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Fiscal Policy, Economic Integration and Unemployment

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Abstract

Fiscal policy is examined in a model of an open economy which is characterised by unemployment caused by efficiency wages. It is shown that the conventional conclusion, according to which mobile capital is untaxed in the presence of wage taxation, is not generally valid. A positive capital tax allows to indirectly tax profits, thereby mitigating unemployment through the reduction in the effective tax burden on labour. It is argued that these policy conclusions are qualitatively unaffected by the cause of unemployment. Moreover, the welfare loss from labour market imperfections increases when tax bases become internationally mobile, which suggests an increasing relevance of domestic labour market reforms.

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1 Introduction

The important clarification of the Production Efficiency theorem of Diamond and Mirrlees (1971) in optimal taxation is that taxes which distort production decisions are dominated by taxes on consumption in an environment where frictions other than the non-availability of lump-sum taxation do not exist. Applied to the issue of international taxation, the Production Efficiency theorem implies that the government in an open economy abstains from source-based capital taxation and uses either commodity taxes or taxes on profits to pay for the cost of national public goods.

Adopting the efficiency wage framework by Shapiro and Stiglitz (1984), this paper analyses whether labour market imperfections alter this result. It is assumed that firms cannot perfectly monitor the effort of their employees and, therefore, have to pay an efficiency wage in order to prevent shirking. The equilibrium of the efficiency wage economy is characterised by a wage which exceeds the market-clearing level. Accordingly, unemployment results. This generates the necessary incentives for employed workers to provide the amount of effort which is required by firms.

This paper shows that tax policy may be used to counteract the distortions caused by labour market imperfections. A reduction in the tax on labour income can raise output through an increase in employment and, thereby, mitigates the efficiency losses due to unemployment. This employment effect of the wage tax cannot be reproduced by the source-based capital tax. We show that the capital tax, however, is used as a substitute for a profit tax in the absence of the latter.

Issues of optimal taxation in the presence of mobile capital and of labour market imperfections have previously been analysed almost exclusively in collective bargaining frameworks.[1] While the qualitative impact of labour taxes in collective bargaining and efficiency wage models is often the same (cf., inter alia, Pissarides (1998), Picard and Toulemonde (2001), Goerke (2002)), this equivalence has not yet been established for taxes on capital and wage taxation in the presence of mobile capital.

The present paper makes three contributions: first, it shows that the qualitative results with respect to optimal tax rates are not affected by the nature of the labour market imperfection. Second, the paper provides a simple workhorse model for analysing

[1] See, among others, Fuest and Huber (1999), Boeters and Schneider (1999), Koskela and Schöb (2002) and Richter and Schneider (2001). Wilson (1990) provides - to our knowledge - the only analysis of optimal taxation in which unemployment is caused by efficiency wages.

issues of optimal taxation in the presence of labour market imperfections. The application of Occam's Razor suggests that future analyses of relevant questions can profitably exploit the features of the Shapiro and Stiglitz (1984) shirking framework. Third, the model indicates that inefficiencies on the labour market itself do not justify measures of international tax harmonization, although the welfare losses from labour market imperfections might rise when capital becomes mobile.

The paper is structured as follows. Section 2 presents the model. We discuss fiscal policy in Section 3. Section 4 concludes.

2 The model

Consider a small open economy which competes for mobile capital on an international market taking world-market prices as given. The country is inhabited by a large number of identical individuals. We allow individuals to choose their work effort and suppose that capital and labour supply are fixed. Effort choices are an employee's private information. Since providing effort creates disutility, employees have an incentives to deliver as little effort as possible. For simplicity, let us assume that effort can only take two values, zero or the positive and exogenously given level required by firms. To provide employees with an incentive not to shirk and to deliver the required effort, the firm pays a wage in excess of the wage paid by other firms. The wage differential generates a loss to a worker who is caught providing too little effort and fired for doing so. The desire of each individual firm to exceed the equilibrium wage results in an efficiency wage which surpasses the market clearing level. A wage in excess of the market clearing level entails unemployment. Thus, in equilibrium the possibility of not being employed due to a job loss replaces the wage differential as the incentive which induces workers to provide the required level of effort. In line with the approach which has generally been employed in the analysis of optimal taxation in the presence of labour market imperfections, unemployment takes the form of the labour supply of each individual worker only being in demand to a certain extent. This simplification allows to model the government's optimisation problem in terms of a representative agent.[2]

[2]See, for example, Fuest and Huber (1999), Koskela and Schöb (2002), Richter and Schneider (2001) and Kleven and Sørensen (1999).

