UNIVERSITÄT BERN

Faculty of Business, Economics and Social Sciences

Department of Economics

Financial Policy

Dirk Niepelt

18-02

March 2018

DISCUSSION PAPERS

Schanzeneckstrasse 1
Postfach
CH-3001 Bern, Switzerland
http://www.vwi.unibe.ch

Financial Policy*

Dirk Niepelt†

Study Center Gerzensee; University of Bern

March 21, 2018

Abstract

This paper reviews theoretical results on financial policy. We use basic accounting identities to illustrate relations between gross assets and liabilities, net debt positions and the appropriation of (primary) budget surplus funds. We then discuss Ramsey policies, answering the question how a committed government may use financial instruments to pursue its objectives. Finally, we discuss additional roles for financial policy that arise as a consequence of political frictions, in particular lack of commitment.

*For comments and discussions, I thank John Hassler, Cyril Monnet and Klaus Neusser.

†E-mail: dirk.niepelt@szgerzensee.ch

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1 Introduction

Tax policy determines when and how the government collects funds from the private sector while financial policy determines how the government shifts purchasing power over time and across states of nature, using market transactions. Conditional on government spending, every tax policy in a dynamic environment goes hand in hand with a financial policy. If the timing of tax collections is of concern to the government, for example because it affects tax distortions or the distribution of tax burdens across agents, then so is financial policy.

When the government only has access to a single security, as often (implicitly) assumed in macroeconomic models and the public debate, the link between tax and financial policy is immediate: The characteristics of the security constrain the set of feasible tax policies, and a given feasible tax policy directly implies the corresponding financial policy. In practice, however, governments have access to a multitude of financial instruments, in particular debt securities and financial assets of different maturities. This multitude of instruments renders the link between tax and financial policy richer and sets the stage for a host of issues that are absent in environments with a single security. In particular, it leads to questions about (i) gross versus net asset positions; (ii) valuation effects and their consequences for the relation between deficit and net asset quotas; (iii) financial engineering to circumvent or relax financial market frictions; and more generally, (iv) optimal government portfolio choice, among others.

This paper reviews findings about the effects of financial policy. Its remainder is composed of four sections. Section 2 builds on basic accounting identities to clarify the relationships between the appropriation of (primary) budget surplus funds and the accumulation of gross and net assets and liabilities. Section 3 reviews qualitative and quantitative theoretical results on optimal (Ramsey) financial policies under commitment. The policy prescriptions discussed in this section derive from four central motives of financial policy—to exploit arbitrage opportunities; to smooth the shadow value of public funds subject to plausible restrictions on the set of available financial instruments; to strengthen resilience; and to achieve other goals like market access or liquidity provision to the private sector. Section 4 reviews theoretical results on optimal financial policy that explicitly take political factors into account. Of central interest in that context are issues of credibility and incentive compatibility. Section 5 concludes.

2 Accounting

Consider a government with gross assets a_t and gross liabilities l_t, both expressed as a fraction of GDP, and a primary surplus quota p_t.[1] Primary surplus funds are used to either pay for new asset purchases or principal and interest on outstanding liabilities. The

[1] The IMF defines gross debt (in our notation: l_t) as "[a]ll liabilities that require future payment of interest and/or principal by the debtor to the creditor" and net debt (in our notation: $l_t - a_t$) as "[g]ross debt minus financial assets, including those held by the broader public sector" IMF (2012, pp. 98–99). We abstract from non-financial assets of the government as well as from different levels and sectors of government.

corresponding primary surplus quotas are denoted p_t^a and p_t^l, respectively, with $p_t = p_t^a + p_t^l$. Between period $t-1$ and period t, nominal GDP grows at rate g_t; assets pay an interest rate r_t^a and experience a capital gains or losses rate v_t^a; and liabilities pay an interest rate r_t^l and experience a capital gains or losses rate v_t^l. The laws of motion for the gross asset and liabilities quotas, respectively, are given by[2]

$$a_t = a_{t-1}\frac{1 + r_t^a + v_t^a}{1 + g_t} + p_t^a, \tag{1}$$

$$l_t = l_{t-1}\frac{1 + r_t^l + v_t^l}{1 + g_t} - p_t^l. \tag{2}$$

According to (1), the asset quota increases only if the total return on assets, $r_t^a + v_t^a$, exceeds the growth rate, g_t, or if primary surplus funds flow into asset accumulation. According to (2), the liabilities quota increases if the total return on liabilities exceeds the growth rate sufficiently strongly to compensate for any flow of primary surplus funds into liabilities repayment.

In steady state, the growth rate, interest rates, and capital gains or losses rates are time-invariant.[3] In a "primary-surplus regime" or "pr" for short, the primary-surplus quota is time invariant as well. In contrast, in a "surplus regime" or "sr" for short (discussed below), the total rather than primary-surplus quota is time invariant.

From (1) and (2), a primary-surplus regime is consistent with the steady state asset and liabilities quotas

$$a^{\text{pr}} = -\frac{p^a}{\phi^a}, \quad l^{\text{pr}} = \frac{p^l}{\phi^l}$$

where we have defined

$$\phi_t^a \equiv \frac{r_t^a + v_t^a - g_t}{1 + g_t}, \quad \phi_t^l \equiv \frac{r_t^l + v_t^l - g_t}{1 + g_t}.$$

The dynamics are convergent towards the steady state values a^{pr} and l^{pr} (such that the government inter temporal budget constraint holds) if $r^a + v^a < g$ and $r^l + v^l < g$ that is, $\phi^a < 0$ and $\phi^l < 0$. In economies where the return on assets equals the marginal product of physical capital, this corresponds to a dynamically inefficient economy.[4] The speeds of adjustment (with non-oscillatory dynamics) then are given by ϕ^a for the asset quota and

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[2]Equation (1) follows from the accounting identity

$$A_t = A_{t-1}(1 + r_t^a + v_t^a) + P_t^a$$

that describes the evolution of the stock of nominal government assets, A_t. Here, P_t^a denotes the part of the nominal primary surplus that funds asset purchases. Dividing both sides of the equation by nominal GDP, Y_t, and using the fact that $A_{t-1}/Y_t = A_{t-1}/(Y_{t-1}(1 + g_t))$ yields (1). Equation (2) can be derived in parallel.

[3]We denote the steady state value of a generic variable x_t by x.

[4]For discussions of dynamic efficiency see, for example, Abel, Mankiw, Summers and Zeckhauser (1989).

ϕ^l for the liabilities quota.[5] Ruling out strictly negative gross asset or liabilities quotas under a convergent primary-surplus regime requires that $p^a \geq 0$ and $p^l \leq 0$.

The total surplus is composed of the primary surplus and the government's net interest income. In parallel to the primary-surplus quota, the surplus quota s_t can be decomposed into the asset and liabilities related quotas

$$s_t^a \equiv p_t^a + a_{t-1}\frac{r_t^a}{1+g_t}, \quad s_t^l \equiv p_t^l - l_{t-1}\frac{r_t^l}{1+g_t}$$

with $s_t = s_t^a + s_t^b$. Using these definitions, (1) and (2) can be rewritten as

$$a_t = a_{t-1}\frac{1+v_t^a}{1+g_t} + s_t^a, \tag{3}$$

$$l_t = l_{t-1}\frac{1+v_t^l}{1+g_t} - s_t^l. \tag{4}$$

A surplus regime is consistent with the steady state asset and liabilities quotas

$$a^{\text{sr}} = -\frac{s^a}{\chi^a}, \quad l^{\text{sr}} = \frac{s^l}{\chi^l}$$

where we have defined

$$\chi_t^a \equiv \frac{v_t^a - g_t}{1+g_t}, \quad \chi_t^l \equiv \frac{v_t^l - g_t}{1+g_t}.$$

The dynamics are convergent towards the steady state values a^{sr} and l^{sr} if $v^a < g$ and $v^l < g$ that is, $\chi^a < 0$ and $\chi^l < 0$. The speeds of adjustment (with non-oscillatory dynamics) then are given by χ^a for the asset quota and χ^l for the liabilities quota. Ruling out strictly negative gross asset or liabilities quotas under a convergent surplus regime requires that $s^a \geq 0$ and $s^l \leq 0$. In contrast with a primary-surplus regime, convergent dynamics in a surplus regime do not only arise in a dynamically inefficient economy.

A comparison of the laws of motion in a convergent surplus regime on the one hand and primary-surplus regime on the other make clear that the transition paths always differ unless the transition in each regime starts from steady state and the steady states under

[5] Using the steady state relationships, (1) and (2) can be rewritten as

$$\begin{aligned} a_t - a_{t-1} &= \phi_t^a(a_{t-1} - a^{\text{pr}}) + a^{\text{pr}}(\phi_t^a - \phi^a) + (p_t^a - p^a), \\ l_t - l_{t-1} &= \phi_t^l(l_{t-1} - l^{\text{pr}}) + l^{\text{pr}}(\phi_t^l - \phi^l) - (p_t^l - p^l). \end{aligned}$$

With interest, capital gains and growth rates as well as the primary surplus quotas at their steady state values, the first equation can be expressed as

$$a_t - a^{\text{pr}} = (1+\phi^a)(a_{t-1} - a^{\text{pr}}).$$

Dynamics are convergent for $-1 < 1 + \phi^a < 1$ or $-2 - g < r^a + v^a < g$. With convergent dynamics, a steady state deviation $a_{t-1} - a^{\text{pr}}$ is reduced by the fraction $-\phi^a$ over one period. A parallel argument applies for the liabilities quota.

both regimes coincide.[6] Similarly, convergent surplus and primary-surplus regimes imply different steady state asset and liabilities quotas unless[7]

$$s^a = p^a \frac{v^a - g}{r^a + v^a - g}, \quad s^l = p^l \frac{v^l - g}{r^l + v^l - g}.$$

The transition path and steady state value of the net asset quota $n_t \equiv a_t - l_t$ in a convergent surplus regime depends on the appropriation of the surplus and the difference between the capital gains rates on assets and liabilities. Letting $\Delta_t^{\text{sr}} \equiv \{v_t^a - v_t^l\}/(1 + g_t)$, (3) and (4) imply

$$n_t = n_{t-1} \frac{1 + v_t^l}{1 + g_t} + a_{t-1} \Delta_t^{\text{sr}} + s_t, \quad n^{\text{sr}} = -\frac{s^a}{\chi^l + \Delta^{\text{sr}}} - \frac{s^l}{\chi^l}.$$

Similarly, the transition path and steady state value of the net asset quota in a convergent primary-surplus regime depends on the appropriation of the primary surplus and the difference between the returns on assets and liabilities.[8]

The preceding results can be summarized as follows:

i. Convergent dynamics in a surplus regime may arise in dynamically inefficient and efficient economies; in a primary-surplus regime, they require a dynamically inefficient economy.

ii. A convergent surplus regime almost always implies a different transition path and steady state net asset quota than a primary-surplus regime.

iii. In a convergent surplus regime, the appropriation of the surplus as well as the difference between the capital gains rates on assets and liabilities affect the net asset quota. Similarly, in a convergent primary-surplus regime, the appropriation of the primary surplus as well as the difference between the returns on assets and liabilities affect the net asset quota.

