Ruhr Economic Papers

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Financing Social Security by Taxing Capital Income – A Bad Idea?

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Ruhr Economic Papers

Published by

Ruhr-Universität Bochum (RUB), Department of Economics
Universitätsstraße 150, 44801 Bochum, Germany

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Vogelpothsweg 87, 44227 Dortmund, Germany

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Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI Essen)
Hohenzollernstrasse 1/3, 45128 Essen, Germany

Ruhr Economic Papers #90

Responsible Editor: Wolfgang Leininger

ISSN 1864-4872 (online) – ISBN 978-3-86788-101-2

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Bibliografische Information der Deutschen Nationalbibliothek
Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.d-nb.de abrufbar.

ISSN 1864-4872 (online)
ISBN 978-3-86788-101-2

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Abstract

This paper examines the growth effects of an increase of capital income taxes with additional revenue being devoted to cut wage-related social security contributions to reduce unemployment. The analysis is carried out in an overlapping generations model with endogenous growth, unemployment and a social security system comprising pensions and unemployment benefits. It is shown that the reform not only promotes employment but may additionally stimulate economic growth. Calibrating the model to match data for the EU15 reveals that European countries can indeed gain in form of higher employment *and* growth if the initial capital income tax is not too high.

JEL Classification: H24, H55, O40

Keywords: Capital income taxation, social security, imperfect labor market, overlapping generations, growth

March 2009

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* Both TU Dortmund. – The authors are grateful to Wolfram F. Richter and to seminar participants at the RWI Essen and the University of Paderborn for helpful comments and suggestions. Financial support of the German Research Foundation (DFG) is gratefully acknowledged. – All correspondence to Lars Kunze, TU Dortmund, Economics Department (Public Finance), 44227 Dortmund, Germany, email: lars.kunze@uni-dortmund.de.

1 Introduction

The combination of high unemployment rates and slow economic growth in most European countries has lead to a re-examination of social security systems and triggered efforts for possible alternatives of financing these systems. Empirical evidence by Daveri and Tabellini (2000) and, more recently, by Planas et al. (2007) suggests that a significant part of European unemployment can be traced back to a steady rise in the costs of labour. Consequently, there exists a direct link between wage-related social security contributions and unemployment. Although unemployment rates have been declining in recent years, the continuous rise in contribution rates resulting from population aging implies that the problem is not only still relevant but will even become more important in the future.

So far, several reform proposals to lower the wage tax have been discussed in the literature. Yet, most existing studies focus on either environmental tax reforms (e.g., Wendner (2001); Ono (2005, 2007)) or the introduction of a consumption tax (e.g., Hu (1996); Lopez-Garcia (1996) and Lin and Tian (2003)) as alternative financing instruments. In contrast, capital income taxation is generally not considered an alternative. This is due to the fact that the literature dealing with optimal capital income taxation, originated by Chamley (1986), generally finds it optimal not to tax income from capital. Moreover, it seems to be apparent that a rise in capital income taxes that reduces the rate of return to savings hinders any growth process driven by capital accumulation. Yet, Uhlig and Yanagawa (1996) and Caballé (1998) derive potential positive growth effects related to a rise in capital income taxation. This is due to a shift of the tax burden from the young generation to the old, giving rise to positive saving and growth effects if the interest elasticity of intertemporal substitution in consumption is sufficiently small. Against this background capital income taxation seems to provide a suitable alternative to wage-related social security contributions.[1] However, both models feature full employment and discuss taxes levied to finance a fixed public budget. Hence, it is not clear a priori whether the derived growth effects survive in the presence of unemployment and tax-financed social security systems.

The present paper examines possible positive growth effects of an increase of the capital income tax used to cut wage-related social security contri-

[1]Quite differently and in contrast with the empirical literature, Birk and Michaelis (2006) develop a model in which the growth rate is independent of payroll taxes and conclude that a reduction of the tax rate on capital financed by higher payroll taxes unambiguously promotes growth.

butions and thereby increase employment. The issue is explored within an overlapping generations model allowing for endogenous growth in the spirit of Romer (1986). To capture important institutional features of European economies, a tax-financed social security system comprising unemployment benefits and pensions is introduced. Moreover, labour markets are imperfect and characterized by wage bargaining between unions and firms generating equilibrium unemployment.

The results of the present model reveal that an increase of capital income taxation that lowers the wage tax not only reduces unemployment but can additionally promote growth. Yet, whether growth is actually stimulated depends on the magnitude of the different, partly opposing effects on capital accumulation. Firstly, there is a direct effect via the public budget inducing a decline of the wage tax. This increases the net income of employed households and thereby promotes savings as well as growth. Secondly, a higher tax on capital income raises the present value of pensions, resulting in a disincentive to accumulate capital and, thus, in lower growth. Thirdly, a rise in the capital income tax provokes the opposing income and substitution effects, and, therefore, has an ambiguous impact on growth.

Consequently, depending on the magnitude of the different effects, a policy reform that increases capital income taxation to lower the labour income tax has the scope to not only reduce unemployment but moreover to facilitate growth. An extension allowing for imperfect mobility of capital reveals that the theoretical results extend to the case of a small open economy. To assess the relevance of possible growth-enhancing effects, the model is calibrated to match data from the EU15. The results imply the existence of a growth-maximizing capital income tax rate that is clearly positive. Moreover, the calibrated model indicates that increasing the capital income tax fosters growth if the initial level of capital taxation is not excessively high.