Government

In each country a national authority (government) uses a source-based tax, t^s, on capital k, wage taxation, t^w, and a tax on profits in order to finance the public good, g, and unemployment benefits, B. Let n depict the employment rate in the economy and assume that each individual supplies one unit of labour but cannot be fully employed due to the monitoring problem. Using the private good as the numeraire and formulating our discussion in terms of *unit taxation*, the public budget constraint is

$$g + B\,(1 - n) = t^w n + t^s k + t^p, \tag{1}$$

where t^p is the revenue from profit taxation.[3]

Households

As in the original model by Shapiro and Stiglitz (1984), individuals are risk-neutral, infinitely lived and discount future payments with the rate R, $R > 0$. They receive interest income for each unit of their capital endowment at the going world interest rate.[4] An individual's instantaneous utility, U, consists of the monetary income and the utility derived from public good consumption, g, less the disutility from effort, e, which either conforms to the level required by firms, $\bar{e} > 0$, or attains its minimum level, $e = 0$. If an individual is employed, she will obtain the net wage, $w - t^w$, receive the return from the capital endowment, and any profits net of profit taxation, π. The instantaneous utility of an individual who provides the required level of effort can, hence, be expressed as:

$$U\,(\bar{e}) = (w - t^w) + R\,k + \pi - \bar{e} + g. \tag{2}$$

If the individual is unemployed, she will receive unemployment benefits, B, instead of the wage income and will not provide a positive level of effort. Otherwise, the instantaneous utility is independent of the employment status. A job loss can occur for

[3]Since our focus is on the efficiency properties of the optimal tax structure only, we will in line with the previous literature (e.g., Koskela and Schöb, 2002) hold g and B constant in the following analysis.

[4]The model implies that all individuals have the same ownership stake in domestic firms and that domestic firms are fully owned by residents. The first assumption allows to concentrate on the efficiency effects of taxation with unemployment in an open economy, the second implies that tax exportation is irrelevant. See Huizinga and Nielsen (1997) for a discussion of tax policy with cross-ownership of firms.

two distinct reasons. Individuals might shirk and are caught doing so with probability c per unit of time. Alternatively, there might be an exogenous shock which induces the firm to dismiss workers. The respective probability for a job loss is b. The probabilities b and c are sufficiently small, implying that the time periods under consideration are short, such that $b\,c \approx 0$. In equilibrium individuals provide the level of effort $\bar{e}$.[5] Accordingly, the expected life time utility of an employed non-shirker, V^{en}, can be expressed as $V^{en}R = w - t^w - \bar{e} + R\,k + \pi + g + b\,(V^u - V^{en})$. Solving for V^{en} yields:

$$V^{en} = \frac{U\,(\bar{e}) + bV^u}{b + R}. \tag{3}$$

A shirker exerts an effort level of $e = 0$ and loses the job with probability $b + c$, but is otherwise identical to a non-shirker. The discounted utility stream of a shirker V^{es} is given by:

$$V^{es} = \frac{w - t^w + R\,k + \pi + g + (b + c)\,V^u}{b + c + R}. \tag{4}$$

A unemployed individual receives unemployment benefits, B, in addition to the income from his capital endowments and any profit income. The probability that a worker who has lost the job obtains a new one is denoted by the job acquisition rate, a. The discounted utility stream of an unemployed V^u, therefore, is

$$V^u = \frac{B + R\,k + \pi + g + aV^{en}}{a + R}. \tag{5}$$

The wage which warrants a positive level of effort by workers is defined by $V^{en} \geq V^{es}$. Solving the equality for w yields:

$$w - t^w = B + \bar{e} + \frac{\bar{e}}{c}\,(a + b + R)\,. \tag{6}$$

The efficiency wage is independent of capital income, profits and the utility from the public good because variations in these variables affect the utility from shirking and providing the required amount of effort equally. A labour market equilibrium requires that inflows into and outflows from unemployment are equal. Since labour supply is normalised to unity and no worker shirks in equilibrium, this equilibrium condition is $bn = a(1 - n)$. Substituting in equation (6) yields:

$$w - t^w = B + \bar{e} + \frac{\bar{e}}{c}\left(\frac{b}{1 - n} + R\right). \tag{7}$$