Figures 1 and 2 illustrate the importance of the decomposition of s into s^a and s^l in a surplus regime. The parameter values underlying the figures resemble values that are relevant for Sweden (Swedish Fiscal Policy Council, 2012, p. 80).[9] Figure 1 plots a^{sr} and

[6]For the transition paths to be identical across regimes, the sequences $\{a_t, l_t\}$ must satisfy

$$s^a = p^a + a_t \frac{r^a}{1 + g}, \quad s^l = p^l - l_t \frac{r^l}{1 + g}$$

in all periods. This is only possible if $a_t = a^{\text{pr}} = a^{\text{sr}}$ and $l_t = l^{\text{pr}} = l^{\text{sr}}$.

[7]This follows from the restrictions $p^a/\phi^a = s^a/\chi^a$ and $p^l/\phi^l = s^l/\chi^l$.

[8]Letting $\Delta_t^{\text{pr}} \equiv \{(r_t^a + v_t^a) - (r_t^l + v_t^l)\}/(1 + g_t)$, (1) and (2) imply

$$n_t = n_{t-1} \frac{1 + r_t^l + v_t^l}{1 + g_t} + a_{t-1} \Delta_t^{\text{pr}} + p_t, \quad n^{\text{pr}} = -\frac{p^a}{\phi^l + \Delta^{\text{pr}}} - \frac{p^l}{\phi^l}.$$

[9]For both figures, we assume $r^a = r^l = 0.02, g = 0.05, v^a = 0.02, v^l = 0.00, s = 0.01.$

l^{sr} against the share of the surplus that flows into asset purchases, s^a/s. A value of one for s^a/s indicates that all of the surplus is used to purchase assets such that $s^l = 0$. The steady state liabilities quota then equals zero (because $v^l < g$) and the steady state asset quota equals 0.35. A value of two for s^a/s indicates that twice the surplus is used to purchase assets; this implies that new liabilities are issued to fund the asset purchases ($s^l = -s$). The steady state asset and liabilities quotas then equal 0.7 and 0.21, respectively, and the steady state net asset quota exceeds the one that results when $s^a/s = 1$, due to the capital gains on the higher asset quota.

Figure 2 plots the values for p^a and p^l implied by s^a/s under the restriction that the steady state asset and liabilities quotas under the primary-surplus and surplus regimes be identical. The figure shows that, holding the total surplus quota s constant, an increase in s^a/s from one to two is equivalent to a doubling of p^a from $0.00\bar{3}$ to $0.00\bar{6}$ and a decrease of p^l from 0 to -0.006. The total primary surplus quota falls as s^a/s increases, again due to the capital gains on the higher asset quota. Under the assumption of a higher interest rate on assets and liabilities, the steady state asset and liabilities quotas remain unchanged as long as the surplus quotas are not altered. The absolute values of the equivalent primary-surplus quotas p^a and p^l fall.[10]

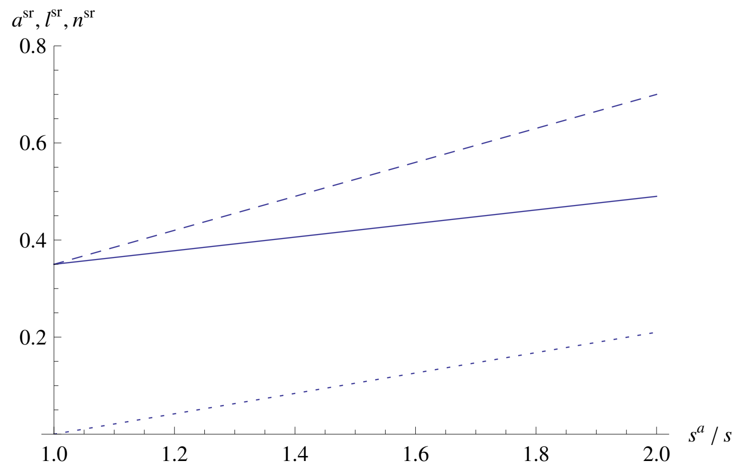

Figure 1: a^{sr} (dashed), l^{sr} (dotted) and n^{sr} (solid) as functions of s^a/s, for fixed s.

Changes in the government's asset and liabilities quotas a and l may go hand in hand with changes in the capital gains rates on these positions, v^a and v^l respectively, for example because an expansion of asset purchases alters the relative exposure to different asset classes.[11] Consider a surplus regime and let η^a and η^l denote the elasticities of χ^a with respect to a, and of χ^l with respect to l, respectively. For $s^a > 0$, the elasticity η^a is positive if v^a decreases with a, and negative otherwise. Similarly, for $s^l < 0$, the elasticity

[10]With $r^a = r^l = 0.025$ and the other parameter values unchanged, we have $p^a = 0.001\bar{6}$ and $p^l = 0$ when $s^a/s = 1$ and $p^a = 0.00\bar{3}$ and $p^l = -0.005$ when $s^a/s = 2$.

[11]Changes in a and l may also be correlated with variations in the economy's long-term growth rate, for example because of induced changes in the national savings rate (Diamond, 1965).

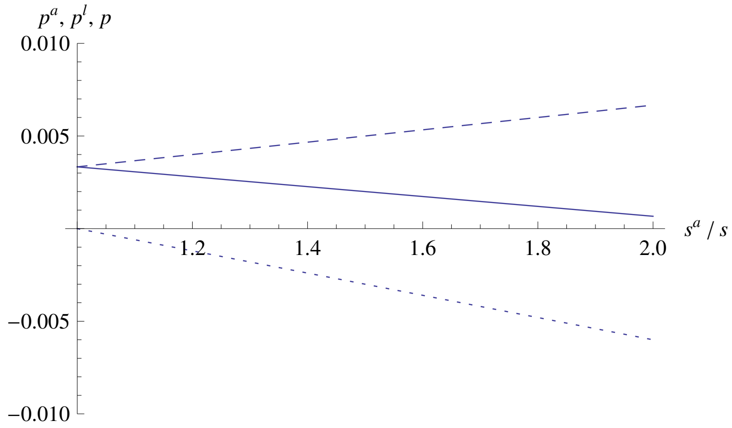

Figure 2: p^a (dashed), p^l (dotted) and p (solid) as functions of s^a/s, for fixed s and subject to the restriction that $a^{\text{pr}} = a^{\text{sr}}, l^{\text{pr}} = l^{\text{sr}}$.

η^l is positive if v^l declines in l, and negative otherwise.[12] The change in the steady state asset and liabilities quotas due to a move from an initial surplus target of $s = s^a + s^l$ to a new one characterized by the changes $ds = ds^a + ds^l$ is given by

$$\begin{aligned} -ds^a &= da^{\text{sr}}\chi^a + a^{\text{sr}}d\chi^a = da^{\text{sr}}\chi^a(1+\eta^a), \\ ds^l &= dl^{\text{sr}}\chi^l(1+\eta^l), \end{aligned}$$

implying that the net asset quota changes by

$$dn^{\text{sr}} = da^{\text{sr}} - dl^{\text{sr}} = -\frac{ds^a}{\chi^a(1+\eta^a)} - \frac{ds^l}{\chi^l(1+\eta^l)}.$$

With convergent dynamics ($\chi^a < 0$ and $\chi^l < 0$) and elasticities in excess of minus one, a higher surplus quota necessarily implies a higher steady state net asset quota. The magnitude of the net asset quota's increase due to a higher surplus quota depends on how ds is split between ds^a and ds^l. If $\chi^a(1+\eta^a)$ is less negative than $\chi^l(1+\eta^l)$, as would typically be the case due to a positive capital gains rate on assets and a zero capital gains rate on liabilities, the net asset quota increases the stronger the more of the surplus quota rise is allocated to asset accumulation. The intuition for the non-neutrality of the composition of surplus *changes* is the same as for the non-neutrality of the composition of the surplus: If capital gains rates on assets exceed those on liabilities (suitably adjusted for the relevant elasticities) then gross asset growth contributes more strongly to net asset accumulation than the reduction of gross liabilities.

Summarizing:

[12] We have

$$\eta^a = \frac{\partial\chi^a/\partial a}{\chi^a}a = \frac{v^{a\prime}(a)/(1+g)}{\chi^a}\frac{(-s^a)}{\chi^a} = -s^a\frac{v^{a\prime}(a)(1+g)}{(v^a-g)^2}, \quad \eta^l = \frac{\partial\chi^l/\partial l}{\chi^l}l = s^l\frac{v^{l\prime}(l)(1+g)}{(v^l-g)^2}.$$

iv. In a convergent surplus regime, an increase in the surplus quota typically has a stronger positive effect on the steady state net asset quota if it funds the accumulation of assets rather than the repayment of liabilities.

Figures 3 and 4 illustrate the effect of a change of surplus quota, ds, on the steady state net asset quota, dn^{sr}. The parametric assumptions underlying the figures are those underlying the previous figures (see footnote 9) as well as $ds = -0.01$, corresponding to a reduction of the surplus quota from 1 to 0 percent. Figure 3 is constructed under the assumption that the capital gains rate increases in the level of assets ($v^{a\prime}(a) = 0.02$) while figure 4 is constructed under the opposite assumption ($v^{a\prime}(a) = -0.02$); in both cases, the capital gains rate on liabilities is assumed to equal zero, independently of the liabilities quota.

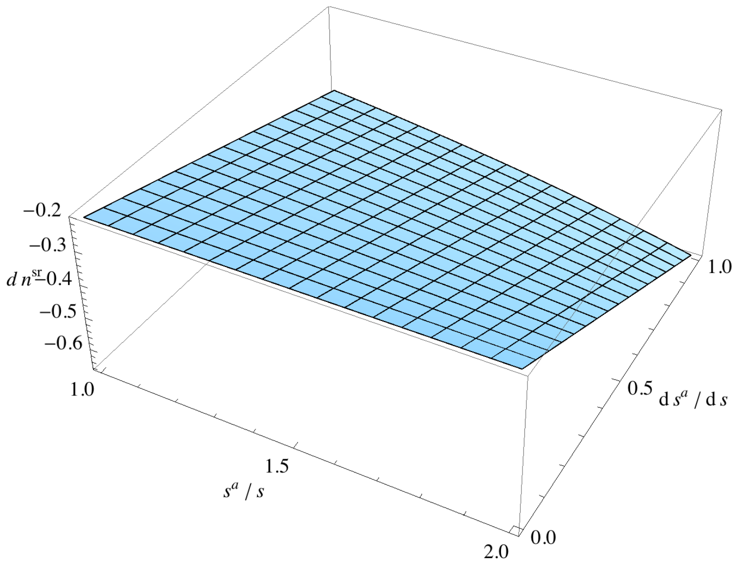

Figure 3: dn^{sr} as function of s^a/s and ds^a/ds, for fixed s and ds and $v^{a\prime}(a) > 0$.