Finally, the welfare effects of the tax reform are discussed. This is important as a reform that is not capable of generating a net welfare gain will most probably lack political support. Extending the previous calibration exercise and focusing on the range of tax rates where growth-enhancing effects occur, however, shows that the reform will indeed generate a net welfare gain already in the first period: while the old population clearly loses, the welfare gains of the young are high enough to compensate for these arising losses.

The remainder is organized as follows. Section 2 presents the model. Section 3 derives the growth effects of the revenue-neutral tax reform and discusses the numerical results. The case of a small open economy and imperfect capital mobility is analyzed in the proceeding section. Section 4 then turns to the welfare implication of the reform and studies whether the reform can generate net welfare for the entire population. Section 5 concludes.

2 The model

Consider a closed economy with overlapping generations in the tradition of Diamond (1965). It is assumed that the population size grows at the constant rate $n = N/N_{-1} - 1$. Labour markets are imperfect in the sense that unemployment results from wage bargaining between unions and firms. Moreover, a social security system ensures against the risk of unemployment and the risk of old age via unemployment benefits and pensions. The basic model setup follows Bräuninger (2005) who studies interrelations between unemployment, pensions and economic growth. We extend this work by introducing capital taxation to explicitly analyze the impact of changes in the taxation of capital income on the growth process.

2.1 Households

At each moment in time, the population consists of a large number N of young individuals which either work or are unemployed and a large number N_{-1} of old individuals which are retired from work. Each young individual inelastically supplies one unit of labour. The fraction of working individuals is given by $(1-u)N$, where u denotes the unemployment rate. When young, individuals work and receive income I, which comprises net wage income if employed or unemployment benefits if unemployed. This income is partly used for consumption in the current period c_1 and partly saved for consumption during the retirement period c_2. Consequently, the individual's first period budget constraint is given by

$$I = c_1 + s. \tag{1}$$

When retired, an individual earns interest income on savings, Rs where $R = (1 + (1 - t^r)r)$ denotes the interest factor and t^r the tax on interest income which constitutes an additional revenue instrument to finance social security. Moreover, the individual receives a pension pw_{+1}. The second period budget can, thus, be described as

$$c_2 = (1 + (1 - t^r)r)s + pw_{+1}. \tag{2}$$

Individuals have identical preferences, depending on consumption during the two periods of life, c_1 and c_2. These preferences are assumed to be described by a CES utility function of the following form

$$U(c_1, c_2) = \frac{c_1^{1-\frac{1}{\sigma}} - 1}{1 - \frac{1}{\sigma}} + \delta \cdot \frac{c_2^{1-\frac{1}{\sigma}} - 1}{1 - \frac{1}{\sigma}}. \tag{3}$$

The parameter δ captures the individual's discount rate and σ the intertemporal elasticity of substitution. Maximizing the above utility function subject to the budget constraints yields the individual savings function

$$s(R, \sigma) = \vartheta(R, \sigma)I - \theta(R, \sigma)pw_{+1} \tag{4}$$

where

$$\vartheta(R, \sigma) = \Big(1 + \delta^\sigma R^{1-\sigma}\Big)^{-1} \quad \text{with} \quad \frac{\partial \vartheta}{\partial R} = \frac{(\sigma - 1)}{\delta^\sigma R^\sigma \cdot \vartheta(R, \sigma)^2} \gtreqless 0 \tag{5}$$

and

$$\theta(R, \sigma) = (\delta^\sigma R^\sigma + R)^{-1} \quad \text{with} \quad \frac{\partial \theta}{\partial R} = -\frac{1 + \sigma \delta^\sigma R^{\sigma-1}}{\theta(R, \sigma)^2} < 0 \tag{6}$$

Besides the straightforward dependence of individual savings on income I and the pension ratio p, the interest factor R affects individual savings via two channels. Firstly, a decline in the interest factor, e.g. resulting from an increase in the capital income tax, causes the income and substitution effects. Which of the two effects dominates depends on the intertemporal elasticity of substitution. For $\sigma > 1$, the substitution effect dominates and savings decline. For $\sigma < 1$, the income effect prevails and individual savings increase. The effect of a declining interest factor on savings is, therefore, ambiguous. Secondly, a lower interest factor raises the present value of pensions. Since pensions and savings are perfect substitutes, this pension effect discourages private capital accumulation and leads to crowding out of individual savings.

2.2 Government

Next, consider the role of the public sector in providing a social security system that comprises both unemployment insurance and pensions. To do so, the government can resort to two fiscal instruments, a wage tax t^w and a tax on capital income t^r, which finance unemployment benefits as well as the pay-as-you-go pension system. It is assumed that the contribution rates can be decided by the government, while the replacement rate and the pension ratio are exogenously given. More precisely, granted unemployment as well as retirement payments are fixed in proportion to the gross wage with the replacement rate $b < 1$ and the pension ratio $p < 1$. Consequently, a balanced public budget requires

$$t^w w(1-u)N + t^r rK = pwN_{-1} + bwuN, \tag{7}$$

where pwN_{-1} constitute aggregate expenditures on pensions for the old generation and $bwuN$ comprise unemployment benefits paid to the fraction of unemployed individuals uN. K denotes the current capital stock which is fully determined by savings of the previous period. To focus on the role of revenue-neutral changes of capital income taxation on growth, the budget constraint is rearranged to express the wage tax t^w as a function of the tax on capital income t^r,

$$t^w = \frac{p + bu(1+n)}{(1-u)(1+n)} - t^r r \frac{K}{w(1-u)N}. \tag{8}$$

Equation (8) reveals that an increase in the tax on capital income leads to a reduction of the wage tax. Moreover, a higher rate of unemployment requires more payments on unemployment benefits and, thus, directly raises the wage tax.

