Capital Tax Competition: Is There A Gain from Monetary Integration?

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5 November 2003

Abstract

We show that monetary integration may result in higher capital taxes. The reason is that taxation of mobile capital in a common currency area may give rise to a vertical externality by shrinking the revenues of the anchor central bank from issuing the common currency. As mobility of tax bases, like capital, gives also rise to horizontal tax inefficiencies, the question arises as to whether instituting a common currency area can be viewed as an efficiency improving arrangement. We argue that this will depend on whether taxes were too low or too high prior to monetary integration, with the latter depending on characteristics of money demand, elasticity of capital, extend of taxation of immobile factors, and size of seignorage and total tax receipts.

Keywords: Tax Competition, Seignorage, Currency Unions.
JEL Classification Numbers: E42, E62, H25, H77

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*I would like to thank Steven McCorriston and Mohan Bijapur for helpful discussions. The usual disclaimer applies.

1 Introduction

Currency unions is a live theme. The Economic and Monetary Union (EMU) is a reality, and a number of countries in the Americas, Eastern Europe, Africa and Asia have been pursuing a currency board (locking national currency to an anchor currency - like dollar, euro or yen) or dollarisation (replacing national currency with a foreign one). These developments have constantly been refreshing the interest of economists in the costs and benefits of such arrangements, since the seminal papers by Mundell (1961), McKinnon (1963) and Kenen (1969). Without doing justice to the vast by now literature on monetary integration, some recent contributions include Canzoneri and Rogers (1990), De Grauwe (1992), Casella (1992), Alesina and Grilli (1992), Sibert (1994), Buiter (1997), Wyplosz (1997), Feldstein (1997), Obstfeld (1997), Eichengreen (1998), Frankel and Rose (1998), Dornbush (2001), Rogoff (2001), Alesina and Barro (2001), Rose and van Wincoop (2001).

The literature on currency unions has identified a number of costs and gains from monetary integration. Costs include the loss of exchange rate as stabilisation instrument, loss of inflation tax and seignorage, loss of a lender as a last resort, free-riding and spillovers from non-cooperative setting of fiscal deficits. Fiscal preparedness raises in turn the question of fiscal coordination between member-countries; see, for instance, Sibert (1994), Dixit (2000), Dixit and Lambertini (2000, 2001a), Beetsma et. al. (2001), Engwerda et. al. (2002), and references therein.

Gains include improvement in credibility, synchronisation of business cycles, and reduction in transaction costs of trade, exchange rate uncertainty and cost of capital. The further integration of goods and capital markets raises in turn the issue of tax coordination between member-countries, as mobility of goods and factors gives rise to horizontal tax externalities; see, for instance, Keen and Smith (1996), Wilson (1999), Sørensen (2000), Lockwood (2001), references therein, and the Primarolo Report (1999).

This paper identifies an additional, and previously unrecognised, implication of multilateral currency unification for the well-being of (potential) member-countries. Namely, we show that *if capital is mobile monetary integration per se (MI hereafter) may result in higher capital taxes.* The reason is as follows. Currency integration implies the loss of seignorage for the countries that abandon their currencies. Yet, in the cases of dollarisations and currency-board arrangements that are promoted by the center, the sharing of seignorage between the anchor and its clients is very likely to be part of the negotiations prior to monetary integration.[1] Such sharing is indeed bound to be part of any agreement for the institution of monetary unions like EMU where the anchor currency is new; in fact, revenues from issues of euro on the part of the European Central Bank (ECB) are distributed back to member-countries according to a well-defined rule that links shares with the relative GDP and population sizes of countries. However, the *sharing* of seignorage under a multilateral currency unification creates a

[1]For similar arguments, see also Dornbusch (2001) and Alesina and Barro (2001).

common-pool problem. Specifically, *for any given before-tax cost of capital*, a unilateral increase in capital taxes results in lower capital inflows, and thereby lower wages, rents from immobile factors and disposable income domestically. The decrease in domestic disposable income reduces in turn real money holdings domestically, and hence shrinks seignorage. If public revenues, and therefore seignorage, are valued by member-countries, the reduction in revenues from issuing money constitutes a cost from using capital taxes. As under seignorage sharing only part of this negative effect is internalised by national tax authorities, MI will lead, ceteris paribus, to higher capital taxes.

Given, then, the horizontal tax externalities also associated with mobility of tax bases, and thereby the possibility that capital taxes are at an inefficient level under monetary autonomy, the question arises as to whether the common-pool effect of MI on capital taxes can be viewed as a benefit from instituting a common currency area. In particular, we ask: can multilateral monetary integration be justified, all other things equal, on the grounds of inducing higher national capital taxes? Or, in other words, can currency unification be viewed as (indirect) means of capital tax coordination? Naturally, the answer depends on whether taxes were too low or too high prior to monetary integration and on the extend of the rise in capital taxes after MI. We show that the answer to the above questions depends on characteristics of money demand, elasticity of capital, size of seignorage and total tax receipts.

Our analysis is somewhat related to Sibert (1992). In that paper as well there is a common-pool problem. Nevertheless, this problem stems from direct income taxation and the focus is on the benefits from the inflation rate being part of a constitution. Also, in that paper there is no mobility in factors of production, and hence there are no horizontal tax externalities under monetary autonomy (the model is an exchange economy). Our work is also related to Keen and Kotsogiannis (2002) (KK hereafter). That paper takes into account not only the fiscal interactions between horizontally related states but also the vertical interactions between a federal authority and the state governments. However, in that paper there is no money, and the common-pool problem, or vertical externality, arises from the taxation of capital by both federal and state governments.

The organisation of the paper is the following. Next Section presents the basic model, while Section 3 derives non-cooperative capital taxes under monetary autonomy and under currency integration. Section 4 compares the outcomes and derives conditions under which monetary integration is a welfare improving institutional arrangement. Section 5 discusses some extensions to the basic model, and Section 6 concludes.