[5]Since individuals are identical, shirking by one implies a choice of effort $e = 0$ by all workers. Given that a positive output requires a positive level of effort under the standard assumption that labour and capital are complements in production, $e = 0$ cannot represent an equilibrium.

The efficiency wage rises with unemployment benefits B, the required level of effort $\bar{e}$ and the interest rate R, since variations in these variables imply that the utility from non-shirking rises relative to that of shirking. For later use it is helpful to explicitly compute the utility stream from employment, V^{en}, and unemployment, V^u, as functions of the exogenous variables. Substituting V^u from equation (5) into the expression for V^{en} from equation (3) - or vice versa -, solving the resulting expression and using (7) to replace for the market-clearing efficiency wage gives:

$$V^{en} = k + \frac{g + B + \pi}{R} + \frac{\bar{e}}{c\,R}\left(\frac{b\,n}{1-n} + R\right) = V^u + \frac{\bar{e}}{c}. \tag{8}$$

In equilibrium, the (discounted) utility stream from being employed and not shirking exceeds the utility of an unemployed worker by the present value of the disutility of $\bar{e}/c$, which a shirker - who is fired with probability c - does not incur.

Production

Firms use capital, k, and effective labour as inputs. Let us define effective labour as $\epsilon := \bar{e}\,n$ and denote partial derivatives by subscripts for notational simplicity. The production function $f(\epsilon, k)$ is homogeneous in $\{\epsilon, k\}$, $f_{ii} < 0\ \forall i = \epsilon, k$, and requires positive inputs of capital and effective labour to generate a nonzero level of output, $f_{ij} > 0\ \forall i \neq j = \epsilon, k$. The Euler theorem implies

$$\bar{e}\,n\,f_{\epsilon\epsilon} + k f_{\epsilon k} \leq 0, \qquad \bar{e}\,n\,f_{k\epsilon} + k f_{kk} \leq 0, \qquad f_{\epsilon k}^2 - f_{\epsilon\epsilon}\,f_{kk} \leq 0, \tag{9}$$

where $f_{k\epsilon} = f_{\epsilon k}$ from Young's theorem. The equality in (9) will hold if the production function is linear homogeneous, while the inequality will apply if the production function shows decreasing returns to scale. We can interpret the latter case as a situation in which a third factor of production, say land, exists, which is in fixed supply and gives rise to pure profits. We suppress the third factor whenever no ambiguities arise. Let us assume that firms maximize after-tax profits $\pi := \max\left[f(\bar{e}\,n, k) - wn - Rk - t^p\right]$. Using (7) in the profit definition, we obtain the following first-order conditions

$$(n): \qquad \bar{e} f_\epsilon - B - \bar{e} + \frac{\bar{e}\,(b + R - n\,R)}{c\,(n-1)} - t^w = 0, \tag{10a}$$

$$(k): \qquad f_k - R - t^s = 0. \tag{10b}$$

Inspection of (10) shows that t^p has no substitution effect on the factor demand decisions. There exists an equilibrium which entails a positive number of firms whenever

the government chooses t^p such that $\pi \geq 0$. Let us now determine the response of firms to a change in taxation. Differentiating (10) and the definition of net profits we obtain

$$\begin{bmatrix} \bar{e}\left(\bar{e}f_{\epsilon\epsilon} - \frac{b}{c(n-1)^2}\right) & \bar{e}f_{\epsilon k} & 0 \\ \bar{e}f_{\epsilon k} & f_{kk} & 0 \\ 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} dn \\ dk \\ d\pi \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ k & n & 1 \end{bmatrix} \begin{bmatrix} dt^s \\ dt^w \\ dt^p \end{bmatrix}. \tag{11}$$