2.3 Production

On the production side of the model, perfect competition between a large number of identical firms is assumed. Given the factor inputs capital K and labour L, the production technology can be described by a Cobb-Douglas production function of the form $Y = AK^\alpha(EL)^{1-\alpha}$ with $0 < \alpha < 1$. The parameter A is a general index of efficiency, while E describes a labour efficiency index depending on the knowledge of workers.

This labour efficiency index allows to model an endogenous growth process in line with Romer (1986) and Lucas (1988): Assuming that knowledge is accumulated in proportion to aggregate capital, the aggregate index of labour efficiency equals $E = K/L$. This implies that there exists a positive externality of the aggregate stock of capital on the production process. Moreover, as will be explained in the following subsection, unemployment occurs in every period with u denoting the proportion of unemployed individuals. It follows that the aggregate labor input can be written as $L = (1-u)N$. The production technology thus simplifies to the AK-type production function allowing for endogenous growth,

$$Y = AK. \tag{9}$$

In line with Corneo and Marquardt (2000), labour efficiency in the present setting is given by aggregate knowledge per employed worker. This captures the idea of learning by doing as an increase in the physical capital stock simultaneously enhances the aggregate stock of knowledge.

Firms maximize profits $\Pi = Y - wL - rK$, implying that the wage rate and the interest rate have to equal the marginal revenue of the respective factor input,

$$w = \frac{\partial Y}{\partial L} = \frac{(1-\alpha)AK}{(1-u)N}, \tag{10}$$

$$r = \frac{\partial Y}{\partial K} = \alpha A. \tag{11}$$

Notice that output and the wage rate are proportional to capital and will grow at the same rate in the steady state. In contrast, the interest rate is constant. An increasing unemployment rate does neither affect output nor the interest rate, but increases the wage rate.

2.4 Labour Market

Despite of the fact that profits will vanish in a competitive market equilibrium, unions can try to capture quasi rents by pushing up their wage demands: For a fixed amount of capital employed by the firm, higher wage demands induce firms to increase the marginal product of labour by lowering the level of employment. This raises the wage rate employed workers receive and is, thus, in the interest of the union.

Following Layard et al. (1991), the wage bargaining process occurs at the firm level with every firm being represented by a union k. Since all firms and unions are identical, it suffices to consider the bargaining problem of a representative union.[2] This representative union is interested in maximizing the aggregate utility of all union members N, which amounts to maximizing the sum of expected income,

$$V = N\left((1-u)(1-t^w)w + ua\right), \tag{12}$$

where $(1-t^w)w$ denotes the net income when staying employed which might occur with probability $1-u$. The variable a describes the alternative income

[2] We will suppress the firm index in the following.

that will be received in case the worker looses the job at this specific firm with probability u. This alternative income can be described by the weighted average $a = \phi ubw + (1-\phi u)(1-t^w)w$, indicating that in the presence of periodical fluctuations on the labour market, each employed worker faces a positive probability $1-\phi u$ of finding a job in another, identical firm. With probability ϕu, the worker remains unemployed for the current period and receives unemployment benefits. Moreover, the alternative income is also what workers will receive in case the bargaining process fails, and thus constitutes the threat point of the union, $\overline{V} = aN$. In contrast, firms intend to maximize profits and face losses in form of the cost of capital $\overline{\Pi} = -rK$ if no solution is reached in the bargaining process. Given this setup, the bargaining process can be described by the Nash-product,

$$\Omega = \left(V - \overline{V}\right)^{\gamma} \left(\Pi - \overline{\Pi}\right)^{1-\gamma} = \left((1-t^w)wL - aL\right)^{\gamma} \left(Y - wL\right)^{1-\gamma} \qquad (13)$$

where γ denotes the bargaining power of the union. Solving the Nash-product reveals that the net wage amounts to a fixed mark up over alternative income,

$$(1-t^w)w = \mu a = \mu \left[\phi ubw + (1-\phi u)(1-t^w)w\right] \qquad (14)$$

with $\mu \equiv 1 + \frac{\alpha\gamma}{(1-\alpha)}$. Rearranging equation (14) shows that the bargaining process directly determines the rate of unemployment,

$$u = \frac{(\mu-1)(1-t^w)}{\mu\phi(1-t^w-b)}. \qquad (15)$$

The unemployment rate resulting from the wage bargaining process depends on the wage tax, while the wage tax arising from the governments budget restriction depends on the rate of unemployment (equation (8)). In line with Bräuninger (2005), solving the two equations verifies the existence of either two unemployment equilibria of which only one is stable, or no equilibrium at all.[3]

These unemployment equilibria are displayed in Figure 1 as intersections of the unemployment rate due to wage bargaining, $u(t^w)$, and the wage tax derived using the public budget constraint, $t^w(u, t^r)$. One can immediately reveal that for a fixed capital income tax t_0^r, the stable unemployment equilibrium can be found at the wage tax t_1^w. Yet, increasing the capital income tax rate shifts the $t^w(u, t^r)$ graph upwards, implying that a new stable equilibrium realizes itself at a lower wage tax and a lower level of unemployment. This gives rise to the following proposition:

[3]To see this, insert equation (8) into (15) to derive a quadratic expression determining the unemployment rate which can be solved for two unemployment equilibria.