2 The Model

Our aim is to make our point - that if capital is mobile then replacing n currencies with a new or existing anchor currency may increase capital taxes and may thereby be, all other things equal, a welfare improving arrangement - in the simplest possible manner. For this reason the basic model

abstracts from any other considerations that may or may not lead to the institution of a monetary union. In particular, we assume throughout that there is no uncertainty and that there are no costs from or restrictions to trade, including costs from currency exchange. In addition, it is assumed that the countries contemplating to form a currency union may trade in goods and factors only with each other but not with countries outside the potential monetary block.[2] Also, we assume that regardless of the monetary arrangement taxes and public spending in each country are set by national governments.

Furthermore, we assume that potential monetary partners are symmetric countries, that capital is perfectly mobile within the potential monetary block, and that each country is populated by a representative agent. These assumptions will enable us to build a basic intuition, and are discussed in Section 5.

Currencies take the form of fiat money. Under monetary autonomy, national currencies are managed by national monetary authorities. When countries form a monetary union national currencies are replaced with a union-wide currency, which is managed by a supra-national monetary authority, the monetary union's central bank. Thus, in that case, while countries have autonomy over national fiscal policies, they face a common union-wide inflation rate which is under the control of the union's central bank. To isolate the effect on capital taxes of monetary integration *per se*, we also choose to abstain from any effect that may arise due to a different union-wide inflation rate than the one faced by the typical client country under monetary autonomy. We do so by not treating explicitly the behaviour of the monetary union's central bank, and assuming that inflation stays the same after the currency unification Section 5 discusses how our results would be affected if we relaxed this assumption.

In effect, our basic framework is the standard capital taxation model of Zodrow and Mieszkowski (1986) and Wilson (1986) (ZMW hereafter), appropriately modified to incorporate money holdings and inflation. In more detail, the world consists of $n > 1$ countries. There is a single composite and traded good, and each country possesses an endowment e of this good. There is also a market for bonds, which all countries have access to at no cost. Let ρ denote the real interest rate in this market.[3]

Each and every national government possesses a per-unit tax on capital employed domestically. In addition, public spending takes the form of public good provision. Assume, for simplicity, that national governments do not issue public debt, i.e. they do not enter the capital market. Expressed in real terms, denote with g_j the level of public good and with v_j any transfer from the national or anchor central bank (CB hereafter), in country j. Assume that CBs must not make losses, or equivalently that only

[2]The latter assumption could be justified with reference to EMU and evidence that location decisions of US based multi-nationals have not been signifantly affected by differences in effective rax rates across the Atlantic, while tax differences within Europe have had a significant effect (see Devereeux and Griffith, 1998).

[3]The law of one price, the Fischer parity condition and the uncovered interest rate parity conditions, that ensure no arbitrage in the markets for the single good and for (real or nominal, domestic or foreign) assets, imply that the real interest rate is common for all countries regardless of the monetary arrangement.

transfers from the CB to the tax authorities are allowed and not the other way around. So, $v_j \geq 0$. Moreover, denote with t_j and k_j the tax and the level of capital in country j. The government's budget constraint, in country j, is then

$$g_j = t_j k_j + v_j. \tag{1}$$

Governments are assumed to be benevolent: they choose national policies $\{g_j, t_j\}$ to maximise the welfare of their representative household. Our assumption that national governments do not tax savings and profits that accrue to domestic producers is discussed in Section 5.

Currencies are issued at the beginning of the period. Depending on the monetary regime, either national CBs issue domestic currencies or the anchor CB issues the common currency. The real revenue from money creation is invested in the capital market. At the end of the period, monetary authorities receive $(1 + \rho)$ per unit of real money balances. In addition, they buy back the outstanding nominal money stocks. As countries are symmetric they will face the same inflation both prior and after monetary integration. Recalling our assumption that monetary integration entails no change in inflation, let π denote the union-wide inflation under any monetary arrangement. The monetary authorities' end-of-period real liability is then equal to $(1-\pi)$ per unit or real money balances; the inflation rate is effectively a tax on real money holdings. Thus, total end-of-period revenues are $(\rho + \pi)$ per unit of real money holdings. We postulate that CBs have no expenses and are not involved in the provision of public goods. Also, CBs meet residually the demand for money, i.e. ensure equilibrium in the market for money. Denoting with m_j the demand for real money balances in country j, we have that under monetary autonomy

$$v_j = (\rho + \pi) m_j. \tag{2}$$

The typical national CB is assumed to be benevolent. It chooses domestic inflation to maximise welfare of the typical household subject to the constraint that $\rho + \pi \geq 0$. Since countries are identical we assume, without loss of generality, that under currency union each member-state receives

$$v_j = v = (\rho + \pi) \sum_j m_j / n. \tag{3}$$

We turn to the description of the private sector in the typical country. Private production in country j takes place by means of a production function $f(k_j)$ with the standard properties. Capital k_j is bought in the capital market at a price ρ, and does not depreciate after its use. Profits are thus given by $f(k_j) - (\rho + t_j)k_j$, and the demand for capital follows from the standard profit-maximisation condition

$$f'(k_j) = \rho + t_j. \tag{4}$$

So, capital is a decreasing function of the gross rate of interest $\rho + t_j$, $k_j = k(\rho + t_j)$ with $k' = 1/f''(k_j)$. Also, equilibrium profits r_j are a decreasing function of the gross interest rate, $r_j = r(\rho + t_j)$ with $r' = -k_j$, where $r() \equiv f(k()) - f'(k())k()$.