We may define for convenience $H := bf_{kk} + c\,\bar{e}\,(f_{\epsilon k}^2 - f_{\epsilon\epsilon}f_{kk})\,(n-1)^2 < 0$, where the inequality follows from (9). Applying Cramer's rule to (11) and maintaining the assumptions used to derive (9) we find

$$\begin{aligned} n_{t^s} &= \frac{c}{H} f_{\epsilon k}\,(n-1)^2 < 0, & n_{t^w} &= -\frac{c}{\bar{e}\,H} f_{kk}\,(n-1)^2 < 0, \\ k_{t^s} &= \frac{1}{H}\left(b - c\,\bar{e}\,f_{\epsilon\epsilon}\,(n-1)^2\right) < 0, & k_{t^w} &= \frac{1}{H}\left(c f_{\epsilon k}\,(n-1)^2\right) < 0, \\ \pi_{t^s} &= -k < 0, & \pi_{t^w} &= -n < 0, \end{aligned} \tag{12}$$

and short inspection shows that $n_{t^p} = k_{t^p} = 0, \pi_{t^p} = -1$, which is suggestive from the arguments given below (10).

Political Equilibrium

The government in each country maximizes the average discounted utility of an individual $nV^{en} + (1-n)\,V^u$ subject to the per-capita revenue requirement (1), taking as given the tax rates chosen by the other countries (Nash equilibrium). We may then write the Lagrangian for the government in a given country as

$$\mathcal{L} = nV^{en} + (1-n)\,V^u - \lambda\left(g + B\,(1-n) - t^w n - t^s k - t^p\right), \tag{13}$$

where λ is the Lagrange parameter on the revenue constraint. Using (8) to substitute out for V^{en} and V^u in (13) we arrive at

$$\begin{aligned} \mathcal{L} = \frac{Rk + \pi(x) + g + B}{R} + \frac{e}{c\,R}\left(R + \frac{b}{1-n(x)}\right) n(x) \\ - \lambda\left(g + B\left(1-n(x)\right) - t^w n(x) - t^s k(x) - t^p\right). \end{aligned} \tag{14}$$

After differentiation we obtain the following first-order conditions

$$\mathcal{L}_{t^p} = \lambda - \frac{1}{R} \geq 0, \tag{15a}$$

$$\mathcal{L}_{t^s} = \frac{b\,e\,n_{t^s} + (n-1)^2\,(c\,\pi_{t^s} + e\,R\,n_{t^s})}{c(n-1)^2 R} + \lambda\,(k + B\,n_{t^s} + t^s k_{t^s} + t^w n_{t^s}) = 0, \tag{15b}$$

$$\mathcal{L}_{t^w} = \frac{b\,e\,n_{t^w} + (n-1)^2\,(c\,\pi_{t^w} + e\,R\,n_{t^w})}{c(n-1)^2 R} + \lambda\,(n + B\,n_{t^w} + t^s k_{t^w} + t^w n_{t^w}) = 0, \tag{15c}$$

where we have used the result $n_{t^p} = k_{t^p} = 0$ from the discussion of the firm's first-order conditions (10) and $\pi_{t^p} = -1$ in the derivation of (15a). The interpretation of (15a) is straightforward. A marginal increase in the profit tax reduces net private consumption exactly by the present value of the public revenue gained. If, however, t^p is bounded, then $\mathcal{L}_{t^p} > 0$ will hold, resulting in $\lambda > 1/R$. The interpretation is that the marginal costs of public funds, measured by λ, increase when public expenditure exceeds the revenue from profit taxation. In this case, the equilibrium value of λ is given by the first-order conditions (15b) and (15c), according to which the government trades the change in 'private' utility of residents (given by the fractions) against the utility from an increase in tax revenue caused by a change in t^w and t^s. The latter is evaluated at the equilibrium level of λ. Using the results given by (12) in (15) yields the set of first-order conditions which we employ subsequently to characterize the tax policy chosen by the government in a world with tax competition and unemployment:

