gamma_f = 1 - D$; then $\Gamma_f > F$, so the probability of default is $\phi_{\max}$. Risk neutral disfavored creditors will set the price of the debt at their expected return on debt, $p = 1 - \phi_{\max} - C$. At this price and risk of default, domestic creditors will want to hold $\Gamma_d(p, \phi_{\max}) = D$. This implies that $\Gamma^*_f = 1 - D$, $\Gamma^*_d = D$ is also an equilibrium allocation, with $p^* = 1 - \phi_{\max} - C$.

Finally, another potential mechanism for multiple equilibria in our revolutionary war debt example is for soldiers to be liquidity constrained. If soldiers require a certain amount of liquidity to buy basic goods, they will need to sell a portion of their debt holdings. However, as speculators buy more debt, the probability of default and the price of the debt will decrease. Since soldiers require a set amount of liquidity, this fall in price will force soldiers to sell more of their debt which will serve further to decrease the price of the government debt. This process will also allow for the existence of multiple equilibria.

6. Extensions

Our model of section 3 describes domestic creditors as favored. Empirically, some countries seem as reluctant to default on debt denominated in foreign currency as

on debt denominated in domestic currency, even though foreign-currency-denominated debt is more likely to be held by foreigners.[11] We could extend our model to match this fact, without assuming that governments are more concerned for foreigners' welfare than for that of domestic citizens. Below, we first sketch such as extension, and then argue that in such a model, reductions in transaction costs may reduce the ability of nations to issue domestic-currency-denominated debt.

In order to understand why countries seem more willing to inflate away domestically denominated debt than to repudiate foreign-currency-denominated debt, it seems reasonable to follow Cole and Kehoe (1996) in assuming that an explicit violation of a contractual obligation (such as outright repudiation of debt) creates some cost due to generalized loss of reputation, including reputation in other areas, such as protection of foreign direct investment. Default of domestic-currency-denominated debt need not be outright, but can be realized through inflation. Investors in domestic-currency-denominated debt know that they are accepting a risk of inflation, so inflation does not entail as great a loss of generalized reputation (and, hence, as great a cost) as explicit repudiation of debt. Then, a government may be willing to use inflation to reduce the value of its indebtedness where it would be unwilling to default outright on it obligations.

Despite its time-inconsistency problem, a government may nonetheless wish to issue domestic-currency-denominated debt; this is well-documented in the literature (Bohn, 1990b; Bohn, 1994; Freeman and Tabellini, 1998; Persson et al., 1987). For example, governments may issue nominal liabilities to shield themselves from the

[11] Though recent events do suggest that countries aren't unwilling to default on (or renegotiate) liabilities to foreign creditors, including ones denominated in foreign currency. In 1998, Russia defaulted on ruble-denominated debt as well as on foreign currency denominated debt. In 1999, Ecuador became the first country to default on its dollar-denominated Brady bonds.

exchange-rate risk associated with debt denominated in foreign currency. Consider the following model. Suppose that the domestic country does not value any goods from abroad in the second period. The only reason it exports in period 2 is to pay off its debt from period 1. The rest of the world is large enough that it acts as if it were risk neutral. The taste in the rest of the world for the good produced by the domestic country is random, so that the price in foreign currency at which the domestic economy can export its good in period 2 is also random. The price of the domestic good in domestic currency is always 1.

If foreign taste for the domestic good turns out to be favorable in period 2, then the good will have a high price in foreign currency, and domestic currency will be valuable. If foreign taste turns out to be unfavorable, then the good will have a low price in foreign currency, and domestic currency will be worth little. If debt is denominated in foreign currency, then the amount of goods that the country has to produce to pay off its debt will vary with foreign taste for the good. Risk to the domestic economy is minimized by denominating the debt in domestic currency, since domestic-currency denomination implied that a constant amount of production from the domestic economy will be needed to pay off the debt to the rest of the world (namely, one unit of output per unit of debt).

In these circumstances, a government that could credibly commit to repay would prefer to issue domestic-currency-denominated debt than foreign-currency-denominated debt. Where credibility is imperfect (as in our model), countries face a tradeoff between denomination in domestic currency in order to protect themselves from exchange-rate risk and denomination in foreign currency in order to reduce the temptation to inflate.