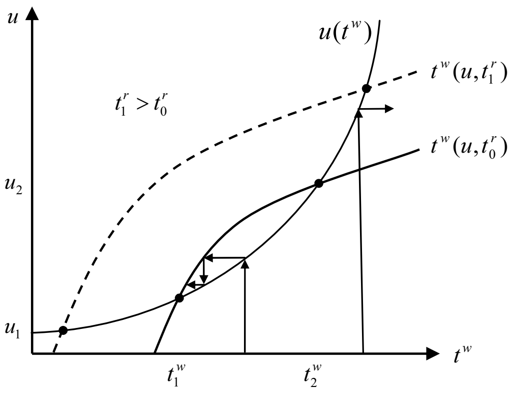

Figure 1: Unemployment equilibria and the role of capital income taxation

Proposition 1. *There exists an indirect, positive effect of the capital income tax on unemployment: Increasing t^r decreases t^w and thereby reduces unemployment.*

Proposition 1 indicates that raising the capital income tax is associated with a lower wage tax and, thus, constitutes a potential policy option to increase the level of employment. The intuition behind this result is the following: A lower wage tax increases the individual's net wage and thus the union's utility. Consequently, the union can mitigate its wage demands and still attain the same utility level as before the tax reform. Lower wage demands then reduce the level of unemployment. Yet, at the same time an increase in the taxation of capital income might reduce private savings incentives and thereby deteriorate growth. To assess the overall effect of such a policy, the following section studies the effects of changes in the capital income tax on the growth factor of the economy.

3 Growth Effects

To determine the growth factor of the domestic capital stock, one needs to derive aggregate savings by summing up individual savings over all residents N. Recall that at every moment in time a proportion $(1-u)$ of the population is employed earning $(1 - t^w)w$, while a fraction u remains unemployed and receives unemployment benefits bw. Thus, aggregate savings can be stated as

$$S = \vartheta(R,\sigma)[(1-t^w)(1-u)+bu]wN - \theta(R,\sigma)pw_{+1}N. \tag{16}$$

In a closed economy setup, aggregate savings of the young are used to finance next period's capital stock $K_{+1} = S$. Therefore, aggregate savings can be used to determine the growth factor of capital $g = K_{+1}/K$. Expressing the wage rate by the marginal productivity of labour, an implicit functional relationship for the growth factor of capital can be derived,

$$g = \vartheta(R,\sigma)\frac{((1-t^w)(1-u)+bu)(1-\alpha)A}{(1-u)} - \theta(R,\sigma)\frac{p(1-\alpha)Ag}{(1-u)(1+n)}. \tag{17}$$

Solving for the growth factor explicitly yields

$$g = \frac{\vartheta(R,\sigma)\left((1-t^w)(1-u)+bu\right)}{\left[\frac{(1-u)}{(1-\alpha)A} + \theta\left(R,\sigma\right)\frac{p}{(1+n)}\right]}. \tag{18}$$

Now consider the growth effect of increasing the capital income tax,

$$\frac{dg}{dt^r} = \frac{(1-t^w)(1-u)+bu}{\chi}\cdot\frac{\partial\vartheta}{\partial t^r} - \frac{gp}{(1+n)\chi}\cdot\frac{\partial\theta}{\partial t^r} - \frac{\vartheta(R,\sigma)(1-u)}{\chi}\cdot\frac{\partial t^w}{\partial t^r} \tag{19}$$

with $\chi = \frac{(1-u)}{(1-\alpha)A} + \theta(R,\sigma)\frac{p}{(1+n)} > 0$. An increase of the capital income tax influences aggregate savings through three channels: Firstly, increasing the capital income tax evokes the opposing substitution and income effects. Therefore, the overall effect on savings and, hence, on growth is ambiguous, $\frac{\partial\vartheta}{\partial t^r} \gtreqless 0$, and depends on the intertemporal elasticity of substitution. Secondly, a higher capital tax increases the present value of pensions $\frac{\partial\theta}{\partial t^r} > 0$. As a consequence, aggregate savings decline as the individuals save less for retirement indicating that the *pension effect* is detrimental to growth. Thirdly, raising the capital tax allows for reduction of labour income taxes $\left(\frac{\partial t^w}{\partial t^r}\right) < 0$. This increases the net wage of the employed part of the population, thereby leading to more income out of which to save. Thus, this *budget effect* is equivalent to a pure positive income effect and fosters the growth process. The overall effect of raising the capital income tax depends both on the magnitude of the various effects and on the direction of the savings effect. This gives rise to the following proposition:

Proposition 2. *Increasing the capital income tax while maintaining a balanced budget may enhance the growth factor.*

The analysis reveals that lowering unemployment by raising the capital income tax rate might be a valuable policy option with the byproduct of potentially even promoting growth. However, it remains to be shown how realistic it is that the policy change actually increases growth. To this end, the model economy is calibrated to fit the situation of the EU15 and to analyze the growth effects of increasing the capital income tax rate in different scenarios.

Before computing the growth effects of an increase of the capital income tax, the parameters of the model have to be fixed. Note that one period in the model is assumed to last half a generation's life, i.e. 30 years. Population grows at the rate $n \approx 0.16$, corresponding to an annual average growth rate of roughly 0.5% over the last 30 years in the EU15[4]. On the side of the households, the parameter δ is set to $\delta = 1$, implying that individuals do not discount future consumption. Yet, in order to evaluate the effect of a change in the discount rate, we additionally consider the case $\delta = 0.55$, thereby matching an annual discount rate of 2%. With respect to the value of the intertemporal elasticity of substitution in consumption, there exists no consensus in the econometric literature. Consequently, most studies like Uhlig and Yanagawa (1996) or Dalgaard and Jensen (2007) assume log-utilities, i.e. $\sigma = 1$.[5] Since the intertemporal elasticity of substitution in consumption is crucial in determining the reaction of individual savings, alternative scenarios with $\sigma = 5/6$ and $\sigma = 10/7$ are also included in the analysis.[6]