$$\mathcal{L}_{t^p} = \lambda - \frac{1}{R} \geq 0, \tag{16a}$$

$$\mathcal{L}_{t^s} = \frac{\alpha \bar{e} f_{kk} + kH}{RH} + \lambda \left[k + \frac{t^s b + c\,(n-1)^2 \left(f_{\epsilon k} \left(B + t^w \right) - t^s \bar{e} f_{\epsilon\epsilon} \right)}{H} \right] = 0, \tag{16b}$$

$$\mathcal{L}_{t^w} = -\frac{\alpha f_{kk} + nH}{RH} + \lambda \left[n - \frac{c\,(n-1)^2 \left(f_{kk} \left(B + t^w \right) - t^s \bar{e} f_{\epsilon k} \right)}{\bar{e} H} \right] = 0, \tag{16c}$$

where we use $\alpha := b + (n-1)^2 R$ in (16) for notational convenience.

3 Nationally optimal tax rates

In a first step we characterize the tax structure under the assumption that profit taxation contributes to tax revenues. We subsequently analyse Nash equilibria either in the absence of profits or a tax on profits. As a main result it turns out that governments will abstain from using the source-based capital tax and will not distort production decisions in a small open economy only if profit taxation contributes to public revenues. However, the source-based capital tax will be used if profit taxation does not generate public revenue, either for the reason that profits taxes are not available or profits are zero. We start our discussion in a scenario in which the government has control over the entire set of taxes. In this case it is possible to show:

Proposition 1. *Assume $t^p > 0$ and that gross profits are positive. Then, the government in a small country does not use the source-based capital tax and subsidises wages in an efficiency wage setting.*

Proof: To prove the first part of the Proposition, take a pair $\{t^s, t^w\}$ such that the first-order conditions (16a) and (16b) are fulfilled. At that point we know $\frac{f_{kk}}{e\, f_{\epsilon k}}\mathcal{L}_{t^s} + \mathcal{L}_{t^w} = 0$ must hold. We then solve the latter expression to obtain

$$\lambda R\, t^s = (1 - \lambda R)\left(k f_{kk} + \bar{e} f_{\epsilon k} n\right). \tag{17}$$

We find from (16a) that $\lambda = 1/R$ when profit taxation is possible and, from (9), we have $k f_{kk} + \bar{e} f_{\epsilon k} n < 0$ when gross profits are positive. Inspection of (17) then shows that the government chooses not to tax mobile capital at source. To prove the second part, we use $\lambda = 1/R$ and $t^s = 0$ in $\mathcal{L}_{t^w}$, which gives

$$c\,(n-1)^2\, t^w = -cB\,(n-1)^2 - e\left(b + (n-1)^2 R\right).$$

The only solution is $t^w < 0$ as required by the Proposition. □

The government does not use the source-based capital tax in the presence of profit taxation in order to avoid the distortion of international capital allocation caused by taxing capital at source. Part of the revenue from profit taxation is then used to subsidise wages. The explanation is that a wage subsidy mitigates the distortion of the domestic factor allocation caused in the presence of an imperfect labour market. Fiscal policy is thus used to increase effective labour input at a given gross wage, thereby reducing the loss in domestic production.

An according result has been derived by Koskela and Schöb (2002, Prop. 2) in a collective wage bargaining framework. They can, furthermore, show that the wage subsidy suffices to eliminate unemployment and interpret this result as a confirmation of the finding by Guesnerie and Laffont (1978) that the output of a price maker should be subsidised until the market price equals marginal costs in a first-best world.[6] Accordingly, if the tax rate on profits is chosen optimally, the government can achieve the first-best allocation in a collective bargaining set-up. This is not feasible in the

[6]Related, Myles (1989) and Konishi (1990) show that fiscal policy can also be used to counteract the efficiency losses generated by imperfect competition on output markets. Konishi (1990) shows in a model where a competitive sector produces intermediate goods for a free-entry Cournot oligopoly that welfare can be raised by the taxation of intermediate goods. In contrast, however, the tax system should reduce the externalities caused by the monitoring problem on the labour market in our model.

