Tax co-ordination
Its desirability and redistributional implications

SUMMARY

In a world of high capital mobility, governments may be tempted to undercut each other's capital income taxes to attract capital from abroad. Since such tax competition may have detrimental effects for all countries, European policy makers have debated the introduction of a minimum capital income tax rate within the EU. This paper develops an applied general equilibrium model to estimate the effects of such tax co-ordination on resource allocation, income distribution and social welfare. The model allows for the concern of policy makers that a rise in capital taxes within the EU may cause a capital flight out of Europe. Capital flight will indeed reduce the welfare gain from tax co-ordination within Western Europe, but a positive net gain will remain, although it is likely to be well below 1% of GDP. The gain from co-ordination will be unevenly distributed across European countries, due to differences in economic structures and in the social preference for redistribution. Moreover, even if the median voter's gain from tax co-ordination may be small, the gains for the poorer sections of society may be quite large.

— Peter Birch Sørensen

The case for international tax co-ordination reconsidered

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1. INTRODUCTION

In open economies linked by trade and capital flows, the tax policy of one country may affect economic activity and public revenue in other countries. This observation has led to numerous calls for international tax co-ordination in the wake of deepening economic integration. In particular, the formation of Economic and Monetary Union in Europe has revitalized the European debate on the need for co-ordination of capital income taxation to ensure realization of the expected gains from further integration of European capital markets.

This paper investigates the scope for co-ordination of capital income taxes within the EU, allowing for the concern of policy makers that higher capital taxes in Europe may cause a flight of capital to the rest of the world. The paper develops a quantitative general equilibrium model describing the allocation and distribution effects of tax competition and tax co-ordination within a unified framework. The analysis highlights the differences between global tax co-ordination and regional co-ordination within a subset of countries. In the case of regional co-ordination, it also illustrates the importance of the policy response from the rest of the world. Fiscal competition will not wipe out capital income taxes, but it will generate an inefficiently low level of capital taxes relative

to taxes on labour. Fiscal competition will also cause a significant drop in redistributive public transfers and an increase in productive government spending benefitting mobile capital. The results indicate that the gains from international co-ordination of capital taxes are likely to be unevenly distributed across countries and particularly *within* each country, with the bulk of the gains accruing to the poorer sections of society. This suggests that the case for international tax co-ordination must rest on fairly egalitarian policy preferences and that co-ordination may be hard to implement politically.

Before substantiating these claims, I will give some background to the current debate on tax co-ordination in Section 2 and offer some evidence of tax competition in Section 3. Section 4 will then present my general equilibrium model designed to analyse the allocation and distribution effects of international tax co-ordination. In Section 5 I will show how this model supports the conclusions mentioned above. Section 6 summarizes my main results.

2. TAX COMPETITION OR TAX CO-ORDINATION?

Early advocates of tax co-ordination like Peggy Musgrave (1969) and Richard Musgrave (1969, Part III) focused on the problem of international double taxation. Double taxation occurs when the taxpayer's country of residence imposes a tax on foreign-source income on top of the tax which has already been paid to the foreign-source country. Guided by the OECD Model Double Taxation Convention (OECD, 1977), policy makers have now established an intricate web of bilateral tax treaties to alleviate international double taxation. Within the EU, the so-called 'Parent-Subsidiary Directive' provides for double tax relief in the field of corporate taxation.