Restricting our attention to non-negative real interest rate, or before-tax user-cost of capital, i.e. $\rho \geq 0$, the typical household allocates its endowment e to real money holdings m_j and bonds $b_j = e - m_j$. At the end of the period it liquidates money holdings, and receives its return from investment and the net of tax equilibrium profits. These three sources of income comprise consumption,

$$\begin{aligned} c_j &= (1+\rho)(e-m_j) + m_j(1-\pi) + r(\rho + t_j) \\ &= (1+\rho)e + r(\rho+t_j) - m_j(\rho+\pi) \\ &\equiv y(\rho, t_j) - m_j(\rho+\pi). \end{aligned} \tag{5}$$

In the latter equation, $y(\rho, t_j)$ denotes disposable income $(1+\rho)e + r(\rho + t_j)$. Our assumption that savings, e, are fixed is discussed in Section 5.

As it is well-known, explaining demand for fiat money in an analytically tractable way is notoriously difficult. For this reason, existing models with money largely fall into two, admittedly simplistic, categories. There are those models where money is a necessary exchange medium; the cash-in-advance models. There are also the money-in-utility models which postulate that individuals derive utility from real money holdings, as the latter economise on transaction costs (e.g. shopping time) associated with purchases. These models yield similar predictions, that also comply with empirical evidence, about the demand for liquidity.[4] Here we focus on the role of money as a medium of exchange that reduces transaction costs. That is, we postulate the following preferences

$$V(c_j, m_j) + \Gamma(g_j), \tag{6}$$

where $\Gamma()$ has the standard properties. We also assume that $V_1 > 0$, $V_2 > 0$, $V_{11} < 0$, *and* $V_2 V_{11} < V_{21} V_1$. Conditioned on the satisfaction of the second order sufficient condition, the latter assumption is necessary and sufficient for real money balances to be a normal good. In Section 5 we discuss how our results would be modified if we assumed, instead, the existence of a cash-in-advance constraint.

It follows that welfare maximisation for given interest rate ρ and policies, taking into account the budget constraint (5), gives demand for liquidity which is increasing with disposable income $y_j \equiv y(\rho, t_j)$, as money here is a normal good, and decreasing with the relative price of holding money, $\rho + \pi$. In more detail, assuming that the second order sufficient condition is satisfied, optimal money holdings when $\rho + \pi > 0$ satisfy the first order condition of the household's problem:

$$V_2(c_j, m_j) = (\rho + \pi) V_1(c_j, m_j). \tag{7}$$

This condition, combined with the budget constraint, gives a money demand $m_j = m(\rho + \pi, y_j,)$, with $m_1 < 0$ and $m_2 > 0$, where $y_j \equiv y(\rho, t_j)$. Let $m_j = m(\rho + \pi, y(\rho, t_j)) \equiv l(\rho, t_j, \pi)$. Clearly, $l_2 < 0$ and $l_3 < 0$. That is, demand for money is decreasing with capital taxes, as higher taxes decrease disposable

[4] See Blanchard and Fischer (1989) Ch 4 and Obstfeld and Rogoff (1996) Chs 8.1-8.3 for some excellent discussions of the issues involved.

income. It is also decreasing with inflation, as the price of money is increasing with inflation. It will also prove useful for what follows to investigate the effect on liquidity of changes in the real interest rate. Increases in the latter result, ceteris paribus, in higher price of money and hence in lower real money balances. At the same time, however, an increase in the real interest rate has an ambiguous effect on the disposable income, as it increases the returns from savings but it also decreases profits. So the effect on liquidity of changes in the real interest rate is ambiguous and depends on the net capital flows; in more detail, $l_1 = m_1 + m_2[e - k_j]$.

Given the above, the value function of typical agent in country j is

$$U(\rho, t_j, \pi, g_j) \equiv V(y(.,.) - (\rho + \pi)l(.), l(.)) + \Gamma(g_j), \tag{8}$$

with - due to the envelope theorem:

$$U_1 = V_1[b_j - k_j], \tag{9}$$

$$U_2 = -V_1 k_j, \tag{10}$$

$$U_3 = -V_1 m_j. \tag{11}$$

Equilibrium in the market for capital is given by

$$\sum_j k(\rho + t_j) = ne, \tag{12}$$

which implies an equilibrium real interest rate $\rho = \rho(\vec{t})$, where $\vec{t} \equiv \{t_1, ..., t_n\}$. Note that in a symmetric equilibrium we have

$$k(\rho + t) = e, \tag{13}$$

and thus $\rho = p(t)$. Let ρ_j denote the marginal effect on real interest rate of a change in the capital tax in country j, evaluated at a symmetric equilibrium. We have that:

$$\rho_j = \frac{p'}{n} \text{ with } p' = -1. \tag{14}$$

Given the symmetry of our model we focus on symmetric equilibria. We also focus on situations where fiscal authorities are involved in a Nash game with each other, to capture fiscal decentralisation. Equilibrium characterisation will also depend on whether policy is discretionary or not. Whether policy is discretionary or not amounts to whether policy-makers can commit or not on their policies prior to individuals deciding on their money holdings. As the price of money depends on capital taxes (indirectly via the real interest rate), capital taxes distort individual decisions and, so, optimally announced policies (when money holdings are not yet determined) are in general different to ex post optimal policies (when real money balances are in place).[5] We assume that national governments and CBs possess the same

[5]For some excellent discussions of the dynamic, or time, inconsistency problem of policies, see Blanchard and Fischer (1989) Ch 11.4 and Persson and Tabellini (2000) Ch 12.2 and 15. Note also that the implicit assumption here, as in all models of capital tax competition, is that tax authorities can commit on their capital taxes prior to capital stock being decided upon by firms. Recall also our assumption that inflation is fixed.

ability to pre-commit. We do so in order to isolate the efficiency implications for decentralised capital tax policy of monetary integration per se. Introducing an asymmetry vis-a-vis pre-commitment technologies would bring about additional considerations,[6] and would obscure the picture, without altering the main insights of our paper.