present shirking framework since the absence of unemployment is incompatible with a positive level of effort. In the seminal paper on tax competition in the presence of unemployment, Wilson (1990) also analyses an efficiency wage model, but presumes a two-sector economy, in which a monitoring problem exists solely in the primary sector. Assuming utility functions which are non-linear in income and employing a rich set of tax instruments Wilson shows that capital should not be taxed while wages and employment are to be subsidised. Proposition 1 is, thus, robust to modifications of the labour market structure. Accordingly, the qualitative equivalence of the finding that wages should be subsidised while capital should not be taxed is obtained independently of the exact modelling of the labour market provides and this is encouraging news in terms of the policy relevance of this finding.

The analysis so far has been based on the assumption that revenues from profit taxation are positive. Assume next that the allocation described in Proposition 1 is not feasible because firms do not make profits. Then, the following result can be established:

Proposition 2. *Assume that the production function is constant returns to scale. Then, the government in a small country characterised by efficiency wage setting does not use the source-based capital tax and taxes wages to finance any positive revenue requirement.*

Proof: Gross profits are zero when the production function is constant returns to scale, implying that (9) holds with strict equality. Inspection of (17) then shows that $t^s = 0$, implying that wage taxation is used by the government to fulfil the public revenue requirement in (1).□

The intuition for Proposition 2 is that a distortion of international capital allocation remains undesirable. However, in contrast to the assumptions on which Proposition 1 is based, the government has to tax wages in order to finance its outlays, despite the positive wage and negative output consequences of a tax on labour income. Since the government subsidises wages in the presence of profit taxation, an immediate implication of Proposition 2 is that welfare is lower in the case of restricted profit taxation.

In a collective wage setting framework, Richter and Schneider (2001) show that the optimal tax on capital will be zero (positive/ negative) if the wage is unaffected

by (rises/ falls with) the level of the capital input and taxes are set prior to wages.[7] A capital subsidy will raise output and employment only if a higher capital input reduces the market power of the owners of labour. In the present efficiency wage framework, aggregate labour demand determines the net wage, which has to be such that it guarantees a positive level of effort (cf. equation (7)). However, the net wage is not directly affected by the capital choices of firms. This explains why capital should not be subsidized in the present model.

The last scenario to be investigated is one in which profits are positive but cannot be taxed. We then have:

Proposition 3. *Assume $t^p = 0$ and that gross profits are positive. Then, the government taxes capital at source in an efficiency wage world, even when the country is small and capital supply infinitely elastic.*

Proof: Recall that in expression (9) the inequalility sign applies when gross profits are positive and that $\lambda > 1/R$ when t^p is bounded. Then, (17) can only be fulfilled for $t^s > 0$ as required by the Proposition. □

Proposition 3 stands in contrast to the results derived in Razin and Sadka (1991) and Bucovetsky and Wilson (1991). This literature demonstrates that a small country, which faces an infinitely elastic supply of capital on the world market, taxes wage income when the only tax on capital is source-based. The contrast in results to our model can be explained by the following arguments. In models of perfect competition, an increase in source-based capital taxation drives capital out of the country until the marginal productivity of capital equals its tax inclusive costs. Hence, wages adjust in order to maintain zero profits in production. This clarifies that, in principle, the wage effect of an increase in source-based capital taxation can be replicated by a wage tax. However, wage taxation avoids the loss in production efficiency caused by source-based capital taxation. This makes intuitive that governments choose not to tax capital at source in models where labour markets are competitive. In the present model, an isolated increase of the source-based capital tax also causes a capital outflow and induces a loss in production efficiency. Here, however, the tax burden of source-based capital taxation is born by profits. Hence, the source-based capital tax acts as an indirect tax on profits, which explains that this tax is used in the absence of a direct

[7] If taxes and wages are determined simultaneously, the tax on capital (labour) will be zero (negative). For further discussion also see Boeters and Schneider (1999), and Fuest and Huber (1999).

profit tax, even in a small open economy. This suggests that it is not the presence of labour market imperfections which generates a positive source-based capital tax in the first place, but the existence of untaxed profits.