The figures show that a reduction of the surplus quota implies a fall in the net asset quota. If $ds^a/ds = 0$ such that all of the adjustment occurs through a change of s^l the gross asset quota remains unchanged and the gross liabilities quota increases (such that the net asset quota falls) by 0.21. If part of the adjustment occurs through a change of s^a the surplus reduction leads to a stronger fall in the net asset quota because the gross asset quota which generates capital gains is reduced. The fall in the net asset quota is particularly pronounced if $v^{a\prime}(a)$ is positive because the capital gains rate then declines with the stock of assets. Moreover, the magnitude of dn^{sr} also depends on the elasticity η^a and thus, on the initial steady state asset quota a^{sr} and therefore the surplus quota s^a.

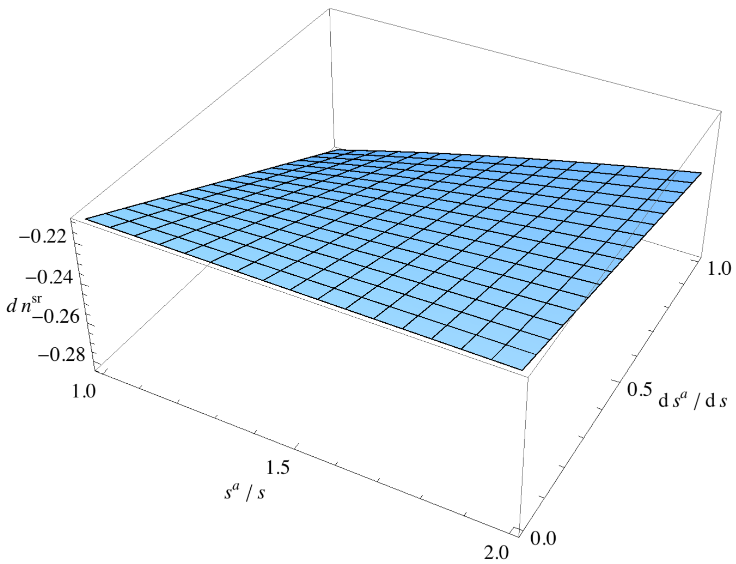

Figure 4: dn^{sr} as function of s^a/s and ds^a/ds, for fixed s and ds and $v^{a\prime}(a) < 0$.

3 Ramsey Policies

Let τ denote a tax policy and $\mathcal{T}$ the set of admissible tax policies satisfying certain institutional restrictions. Similarly, let f denote a financial policy and $\mathcal{F}$ the set of admissible financial policies implied by the financial instruments at the government's disposal. In section 2, τ was implicit in the sequence of primary surpluses $\{p_t\}$ and f corresponded to the sequence $\{a_t, l_t\}$. More generally, a financial policy may include many more elements as discussed below. A policy (τ, f) is feasible if it is admissible and satisfies the government's dynamic budget constraints as well as other implementability constraints. A policy is optimal (indicated by a "star") if it is the best feasible policy under commitment. We assume that the government evaluates feasible policies according to the allocations they implement.

The financial instruments at the government's disposal may be redundant, and the lack of (other) financial instruments may be constraining. Financial instruments are redundant if a given tax policy in combination with *multiple* admissible financial policies implements the same allocation such that the set of optimal financial policies, $\mathcal{F}^\star \subseteq \mathcal{F}$ say, contains multiple elements. Lack of financial instruments is constraining if the optimal policy $(\tau, f)^\star$ implements an allocation that is strictly inferior to the allocation implemented by another policy that uses more financial instruments.

Whether financial instruments or the lack thereof are redundant and/or constraining depends on the nature of tax policies. Under the conditions of the Ricardian equivalence proposition (Barro, 1974) tax policy does not affect the equilibrium allocation (conditional on government spending)—the tax policy under a balanced budget requirement and any other tax policy satisfying the government's inter temporal budget constraint implement the same allocation.[13] This implies that the optimal tax and financial policies are indeterminate; every financial instrument is redundant; and there is no constraining lack of financial instrument.

Under less restrictive conditions, the timing of taxation does affect the equilibrium allocation, unlike in a Ricardian environment.[14] The optimal tax policy then is determinate (or at least not fully indeterminate) but the optimal financial policy may still be indeterminate; some financial instruments may be redundant; and the lack of others may be constraining.

Of interest for our purposes are theories of $\mathcal{F}^\star$ conditional on $\mathcal{F}$. We consider several such theories, focusing on those in which financial policy does not "trivially" follow from the optimal tax policy: We do not discuss basic, deterministic "tax smoothing" policies (see Barro (1979)) or the implications for financial policy of "tax shifting" (allocating the burden of taxation across groups, see Diamond (1965) or Niepelt (2004*b*)). Instead, we concentrate on the implications for financial policy of the objective to exploit arbitrage opportunities; to smooth the shadow value of public funds subject to plausible restrictions on the set of available financial instruments; to strengthen resilience; and to achieve other goals like market access or liquidity provision to the private sector.

We often consider a simple three period economy, $t = 0, 1, 2$, that is subject to risk in the intermediate period. The state of nature in period $t = 1$ may either be "0" or "1", with ex-ante probability π and $1 - \pi$ respectively. Since the economy is not subject to risk after the intermediate period, the event tree of the economy includes five nodes or histories, one in the initial period and two each in periods $t = 1$ and $t = 2$. We index these five nodes by $\epsilon = 0, 10, 11, 20, 21$ where the first digit of the index represents the period and, if applicable, the second one the state of nature (see figure 5).

Let $q_{\epsilon,\hat{\epsilon}}$ denote the price of an Arrow security in history ϵ that pays off in history $\hat{\epsilon}$. In line with the notation introduced in the previous section, we denote primary government surpluses by p_ϵ. Moreover, we denote by $\alpha_{\epsilon,\hat{\epsilon}} \geq 0$ and $\lambda_{\epsilon,\hat{\epsilon}} \geq 0$ the number of claims that are issued at node ϵ and stipulate payment of one unit in history $\hat{\epsilon}$ to the government or from the government, respectively; the net lending position is denoted by $\nu_{\epsilon,\hat{\epsilon}} \equiv \alpha_{\epsilon,\hat{\epsilon}} - \lambda_{\epsilon,\hat{\epsilon}}$. Gross assets $a_{\bar{\epsilon}}$ and liabilities $l_{\bar{\epsilon}}$ as well as net assets $n_{\bar{\epsilon}} \equiv a_{\bar{\epsilon}} - l_{\bar{\epsilon}}$ at node $\bar{\epsilon}$ therefore correspond to the present values of all outstanding $\alpha_{\epsilon,\hat{\epsilon}}$'s, $\lambda_{\epsilon,\hat{\epsilon}}$'s and $\nu_{\epsilon,\hat{\epsilon}}$'s, respectively.

In this economy, the government has access to at most twelve fundamental financial instruments: Four short-term Arrow securities (both assets and liabilities) issued in the initial period; four long-term Arrow securities issued in the initial period; and four short-

[13]For related neutrality results, see Sargent (1987), Rangel (1997), Coleman (2000), Ghiglino and Shell (2000), Bassetto and Kocherlakota (2004), Gonzalez-Eiras and Niepelt (2015).

[14]Examples of environments where the timing of taxation affects the allocation include, among others, open economies where the private sector has no access to financial markets and relies on the government, through non-distorting tax and debt policy, to smooth disposable income and household consumption (as assumed in sovereign debt models (Eaton and Gersovitz, 1981)); economies where taxes are distorting and the government aims at minimizing ("smoothing") tax distortions (Barro, 1979; Lucas and Stokey, 1983; Aiyagari, Marcet, Sargent and Seppälä, 2002); economies where the timing of taxation affects the wealth distribution (Diamond, 1965; Niepelt, 2004*b*); or economies where government bonds serve the private sector as a savings and self insurance vehicle (Aiyagari and McGrattan, 1998; Shin, 2006). See also Missale (1999, ch. 2).

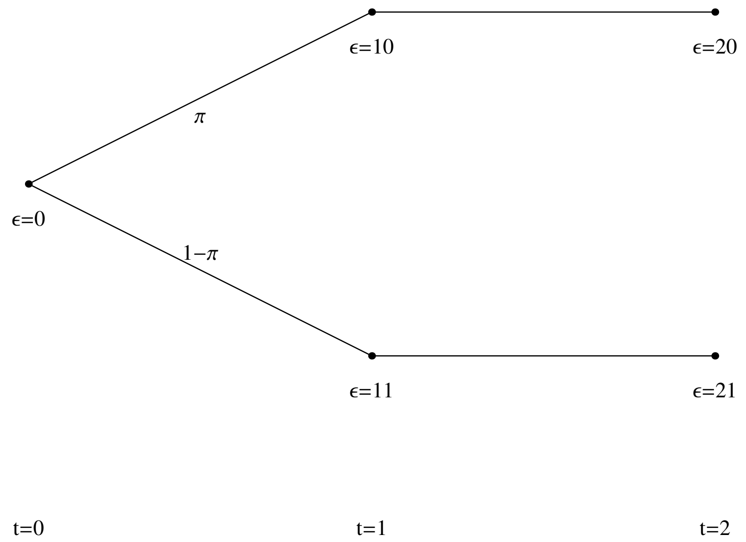

Figure 5: Event tree.

term Arrow securities issued in the intermediate period in any of the two states of nature. Absent any restrictions on financial instruments, the set of admissible financial policies $\mathcal{F}$ thus is given by

$$\mathcal{F}^u = \{\alpha_{0,10}, \alpha_{0,11}, \lambda_{0,10}, \lambda_{0,11}, \alpha_{0,20}, \alpha_{0,21}, \lambda_{0,20}, \lambda_{0,21}, \alpha_{10,20}, \alpha_{11,21}, \lambda_{10,20}, \lambda_{11,21} | \alpha \geq 0, \lambda \geq 0\}$$

where the superscript "u" stands for unrestricted and α and λ denote the vectors of long and short positions.