To focus on the role of revenue-neutral changes of capital income taxation on growth and in line with the formal model analysis, the wage tax is determined endogenously to balance the budget. The exogenously given policy variables pension level p and replacement rate b are set to $p = 0.63$ and $b = 0.32$. Both values correspond to recent averages in the EU15 (OECD, 2007a,b). The production function is calibrated following the standard literature (Layard et al., 1991), entailing that the capital income share α is approximated by $\alpha = 0.3$. In order to match the average unemployment rate in the EU15 of 7.7% in 2006, the parameter ϕ is set to 2.25 and the bargaining power of the union γ to 0.175, resulting in a mark-up over the alternative income of $\mu = 7.5\%$.[7] Following the literature and matching the data of the EU15, the production efficiency index is set to $A = 14$.[8] This generates annual growth and after tax interest rates of 1.5% and 4.5%, respectively, for a capital

[4] See OECD (2008).

[5] Dalgaard and Jensen (2007) justify this observing that the empirical savings elasticity is more or less constant. This implies that substitution and income effects offset each other, which will only be the case if $\sigma = 1$.

[6] These choices correspond to the values used by Rivas (2003) who carries out a similar calibration exercise.

[7] Since estimates of μ range from $5\% - 15\%$, the parameter choice is in line with the empirical literature, see e.g. Layard et al. (1991).

[8] We choose a slightly higher value than the one used by Uhlig and Yanagawa (1996) in order to generate more plausible values for the growth and interest rate.

income tax rate of 35%.[9] The parameters of the model are summarized in table 1.

Parameters

population growth rate	n≈ 0.16
individual discount rate	δ=1 [0.55]
elasticity of substitution	σ=1 [0.83, 1.43]
capital income share	α=0.3
index of labour market fluctuations	ϕ=2.25
union bargaining power	γ=0.175
production efficiency index	A=14

Table 1: Fixed parameters

In a next step, the effects of an increase of the capital income tax on growth are computed. Since there are no transitional dynamics, such a shock can completely be described by the derivative of the growth factor with respect to the capital income tax, dg/dt^r. Varying t^r, σ and δ, the entries in table 2 depict the change in the growth factor resulting from a marginal increase in the capital tax rate, dg/dt^r and taking into account that additional revenue is used to reduce the wage tax. Since t^w is endogenously determined, each choice of the capital income tax t^r implies a corresponding wage tax rate, displayed in the second row. The range of capital income tax rates is chosen to roughly match labour income tax rates in the EU15, ranging from 23% to 56%.

The calibration exercise reveals that there are cases with plausible parameter constellations where an increase in the capital income tax fosters growth, e.g. for capital income tax rates between 0.25 and 0.45 growth rises if the intertemporal elasticity of substitution does not exceed $\sigma = 1$. Clearly, in case of $\sigma > 1$, positive growth effects are less probable as the substitution effect, that negatively affects savings, becomes more and more pronounced. Moreover, as the capital income tax increases, it is less likely that the proposed policy reform promotes growth. Rather, the growth effect of marginally raising the capital tax is decreasing in t^r. Consequently, there seems to exist a growth-maximizing capital income tax rate which, however, depends on the parameter values chosen. For $\sigma = 1$, for example, this growth-maximizing

[9]This choice is in line with Rivas (2003). Moreover, the value roughly matches the average effective tax rate on capital income for the EU15 countries in the period of 1975-2000 (Carey and Rabesona, 2002).

		$\sigma = 0.83$		$\sigma = 1$		$\sigma = 1.43$	
t^r	t^w	$\delta = 1$	$\delta = 0.55$	$\delta = 1$	$\delta = 0.55$	$\delta = 1$	$\delta = 0.55$
0.25	0.51	0.64	0.40	0.62	0.33	0.55	0.07
0.3	0.49	0.58	0.36	0.52	0.27	0.36	-0.05
0.35	0.46	0.51	0.31	0.42	0.20	0.16	-0.17
0.4	0.44	0.43	0.25	0.31	0.12	-0.05	-0.31
0.45	0.42	0.34	0.19	0.19	0.04	-0.29	-0.44
0.5	0.40	0.24	0.12	0.05	-0.05	-0.55	-0.59
0.55	0.38	0.13	0.04	-0.10	-0.15	-0.83	-0.74
0.6	0.36	0.00	-0.05	-0.27	-0.26	-1.14	-0.90

Table 2: Growth effects of marginally raising the capital income tax

capital income tax rate is well above 45%.

What are the policy conclusions to be drawn from this calibration exercise? Of course, the model can not exactly mirror the situation in the EU15. Still it points to an important insight that has so far been neglected in policy discussions: The effects of raising the capital income tax rate are not as straightforward as often suggested. Especially when allowing for social security systems and unemployment, additional effects arise that might offset the (possibly negative) direct savings effects. As has been shown, this might not only influence growth positively, but moreover raise the level of employment if revenues are used to lower taxes on wage income.

3.1 Extension: Growth in a small open economy

So far, a closed economy has been studied. Clearly, this puts major restrictions to the results derived as capital in a closed economy cannot escape domestic taxation. To evaluate the growth effects of the proposed policy reform in an open economy setup, this section introduces imperfect capital mobility, implying that capital can at least to some extent avoid excessive tax rates by means of capital flight.

Allowing for capital mobility, two cases have to be distinguished: Firstly, the domestic country might be more productive than the rest of the world, entailing that the domestic rate of return r exceeds the world interest rate r^* and capital flows into the country. Yet, the domestic economy could also be less productive than the rest of the world, in which case capital would be exported due to the higher world interest rate attainable abroad. To distinguish both cases, an indicator variable $\eta \in \{0, 1\}$ is introduced which takes the value $\eta = 1$ if the domestic country is low-productive and exports capital, and $\eta = 0$ if capital is imported.