Applying our previous analysis to this richer situation suggests that if transaction costs in domestic-currency-denominated debt are high, for example, because costs of changing currency are great, then countries will be able to issue domestic-currency-denominated debt. However, reductions in transaction costs lower the welfare associated with issuing debt denominated in domestic currency. They do not alter the welfare associated with issuing foreign-currency-denominated debt. Thus, in this situation, our model implies that reductions in transaction costs could lead to a switch from denomination of debt in domestic currency to denomination in foreign currency. These reductions in transaction costs could thus reduce welfare by reducing countries' ability to insure exchange rate risk, without increasing their ability to commit to repay debts.

7. Conclusion

Standard analysis would suggest that a reduction of transaction costs facing foreign investors should improve sovereign debtors' terms of credit. Our model demonstrates, however, that when a government cannot selectively default on debts to only some of its bondholders, and when its willingness to default varies with the distribution of its obligations among various claimants, then reduced transaction costs can actually worsen the government's terms of credit and social welfare. In particular, a reduction in transaction costs has two opposing effects on the government's terms of credit. On the one hand, disfavored creditors facing lower transaction costs will tend to bid up the price of government debt. On the other hand, because the aggregate amount of debt held by disfavored creditors increases, the government's desire to default will be higher. *Ex ante*, rational creditors will demand a premium for this additional default risk. In the context we examine, if the cost of default is sufficiently low, the latter effect will predominate,

and the price of government debt will fall with the reduction in transaction costs. Our exposition holds with real debt and other default or renegotiation mechanisms as well. Indeed, we have illustrated how our main results are robust to allowing the government to optimally choose how much debt to issue. In a simplified model of real debt with default through repudiation as shown in section 5, we also show that if disfavored creditors are less risk averse than favored creditors, there may be multiple equilibria in the market for government debt.

These results suggest that some amount of friction in international financial markets can be good for sovereign debtors. In particular, they suggest a reason why governments would want to reduce the liquidity of their debt instruments or to segment the markets in which they place their debt. In fact, governments do issue debt that is differentially targeted to domestic or foreign creditors. For instance, many countries issue savings bonds which are nontransferable for difficult to transfer. Domestic-currency-denominated debt may likewise be more attractive to domestic investors than foreign ones.

This model was presented in terms of sovereign debt, but the analysis may have implications for foreign investment, or other situations in which an agent has some control over an asset's value, and the agent's incentive to affect the asset's value varies with the identity of the claimants of that value. For instance, a government privatizing a firm may later desire to expropriate some of the value of the privatized firm through taxation. If the government's desire to expropriate value depends on the distribution of shares and the identity of shareholders (for example, the government may be tempted to expropriate the vale of firms that have a large amount of foreign ownership), then some

amount of illiquidity in this asset can be optimal. Indeed, this model suggests a rationale for the observed phenomenon of different classes of shares issued by some firms: some that can only be held domestically, and some that can be traded internationally.

Similarly, this model can be applied to the potential tradeoff, noted in the corporate finance literature, between liquidity and control: increasing the liquidity of share in a firm offers the benefits of a more liquid market, but may tend to disperse ownership and make monitoring more difficult (Coffee, 1991; Bhide, 1993; Admati et al., 1994). For instance, consider a privately held firm with significant ownership by employees which then lists on a stock exchange. Listing on the exchange reduces transaction costs in the market for the firm's shares. This encourages the employees to sell their shares for portfolio diversification reasons. However, once the shares have been sold, and ownership is diversified, no individual has an incentive to monitor the managers, and so the managers' incentive to maximize shareholder value may be reduced. This scenario is analogous to the model of sovereign debt we explore in this paper, and similar results apply.[12]

In fact, this example from corporate finance suggests another application of this model to sovereign debt, different from the one explored in this paper. A sovereign debtor facing a financial crisis may find it easier to renegotiate the terms of its debt if that debt is held by a small number of creditors (e.g., a few large banks) than if the debt is held by a diffuse set of small bondholders. A failure to renegotiate, in turn, is more likely to precipitate a crisis, and hence default. Lower transaction costs, then to the extent that they increase dispersion of bond ownership, again generate a tradeoff between risk-sharing and increased risk of default. In this case, the identity of creditors matters not

[12] We owe this example to Mathias Dewatripont.

because it affects that debtor's incentives to affect the value of the debt, but because it constrains the debtor's ability to do so; the results of our model still apply.