The government's budget constraints reflect the pricing kernel q and the available financial instruments defined by $\mathcal{F}$. If the kernel is arbitrage free the dynamic budget constraints of the government read

$$\left.\begin{array}{rcl} p_0 & = & \sum_{i=0,1} q_{0,1i}(\nu_{0,1i} + q_{1i,2i}\nu_{0,2i}), \\ p_{1i} + \nu_{0,1i} & = & q_{1i,2i}\nu_{1i,2i}, \quad i = 0, 1, \\ p_{2i} + \nu_{0,2i} + \nu_{1i,2i} & = & 0, \quad i = 0, 1. \end{array}\right\} \tag{5}$$

If, in addition, the set of financial instruments is sufficiently large to render financial markets complete then the dynamic budget constraints (5) reduce to the single, inter temporal budget constraint

$$p_0 + \sum_{i=0,1} q_{0,1i}(p_{1i} + q_{1i,2i}p_{2i}) = 0. \tag{6}$$

A policy (τ, f) and the allocation it implements pin down the primary surpluses across the five histories, $(p_0, p_{10}, p_{11}, p_{20}, p_{21})$, as well as the net asset positions (at the beginning of the period) $(0, \nu_{0,10} + q_{10,20}\nu_{0,20}, \nu_{0,11} + q_{11,21}\nu_{0,21}, \nu_{0,20} + \nu_{10,20}, \nu_{0,21} + \nu_{11,21})$.

3.1 Exploiting Arbitrage Opportunities

Arbitrage opportunities for the government may arise if government lending and borrowing is priced off different pricing kernels. In a deterministic environment this corresponds to different interest rates on borrowing and lending. Suppose that only state "0" may materialize such that $\pi = 1$ and let

$$\mathcal{F} = \{f \in \mathcal{F}^u | \alpha_{0,11} = \lambda_{0,11} = \alpha_{0,21} = \lambda_{0,21} = \alpha_{11,21} = \lambda_{11,21} = 0\}.$$

Suppose further that the government lending gross interest rate equals r as does the government borrowing rate between periods $t = 1$ and $t = 2$ but that between periods $t = 0$ and $t = 1$, the borrowing rate $q_{0,10}^{-1}$ may differ from r. The dynamic budget constraints of the government then read

$$\begin{aligned} p_0 + q_{0,10}\lambda_{0,10} &= r^{-1}(\alpha_{0,10} + r^{-1}\nu_{0,20}), \\ p_{10} + \nu_{0,10} &= r^{-1}\nu_{10,20}, \\ p_{20} + \nu_{0,20} + \nu_{10,20} &= 0 \end{aligned}$$

and imply the inter temporal budget "constraint" $\sum_{t=0}^{2} r^{-t} p_t = (r^{-1} - q_{0,10})\lambda_{0,10}$.

If $q_{0,10} > r^{-1}$ such that the government may borrow at a lower rate than lend the inter temporal budget constraint of the government does not bind. Accordingly, the government's optimal portfolio structure involves unbounded short-term borrowing, $\lambda^{\star}_{0,10} \to \infty$, if taxation is socially costly. More realistically, the market discount factor $q_{0,10}$ may *initially* exceed r^{-1} but as $\lambda_{0,10}$ increases, $q_{0,10}$ may fall until it equals r^{-1}. With this modification, the government's inter temporal budget constraint does bind but gross borrowing continues to optimally exceed net borrowing if the government wishes to relax its budget constraint.

The latter qualification is important. While exploiting arbitrage opportunities can help improve the budgetary position of the government it need not be (socially) optimal. For example, if the government aims at maximizing private sector welfare, and if the private sector's financial losses mirror the reduction in tax collections due to the government's arbitrage gains, then exploiting arbitrage possibilities may be pointless. This qualification notwithstanding, practitioners appear to view certain debt restructuring operations, for example concerning "on-the-run securities," as profitable and attractive.[15]

Summarizing:

v. Gross government borrowing optimally exceeds net borrowing when the government's lending rate exceeds the borrowing rate and if the government wishes to relax its budget constraint.

[15] According to OECD (2013, p. 108), "exchanges and buybacks allow debt managers to increase the issuance of on-the-run securities above and beyond what would otherwise have been possible. The resulting more rapid build-up of new bonds enhances market liquidity of these securities. This in turn should eventually be reflected in higher bond prices. Hence, ... these operations may also contribute to lower funding costs for governments." The reason why investors wish to acquire securities of a particular type although those do not offer higher yield presumably relates to the fact that the sought-after securities deliver additional services relative to comparable financial instruments. Guibaud, Nosbusch and Vayanos (2013) propose a model of "bond market clienteles."

3.2 Smoothing the Shadow Value of Public Funds

Consider next the environment with risk and suppose that the kernel is arbitrage free. Suppose furthermore that the government in period $t = 0$ has access to a short-term security with return vector $[1\ \gamma]'$ in nodes $\epsilon = 10$ and $\epsilon = 11$, respectively, and a long-term security with return vector $[1\ \delta]'$ in nodes $\epsilon = 20$ and $\epsilon = 21$, respectively, where γ and δ denote non-negative scalars. Moreover, the government may borrow or lend short term in nodes $\epsilon = 10$ and $\epsilon = 11$ such that

$$\mathcal{F} = \{f \in \mathcal{F}^u | \nu_{0,10}\gamma = \nu_{0,11}, \nu_{0,20}\delta = \nu_{0,21}\}. \tag{7}$$

Government policy is constrained by (5) and (7) as well as certain other implementability constraints.

Consider any security held between periods $t = 0$ and $t = 1$ and let r_1 denote its state contingent gross return in period $t = 1$. If private investors hold the security the usual Euler equation $u_0' = \beta\mathbb{E}[u_1' r_1]$ states that the expected net benefit of doing so equals zero at the margin.[16] A parallel Euler equation applies for the government that weighs the benefit and cost of issuing or holding the security. Letting ζ_ϵ denote the normalized[17] multiplier in the government's Ramsey program attached to the government dynamic budget constraint the government's Euler equation reads

$$\zeta_0 u_0' = \beta\mathbb{E}[\zeta_1 u_1' r_1].$$

Accordingly, the net benefit for the government of the security depends on the tightness of its budget constraint in period $t = 0$ ($\zeta_0 u_0'$), the average tightness in period $t = 1$, the security's average return $\mathbb{E}[r_1]$ and the correlation of the return with the tightness in period $t = 1$. If taxes in node ϵ are not distorting then $\zeta_\epsilon = 0$.

If markets are complete for private investors then the price of an Arrow security satisfies $q_{0,\epsilon} = \beta\text{prob}(\epsilon)u_\epsilon'/u_0'$. If markets are complete for the government then the price of the same Arrow security also satisfies $q_{0,\epsilon} = \beta\text{prob}(\epsilon)\zeta_\epsilon u_\epsilon'/\zeta_0 u_0'$. As a consequence, $\zeta_0 = \zeta_\epsilon$ for all ϵ if both the government and the private sector face complete markets. If the government faces incomplete markets, in contrast, then ζ_ϵ may not be constant across histories.[18]

Consider a financial policy $f \in \mathcal{F}$ that is implemented using the portfolio $\omega = [\omega_{0,1}, \omega_{0,2}, \nu_{10,20}, \nu_{11,21}]'$. Here, $\omega_{0,1}$ and $\omega_{0,2}$ denote the government's net positions in the short- and long-term security in period $t = 0$, respectively. The cash flows c across nodes 10, 11, 20 and 21 that are generated by this portfolio equal $c = M\omega$ with

$$M = \begin{bmatrix} 1 & 0 & -q_{10,20} & 0 \\ \gamma & 0 & 0 & -q_{11,21} \\ 0 & 1 & 1 & 0 \\ 0 & \delta & 0 & 1 \end{bmatrix}.$$

[16]The Euler equation assumes that investors have time separable preferences with discount factor β; u_t' denotes the potentially random marginal utility in period t.

[17]By the investor's marginal utility of consumption in the state as well as the latter's ex-ante probability.

[18]If the security pays a safe return and both the government and the private sector hold it then $\zeta_0 u_0' = \beta\mathbb{E}[\zeta_1 u_1']r_1$ and $u_0' = \beta\mathbb{E}[u_1']r_1$. This implies $\zeta_0 = \mathbb{E}[\zeta_1 u_1']/\mathbb{E}[u_1']$.

If $\gamma q_{10,20} = \delta q_{11,21}$ then M is singular, markets are incomplete and (7) constrains both $f^\star$ and $\tau^\star$. If $\gamma q_{10,20} \neq \delta q_{11,21}$, in contrast, then M has full rank, markets are complete (the return vectors of admissible portfolios span the state space) and the constraints (5) and (7) collapse to the inter temporal budget constraint (6). In this case, only (6) constrains $\tau^\star$ while (7) and $\tau^\star$ constrain $f^\star$. In particular, since the financial policy must finance the primary deficits $-p^\star = -(p^\star_{10}, p^\star_{11}, p^\star_{20}, p^\star_{21})$ under the optimal tax policy, restriction (7) requires $p^\star = -M\omega^\star$. Since M is invertible a unique $\omega^\star$ exists that satisfies this restriction, namely $\omega^\star = -M^{-1}p^\star$. The optimal short- and long-term net positions thus are given by

$$\omega^\star_{0,1} = \frac{\delta q_{11,21} P^\star_{10} - q_{10,20} P^\star_{11}}{\gamma q_{10,20} - \delta q_{11,21}},\ \omega^\star_{0,2} = \frac{P^\star_{11} - \gamma P^\star_{10}}{\gamma q_{10,20} - \delta q_{11,21}}$$

respectively, where $P^\star_{10} \equiv p^\star_{10} + q_{10,20} p^\star_{20}$ denotes the present discounted value of government surpluses at node 10 and $P^\star_{11} \equiv p^\star_{11} + q_{11,21} p^\star_{21}$.

Farhi (2010) discusses the government's Euler equation (or counterpart of the standard C-CAPM equation) in a model with safe government bonds and risky capital as well as labor and capital income taxes. In his model, the government faces incomplete markets because bond returns are risk free and taxes on capital income are predetermined for one period. In a calibrated version of the model, Farhi (2010, p. 944) finds that the optimal policy involves huge and opposing positions in debt and physical capital. Whether the government should go long or short in physical capital depends on the relative prevalence of productivity and government spending shocks.

Bohn (1990) also discusses optimal government debt policy from an incomplete markets risk sharing perspective.[19] He assumes risk neutral consumers and a convex tax collection cost function $h(\tau)$ along the lines of Barro (1979)[20] such that $\zeta_\epsilon = h'(\tau_\epsilon)$. Accordingly, the government's Euler equation reads

$$h'(\tau_0) = \beta \mathbb{E}[h'(\tau_1) r_1]$$

for every security in the government's portfolio. Comparing this optimality condition with US time series, Bohn (1990) analyzes the usefulness of various securities for tax smoothing purposes. Under several simplifying assumptions and based on US data until 1989, he finds that "a number of security returns are correlated with tax rates, leading to a rejection [of the hypothesis that the government optimally employs these securities to smooth tax collection costs]. Estimates of optimal debt portfolios provide strong support for using nominal, nonindexed, government debt, but provide only weak evidence on the maturity distribution. Moreover, it seems that the government could improve tax smoothing by having some nontraditional liabilities, like foreign-currency debt or a short position in the stock market" (p. 1229).