The issue of double taxation has thus become less pressing. Instead there has been a growing concern that income from international activity may be *undertaxed*, as increasing capital mobility reduces the incentive for source countries and the ability of residence countries to tax mobile activities. Residence countries have difficulties monitoring and taxing accrued income from outward foreign investment. At the same time source countries are reluctant to impose high taxes on inward foreign investment for fear of provoking capital flight. Indeed, the attempts of governments to attract mobile capital by offering a favourable tax climate may trigger a process of international *tax competition* in which taxation and public spending is driven below the optimal level – the (in)famous 'race to the bottom'.[1] Concern about such effects of tax competition was already expressed by Oates (1972, p. 143). Later, it was underpinned by Zodrow and Mieszkowski (1986) and Wilson (1986) who showed that reliance on source-based capital income taxes will cause an underprovision of public goods in an environment of tax competition. Gordon (1986) and Razin and Sadka (1991) projected that capital income taxes will vanish altogether in small open economies faced with perfect capital

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[1] There is ample evidence that tax policy affects the location of economic activity. See Hines (1999) for a survey of the empirical literature.

mobility, given that residence countries cannot enforce taxes on foreign-source capital income, and given that they can tax immobile factors. Sinn (1997) argued that tax competition will not cause an underprovision of public goods when governments can tax immobile labour, but it will imply a more unequal income distribution and cause the welfare state to break down altogether if labour mobility is added to capital mobility. Keen and Marchand (1997) pointed out that, just as fiscal competition may induce governments to change their tax structures with undesirable consequences for income distribution, it may also lead to an increase in expenditures benefiting mobile capital at the expense of spending on public goods benefiting immobile consumers.

Despite these and many other contributions indicating negative effects of tax competition,[2] the case for international tax co-ordination is by no means universally accepted. In the spirit of Brennan and Buchanan (1980), several writers have argued that fiscal decentralization and the ensuing tax competition helps to constrain the rent-seeking activities of politicians, bureaucrats and special interest groups. For example, in defence of Britain's opposition to a withholding tax on interest paid to EU residents, an editorial in The Economist (27/11/99) argued that 'tax competition (tending to lower tax rates) is just what the EU needs'. But even if a fraction of government spending may represent pure 'waste', capital income tax competition will be welfare-improving only if the 'waste' fraction exceeds the elasticity of the tax base with respect to the capital income tax rate – a result demonstrated by Edwards and Keen (1996). This condition seems unlikely to be met in a world of high capital mobility where the capital income tax base is very elastic.

Most of the literature emphasizing welfare losses from tax competition has focused on the effects of capital mobility. Another strand of literature stresses labour mobility, arguing that tax competition in a world with mobile individuals helps local jurisdictions to achieve an efficient level and pattern of public spending, as citizens reveal their preferences for public goods by voting with their feet, moving to the jurisdiction offering their preferred fiscal policy package. This is the famous Tiebout (1956) hypothesis. Unfortunately the conditions necessary for an efficient Tiebout equilibrium are very restrictive. First, the government must be able to collect a 'head tax' from each resident equal to the cost of providing him with the chosen level of public goods and services. Similar lump sum taxes may be necessary to ensure an efficient location of mobile firms (see Richter, 1994; Richter and Wellisch, 1996). Secondly, an efficient decentralized Tiebout equilibrium will not exist if there are economies of scale in the provision of public goods (Bewley, 1981; Sinn, 1997). Moreover, the Tiebout literature focuses entirely on efficiency issues, neglecting the fact that factor mobility weakens the ability of governments to redistribute income from rich to poor. Finally, in an international context with cultural and political barriers to labour mobility, governments compete mainly to attract mobile capital, and the efficiency-enhancing process of citizens voting with their feet cannot be relied upon.

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[2] See Devereux (1996) and Wilson (1999) for recent surveys of the theory of tax competition.

Against this background I will seek to explain and to quantify the losses from international fiscal competition and the potential gains from of tax co-ordination. I will focus on fiscal competition for mobile capital, since international labour mobility is still rather limited. Without denying their importance, I will leave aside issues of commodity tax competition, recently surveyed by Keen and Smith (1996) and Lockwood (1999).