In terms of our model, if pre-commitment of policies is feasible then (all) domestic policy-setters take into account, when decide upon policy, that $m_j = l(\rho(\vec{t}), t_j, \pi)$. If, on the other hand, policies must be credible then m_j is treated as exogenously given, i.e. policies are chosen *as if* $l_1 = l_2 = l_3 \equiv 0$. To capture in a concise way the different incentives, depending on the existence of pre-commitment technologies, on the part of policy-makers, we follow hereafter the convention that $m_j = \hat{l}(\rho, t_j, \pi)$ with $\hat{l}_\kappa = 0$ if policy-makers cannot pre-commit, and $\hat{l}_\kappa = l_\kappa$ otherwise, where $\kappa = 1, 2, 3$.

Finally note that as the typical monetary and tax authorities face the same objective function a direct application of the envelope theorem implies that the sequence of the moves between the CBs and the fiscal authorities is not crucial for policy determination under monetary autonomy. In fact, non-cooperative tax and monetary policy under monetary autonomy is given by maximising the typical resident's welfare with respect to t_j and $\pi \geq -\rho(\vec{t})$, taking into account that $m_j = \hat{l}(\rho, t_j, \pi)$.

The objective function of the typical national (consolidated) government under monetary autonomy can be written as:

$$W^a(\vec{t}, \pi) \equiv U(\rho(\vec{t}), t_j, \pi, t_j k(.) + (\rho(\vec{t}) + \pi)\hat{l}(.)). \tag{15}$$

So, at an interior solution, inflation $\pi > -\rho(\vec{t})$ is given by $\frac{\partial W^a(\vec{t},\pi)}{\partial \pi} = 0$, which evaluated at the symmetric equilibrium is:[7]

$$-V_1(c, m)m + \Gamma'(g)[m + (\pi + \rho)\hat{l}_3] = 0. \tag{16}$$

That is, in an equilibrium with positive real money holdings,[8] the inflation tax follows the well-known inverse elasticity rule. Equivalently, inflation is set so that the marginal benefit from an additional unit of seignorage and thereby public good, Γ', is equal to the marginal cost of public funds, $V_1/(1 - \hat{\varepsilon}_1)$, where $\hat{\varepsilon}_1 \equiv -(\pi + \rho)\frac{\hat{m}_1}{m}$ is the price elasticity of money demand from the policy-makers' point of view.

We are now ready to turn to capital taxation and the implications for tax policy of currency unification.

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[6] See for instance Huber (1998), Dixit and Lambertini (2001b).

[7] Sufficiently strong preferences for public good would ensure a positve price of real money balances.

[8] Sufficiently high marginal utility of money at zero holdings would ensure this.

3 Capital Taxation

3.1 Monetary Autonomy

We start with capital setting when each country possesses its own currency. The typical capital tax t^a is given by $\frac{\partial W^a(\vec{t},\pi)}{\partial t_j} = 0$, which evaluated at the symmetric equilibrium gives:

$$-V_1(c,m)[m\frac{p'}{n} + e] + \Gamma'(g)\{[tk' + m + (\pi+\rho)\hat{l}_1]\frac{p'}{n} + e + tk' + (\pi+\rho)\hat{l}_2\} = 0. \tag{17}$$

To understand the above condition note that a marginal increase in capital tax has a direct effect on REVENUES, capital, profits and thereby disposable income AND MONEY HOLDINGS, and an effect on the real interest rate. The term $(p'/n)\Gamma'(g)tk'$ represents the change in welfare that arises from the effect on capital tax revenues of tax-induced changes in the real interest rate. To see this, note that the marginal effect on capital tax revenues of a change in price of capital is $tk' < 0$. As $(p'/n)\Gamma'(g) < 0$, we have that this effect represents a benefit from higher taxes.

Note that, as the before-tax user-cost of capital ρ is common to all countries, the above effect of a unilateral change in capital tax will be faced by each and every country. So, taxation of mobile capital creates a positive externality through its effect on foreign capital tax revenues. The extend of this externality is positively related to the responsiveness of capital to the after-tax price of capital $\rho + t$. This is the standard horizontal externality that arises due to the mobility of capital, and has been emphasised in the ZMW model. It leads ceteris paribus to too low taxes. We call it the tax competition effect.

The term $e[\Gamma'(g) - V_1(c,m)] + \Gamma'(g)tk']$ represents the change in welfare that arises from the direct effect on capital and thereby profits, disposable income, and capital and profit tax revenues. Specifically, the effect on disposable income of a marginal increase in capital tax, in a symmetric equilibrium, is $-e < 0$. So, consumption decreases and this effect pushes towards low taxes. Finally, the marginal effect on capital tax revenues of a change in tax is $e + tk'$. For low taxes the revenues from taxing capital increase, and this represents a benefit from higher taxes, and vice versa.

The remaining terms capture the effects that arise due to the presence of money. To start with, the term $-m(p'/n)V_1(c,m)$ reflects the effect on private consumption, for given disposable income, of tax-induced changes in the real interest rate. A marginal increase in the real interest rate, while maintaining income, decreases consumption by the amount of real money holdings m. As $(p'/n)V_1 < 0$, this pushes towards high taxes. Turn, now, to the term $(p'/n)\Gamma'(g)[m + (\pi+\rho)\hat{l}_1]$. As $(\pi+\rho)m(\rho+\pi, y(\rho,t))$ is the (opportunity or stock measure of) seignorage of each and every national government, $m + (\pi+\rho)\hat{l}_1$ reflects the change in national CB's revenues from a tax-induced change in the real interest rate. In more detail, a decrease in the real interest rate decreases the rate of return the CB faces when entering the capital market, and hence shrinks its revenues by the level of real money balances m. As $\Gamma'(g)(p'/n) < 0$, this constitutes a cost of taxation. A decrease in the real interest rate affects also the demand for liquidity

and thereby the tax base of the CB. In a symmetric equilibrium we have that $\hat{l}_1 = \hat{m}_1$: a tax-induced decrease in the real interest rate increases the monetary base, and thereby public good provision.