Accordingly, different results in the related literature can be explained by alternative assumptions with respect to labour market institutions. Richter and Schneider (2001, Prop. 9) conclude in a model with collective wage setting that governments will tax capital if wages are not decreasing with capital. However, the government may find it attractive to (implicitly) restrict wage claims by subsidising capital in an environment where the wage rate decreases with the capital employed in firms. Related, Koskela and Schöb (2002, Prop. 3) demonstrate in a model of wage bargaining that we should observe source-based capital taxes on mobile capital in scenarios where it is not profitable to restrict the power of unions through a negative source-based capital tax.

This leads us to the question about the optimal level of wage taxation in our model. Intuitively, two counteracting effects are relevant for the government when choosing this tax. First, increasing the wage tax at a given level of public spending allows to reduce the source-based capital tax. Second, the increase in wage taxation which is necessary to keep the public budget balanced leads to an increase in the efficiency wage which will lead to a higher level of unemployment and, at the same time, an increasing part of profits is not even taxed indirectly. We are not able to obtain unambiguous results in a model which encompasses both positive and negative effects from wage taxation. The next Proposition summarizes our findings for the wage tax.

Proposition 4. *Assume $t^p = 0$ and that gross profits are positive. In an efficiency wage economy, the wage tax is the higher, the greater are the distortions of the tax system (caused by source-based capital taxation and wage taxation) and the lower are distortions on the labour market.*

Proof: Recall that $\lambda > 1/R$ when t^p is bounded and that the equilibrium level of λ is given by the simultaneous solution of the first-order conditions for t^s and t^w. Consider the fictional case that the government has direct control over the gross wage. Is it profitable to increase wage taxation in this scenario? The first-order condition says

$$\mathcal{L}_w = \frac{b\,\bar{e}\,n_w + (n-1)^2\,(c\,\pi_w + \bar{e}\,R\,n_w)}{c(n-1)^2 R} + \lambda\left(t^s k_w + (B + t^w)\,n_w\right) = 0. \qquad (18)$$

Inspection of first-order conditions (18) and (15c) shows

$$\mathcal{L}_w = -\mathcal{L}_{t^w} + \lambda\, n = 0. \tag{19}$$

Hence, $\mathcal{L}_{t^w} - \mathcal{L}_w = \lambda\, n > 0$ from first-order condition (16a). The utility increase obtained from increasing the wage tax is the higher, the higher the marginal costs of public funds λ and the higher the level of employment n. $\square$

The intuition for the result is as follows. First, notice that the wage tax and the source-based capital tax both lead to an increase in unemployment as evidenced by (12) under the standard assumption that labour and capital are complements in production. This observation would suggest that the government chooses to use the two taxes to pay for the costs of the public good. However, it is clarifying to see that both taxes affect employment through quite different channels in our model. From the first-order condition of firms (10b) the marginal productivity of capital must rise when the source-based capital tax is increased, leading to a reduction in capital's contribution to profits from (12). For $f_{\epsilon k} > 0$, firms reduce labour demand since the efficiency wage has to be held constant. In contrast, an increase in the wage tax leads to a rise in the marginal productivity of labour from (10a) and thereby reduces employment (see (12)). The argument makes clear that the welfare effects of both taxes crucially depend on the complementary assumption put on the production technology and on the level of firms' profits. If profits are rather high, then it is suggestive from Proposition 1 that fiscal authorities will use the revenue from indirect profit taxation (through source-based capital taxation) in order to subsidise labour. In contrast, if profits are zero then Proposition 2 will apply which explaines the absence of capital taxation.