Summarizing:

vi. The government's portfolio choice problem parallels the program of a private investor. The optimal portfolio composition depends on the correlation between security returns and the tightness of the government budget constraint.

[19] See also Gale (1990) and Missale (1999).
[20] See Farhi (2010, p. 935) for a critical discussion.

vii. With complete markets, the shadow value of public funds is constant and conditional on the government's inter temporal budget constraint, tax and financial policy are disconnected.

viii. Bohn (1990) assesses which securities may be employed to smooth the shadow value of government funds across states. His analysis could be updated and his approach extended and applied to other countries.

In the following, we consider realistic restrictions on $\mathcal{F}^u$ that give rise to a hedging motive for the government.

3.2.1 Non-Contingent Yields

If the yields on government securities are not contingent on the state of nature then

$$\mathcal{F} = \{f \in \mathcal{F}^u | \nu_{0,10} = \nu_{0,11}, \nu_{0,20} = \nu_{0,21}\}. \tag{8}$$

Denoting short- and long-term net lending by $\nu_{0,1}$ and $\nu_{0,2}$, respectively, an admissible financial policy $f \in \mathcal{F}$ is characterized by the net lending positions $\nu = [\nu_{0,1}, \nu_{0,2}, \nu_{10,20}, \nu_{11,21}]'$. Restriction (8) constitutes a special case of (7) (and ν constitutes a special case of ω) with $\gamma = \delta = 1$. It follows from the previous discussion that markets are complete if $q_{10,20} \neq q_{11,21}$, and incomplete otherwise.

Consider first the complete markets case where the constraints (5) and (8) collapse to the inter temporal budget constraint (6). The non-contingent yield restriction (8) then implies an optimal maturity structure in period $t = 0$,

$$\nu^\star_{0,1} = \frac{q_{11,21} P^\star_{10} - q_{10,20} P^\star_{11}}{q_{10,20} - q_{11,21}}, \; \nu^\star_{0,2} = \frac{P^\star_{11} - P^\star_{10}}{q_{10,20} - q_{11,21}}.$$

Suppose node 10 represents a business cycle upturn and node 11 a downturn, implying $P^\star_{10} > 0$ (primary surpluses) and $P^\star_{11} < 0$ (primary deficits) under the optimal policy. If the interest rate in the downturn is lower than in the upturn ($q_{11,21} > q_{10,20}$) then (8) implies a short-term net borrowing position and a long-term net lending position, $\nu^\star_{0,1} < 0 < \nu^\star_{0,2}$. Intuitively, state contingent primary surpluses call for counterbalancing net asset positions and more specifically, higher net assets in the downturn. A portfolio with long-term net lending generates such state contingent net assets even in the absence of contingent yields because it produces capital gains on the long-term loans in the downturn when market interest rates drop, and capital losses in the upturn when interest rates rise.

If the interest rate in the downturn is higher than in the upturn, in contrast, then the optimal financial policy involves short-term net lending and long-term net borrowing. In either case the size of the lending or borrowing positions increases with the magnitude of the present discounted primary surpluses or deficits. Moreover, it decreases with the interest rate differential in the two states—larger interest rate differentials allow for smaller gross positions.

Angeletos (2002) extends the above complete markets analysis. He considers an infinite horizon, closed economy with as many maturities as states. Interest rates in his model are stochastic because the Ramsey tax policy supports a stochastic consumption profile and thus, a stochastic inter temporal marginal rate of substitution of the representative household. In a baseline example with government spending shocks, Angeletos (2002) finds that primary surpluses tend to go hand in hand with low interest rates. In line with the above discussion, he finds that the optimal maturity structure in the baseline example involves short-term net lending and long-term net borrowing.

Buera and Nicolini (2004) argue, however, that these predictions are not robust. They report that small variations in parameter values imply large changes in the optimal maturity positions in the model, and that these positions are very large in absolute value and far from what is observed in the data. In an example with four states of nature that is calibrated to match US data, their model predicts an optimal financial policy that swaps bonds "on the order of a few hundred times total GDP each period" (p. 553).

Faraglia, Marcet and Scott (2010) extend the analysis of Buera and Nicolini (2004) by incorporating physical capital and habits in the model. They report that the predicted optimal maturity positions remain very large and are volatile. Faraglia et al. (2010) confirm Buera and Nicolini's (2004) finding that the model predictions for both the size and the sign of the maturity positions are very sensitive to changes in stipulated parameter values or assumptions regarding the available maturities. They also argue that subject to potential model misspecification or transaction costs, an optimizing government would "prefer to follow a balanced budget rather than implement the optimal portfolio structure recommended by the complete market approach" (p. 835).

Summarizing:

ix. The restriction that securities may not have state contingent yields is not costly if the government has access to a sufficiently rich set of maturities and interest rates are state contingent. In this case, markets are complete and the non-contingent yield restriction implies an optimal maturity structure. According to simulation results, the predictions of the complete market approach to the choice of maturity structure are sensitive to changes in the model specification and not in line with the data.

When the government has access to fewer maturities than there are states of nature, or if interest rates do not sufficiently vary across states then the government faces incomplete markets and optimally engages in precautionary savings. Moreover, if it has access to multiple securities, the government solves a portfolio choice problem of the type discussed earlier.

Aiyagari et al. (2002) analyze the government's precautionary savings motive under the assumption that the government may only issue short-term debt with non-contingent yield. They find that the government optimally accumulates net assets up to the point where the interest income from the net asset position suffices to finance worst case government spending.[21]

[21] In Aiyagari et al.'s (2002) representative agent environment the inter generational wealth distribution is of no concern. Bhandari, Evans, Golosov and Sargent (2013) extend Aiyagari et al.'s (2002) model to incorporate heterogeneity.

Nosbusch (2008) analyzes the maturity choice in an incomplete markets model where the government has access to short- and long-term nominal bonds with non-contingent yields only. In contrast to Bohn (1990), he allows for risk aversion on the part of investors and thus, in equilibrium, higher yields on securities that provide risk sharing benefits. For the same reason as in the complete markets case (Angeletos, 2002) he finds that the government should optimally borrow long term and lend short term. The implied maturity positions are large.

Nosbusch (2008) also finds that the incomplete markets restriction is not very costly; the extent of optimal tax smoothing when only two maturities can be employed is not much smaller than the extent in a complete markets environment with many maturities. Nosbusch (2008, p. 479) argues that even in the presence of debt overhang as well as constraints on government lending, some long-term borrowing is optimal but at the same time, "leverage is necessary for achieving a substantial fraction of the benefits of tax smoothing across states."

According to Faraglia et al. (2010, p. 822), however, Nosbusch's (2008) results are not robust: "Small variations even in the choice of maturities available to the government can easily reverse the issue-long-buy-short recommendation as can allowing for both productivity and expenditure shocks."

Summarizing:

x. According to simulation results, restrictions on the set of available securities have minor costs. However, the predictions of the incomplete market approach to the choice of maturity structure are sensitive to changes in the model specification and not in line with the data.

When payoffs are specified in nominal terms stochastic inflation renders real returns state contingent. This triggers the question whether monetary policy can and should help hedge fiscal shocks, by influencing inflation. The answer to this question clearly is in the affirmative if inflation is without other economic consequences. In the more plausible case where inflation does have such additional consequences a trade-off emerges.

Siu (2004) analyzes a model where the government has powers to affect inflation. In his model, unanticipated inflation renders bond returns state contingent but also causes relative price distortions and as a consequence, costly misallocation. The Ramsey policy balances the hedging benefits of state-contingent real yields against these misallocation costs. Siu (2004, p. 577) finds that "for post-war calibrations, the gains from achieving state-contingency in real debt returns are small relative to the misallocation costs induced by variable ex-post inflation." This finding is consistent with the conclusions discussed earlier according to which the cost of reduced smoothing possibilities due to restrictions on financial instruments is limited. However, Siu (2004, p. 577) adds that "[a]s the volatility in government spending increases, the shock absorbing benefits of state-contingent inflation come to dominate the costs of resource misallocation."

Hall and Sargent (2011) decompose the evolution of the government debt quota in the United States and document the time varying contribution of surprise inflation to it. Blanchard, Dell'Ariccia and Mauro (2013, p. 14) report that "IMF staff simulations suggest that, for the G7 economies, if inflation were to increase from the current average projected pace of less than 2 percent to, say, 6 percent, the net debt ratio would decline, after five years, by about 10 percent of GDP on average .... The effect would be larger if central banks could maintain lower real interest rates for some time."

Summarizing:

xi. When yields are specified in nominal terms and are restricted to be non-contingent unanticipated inflation can partially compensate for the lack of explicit state contingency. But misallocation as a consequence of unanticipated inflation renders this costly. According to simulation results, unanticipated inflation is an inefficient fiscal shock absorber unless the shocks are very large.

3.2.2 Borrowing Constraints

If the government is subject to a borrowing constraint, for example due to a "sudden stop" in funding markets, then fresh borrowing is ruled out and as a consequence, fresh net lending strictly positive. The wider implications of this depend on the financial market structure.[22]

Consider first the case where the government only has access to short-term securities with non-contingent yields and faces a borrowing constraint in node $\epsilon = 11$. The set of admissible financial policies then is given by

$$\mathcal{F} = \{f \in \mathcal{F}^u | \nu_{0,10} = \nu_{0,11}, \nu_{0,20} = \nu_{0,21} = 0, \nu_{11,21} \geq 0\}.$$

In this environment, the threat of a binding borrowing constraint in period $t = 1$ may lead the government to save more in period $t = 0$ than it would save if no such threat were present—it may build up a "buffer stock" in direct analogy with household behavior in a savings problem.[23]

In particular, suppose that the government values disposable funds in a period according to some strictly increasing and concave payoff function.[24] The government's value function of net assets brought into period $t = 1$ then is strictly increasing and concave as well. With a binding borrowing constraint in period $t = 1$ disposable funds in the period are smaller than with a non-binding constraint and accordingly, the slope of the value function is higher. The expected slope of the value function in period $t = 1$ thus increases with the risk that the borrowing constraint binds. Since the optimal financial policy equates the expected shadow values of public funds between the two periods risk of a binding borrowing constraint in the intermediate period increases optimal net lending in the initial period.

Access to longer-term securities may soften or even undo these implications of a borrowing constraint. This can most clearly be seen in a deterministic environment: While the borrowing constraint then prevents the government from *directly* shifting funds from

[22]The discussion abstracts from *economy wide* borrowing constraints. The latter may give rise to efficiency losses due to pecuniary externalities. See, for example, Bianchi (2011).