As these welfare effects arise from tax-induced changes in the common real interest rate, these effects also will be faced by each and every country. *Thus, taxation of capital in the presence of seignorage gives rise to an additional horizontal externality, the direction of which depends on the elasticity of money demand with respect to the real interest rate and the relative valuation of private and public consumptions.* In particular, if policies are discretionary (i.e. $\hat{l}_1 = 0$) and private consumption is valued, at the margin, less than public consumption, taxation of capital creates a negative externality through its effect on the revenues of the CBs for any given level of real money holdings. Naturally, this effect counteracts the tax competition effect. If, on the other hand, policies can be pre-committed upon and money demand is very responsive to changes in the price of money, then the effect of capital taxation on the CBs' tax bases dominates, and taxes tend to be too low. Similarly if policies are discretionary and private consumption is valued, at the margin, more than public consumption[9]

The last incentive that influences tax-setting arises from the direct effect of capital tax on the monetary authority's tax base, and is represented by the remaining term $\Gamma'(g)\ (\pi + \rho)\hat{l}_2$. A marginal increase in the capital tax decreases domestic capital, profits, disposable income and hence demand for real money balances by $-\hat{l}_2$. This in turn implies that the CB's revenues decrease by $-(\pi + \rho)\hat{l}_2$. As a transfer from the CB is valued, due to public good provision, this effect represents a cost of higher tax.

3.2 Monetary Integration

We turn to the case of currency unification. The objective function of the typical national tax authority can be written as:

$$W^u(\vec{t}, \pi) \equiv U(\rho(\vec{t}), t_j, \pi, t_j k(.) + \frac{(\rho(\vec{t}) + \pi)}{n} \sum_j \hat{l}(\rho(), t_j, \pi)). \tag{18}$$

The typical capital tax t^u is given by $\frac{\partial W^u(\vec{t},\pi)}{\partial t_j} = 0$, which evaluated at the symmetric equilibrium gives:

$$-V_1(c, m)[m\frac{p'}{n} + e] + \Gamma'(g)\{[tk' + m + (\pi + \rho)\hat{l}_1]\frac{p'}{n} + e + tk' + (\pi + \rho)\frac{\hat{l}_2}{n}\} = 0. \tag{19}$$

Note that all the effects, except the direct one of capital tax on seignorage, are the same as above. That is, national tax authorities face the same incentives under both monetary autonomy and currency union with one exception. In particular, from the point of view of each and every national tax government the direct effect on *appropriated* seignorage of a marginal change in domestic capital tax is given by $(\pi + \rho)\hat{l}_2$ under national currencies but by $(\pi + \rho)\frac{\hat{l}_2}{n}$ under a common currency. This is a direct consequence of the seignorage sharing arrangement under currency unification. As an increase in

[9]See also Makris (2003).

capital tax decreases capital and thereby disposable income, demand for money and the CB's tax base, we clearly then have that:

Proposition 1: *Multilateral monetary integration per se (i.e. replacing national currencies with an anchor currency under an agreement of seignorage sharing and maintaining inflation) results in higher capital taxes if and only if capital taxes can be pre-committed upon prior to money demand being determined.*

Given, as we have seen in Section 3.1, that capital taxation gives also rise to horizontal tax externalities, the above result raises the issue of whether MI is welfare improving. We turn to this next.

4 Normative Analysis

So far, we have analysed the positive effects of MI on the setting of taxes. We can now ask whether MI leads to aggregate efficiency gains, or even Pareto-improvements.

Assume that all countries set the same tax, as they do in symmetric equilibrium, i.e. $t_j = t$. If all taxes are constrained to be the same, then there are no capital outflows or inflows to a particular country, and so capital stocks in all countries are fixed at e. Also, seignorage in each and every country is $(\pi + \rho)m(\pi + \rho, y(\rho, t))$ *regardless of the monetary arrangement.* So, whatever t, the utility of the representative agent in any typical country is

$$W(t, \pi) \equiv U(p(t), t, \pi, tk(p(t) + t) + (\pi + p(t))\hat{l}(p(t), t, \pi). \tag{20}$$

Then if $W(t'', \pi) > W(t', \pi)$, a social planner could change t' to t'' leaving all countries strictly better off. That is, t'' is Pareto-preferred to t'. Therefore, it is natural to define the t that maximises W given the union-wide inflation as the *efficient tax.* Assuming that W is strictly quasi concave, in an interior solution the efficient tax $t^*(\pi)$, given inflation, is characterized by the first-order condition

$$\begin{aligned} W_t(t, \pi) &= -V_1(c, m)[mp' + e] \\ &\quad + \Gamma'(g)\{[tk' + m + (\pi + \rho)\hat{l}_1]p' + e + tk' + (\pi + \rho)\hat{l}_2\} \\ &= 0. \end{aligned}$$

Note that the incentives faced by a social planner are identical to the ones faced, in a symmetric equilibrium, by the typical national government under monetary autonomy, with the only difference that a social planner takes into account the full effect of a marginal change in the (symmetric) capital tax on the real interest rate, instead of just the $1/n^{th}$ of the total effect (recall that $\rho_j = \frac{p'}{n}$ and compare the above condition with (17)). This is a direct consequence of the fact that capital taxation gives rise to horizontal tax externalities through its effects on the common before-tax cost of capital ρ, and these externalities are internalised by a social planner. This observation will prove crucial shortly after.