Following Bräuninger (2002), it is further assumed that there exists a limit on both capital in- and outflows. More precisely, imports and exports of capital F are restricted to a fixed proportion m with $0 < m < 1$ of domestic assets, which are determined by previous savings S_{-1}. The limit on capital imports can be justified by the fact that foreign investors will typically not finance the entire amount of assets requested, but rather limit their investments in relation to assets held by the debtor country. Moreover, it seems to be plausible to assume that residents are to some extent home-biased, implying that they will at most invest a proportion m of their savings abroad irrespective of a potentially remaining difference in the rates of return. This might e.g. result from an informational advantage with respect to the domestic market, implying that domestic bonds are perceived as more secure. Assuming a sufficiently high differences in the rates of return between the domestic economy and the rest of the world, these limits will always be binding. Consequently, both cases can be summarized by

$$F = (1 - 2\eta)mS_{-1}. \tag{20}$$

If $\eta = 1$, it follows that $F = -mS_{-1}$, indicating that part of domestic assets are invested abroad. If $\eta = 0$, then $F = mS_{-1}$ denotes capital that is being imported.

The government can impose different taxes on the various forms of capital income that might arise. The tax τ^i is levied on returns to capital inflows (inbound investments), i.e. investment of non-residents in the domestic economy. τ^o denotes the tax rate on capital outflow (outbound investments), i.e. investment of residents abroad. In analogy to the closed economy, t^r is the tax on interest income of residents in the domestic economy. Introducing the different tax rates on capital income allows to distinguish between the residence and source principle of international taxation: Under the residence principle, resident's capital income from various sources is taxed at a single rate, $t^r = \tau^o$, and non-resident's capital income is tax-exempt, $\tau^i = 0$. In contrast, only domestic source capital income is taxed if the source principle is realized, that is $t^r = \tau^i$ and $\tau^o = 0$.

Allowing for capital mobility, there may be additional tax revenue in comparison to the closed economy, depending on the principle of taxation used and on whether capital is exported or imported. While public expenditures remain unchanged, the revenue side of the public budget becomes

$$t^w w(1-u)N + t^r r(1-\eta m)S_{-1} + \tau^i r(1-\eta)mS_{-1} + \tau^o r^* \eta m S_{-1}. \qquad (21)$$

Once again, one can rearrange the constraint to express the wage tax as a function of capital income taxation,

$$t^w = \frac{p + bu(1+n)}{(1-u)(1+n)} - \tau \frac{S_{-1}}{w(1-u)N} \qquad (22)$$

where $\tau = (1-\eta m)t^r r + (1-\eta)m\tau^i r + \eta m \tau^o r^*$ comprises the tax per unit of capital invested. If capital is exported ($\eta = 1$), this per unit tax reduces to $\tau = (1-m)t^r r + m\tau^o r^*$, indicating that returns to capital invested at home are taxed at the rate t^r, while capital returns earned abroad are subject to the tax rate on outbound investments, τ^o. If capital is imported ($\eta = 0$), the per unit tax on capital comprises taxes on resident's capital investments S_{-1} and taxes on inbound investments mS_{-1}, $\tau = t^r r + m\tau^i r$. In either case, and in line with the closed economy setup, increases in capital income taxation permit a reduction of the labour income tax.

On the household side, allowing for capital mobility introduces the possibility to invest abroad and possibly earn a higher rate of return. Since different tax rates might apply to investments at home and abroad, capital income of residents can be summarized as

$$[1 + (1-t^r)r]\,(1-\eta m)s + [1 + (1-\tau^o)r^*]\,\eta m s. \qquad (23)$$

For $\eta = 0$, the economy is high productive and all savings will be invested at home, implying that the rate of return coincides with the one derived in the closed economy setup, $1 + (1-t^r)r$. If $\eta = 1$, however, a fraction m of individual savings is invested abroad and the interest factor now comprises rates of return to different sources of capital income. Introducing the interest factor $\widetilde{R} = 1 + [(1-t^r)r(1-\eta m) + (1-\tau^o)r^*\eta m]$ allows to rewrite capital income in a way that matches the formulas of the closed economy case, namely as $\widetilde{R}s$. Although households can avoid excessive taxation to some extend by shifting a part of their investments abroad, the discount rate is negatively affected by both increases in the tax rate of domestic as well as outbound investments.

While households are possibly confronted with a different rate of return to their investments, individual decision making itself is unaffected by capital mobility. Consequently, maximizing utility yields a same savings function as before,

$$s(\widetilde{R},\sigma) = \vartheta(\widetilde{R},\sigma)I - \theta(\widetilde{R},\sigma)pw_{+1}. \tag{24}$$

It is important to point out, however, that the functional forms of $\vartheta(\cdot)$ and $\theta(\cdot)$ remain the same, entailing that savings react to changes in the discount rate in the same manner as they do in the closed economy model.