[23]See Gollier (2001, chapter 18) for a discussion of buffer stock saving. Aiyagari (1994) analyzes precautionary saving of households in general equilibrium.

[24]Buffer stock saving is a consequence of risk aversion, not prudence (Gollier, 2001, chapter 18).

period $t = 2$ to period $t = 1$ it can be neutralized without cost by borrowing long term and lending short term in the initial period. Markets thus are complete and the borrowing constraint is irrelevant.

The empirically more relevant case involves both risk and a borrowing constraint, in node $\epsilon = 11$ say. Suppose as before that yields must be non-contingent. The set of admissible financial policies then is given by

$$\mathcal{F} = \{f \in \mathcal{F}^u | \nu_{0,10} = \nu_{0,11}, \nu_{0,20} = \nu_{0,21}, \nu_{11,21} \geq 0\}.$$

In parallel to the environment without risk, the possibility to borrow long term in the initial period has the consequence that the borrowing constraint need not imply positive net asset holdings in node $\epsilon = 11$. Nevertheless, and in contrast with the environment without risk, the borrowing constraint in combination with the non-contingent yields restriction renders markets incomplete[25] and a trade-off emerges between insurance and inter temporal smoothing. More specifically, long-term lending in period $t = 0$ may be beneficial for insurance purposes while long-term borrowing may be attractive because it relaxes the borrowing constraint.

Bianchi, Hatchondo and Martinez (2013) analyze the implications of an occasionally binding borrowing constraint in a small open economy where only the government has access to financial markets. Bianchi et al. (2013) do not study the Ramsey problem but assume that the benevolent government cannot commit. As a consequence, the government may opportunistically default along the equilibrium path. Allowing for debt of different maturities Bianchi et al. (2013) find in simulations that the optimal policy subject to lack of commitment uses long-term borrowing and short-term lending to relax the borrowing constraint.

Summarizing:

xii. Even if the government has access to a rich set of maturities and interest rates are stochastic, markets may be incomplete if a non-contingent yield restriction is accompanied by a (stochastic) borrowing constraint. In this case, the optimal financial policy trades off insurance and inter temporal smoothing.

To gain more insight into the trade-off between insurance and inter temporal smoothing, consider an infinite horizon model with two possible states in each period: a "normal" state with ex ante probability π and a sudden stop state where the government is subject to a borrowing constraint. Gross interest rates equal r_n in the normal state and r_s in the sudden stop state. In the normal state, a short-term zero coupon security trades at price $1/r_n$ and a long-term (two period) zero coupon security at price $1/R^2$ with $R^2 = r_n(\pi r_n + (1 - \pi)r_s)$.

Suppose the government lends or borrows constant fractions of GDP short term and long term as long as the economy remains in the normal state. Denoting short- and long-term net lending quotas by ν_{+1} and ν_{+2}, respectively, the surplus quota in a normal period equals

$$s_n = p_n + \frac{\nu_{+1}}{1+g} + \frac{\nu_{+2}}{(1+g)^2} - \frac{\nu_{+1}}{r_n} - \frac{\nu_{+2}}{R^2},$$

[25] Markets are complete if the borrowing constraint does not bind.

reflecting the primary surplus quota, maturing short- and long-term net lending positions from previous periods (suitably normalized by the economy's growth rate) as well as fresh short- and long-term net lending. The net asset quota in a normal period reflects maturing securities as well as the market value of outstanding long-term net lending positions that is,

$$n_n = \frac{\nu_{+1}}{1+g} + \frac{\nu_{+2}}{(1+g)^2} + \frac{\nu_{+2}}{(1+g)r_n}.$$

In a sudden stop the interest rate changes to r_s and as a consequence, the net asset quota (after a longer spell of normal periods) equals

$$n_s = \frac{\nu_{+1}}{1+g} + \frac{\nu_{+2}}{(1+g)^2} + \frac{\nu_{+2}}{(1+g)r_s}$$

while the *liquid* net asset quota is given by

$$nliqu_s = \frac{\nu_{+1}}{1+g} + \frac{\nu_{+2}}{(1+g)^2}$$

if long-term investments cannot be sold before maturity.

Conditional on values for (π, r_n, r_s, g) and a fixed net asset quota in normal periods, n_n, the choice of maturity structure (ν_{+1}, ν_{+2}) determines the net asset quota n_s and liquid net asset quota $nliqu_s$ in a sudden stop as well as the "financial surplus quota" in normal periods, $s_n - p_n$. In particular, manipulation of the above relationships yields

$$\begin{aligned} n_s &= n_n + \frac{\nu_{+2}}{1+g}\left(\frac{1}{r_s} - \frac{1}{r_n}\right), \\ nliqu_s &= n_n - \frac{\nu_{+2}}{(1+g)r_n}, \\ s_n - p_n &= n_n\left(1 - \frac{1+g}{r_n}\right) + \nu_{+2}\left(\frac{1}{r_n^2} - \frac{1}{R^2}\right). \end{aligned}$$

The first two equations confirm the earlier finding of potentially conflicting objectives: When $r_s < r_n$ then high net assets in a sudden stop (allowing to compensate for higher primary deficits) are incompatible with high *liquid* net assets (providing fiscal space in spite of the borrowing constraint). On the one hand, long-term net lending provides insurance because the market value of outstanding long-term loans appreciates in a sudden stop. On the other hand, conditional on n_n, long-term net lending (and accordingly, short-term net borrowing) reduces liquid net wealth. If interest rates during sudden stop periods rise, in contrast, then the conflict disappears.

A second conflict of interest arises with respect to the net asset quota in a sudden stop and the financial surplus quota in normal times. Independently of whether $r_s < r_n$ or not, the effect of long-term net lending on these two quotas is of opposing signs. Intuitively, when interest rates fall during a sudden stop then insurance requires a long-term net lending position. But in this case, $R < r_n$ and long-term lending therefore implies, on average, lower interest revenue than short-term lending. The reverse argument applies when $r_s > r_n$.

Note that the conflict between the objectives of providing insurance and liquidity and doing so at low cost is present conditional on the net asset position in normal periods, n_n, as well as the primary surplus, p_n. Running a higher primary surplus or accumulating a higher net asset quota therefore does not alter the fundamental conflict.

Summarizing:

xiii. For the choice of maturity of government securities, the objective to hedge fiscal shocks may or may not conflict with the objective to relax borrowing constraints, while the objective to hedge fiscal shocks always conflicts with the objective to generate surpluses in normal times. These conflicts are present for any level of primary surplus or net asset quota.

If illiquidity arises for some other reason than maturity then the previous analysis applies in modified form. Suppose that one form of short-term net lending, ν_{+1}, has one period gross return r and can be transformed into cash in all periods while the other form, ν_{+2}, has one period return R and cannot be transformed into cash in sudden stop periods. We then have

$$\begin{aligned} s_n &= p_n + \frac{\nu_{+1}}{1+g} + \frac{\nu_{+2}}{1+g} - \frac{\nu_{+1}}{r} - \frac{\nu_{+2}}{R}, \\ n_n &= n_s = \frac{\nu_{+1}}{1+g} + \frac{\nu_{+2}}{1+g}, \\ nliqu_s &= \frac{\nu_{+1}}{1+g} \end{aligned}$$

and manipulation of these relations yields $n_s = n_n$ as well as

$$\begin{aligned} nliqu_s &= n_n - \frac{\nu_{+2}}{1+g}, \\ s_n - p_n &= n_n \left(1 - \frac{1+g}{r}\right) + \nu_{+2} \left(\frac{1}{r} - \frac{1}{R}\right). \end{aligned}$$

If the return R on the illiquid asset is higher than the return r on the liquid one then the objectives to provide liquidity and to generate surpluses in normal times necessarily conflict.

Summarizing:

xiv. In the presence of an illiquidity premium, the objective to provide liquidity during a sudden stop conflicts with the objective to generate surpluses in normal times. This conflict is present for any level of primary surplus or net asset quota.

3.3 Strengthening Resilience

When an individual investor's willingness to purchase government debt depends on her expectation about other investors' decisions, multiple equilibria may arise. For example, a "good" equilibrium may occur where all investors perceive the government's financial situation as healthy and as a consequence, decide to extend credit at favorable conditions such that the government can roll over its debt without problems. But a "bad" equilibrium may occur as well where investors are pessimistic and do not extend credit or do so only subject to harsh conditions such that the government cannot roll over its debt in a sustainable manner.

When large volumes of debt have to be refinanced within a short time span—as is the case when government debt is short-term rather than long-term with maturity dates spread out across periods—it is more likely that a bad equilibrium may occur. Long-term funding therefore renders government finances less vulnerable and may for that reason be preferable to short-term financing. Arguments along this line have been proposed, for example, by Calvo (1988), Alesina, Prati and Tabellini (1990), Giavazzi and Pagano (1990), Rodrik and Velasco (1999) and Cole and Kehoe (2000).[26] Related, OECD (2013, p. 52) argues that "panicky market reactions may generate self-fulfilling prophesies. ... [O]vershooting and undershooting of prices can be observed whereby 'animal spirits' (threaten to) push government securities markets into self-fulfilling bad equilibria. For example, a recent study shows that animal spirits are playing an important role in explaining sovereign CDS spreads for euro area bond markets, especially during highly stressful episodes." Phelan (2004) draws a distinction between the maturity of debt and the sequencing of debt rollovers which matters for rollover crises. Recent academic and policy discussions in the context of the European debt crisis focus on the role of central bank policy for fiscal resilience if government debt is local currency denominated (see, for example, Aguiar, Amador, Farhi and Gopinath, 2013; Blanchard et al., 2013; Corsetti and Dedola, 2013).

Chamon (2007) shows that a simple mechanism may be able to eliminate the coordination failure at the root of a rollover crisis. His mechanism renders an investor's bid for new government debt contingent on the government being able to secure sufficient funding from other investors. As a consequence, individual investors are no longer exposed to the risk that a self fulfilling rollover crisis may occur and their equilibrium strategy therefore is to offer refinancing according to the good equilibrium terms. No convincing argument has been brought forward to explain why sovereign debt auctions do not make use of this mechanism.

Contrary to the logic of lengthening the maturity structure in order to reduce rollover risk it is sometimes proposed to "diversify" rollover risk by issuing debt instruments of different characteristics, including many different maturities. Underlying this proposal could be the view that different debt instruments are traded on segmented markets whose risks of "break down" are independent. OECD (2013, p. 22) discusses diversification along the maturity dimension for fiscal resilience reasons.

Due to financial repression, home bias or other reasons domestic investors are more likely to hold government liabilities than foreigners; they might also be less likely to "run" in times of fiscal stress. As a consequence, a debt ownership structure tilted towards domestic creditors may strengthen fiscal resilience.[27]

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[26] See also Conesa and Kehoe (2012).