We can now pose the question of the first paragraph of this section more precisely: does MI move the equilibrium tax in the direction of its efficient level, i.e. is t^u Pareto-preferred to t^a? Or, is the reverse the case? We have in a straightforward manner, after recalling Proposition 1::

Proposition 2. *(A) If capital taxes are discretionary, there are no efficiency gains from monetary integration per se, as taxes remain the same* ($t^u = t^a$).

(B) If instead capital taxes can be pre-committed upon prior to the determination of money demand we have the following: (i) Suppose that the currency union is not characterised by over-taxation of capital. Then MI leads to a change in the equilibrium tax towards its efficient level ($t^a < t^u \leq t^*$). *(ii) Suppose that capital taxes are inefficiently high under monetary autonomy. Then MI leads to a change in the equilibrium tax away from its efficient level* ($t^u > t^a > t^*$). *(iii) Suppose that the currency union is characterised by over-taxation of capital, while capital taxes are inefficiently low under monetary autonomy. Then whether MI leads to a Pareto improvement depends on the curvature of W.*

The intuition for Proposition 2 is simple. If capital taxes are discretionary, real money holdings are inelastic to tax changes. Thus there is no common pool problem due to seignorage sharing and taxes remain unaffected from currency unification. Given, however, that MI leads to higher taxes when the latter can be pre-committed upon, monetary integration is a Pareto improvement arrangement if and only if taxes are initially (i.e. prior to currency unification) too low and the increase in taxes sufficiently small.

In what follows we restrict attention to the case of pre-commitment. The above Proposition emphasises that a necessary condition for MI to be Pareto improving is that capital taxes under monetary autonomy are inefficiently low, i.e. $t^a < t^*$. To gain an insight on the factors that influence the satisfaction of this necessary condition, note that after using the condition that characterises the capital tax under monetary autonomy, (17), we have

$$\begin{aligned} W_t(t,\pi) &= (1-1/n)p'[m(\Gamma'(g)-V_1(c,m))+\Gamma'(g)(tk'+(\pi+\rho)l_1)] \\ &\equiv W_t^a. \end{aligned} \tag{21}$$

W_t^a represents the difference in incentives between a social planner and the typical national tax authority under monetary autonomy. As we have seen above this difference stems from the non-cooperative behaviour of tax authorities and the effect capital taxes have on the common before-tax price of capital. Clearly, then, monetary autonomy is characterised by under-taxation of capital if and only if $W_t^a > 0$. Obviously, the net externality has an ambiguous direction, and so taxes under monetary autonomy may be too low or too high depending on the cash-flow measure of seignorage m, tax-elasticity of capital $\eta \equiv -tk'/k$, price of money $\pi + \rho$, and the characteristics of the money demand l_1.

To see the implications of Proposition 2 we presume that capital taxes are positive.[10] The direction of tax inefficiency under monetary autonomy depends on the standard tax competition effect

[10]Sufficiently strong preferences for public good would ensure a positve tax on capital.

and on the net horizontal externality that arises in a world with national monies. After eliminating m from above by using (17), one can see that W_t^a is proportional to $(n-1)[e(V_1-\Gamma')-\Gamma' tk'-\Gamma'(\pi+\rho)l_2]$. To sign this term one needs also to use the information about monetary policy under national currencies. Recall that inflation follows the inverse elasticity rule (16). Combining the above information, and using the fact that in symmetric equilibrium $k=e$, we have that W_t is proportional to $\eta-\varepsilon_1+\varepsilon_2\frac{(\pi+\rho)m}{y}$, where ε_2 is the income elasticity of the demand for money, $\frac{y}{m}m_2$. So, in a world with national monies, capital taxes are too low if and only if $\eta+\varepsilon_2\frac{(\pi+\rho)m}{y}>\varepsilon_1$. Noting that in equilibrium $y=e+f(e)-g+(\pi+\rho)m$, we have that in the presence of pre-commitment technologies that enable tax authorities to abide by their policy announcements, the less sensitive to interest rates and the more sensitive to income money demand is, the more elastic capital is, the higher seignorage is and the higher public spending is, the more likely is that capital taxes are too low.

Take, for instance, the example of United States used in KK. Using an estimate of 0.25 for the elasticity of capital with respect to the user cost of capital (by Chirinko et al. (1999)), and supposing a tax-inclusive tax rate $t/\rho=0.2$ - which is in line with the calculation of the effective marginal tax by Chennells and Griffith (1997) - we can estimate the value of 0.04 for the tax-elasticity η. In addition, using an estimation of (cash flow definition of) seignorage m as a proportion to GDP equal to 1% and total tax receipts as a proportion of GDP equal to 29,6% (from OECD statistics for the year 2003), and nominal interest rate of 2% we can calculate $(\pi+\rho)m/y=0.3$. Using an income elasticity of money demand equal to 1, we have then that capital taxes will be too low if the price-elasticity of money is lower than $0.34/1.02=0.33$. Given that empirical studies have found interest elasticities between zero and 0.5 and income elasticities between 0.5 and 1, of money demand,[11] these calculations suggest that there might be a scope for MI on the grounds of pushing taxes closer to their efficient level.[12] If indeed $t^a<t^*$ is the case and MI raises taxes by too much (i.e. so that $W(t^u,\pi)>W(t^a,\pi)$) then MI is a Pareto improving arrangement.

5 Extensions

In this Section we discuss some of our assumptions. We start with the case of taxable profits at a rate $\theta>0$. In this case the j tax authority's budget constraint becomes $g_j=t_jk_j+\theta r_j$, and disposable income increases by $(1-\theta)r_j$. Following similar steps to the ones in the previous Section one can then easily see that W_t^a increases by $(1-1/n)p'\theta e(V_1-\Gamma')$. This term represents the net horizontal externality that arises from the effect on disposable income (and hence private consumption) and profit tax revenues

[11] See, for instance, Stephen M. Goldfeld and Daniel E. Sichel, "The Demand for Money", Handbook of Monetary Economics, vol 1, pp. 299-356, 1990, North-Holland.