Clearly, in the presence of mobile capital, the capital stock no longer corresponds to previous savings. Rather, to determine the amount of capital employed in the domestic economy in a given period one needs to adjust domestic assets by the amount of in- or outbound investments F,

$$K_{+1} = S + F_{+1} = (1 + (1-2\eta)m)\, S. \tag{25}$$

Dividing by K, one obtains an implicit expression for the growth factor of capital,

$$g = \frac{K_{+1}}{K} = (1 + (1-2\eta)m)\,\frac{S}{K} \tag{26}$$

Obviously, the growth factor of capital is higher if capital flows into the country in which case the growth rate becomes $g = (1+m)S/K$ while capital outflow reduces growth by the factor $1-m$. Taking into account that the interest factor and the wage tax are affected by changes in the tax system, the growth factor resembles the one derived for a closed economy setup,

$$g = \frac{\vartheta(\widetilde{R},\sigma)\,((1-t^w)(1-u)+bu)}{\left[\frac{1}{1+(1-2\eta)m}\frac{(1-u)}{(1-\alpha)A} + \theta\left(\widetilde{R},\sigma\right)\frac{p}{(1+n)}\right]} \tag{27}$$

As equation (27) suggests, the qualitative effects of raising the capital income tax rates remain unchanged since both the interest factor and the wage tax respond in the same way. Yet, the overall effect additionally depends on the regime of international taxation.

Under *residence-based taxation of capital income* , $t^r = \tau^o$ and $\tau^i = 0$, domestic investors are hit by the tax increase no matter where they invest their assets while foreign investors are tax exempt in the local economy. Hence, changes in the capital income tax do not influence the relation between the domestic and the world rate of return, and an increase in the capital income tax will not alter the status of the domestic country as low- or high-productive. Yet, under *source-based taxation of capital income*, $t^r = \tau^i$ and

$\tau^o = 0$, the relation between the domestic and the world rate of return to capital is affected by changes in the capital income tax. To see this, consider again a foreign investor who intends to invest in a high-productivity country. A rise in the source-based tax on capital investments might render such an investment inefficient as profound increase in the taxation of domestic capital returns could turn a high- into a low-productivity country. Such a policy would clearly result in capital outflows combined with a sharp decline of the growth factor. Yet, given the predominance of the residence principle in the EU15 with respect to the returns on savings, this problem of source-based income taxation seems to be of minor practical importance. Rather, the analysis reveals that allowing for mobile capital does not change the results: raising the capital income tax to finance a reduction of wage taxation can not only increase employment but also promote economic growth. The proceeding part of the paper will, thus, return to analyzing the closed economy model.

4 Welfare Effects

So far, the analysis has focused on the growth effects of increasing capital taxation. However, it remains unclear in which way the reform affects the welfare of the different generations and if potential losers can be compensated by the winners of the tax change. Yet, this is of special importance in determining the political support for such a reform. To address this issue, the following section sheds light on the question whether a reform capable of generating positive growth effect additionally leads to a net welfare gain for the economy. To this end, the welfare effects of a tax reform today are firstly evaluated for the currently young and all successive generations, given that growth is indeed positively affected. In a second step, the welfare effects for the currently old population are derived and the potential for compensation is determined in a calibration exercise.

Consider first the welfare effects of the currently young and all subsequent generations. As the tax change is assumed to be announced prior to private decision making, these individuals can fully adjust to the new tax rates. To determine the welfare effects of these adjustments, one needs to derive the individual's indirect utility function $\Gamma(R, I, w_{+1})$. Recall that income I refers to the net wage in case of employment and to unemployment benefits in case of job loss. Noting that wages grow at the rate $g/(1+n)$ simplifies the indirect utility function to

$$\Gamma(R,I,g) = \frac{\left[1+\delta^{\sigma}R^{\sigma-1}\right]^{\frac{1}{\sigma}}}{1-1/\sigma}\left(I+\frac{pwg}{(1+n)\,R}\right)^{1-\frac{1}{\sigma}} - \frac{(1+\delta)}{1-1/\sigma}, \qquad (28)$$

which describes the individual's maximum utility given the price for future consumption R and the present value of life-time income, $I+\frac{pwg}{(1+n)R}$. The welfare effects for the young and all successive generation can now be derived as

$$\frac{\partial\Gamma}{\partial t^r} = \tilde{\chi}\underbrace{\left(\frac{\delta^{\sigma}R^{\sigma-1}I-\frac{pwg}{(1+n)}}{(1+\delta^{\sigma}R^{\sigma-1})}\right)}_{\gtreqless 0}\frac{\partial R}{\partial t^r}+\tilde{\chi}\left(\frac{\partial I}{\partial t^w}\frac{\partial t^w}{\partial t^r}+\frac{pw}{(1+n)\,R}\frac{dg}{dt^r}\right) \qquad (29)$$

with $\tilde{\chi}=\left(\frac{1+\delta^{\sigma}R^{\sigma-1}}{I+\frac{pwg}{(1+n)R}}\right)^{\frac{1}{\sigma}}>0$. Clearly, changes in the capital income tax rate affect welfare via three different channels. Firstly, increasing the capital income tax directly reduces the private return to savings, $\frac{\partial R}{\partial t^r}<0$ and, thereby, affects the present value of an individual's life-time income in an ambiguous way: On the one hand, it induces an income effect that decreases future consumption possibilities, but on the other hand it increases the present value of future pensions. Secondly, raising the capital tax allows for a reduction of the wage tax, $\frac{\partial t^w}{\partial t^r}<0$, which increases the net income of employed individuals and, thus, their present and future consumption. Consequently, the positive effects of the tax reform are higher for employed individuals than they are for the unemployed and can at least partially offset the possibly negative effects resulting from changes in the private return to savings. Thirdly, the growth effects of the tax reform directly influence future wages and, therefore, the pension income of individuals. As has been discussed before, these growth effects are in general ambiguous, $\frac{dg}{dt^r}\gtreqless 0$. Yet, if positive growth effects are present, these will contribute to the welfare of the currently young and all successive generations and, thereby, render a net welfare gain even more probable.