[27] OECD (2013, ch. 4, 5) discusses how during the European debt crisis challenges in primary markets lead sovereigns to broaden the investor base and to change issuance procedures to improve resilience. Bond exchanges and buybacks were also used to reduce rollover risk (OECD, 2013, ch. 6).

Summarizing:

xv. The probability of a bad equilibrium with a rollover crisis may depend on the extent of short-term funding, the currency denomination of public debt and central bank policy as well as the ownership structure of public debt. A better contracting approach may help eliminate the bad equilibrium.

3.4 Achieving Other Goals

Financial policy can help achieve other goals. We discuss two of them, the more narrow fiscal goal of market access and the broader macroeconomic goal of liquidity provision.

3.4.1 Market Access

The market micro structure of financial markets may imply that the terms of the government's market access respond to changes in the net supply of government securities. This might reflect asymmetric information between a government willing to sell or buy securities and private investors considering buying or selling them or technical and time constraints in the rating and underwriting process.

One approach to modeling endogenous market access builds on the extreme assumption that a government that is not borrowing or lending in a particular market segment in period t will be borrowing or lending constrained in the subsequent period. Conditional on not borrowing or lending in period t, the government then foresees future financial policy choices that resemble those discussed in subsection 3.2.2. The new trade-offs arise from a comparison of the cost of borrowing or lending more than otherwise optimal in a period and the benefit of avoiding a borrowing or lending constraint in the future.

A more plausible approach posits that the cost of borrowing and the return on lending are functions of the government's gross borrowing or gross lending positions in the current period relative to those positions in the previous period. It is natural to assume in this case that the gross lending rate is a decreasing function and the gross borrowing rate an increasing function of its argument. Letting φ denote either lending or borrowing, the Euler equation for borrowing and/or lending discussed in subsection 3.2 then is modified to

$$\zeta_t u'_t = \beta \mathbb{E}\left[\zeta_{t+1} u'_{t+1} r^{\varphi}_{t+1}\right] + \beta \mathbb{E}\left[\zeta_{t+1} u'_{t+1} {r^{\varphi}}'_{t+1} \frac{\varphi_{t,t+1}}{\varphi_{t-1,t}}\right] - \beta^2 \mathbb{E}\left[\zeta_{t+2} u'_{t+2} {r^{\varphi}}'_{t+2} \frac{\varphi^2_{t+1,t+2}}{\varphi^2_{t,t+1}}\right]$$

where the two new terms on the right-hand side represent the price effects on inframarginal borrowing or lending in the current and subsequent period. The logic of the variable-interest-rate case in subsection 3.1 applies. As long as the marginal benefit of gross lending (the right-hand side of the above Euler equation with lending) exceeds the marginal cost of gross borrowing (the right-hand side with borrowing) financial policy can be improved by increasing gross lending and borrowing positions.

Summarizing:

xvi. A concern for market access under adverse funding conditions may rationalize larger gross borrowing and lending positions than otherwise warranted.

3.4.2 Liquidity Provision

If government debt provides liquidity services or otherwise is "special" among the assets held by the private sector then issuing government debt may have beneficial macroeconomic effects on its own.[28] We review several arguments along those lines.

Woodford (1990) and Holmström and Tirole (1998) emphasize the role of public debt for creating private liquidity when productive agents are borrowing constrained because of limited commitment. The authors point out that issuing public debt and lowering contemporaneous taxes improves the liquidity position of these agents and enables them to better exploit gains from trade. Public debt issuance therefore can help support economic activity if the government can commit (to future taxation) while private agents cannot.

An implication of the above argument is that government borrowing should be positively correlated with the severity of commitment problems in the private sector *relative* to the severity of such problems for the government. Woodford (1990) and Holmström and Tirole (1998) assume that the government can fully commit such that credibility problems in the public sector are absent. More realistically, one may assume that governments face credibility problems as well or maybe even more pronounced ones, in particular when public debt issuance is high (see the discussion in subsection 4.1.2).[29] In the recent financial crisis, credibility of private sector agents (banks) initially suffered more than the trustworthiness of governments but in relative terms, the credibility of the public sector has deteriorated since. According to the public-debt-as-private-liquidity view, this relative deterioration should have been accompanied by austerity in the sense of public debt reduction.

Aiyagari and McGrattan (1998) highlight another macroeconomic role for government debt. In their model, households may save in the form of physical capital and public debt. Both assets have the same return characteristics but in general equilibrium, capital and debt accumulation have different effects on production and inter personal risk sharing. As a consequence, there exists an optimal supply of government debt.

Financial market participants frequently point to different reasons for the special nature of government debt, for example that government securities are particularly useful as collateral and store of value because they can easily be bought and sold on highly liquid markets. But this empirical observation need not imply that government securities are of a special nature that makes it socially beneficial to supply more of them than otherwise warranted. First, it could be the case that the observed equilibrium with government debt as the predominantly used collateral is just one outcome among many (equally efficient) ones where investors coordinate on some arbitrary security. Changing financial and tax policy in response to varying demand for the arbitrary collateral asset then would appear to be not optimal.

[28] According to *The Economist* ("Losing interest," June 14, 2008), the UK Debt Management Office "argues that cost is not the only factor. There is a virtue in being predictable, and in keeping all sections of the bond market supplied with debt to trade."

[29] A private agent's breach of contract can more easily be sanctioned by a court than a government's breach of promises. In the domain of international borrowing the situation may be less clear cut because a private payment promise to a foreigner may not be more credible than a promise by the sovereign if the latter can control national courts ("sovereign ceiling").

Second, the coordinated use of government securities may not be arbitrary but rather the consequence of distortions like regulatory requirements that favour the use of these securities.[30] While demand for public debt might be strong in that case, due to an implicit subsidy, supplying the debt just in order to satisfy demand is unlikely to be socially beneficial.

Third, even if the demand for government securities is strong although it is not distorted this may not imply that an accommodating debt policy is warranted. For example, as one underlying cause for the special nature of government debt, it is often argued that the latter effectively is default risk free and thus "informationally insensitive." (This perception might have changed during the recent financial crisis.) While it is possible for public debt to be default risk free[31] it is far from clear that a fiscal-monetary policy regime that generates default risk free public debt is optimal. For the negative consequences of servicing the debt in all contingencies (for example, due to very high tax rates during a depression) may outweigh the benefits of access to default risk free securities for financial market participants.[32]

Finally, it is unclear a priori whether the fiscal authority is best placed to respond to "liquidity shocks" in financial markets or whether principal responsibility should lie with the central bank. If a shock to the severity of moral hazard frictions undermines the private sector's ability to borrow, as in Holmström and Tirole (1998), and if changing the time profile of tax collections does not aggravate other problems then a tax and financial policy that helps alleviate the consequences of the frictions may well be optimal. But if the liquidity shock reflects a sudden increase in the private sector's preference for cash or its (near) substitutes then an expansion of the supply of government securities may not be optimal—even if financial markets applauded it because public debt combines cash like features with a positive nominal return. Instead, the authority best positioned to directly address the change in macroeconomic conditions then is the central bank.

Summarizing:

xvii. When commitment problems in the public sector are less severe than in the private sector, government debt can effectively create private liquidity and help alleviate frictions in the private sector.

[30] OECD (2013, p. 46) argues that "[t]he demand for safe sovereign assets has increased due to regulatory changes, non-conventional balance sheet policies by central banks, heightened risk aversion (leading to the use of high grade collateral to support funding and other transactions), and a build-up of foreign exchange reserves in several countries." As examples for regulatory changes, changing risk weights, liquidity buffers for banks, regulatory pressures to hold high grade collateral and greater use of central counterparties (CCPs) in OTC derivatives markets are given.

[31] See, for example, the discussion in Leeper (1991) on "active" or "passive" policy regimes. Canzoneri, Cumby and Diba (2011) review the literature on the interaction between fiscal and monetary policy.

[32] Berriel and Bhattarai (2013) analyze a different motivation to hold government debt. In their model, a government mostly spends in terms of domestic goods and taxes domestic citizens. Citizens wish to hold government bonds because this provides insurance against shocks that lead to a revaluation of government debt, for example inflation shocks. They also wish to hold domestic equity whose price rises if the government's demand for domestic production rises. Note that in this model, the favourable hedging characteristics of public debt for private agents do not a priori provide a reason for the government to adjust its optimal financial policy.

xviii. Even if financial market participants perceive government debt as a particularly valuable asset class supplying such debt more than otherwise needed may not be warranted.

4 Politics

4.1 Fostering Credibility

If policy makers lack commitment, an equilibrium policy does not only have to satisfy the requirement that it implements an economic equilibrium but it must also be incentive compatible or time consistent. The incentive compatibility constraints (weakly) reduce the value of a policy program (Kydland and Prescott, 1977). By relaxing the incentive compatibility constraints, financial policy can help reduce the social losses that arise as a consequence of policy makers' lack of commitment.

4.1.1 Taxes

Lucas and Stokey (1983) analyze the program of a Ramsey government that aims at minimizing tax distortions in a closed economy and has access to an unrestricted set of Arrow securities. They assume that the government can commit to debt repayment but not to a tax plan. The allocation implemented under the ex-ante optimal tax policy uniquely determines the market value of outstanding debt in every period (and history) but it does not pin down the maturity structure of debt.

While the choice of maturity structure thus is irrelevant ex ante it is non-neutral ex post. This is a consequence of the fact that a change of tax policy ex post affects equilibrium interest rates and thus, has a differential effect on the market value of outstanding short-term or long-term debt (see the discussion of Angeletos's (2002) model in subsection 3.2.1). Holding the initial market value of outstanding debt constant, variations in the maturity structure therefore make it more or less costly to change the tax policy ex post.

Lucas and Stokey (1983) demonstrate how the government can exploit this feature in order to render the Ramsey policy time consistent. They show that there exists a unique maturity structure with the property that any incentive to change tax policy ex post in order to exploit modified tax elasticities is exactly counter balanced by the incentive not to change policy because this would increase the market value of the outstanding debt (Persson, Persson and Svensson, 1987). Clearly, this role of the maturity structure ceases to exist if equilibrium interest rates are exogenous, as for example in a small open economy.

The general point of Lucas and Stokey's (1983) analysis relates to the fact that financial policy may be neutral ex ante but non-neutral ex post by affecting future state variables. In Lucas and Stokey (1983), this state variable is the maturity structure of outstanding debt and thus, the elasticity of the market value of outstanding net debt with respect to changes in tax policy. More generally, it can be any state that determines the strength of negative side effects of a policy change ex post.[33]

Summarizing:

xix. With lack of commitment to distorting tax policy, making the market value of government debt responsive to ex-post policy changes can help render the ex-ante optimal tax policy time consistent. When interest rates vary with the tax policy the maturity structure may be employed to that effect.