[12] Note that $(1+i)(1-\pi)=1+\rho$ where i is the nominal interest rate. So $\rho+\pi=(1-\pi)\ i=(1+\rho)i\ /\ (1+i)$ and $\varepsilon_1=[-(i\partial m)/(m\partial i)]\ (1+i)$. Also, for small inflation and nominal interest rates we have $\rho+\pi\simeq i$.

abroad of tax-induced changes in the real interest rate, regardless of the monetary arrangement. To see this, note that the marginal effect on disposable income of an increase in price of capital, in a symmetric equilibrium, is $e-(1-\theta)k=\theta e>0$. As $p'V_1<0$ we then have that this negative externality leaves, all other things equal, taxes too high, as long as profits are taxed. Similarly, the marginal effect on public revenues from taxation of profits of a change in price of capital, in a symmetric equilibrium, is $-\theta k=-\theta e<0$. This positive externality leads, ceteris paribus, to under-taxation of capital. These two horizontal externalities that arise due to the taxation of profits have also been identified by KK in a model with no money. Clearly, the direction of the net externality that arises due to taxation of immobile factors depends on the relative marginal valuation of private and public consumptions. Here, due to the inflation policy rule (16), private consumption is valued less than public spending, and so this externality reinforces the tax competition effect.

However, taxation of profits reinforces also the externality that arises under any monetary arrangement from the effect on money demand of tax-induced changes in the real interest rate. This is a direct consequence of the fact that now a tax-induced decrease in the equilibrium real interest rate does decrease disposable income and thereby the monetary tax base(s). In particular, now we have that in a symmetric equilibrium $\hat{l}_1=\hat{m}_1+\hat{m}_2\theta e>\hat{m}_1$. We then have that, under pre-commitment, taxes are too high under monetary autonomy if and only if $\varepsilon_1(1-\theta)>\eta+\varepsilon_2\,\frac{(\pi+\rho)m}{y}(1-\theta)$. Clearly, then, if immobile factors are fully exploited (i.e. $\theta=1$) we have that taxes under monetary autonomy are inefficiently low regardless of the characteristics of money demand.[13]. AMBIGUOUS EFFECT ON BENEFICIARY ROLE OF MI

One may wonder how would our results be affected if savings were endogenous and countries could also deploy a per-unit tax on asset holdings $b_j=e_j-m_j$. If policies are discretionary our results remain unchanged, as then policies are also set after savings are in place. To examine the case when policies can be pre-committed upon, let savings in state j being equal to past endowment of composite good w minus past consumption q_j, and suppose that bonds are taxed with a per-unit tax τ. In this case, the net-of-taxes wealth h_j is equal to $h_j=(1+\rho-\tau_j)w+r_j=h(\rho-\tau_j,\rho+t_j)$ and the intertemporal budget constraint is defined as $q_j(1+\rho-\tau_j)+c_j+m_j(\pi+\rho-\tau_j)=h_j$. Standard consumer theory then tells us that savings in country j are given by a function $e(\rho-\tau_j,\pi+\rho-\tau_j,h_j)$ with $e_3()<0$ - if consumption is a normal good, $e_2()<0$ representing the substitution effect due to an increase in the price of real money balances, and $e_1()>0$ representing the substitution effect due to an increase in the price of past consumption. Let us denote with s' the effect on savings of a marginal increase in the after-tax real interest rate, i.e. $s'=e_1+e_2+e_3(w-k)$. Following similar steps to the ones in the previous Section one can then easily see that W_t^a, in (21), increases by $(1-1/n)p'\Gamma'\tau(s'-l_1)$.[14] This

[13]See also KK for a similar result in a model with no money.

[14]Now in a symmetric equilibrium $k(\rho+t)=s(\rho,\tau,\pi,t)$. So, the interest rate now depends also on inflation and the savings tax, and p' in the main text denotes, with some abuse of notation, the change in the interest rate of the symmetric

term captures the horizontal externality that arises from the effect on asset tax revenues of a tax-induced change in the real interest rate. This term has the opposite sign of the change in equilibrium asset tax revenues $\tau(s' - l_1)$. So, if bonds are taxed and depend positively on their returns, i.e. $s' > l_1$, this horizontal externality is negative, counteracts the tax competition effect, and makes it more likely that decentralised capital taxes are too high under monetary autonomy.

In fact, if savings are endogenous, capital taxes may be too high for an additional reason. Namely, the externality that arises from the effect on CB's tax base of a tax-induced change in the real interest rate is stronger, if savings increase with their returns. To see this, suppose, for expositional clarity, that utility is given by $H(q) + V(c, m) + \Gamma(g)$, and therefore that money demand is still given by the function $m(\pi_j + \rho - \tau_j, y_j)$. Note also that now disposable income is affected by changes in savings, as $y_j = (1 + \rho - \tau_j)e() + r_j$. If, then, $s' > 0$, a decrease in the interest rate lowers savings, and thereby disposable income and demand for liquidity. So, a tax-induced decrease in the real interest rate shrinks even further the CB's tax base, thereby reducing fiscal revenues abroad further. More formally, now l_1 $= m_1 + m_2\ (1 + \rho - \tau)s' > m_1$. SO BENEFICIARY ROLE DECREASES

What is crucial for our result that currency unification may lead ceteris paribus to higher capital taxes is that real money balances are increasing with disposable income. The latter property is also important for our observation that taxes may be too high under monetary autonomy (even if immobile factors are not taxed). Money demand would also increase with disposable income in any equilibrium with positive nominal interest rate, if demand for liquidity stemmed from a cash-in-advance constraint $m_j(1-\pi) \geq c_j$. This is the most popular variant of liquidity constraints, requiring that money holdings must be at least as high as the value of purchases.[15] Thereby deploying a cash-in-advance model would not affect qualitatively the main insights of our paper.