Appendix A

Proof of Proposition 4. We can calculate the effect from changes in C in the TCE using the expression in equation (27). From equation (27) we can write

$$\frac{\partial}{\partial C} TCE = \left[v'(p) - \Gamma_d\right]\frac{\partial p}{\partial C} + \frac{\partial \Gamma_d}{\partial C}\left([p - .(1-\tau_e)] - r\sigma^2 .\left[\gamma_d - \frac{h}{n_d}\right]\right) +$$

$$+ \left[k .\tau_e - \Gamma_f\right]\frac{\partial \tau_e}{\partial C} . \quad (30)$$

The expression above is very intuitive. The first term represents the direct effect from the change in the terms of trade in the total amount financed of public goods (fixed the amount of debt held by the foregin and domestic creditors and the level of inflation) The second term reflects the effect from the change in the equilibrium quantities of debt held by both domestic and foreign creditors. Given that the total quantity of debt is fixed, this is just a change in the composition of the debt between domestic and foreign creditors.

On one hand, an increase in the amount of debt held by foreingners increases the cost of financing the public good, from a domestic social poitn of view, since foreigners need to be compensated for the inflationary default. On the other hand, an increase in the importance of foreign creditors reduces the exposure of domestic citizens to the risk associated with domestic debt. From the demand fro debt of domestci agents, one can immediately see than in our model those two effects cancel out in the second term in equation(30).

Finally, there is the effect from the change in the level of inflation. Given that the government is choosing the level of inflation to maximize social welfare, the marginal effect from changes in inflation is zero. Recalling that $\tau_e = \frac{\Gamma_f}{k}$, it follows that the third term in equation(30) is equal to zero. Those last two observations imply that the last two terms in equation (30) are zero, what lead us to equation (28).

Appendix B

The total certainty equivalent defined by (19), and hence the results of Section 3, assume equal welfare weights for rich and poor.[13] More generally, we can define the total certainty equivalent for an arbitrary welfare weight $\alpha \in [0,+\infty)$ on the utility of the poor:

$$TCE = v(p) - \frac{k}{2}(\tau_e^2 + \sigma^2) + n_d(\mu_q - \frac{r}{2}\sigma_q^2) - \alpha(1-h)D(1-\tau_e) - \alpha\frac{r}{2}(1-h)^2 D^2\sigma^2, \quad (31)$$

where $v = v_1 + \alpha v_2$ and $k = k_1 + \alpha k_2$.

The first thing to notice is that since the equilibrium allocation of the debt between domestic and foreign creditors does not depend on the expected level of inflation, the equilibrium allocation of the debt will remain the same(given by equations (17) and (18)).

[13] Since *v* and *k* can reflect different weights on rich and poor, the only assumption, in fact, is that the social planner gives equal weight to a unit of taxes (inflation-risk adjusted) whether levied on the rich or poor.

However, now the government's inflation decision will be different. A simple way to see how this decision changes is to notice that the TCE can be written in terms of the previous TCE (TCE_0) as

$$TCE = TCE_0 + (1-\alpha)(1-h)D(1-\tau_e) - \alpha\frac{r}{2}(1-h)^2 D^2\sigma.^2$$

The only change in the government decision comes from the fact that inflation redistributes income from the rich to the poor and the government now weights those groups differently. The new government's inflation decision is given by

$$\tau_e = \Gamma_f / k + \frac{(1-\alpha)}{k}.(1-h).D\,.$$

Following the same steps as before we will also obtain the equilibrium price of the debt is given by

$$p = (1-\tau_e) - \frac{(1-h)}{n_f + n_d}.Dr\sigma^2 - C.\pi_f\,.$$

Since $\partial\tau_e/\partial C$ is the same as before, we also have that $\partial p/\partial C$ does not change, and proposition 3 remains unchanged. There is still the issue of what happens now to domestic social welfare. We have that the change in social welfare is now given by

$$\frac{\partial}{\partial C}TCE = [v'(p) - \Gamma_d]\frac{\partial p}{\partial C} + \frac{\partial\Gamma_d}{\partial C}\left([p - .(1-\tau_e)] - r\sigma^2.\left[\gamma_q - \frac{hD}{n_d}\right]\right) +$$

$$+\left[k.\tau_e - \Gamma_f - (1-\alpha).(1-h)D\right]\frac{\partial\tau_e}{\partial C}.$$

We have the same expression as before, except for one term. The change in inflation now has an additional effect on social welfare, given by the fact that inflation redistributes income among the different domestic groups. However, the same reasoning

described before also applies here. The government is already choosing the level of inflation to maximize social welfare (incorporating this new effect), and therefore the marginal effect on social welfare should be null.