4.1.2 Debt Repayment

With lack of commitment to debt repayment, a government honors its debt obligations only if the cost of default exceeds the cost of transferring principal and interest to the creditors. The cost of default may result from a loss of trust, unwarranted distributive implications, output losses or, if creditors are international investors, from sanctions or disruptions on international financial markets, exclusion from trade or trade credit or even military intervention.[34] The cost of transferring funds to creditors amounts to the social value of public funds net of the social value of funds owned by the creditors (the latter value may equal zero, in particular if creditors are foreign nationals).[35]

With sovereign credit risk, higher debt issuance typically reduces the probability of future repayment. Assume for simplicity that the government in period $t+1$ incurs a cost L_{t+1} in case of default where L_{t+1} is the realization of a random variable with cumulative distribution function $G(\cdot)$. The government then repays short-term non-contingent liabilities maturing in period $t+1$, $l_{t,t+1}$, if and only if $L_{t+1} \geq l_{t,t+1}$. Letting δ denote the discount factor of risk neutral international investors, sovereign debt $l_{t,t+1}$ therefore is priced at $q_{t,t+1} = \delta(1 - F(l_{t,t+1}))$ and a marginal increase of $l_{t,t+1}$ raises the government's value by

$$-\zeta_t u'_t l_{t,t+1} \delta G'(l_{t,t+1}) + \delta(1 - G(l_{t,t+1}))\zeta_t u'_t - \beta \mathbb{E}_t[\zeta_{t+1} u'_{t+1} | \text{no default}].$$

This marginal effect consists of three parts. The two terms on the right-hand side represent the smoothing benefit from the marginal unit of debt.[36] Issuance of a marginal

[33] Rogers (1986) and Armenter (2007) show how distributive implications of tax policy changes may counteract a government's incentive to renege on the ex-ante optimal policy.

[34] Eaton and Gersovitz (1981) argue that the threat of financial autarky discourages strategic default. For discussions and applications of this hypothesis as well as analyses of the role played by the available financial instruments, see Bulow and Rogoff (1989*b*), Grossman and Han (1999), Kletzer and Wright (2000), Alvarez and Jermann (2000), Kehoe and Perri (2002) and Ljungqvist and Sargent (2004, ch. 19), among many others. Cole and Kehoe (1998) and Sandleris (2008) argue that a sovereign default serves as a negative signal, inducing parties outside of the credit relationship to initiate actions that are costly for the government. Bulow and Rogoff (1989*a*), Bulow and Rogoff (1989*b*), Cole and Kehoe (2000), Aguiar and Gopinath (2006) and Arellano (2008) consider more direct default costs in the form of output losses. See Eaton and Fernandez (1995) for an overview over the literature and Reinhart and Rogoff (2004), Sturzenegger and Zettelmeyer (2006, pp. 49–52) or Panizza, Sturzenegger and Zettelmeyer (2009) for a discussion of the costs of sovereign defaults.

[35] Kydland and Prescott (1977) and Fischer (1980) discuss the government's incentive to default when taxes are distorting.

[36] This smoothing benefit resembles the consumption smoothing benefit in a household savings problem. It differs because of the presence of default risk and the multiplier ζ.

unit of debt at price $\delta(1 - G(l_{t,t+1}))$ provides current funds that are valued at $\zeta_t u_t'$ but requires repayment in the non-default states in the subsequent period.[37] The term on the left-hand side represents the negative effect on the funds raised from the inframarginal units of debt. A direct consequence of lack of commitment, this effect arises because a government's choice of debt issuance alters the subsequent government's choice of repayment and thus, the current price.

Default risk has positive and negative consequences for the value of the government's program. On the positive side, default renders debt implicitly state contingent and thereby may improve risk sharing (Zame, 1993). On the negative side, default gives rise to losses which are reflected in the leftmost term of the marginal effect discussed above.[38]

Niepelt (2014) analyzes a setup where the government may issue both short- (one-period) and long-term (two-period) debt. He assumes that a default decision affects all liabilities maturing in that period, both short-term debt issued in the previous period and long-term debt issued two periods before (pari passu). Niepelt (2014) shows that an appropriate choice of maturity structure can help limit the losses that arise as a consequence of the government's lack of commitment. Intuitively, for each maturity, the negative effect on the funds raised from inframarginal units relative to the smoothing benefit from the marginal unit is a convex function of the quantity of that maturity. As a consequence, the equilibrium maturity structure is interior. It smoothes cost-benefit ratios across maturities, in parallel to tax rates in optimal tax policy problems that smooth tax distortions (Barro, 1979; Lucas and Stokey, 1983).

Niepelt (2014) shows that in the sovereign debt context, lack of commitment manifests itself twofold: In the ex-post optimal choice of repayment rate which causes the negative effect on the funds raised from inframarginal units; and in the ex-post optimal choice of new debt issuance which affects the size of this effect. The convexity of the cost-benefit ratio mentioned earlier implies that more inherited, outstanding debt leads a government to reduce new short-term debt issuance (the second manifestation). Long-term debt issuance therefore increases the amount of debt maturing in the long term by less than one-to-one, in contrast with the issuance of one-period debt which results in a one-to-one increase in the amount of debt coming due in the subsequent period. As a consequence of this difference, long-term debt issuance has a smaller price impact than short-term debt issuance, due to the tight connection between the amount of debt coming due and the default risk (the first manifestation). This smaller price impact gives rise to an advantageous cost-benefit ratio of long-term debt. As a result, the equilibrium maturity structure is tilted towards the long end. Higher levels of debt worsen the cost-benefit

[37]The marginal effect of debt issuance on the government's continuation value equals the expected loss from repaying the *marginal* unit of debt. Although a small increase in $l_{t,t+1}$ also affects the repayment probability of the inframarginal units of debt, no welfare effects due to less likely repayment of inframarginal units is apparent. This is a consequence of the fact that less likely repayment of inframarginal units goes hand in hand with more likely default costs L_{t+1}. The welfare effects associated with these two changes cancel since the subsequent government is indifferent at the margin between repaying or defaulting, and due to the congruence of the subsequent government's objective function and the current government's continuation value function. See Niepelt (2014) for a discussion.

[38]See the discussion in Niepelt (2014). The fact that default risk reduces average debt repayment does not have welfare implications because the price of debt accounts for this.

ratio of long-term debt and high debt-to-GDP ratios therefore go hand in hand with a more balanced maturity structure.

The picture that emerges from the closed-form solutions in Niepelt's (2014) model is one of an interior maturity structure with positive gross positions, in line with the empirical evidence, but in contrast with predictions from models that stress the role of the maturity structure in completing markets or avoiding bad equilibria with rollover crises (see the discussion in subsections 3.2 and 3.3). The model predicts a shortening of the maturity structure when debt issuance is high, in line with evidence summarized by Rodrik and Velasco (1999); around times of low output ("crises"), consistent with the evidence reported by Broner, Lorenzoni and Schmukler (2013); and in periods with low output volatility.[39]

In Lucas and Stokey (1983) an appropriate choice of maturity structure fully relaxes the no-commitment constraints in the government's program and allows to implement the Ramsey tax policy. In Niepelt (2014), in contrast, the Ramsey policy cannot be implemented; an appropriate choice of maturity structure softens the negative consequences of lack of commitment in that model but it cannot eliminate them completely. Niepelt (2004*a*) shows that this negative result can be overturned if the government is not indifferent with respect to the wealth distribution among its creditors and if it can control the debt ownership structure. Since the latter determines the distributive implications of a government default, a government can be discouraged from defaulting if the ownership structure is tilted towards favored groups.[40] With an appropriate choice of ownership structure of sovereign debt, the Ramsey tax policy therefore can be implemented even if the government cannot commit.[41] Calvo and Guidotti (1990) and Missale and Blanchard (1994) discuss the role of debt indexation, denomination and maturity in softening the negative consequences of lack of commitment.

Summarizing:

xx. With lack of commitment to debt repayment and pari passu, a balanced maturity structure can help minimize the social losses caused by the no-commitment friction.

xxi. With lack of commitment to debt repayment and government preferences with respect to the wealth distribution of government creditors, an appropriate ownership structure of public debt can help counteract ex-post incentives to default.

4.2 Improving Fiscal Policy Choices

As is well understood and was mentioned before, financial policy can not only help collect taxes in the least distorting manner (Barro, 1979; Lucas and Stokey, 1983) but also

[39]For a related, quantitative analysis see Arellano and Ramanarayanan (2012).

[40]See also Tabellini (1991), Dixit and Londregan (2000) or Kremer and Mehta (2000).

[41]Dellas and Niepelt (2016) analyze a model where the ownership structure of public debt affects the sovereign's cost of defaulting and thus, the severity of the no-commitment problem. They argue that official lenders like the IMF or the European Union are better placed to induce sovereign debtors to service outstanding loans than private lenders and they use this argument to explain the recent debt crisis in countries like Greece, Italy, Ireland, Portugal or Spain.

allocate tax burdens across groups in the preferred way (Diamond, 1965; Niepelt, 2004*b*). The latter role is important not only for equity reasons. For if government spending is determined in the political process (rather than being exogenously given as often assumed in analyses of financial policy) then the possibility to shift the burden of taxation may facilitate better societal government spending choices.

Bassetto and Sargent (2006) make this point in the context of an overlapping generations economy where government spending on durable public goods is decided in the political process. Suppose for simplicity that in each period, there are young and old agents alive; old agents die at the end of the period. Government spending benefits both age groups to the same extent, and taxes are collected symmetrically from both groups. Under these conditions, young agents prefer much higher government spending than old agents if spending is fully financed by contemporaneous taxes (because the young enjoy the benefits of public spending over two periods rather than just one). If spending is partly financed through the issuance of public debt that is serviced by future tax payers, in contrast, then the conflict of interest between young and old voters is reduced. Depending on the aggregation of group preferences in the political process, one financing arrangement may be preferable to the other in terms of delivering good outcomes.[42]

Bassetto and Sargent (2006) analyze the relationship between the durability of public goods, population growth and the optimal extent of debt financing and they relate their findings to the benchmark "golden rule" according to which nondurable goods and services should be financed out of contemporaneous taxes while durable goods may be financed by issuing debt.

Summarizing:

xxii. By shifting tax burdens to specific groups in society, tax and financial policy can contribute to improved fiscal policy choices.

5 Conclusion

We have reviewed mechanisms through which financial policy may contribute towards achieving various goals. Summaries i. to xxii. throughout the body of the paper collect the main findings.

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[42]The trade-off between the different arrangements is more complicated than this brief discussion suggests because young agents might strategically withhold support for contemporaneous government spending, anticipating more spending by voters in the subsequent period in response.

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