We turn to the case of asymmetric countries. The first implication of asymmetries between countries is that the shares of seignorage may differ across the monetary union. Yet, any share will in general be less that 100%, and so our main message that monetary integration may create a common pool problem and thereby raise capital taxes will be unaffected. Another implication of asymmetries across countries is that the union-wide inflation will in general be different than national inflation

equilibrium due to a marginal change in the capital tax. Note that still $p' < 0$, though the sign of $p' + 1$ is no longer unambiguous.

[15]If $\rho + \pi > 0$ then holding money is costly. If real money balances provide no utiliy, i.e. if $V_2 = V_{12} \equiv 0$, then the cash-in-advance constraint binds. It follows, then, from the budget constraint that $m_j = y_j/(1+\rho)$. Thus, after using the definition of disposable income we can see that real money holdings are decreasing with both the real interest rate and the capital tax. Note, furthermore, that money holdings are independent of inflation. Introducing such dependence can be achieved by postulating that bonds are credit goods that can provide some liquidity (see, for instance, Lucas and Stokey, 1987). In this case, the cash-in-advance constraint becomes $(\gamma b + m)(1 - \pi) \geq c$ where $\gamma > 0$ is the degree of liguidity provided by non-monetary assets. If $\pi + \rho > 0$ and $\gamma \leq 1$ then again the cash-in-advance constraint binds, and thereby $m_j = [y_j - \gamma e\ (1-\pi)]\ /\ (1+\rho-\gamma\ (1\ -\ \pi))$, which is a decreasing function of inflation, capital tax and real interest rate.

rates under monetary autonomy. ALSO FOR WHEN ECB IS A PLAYER (EVEN IF NO LEADER INFLATION WILL CHANGE AS THE TAX FOC CHANGES!!) Such divergence will in turn have an additional effect on the incentives of national tax authorities, and may lead to some countries imposing lower taxes when they are part of a common currency area. In fact this will tend to be the case for countries that face an increase in the price of money from entering a common currency area. This is a direct consequence that the price of money affects positively the direct revenue cost from higher capital taxes and lower monetary tax base. SO BENEFICIAL ROLE IS LESS CLEAR

One of the main reasons for moving to a common currency area is that the same money facilitates trade in goods, and - more importantly for our purposes - financial exchanges by reducing the cost of capital.[16] Lower transaction costs will in turn imply higher capital mobility and thereby a stronger tax competition effect. So, if capital markets are not fully integrated prior to currency unification, a decrease in transaction costs due to MI may push towards low capital taxes *under monetary integration.* Our basic model ignores such an effect of MI on capital taxes, as capital has been assumed to be perfectly mobile regardless of the monetary arrangement. Yet, our framework can easily be extended to feature a positive effect on capital mobility of MI. The simplest way is to assume that the user-cost of capital is $\rho + t + \mu$, where μ is a per-unit transaction cost,[17] and that the transaction cost decreases after a currency unification. Then, whether MI leads to higher taxes or not will depend on the relative strength of the common-pool effect on capital taxes we have emphasised in this paper and of the effect on capital taxes of higher capital mobility. SO BENEFICIAL ROLE IS LESS CLEAR

As we have stressed, recognising that currency unification per se may have an effect on national capital taxes leads us to an investigation of whether taxes are too low or too high under monetary autonomy and thereby of whether monetary integration is a welfare improving arrangement. Ultimately, whether there is a gain from monetary integration or not will depend on the horizontal externalities associated with capital taxation. Above we have concentrated on the well-known tax competition effect, and the less familiar externalities that arise due to taxation of immobile factors (see also KK) and due to the presence of money (see also Makris (2003)). However, there are may be additional tax externalities, leading to too high capital taxes prior to monetary integration. So we have, for instance, the tax-exporting effect in the presence of foreign ownership (see Huizinga and Nielsen (1997)), the terms-of-trade effect when countries differ in terms of their net capital exports (see DePater and Myers (1994)), the amenities-competition effect (see Noiset (1995) and Wooders et. al. (2001)).

Furthermore, deciding on the desirability of monetary integration on the grounds of its effect on capital taxes will also be affected by any asymmetries within the countries. Asymmetries within

[16]See, for instance, Alesina and Barro (2001). For some emprical evidence on this see Rose and van Wincoop (2001) and Hardouvelis et. al. (1999).

[17]Our results would have not been altered qualitatively if we had assumed instead that the transaction cost is a strictly increasing and convex function of capital imports.

countries will give rise to redistributional considerations and political interactions for the determination of national capital taxes and of whether to enter a common currency area as (indirect) means of capital tax coordination. For an analysis of related issues in models without money see Persson and Tabellini (1992), Fuest and Huber (2001), Kessler et al (2000, 2002), Grazzini and van Ypersele (2003), Lockwood and Makris (2003).

6 Conclusions

We have shown that multilateral currency integration results in higher capital taxes under policy pre-commitment. The reason is that taxation of mobile capital in a monetary union may give rise to a vertical externality by shrinking the revenues of the anchor central bank from issuing the common currency. As mobility of capital gives also rise to horizontal tax inefficiencies, the issue arises as to whether instituting a common currency area can be viewed as an efficiency improving arrangement. As we have argued, this will depend on whether taxes were too low or too high prior to currency unification, with the latter depending on characteristics of money demand, elasticity of capital, extend of taxation of immobile factors, and size of seignorage and total tax receipts.

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