We may now summarise our discussion with a concluding Proposition on the welfare implications of tax harmonization:

Proposition 5. *Starting from the tax structure in the Nash equilibrium, a simultaneous increase of the source-based capital tax in all countries is welfare improving in an efficienvy wage economy, given the available taxes.*

Proof: Recall that capital supply is given. Hence, if all countries are unified in a single country then the source-based capital tax will be lump-sum. However, Proposition 1 clearly demonstrates that fiscal authorities choose not to levy the source-based capital tax in scenarios with decentralized tax setting when the profit tax is also available. Since fiscal authorities are *not* indifferent in their fiscal choices, the openness of a

country and, thus, the degree of tax competition has an effect on the tax structure chosen by each government, as required by the Proposition. □

In models of tax competition with competitive labour markets the intuition for the welfare enhancing impact of a coordinated increase in source-based capital taxation is that a simultaneous tax increase in all jurisdictions prevents the tax-driven reallocation of capital. In the presence of unemployment, the positive welfare effects of tax coordination are strengthened since coordination of capital taxation allows for a reduction of wage taxation and thereby increases employment. In this sense, labour market imperfections and the mobility of tax bases are 'additive' in their effects on welfare. In a broader sense, measures of international tax coordination are not a substitute for reforms of domestic labour markets. Instead, the globalisation of tax bases stresses the need for such reforms.

To clarify the argument, let us shortly characterize fiscal policy in the benchmark of a closed economy assuming that taxation of profits is restricted. The structure of our model implies that the source-based capital tax replicates the economic properties of a tax on profits when capital is internationally immobile. Then, Proposition 1 suggests that the fiscal authority will use the lump-sum tax on the capital stock and a wage subsidy to counteract the labour market imperfection. Let us now open the economy. The government in an open economy taxes mobile capital according to Proposition 3. However, the profit tax must not be available to obtain this result. Hence, the fiscal authority is not indifferent between profit and capital taxation. This argument clarifies that the marginal costs of public funds in an open economy exceed the respective costs in a closed economy. Turning to wage taxation, it is straightforward from Proposition 1 that it is profitable to subsidise wages in a closed economy when a lump-sum tax on the capital stock is available. Notice, that only the qualitative implications of this result remain valid when the tax base of the capital tax becomes mobile. We know from Proposition 4 that the government in an open economy subsidises wages only in cases where the distortion caused by capital taxation is sufficiently small. Hence, it may be profitable to counteract the labour market imperfection even in an open economy. However, it becomes increasingly difficult to raise the tax revenue required to subsidise wage income. Notice that a basic reason for the revenue need could be overcome if the labour market imperfection were to disappear.

4 Conclusions

In this paper we combined the implications of labour market imperfections due to efficiency wages and internationally mobile capital for tax policy. Our main insights are as follows. (*i*) The result that fiscal authorities chose a non-zero level of source-based capital taxation does not specifically depend on the nature of the labour market imperfection in the empirically perhaps most plausible case in which wages weakly increase with the capital employed, but on the non-availability of a tax on profits. The result suggests that the source-based tax is used as an indirect tax on profit income in the absence of a direct tax on profits. (*ii*) If profits are zero, then it will not be profitable for fiscal authorities to choose a non-zero tax on mobile capital. In the presence of untaxed profits, however, it may (*iii*) be profitable to use the tax revenue from source-based capital taxation to subsidize wages in order to counteract the distortion on the domestic labour market. (*iv*) Raising tax revenue will be increasingly difficult if tax bases become internationally mobile. This causes an increase in the welfare costs of a tax policy which aims at counteracting the distortions on domestic markets. However, labour market imperfections do not constitute a separate reason for tax coordination.

While this paper has focused on specific aspects of the interaction of tax competition with unemployment, many issues are still left for future research. For instance, we have assumed that individuals are identical. However, we observe heterogeneous individuals which may differ with respect to their abilities in the real world, and these differences should also be taken into account when thinking about tax policy. An exogenous capital supply which renders the residence-based capital income taxation lump-sum may also be an important factor. We believe, however, that these extensions, while valuable and worth pursuing are unlikely to change the basic mechanisms discussed in this paper. For example, when residence-based capital taxation is sustainable in a world with endogenous capital supply and decentralized tax setting, then the source-based capital tax we considered would still be used as an indirect tax on profits and we would still obtain the result that coordination of capital taxes is not a substitute for domestic reforms. To sum up, the simple model of the present paper allows to give an answer to the question through which channels market integration may intensify the detrimental effects of labour market imperfections. Whether the globalisation of markets is neutral to welfare, whether it increases or even reduces the welfare losses from domestic market imperfections with asymmetric countries and individuals is an interesting topic for future research.

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