3. EVIDENCE OF TAX COMPETITION

Because of monitoring problems it is difficult for residence countries to enforce taxes on foreign-source capital income. This holds in particular for personal taxes on income from foreign portfolio investment. In the area of corporate income taxation many residence countries explicitly exempt foreign-source income from domestic tax, and most other countries only tax the foreign-source income of their 'resident' multinationals to the extent that this income is repatriated to the parent company, and only in so far as the domestic tax liability exceeds the source tax which has already been paid to the foreign country. As a first approximation, it is therefore fair to say that the source principle prevails in the taxation of capital income.[3]

In the field of portfolio investment where the transaction costs of shifting between domestic and foreign investment are small, the combination of capital mobility and source-based taxation is likely to exert a strong downward pressure on tax rates. Since investment in debt instruments accounts for the bulk of foreign portfolio investment, we would thus expect to observe a significant drop in tax rates on interest income in an era when capital controls are lifted and financial markets are liberalized.

The impact of rising capital mobility on the taxation of direct business investment is more subtle. The effective tax rate on business profits depends on the rules defining the tax base and on the statutory (corporate) tax rate applied to taxable profits. If governments must raise a certain amount of revenue via taxes on corporate income, a rise in foreign direct investment will induce policy makers to lower the statutory tax rate and to broaden the tax base by reducing depreciation allowances and eliminating special investment incentives (see Haufler and Schjelderup, 1999a). The reason is that a lower *statutory* corporate tax rate makes government revenue less vulnerable to the profit-shifting activities of multinational corporations such as the practice of allocating taxable profits to low-tax jurisdictions by manipulating prices in intra-firm transactions (transfer-pricing), and the practice of allocating company debt and the associated deductions for interest payments to subsidiaries in high-tax countries (thin capitalization).

While it seems clear that transfer-pricing and thin capitalization will induce cuts in statutory corporate tax rates, it is less clear why governments faced with rising foreign direct investment would broaden the tax base to maintain the effective corporate tax rate, if they have access to other taxes on less mobile factors. Two facts may help us to

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[3] Sørensen (1993) offers a more detailed account of the practical difficulties of implementing consistent residence-based taxation of capital income.

understand this: (1) the return to direct investment often includes an element of location-specific pure profit; (2) economic integration increases the international cross-ownership of firms. The first fact means that capital owners cannot fully shift the burden of the source-based corporation tax onto other factors of production. The second fact means that a growing share of the domestic capital stock becomes foreign-owned. The corporate income tax then becomes a more effective tool for shifting the domestic tax burden onto foreigners, since the source-based corporation tax will fall to a larger extent on the pure profits accruing to foreign investors. As Mintz (1994) and Huizinga and Nielsen (1997) have emphasized, this opportunity for *tax exportation* provides an incentive for (nationalistic) governments to *raise* the effective corporate tax rate as a reaction to deepening economic integration.[4]

In summary, while growing capital mobility coupled with source-based taxation may be expected to drive down *statutory* tax rates on corporate profits and personal capital income, it will have two offsetting effects on *effective* corporate tax rates. On the one hand governments have an incentive to lower effective tax rates in an effort to attract increasingly mobile business activities. On the other hand increasing foreign ownership of domestic firms makes it more tempting to use the domestic corporation tax as a means of exporting part of the domestic tax burden. The net impact of these offsetting incentives on effective corporate tax rates is ambiguous, although most writers on tax competition seem to believe that the former effect will dominate. With these observations in mind, let us turn to the data.

Table 1 shows that statutory tax rates on capital income in the OECD area have declined significantly from the mid 1980s to the late 1990s, consistent with the hypothesis that the increase in capital mobility over this period has intensified tax competition. The theory of tax competition suggests that small countries will *ceteris paribus* set a lower tax rate on capital income than large countries, because the smaller countries face a higher elasticity of capital supply from the world capital market (see Bucovetsky, 1991; Wilson, 1991). For the same reason an increase in capital mobility over time should cause a larger drop in capital income tax rates in the smaller countries. On average, the data in Table 1 are seen to be consistent with this prediction.