The welfare effects for the currently old population are more clear-cut as these individuals can no longer adjust to changes in tax rates. Rather, decisions on the amount of savings of this generation, s_{-1}, have been made prior to the tax reform and, together with pension, determine their level of old-age consumption, $c_{2,-1}=Rs_{-1}+pw$. While the level of pension in the period of reform remains unchanged, an increased capital income tax reduces the returns of these savings and, thus, lowers individual welfare,

$$\frac{\partial U(c_{1,-1},c_{2,-1})}{\partial R}\frac{\partial R}{\partial t^r}=\delta c_{2,-1}^{-\frac{1}{\sigma}}\cdot s_{-1}\frac{\partial R}{\partial t^r} \qquad (30)$$

with $c_{1,-1}$ and $c_{2,-1}$ denoting current and old-age consumption of the generation born in period -1. As equation (30) reveals, the old generation experiences a welfare loss. This gives rise to the following proposition:

Proposition 3. *Increasing the capital income tax while maintaining a balanced budget may enhance individual welfare for the current and all subsequent generations, while the presently old generation experiences a welfare loss.*

As the welfare effects for the young generation are ambiguous while the old generation loses, it remains unclear whether the reform can generate a net welfare gain. Thus, political support might be lacking even in case of positive growth effects. To clarify whether this is indeed the case, the following calibration computes the marginal welfare effects of the tax reform, given that growth is positively effected, $dg/dt^r > 0$. More precisely, the calibration

		young		**old**		**net effect**	
t^r	t^w	$\delta = 1$	$\delta = 0.55$	$\delta = 1$	$\delta = 0.55$	$\delta = 1$	$\delta = 0.55$
0.25	0.51	1.81	1.75	-0.44	-0.24	1.67	1.79
0.3	0.49	1.73	1.67	-0.45	-0.25	1.57	1.70
0.35	0.46	1.65	1.60	-0.46	-0.25	1.46	1.60
0.4	0.44	1.56	1.52	-0.47	-0.26	1.34	1.50
0.45	0.42	1.46	1.43	-0.48	-0.27	1.21	1.40

Table 3: Welfare effects of marginally raising the capital income tax for currently and formerly employed individuals

builds on the previous calibration exercise and determines the welfare effects for the range of capital income tax rates for which a positive growth effect has been derived. For clarity of presentation, the results displayed refer to the case $\sigma = 1$.[10] The parameter choices as depicted in table 1 remain unchanged. Moreover, the capital stock in the period of tax reform has been normalized to one. The entries in tables 3 and 4 depict changes in the level of welfare for the young and old generation, respectively, which result from a

[10]The findings are equally well supported by the calibration results for $\sigma = 5/6$ and $\sigma = 10/7$, which can be obtained from the authors upon request.

		young		old		net effect	
t^r	t^w	$\delta = 1$	$\delta = 0.55$	$\delta = 1$	$\delta = 0.55$	$\delta = 1$	$\delta = 0.55$
0.25	0.51	1.97	1.79	-0.24	-0.12	2.05	1.96
0.3	0.49	1.99	1.80	-0.22	-0.10	2.09	1.99
0.35	0.46	2.00	1.81	-0.19	-0.08	2.12	2.01
0.4	0.44	1.99	1.80	-0.16	-0.06	2.15	2.03
0.45	0.42	1.97	1.78	-0.13	-0.04	2.16	2.03

Table 4: Welfare effects of marginally raising the capital income tax for currently and formerly unemployed individuals

marginal increase in the capital income tax rate. For clarity of presentation we distinguish between individuals with and without an employment history. The net welfare effect is derived comparing the marginal welfare effect of the currently young generation with the loss of the old generation, taking into account that the population grows at rate n and unemployment declines as a response to lower labour income taxation. This net effect determines the scope for compensation between winners and losers in the period of reform. As the calibration reveals, positive welfare effects arise as long as capital income taxation promotes growth: Although the old generation experiences a decline in consumption, the gains for the young are high enough to compensate them, e.g. by means of an intergenerational transfer in the period of reform.

5 Conclusion

This paper analyzes the growth effects of a revenue neutral tax reform that increases the tax rate on capital income to reduce wage-related social security contributions. We find that such a policy not only reduces unemployment but can additionally promote economic growth. The overall effect on growth, however, depends on different, partly opposing effects on capital accumulation. Firstly, the lower wage tax directly raises the net income of households, thereby fostering savings and, consequently, growth. Secondly, the present value of pensions increases, inducing a disincentive to accumulate capital and, thus, leading to lower growth. Thirdly, there are the opposing income and substitution effects, having an ambiguous impact on growth. Depending on the magnitude of the various effects, a policy reform that increases the capital income tax in a revenue-neutral way has the scope to not only reduce unemployment but moreover facilitate the growth process.

Calibrating the model to match data from the EU15 suggests that the aforementioned tax reform can indeed be growth-enhancing if the initial capital income tax is not too high. This is due to the fact that there seems to exist a growth-maximizing level of the capital income tax below which any increase of the tax on capital income contributes to the growth process. In an extension to the basic model setup, imperfect mobility of capital is allowed for to capture the fact that taxes on capital income might cause capital flight and thereby severely affect the growth process. Yet, it is shown that as long as the residence principle prevails the qualitative results do not hinge on the closed economy setup. Even in case of imperfect capital mobility, an increase of the capital income tax not only promotes employment but may additionally foster growth. Moreover, it is shown that political support for the aforementioned reform is probable as long as growth-promoting effects are present: since the gains of the young generation outweigh the losses for the old, the reform generates a net welfare gain for the entire population.

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