As before, we have that

$$\frac{\partial TCE^*}{\partial C} = \left(v'(p^*) - \Gamma_d^*\right)\frac{\partial p^*}{\partial C}.$$

Therefore, proposition 4 also remains valid.

References

Adler, Michael and Bernard Dumas, "International Portfolio Choice and Corporation Finance: A Synthesis," *Journal of Finance*, v. 38 (June 1983), 925-84.

Admati, Anat R. et al., "Large Shareholder Activism, Risk Sharing, and Financial Market Equilibrium," *Journal of Political Economy*, v. 102 (December 1994), 1097-130.

Anderson, William, G. *The Price of Liberty*. University Press of Virginia (1983).

Bhide, Amar, "The Hidden Costs of Stock Market Liquidity," *Journal of Financial Economics*, v. 34 (August 1993), 31-51.

Bohn, Henning, "A Positive Theory of Foreign Currency Debt," *Journal of International Economics*, v. 29 (November 1990), 273-92.

Bohn, Henning, "Tax Smoothing with Financial Instruments," *American Economic Review*, v. 80 (December 1990), 1217-30.

Bohn, Henning, "Time Consistency of Monetary Policy in the Open Economy," *Journal of International Economics*, v. 30 (May 1991), 249-66.

Bohn, Henning, "Why Do We Have Nominal Government Debt?" in *Monetary and Fiscal Policy*, v. 1 (eds. T. Persson and G Tabellini), MIT Press (1994), 405-420.

Bolles, Albert S. *The Financial History of the United States from 1789 to 1860.* Volume II, Augustus M. Kelley (1894).

Calvo, Guillermo, "On the Time Consistency of Optimal Policy in a Monetary Economy," *Econometrica*, v. 46 (November, 1978), 1411-28.

Calvo, Guillermo, "Betting against the State: Socially Costly Financial Engineering," *Journal of International Economics*, v. 51 (June 2000), 5-19.

Coffee, John C., "Liquidity versus Control: The Institutional Investor as Corporate Monitor," *Columbia Law Review*, v. 91 (October 1991), 1277-1368.

Cole, Harold and Patrick Kehoe, "Reputation Spillover Across Relationships: Reviving Reputation Models of Debt," NBER Working Paper 5486 (March 1996).

Drazen, Allen, "Towards a Political-Economic Theory of Domestic Debt," in *The Debt Burden and Its Consequences for Monetary Policy* (eds. G. Calvo and M. King), St. Martin's Press (1998), 159-76.

Feldstein, Martin and Phillipe Bacchetta, "National Savings and International Capital Flows," *Economic Journal*, v. 90 (June 1980), 314-329.

Ferguson, E. James. *The Power of the Purse.* University of North Carolina Press (1961).

Frankel, Jeffrey, *On Exchange Rates*, MIT Press (1993).

Freeman, Scott and Guido Tabellini, "The Optimality of Nominal Contracts," *Economic Theory*, v. 11 (May 1998), 545-62.

Grayson, Theodore J. *Leaders and Periods of American Finance.* John Wiley & Sons, Inc. (1932).

Krugman, Paul, "Currency Crises," mimeograph, October 1997.

Kydland, Finn E. and Edward C. Prescott, "Rules Rather Than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy*, v. 85 (June 1977), 473-91.

Lewis, Karen K., "Puzzles in International Financial Markets," in *Handbook of International Economics*, v. 3 (eds. G. Grossman and K. Rogoff), Elsevier (1995), 1913-2030.

Lewis, Karen K., "Trying to Explain Home Bias in Equities and Consumption," *Journal of Economic Literature*, v. 37 (June 1999), 571-608.

Obstfeld, Maurice and Kenneth Rogoff, *Foundations of International Macroeconomics*, MIT Press (1996).

Perkins, Edwin J. *American Public Finance and Financial Services 1700 – 1815.* Ohio State University Press (1994).

Persson, Mats et al., "Time Consistency of Fiscal and Monetary Policy," *Econometrica*, v. 55 (November 1987), 1419-31.

Reede, Arthur H. *The Financing of the American Revolution.* Rochester Press (1996).

Shiller, Robert J., "Aggregate Income Risks and Hedging Mechanisms," *Quarterly Review of Economics and Finance*, v. 35 (Summer 1995), 119-52.

Stabile, Donald, *The Origins of American Public Finance: Debates over Money, Debt, and Taxes in the Constitutional Era, 1776*