Table 2 considers the evolution of the *average effective tax rate* on capital income, defined as total revenue from the taxation of capital, property and wealth as a percentage of the estimated total income from capital. To put these figures in perspective, the table also shows the change in the total average effective tax rate on labour income from the first half of the 1980s to the first half of the 1990s, accounting for the fact that consumption taxes are really indirect taxes on labour, since they contribute to the total wedge between the gross real labour cost to the employer and the real after-tax wage rate received by the

[4] When residence countries offer a credit for taxes paid to the foreign-source country, source countries can levy taxes without deterring inward foreign investment and will therefore wish to impose source taxes up to the maximum limit on the residence country's tax credit (see Sørensen, 1990; Gordon, 1992). Gordon suggests that large residence countries offer foreign tax credits to encourage source taxation abroad so that residence countries can maintain positive levels of tax on *domestic* investment without provoking a capital flight.

Table 1. Statutory tax rates on capital income

	Tax rate on retained corporate income (%)[a]			Top personal tax rate on interest income (%)[b]		
	1985	1999	Change 1985–99	1985	1998	Change 1985–98
Small countries (< 20 mill.)						
Denmark	50	32	−18	73.2	60	−13.2
Finland	57	28	−29	71	28	−43
Norway	51	28	−23	40.5	28	−12.5
Sweden	52	28	−24	50	30	−20
Belgium	45	40.2	−4.8	25	15	−10
Netherlands	42	35	−7	72	60	−12
Luxembourg	45.5	37.5	−8.0	57	50	−7
Ireland	50(10)	28(10)	−22	60	27	−33
Portugal	50	34	−16	15	20	5
Austria	61.5	34	−27.5	62	25	−37
Switzerland	35.0	25.1	−9.9	45.8	45	−0.8
Australia	50	33	−17	60	47	−13
Average for small countries	49.1[c]	31.9[c]	−17.2[c]	52.6	36.3	−16.4
Larger countries (> 40 mill.)						
Spain	33	35	2	66	31	−35
Italy	47.8	37	−10.8	12.5	12.5	17.5
France	50	40	−10	26	20.9	−5.1
Germany	61.7	52.3	−9.4	54.5	53	−1.5
UK	40	30	−10	60	40	−20
USA	49.5	38	−11.5	54	39.8	−14.2
Japan	55.4	48	−7.4	20	20	0
Average for large countries	48.2	40.0	−8.2	41.9	31	−10.9

Notes: [a] Including local taxes.
[b] Many countries have special savings incentives with lower tax rates. These are not reflected in the table.
[c] For manufacturing corporations in Ireland a low 10% corporate income tax applies (as indicated in parentheses). If this rate is used in computing the average for small countries the figures would be 45.8, 30.4 and −15.4 respectively.

Sources: The figures for 1985 were taken from the Ruding Report (1992), tables 8.5 and 8.6. The figures from 1998 and 1999 were taken from Andersson (1999).

employee. The *total* average effective tax rate on labour income reported in Table 2 thus includes indirect as well as direct taxes (see the formula in the note to the table).

According to Table 2 the recent drop in statutory tax rates on capital income has not translated into a similar drop in the effective tax rate. This reflects the fact that recent tax reforms in the OECD area have combined cuts in statutory tax rates with measures to broaden the capital income tax base. Indeed, on average the effective tax rate on capital has been roughly constant for all the country groups in Table 2. An alternative grouping into small and large countries did not reveal any systematic effect of country size on the evolution of tax rates.

The estimates in Table 2 are based on a methodology developed by Mendoza *et al.* (1994). Like all calculations of effective tax rates, they may suffer from measurement problems (see Volkerink and de Haan, 1999). Yet the alternative measures of effective

Table 2. Average effective tax rates on labour and capital income

	Total effective tax rate on labour income (%)[a]		Effective tax rate on capital income (%)	
	1981–85	1991–95	1981–85	1991–95
Nordic countries				
Denmark	55.64	59.74	47.82	40.04
Finland	45.23	49.51	35.20	45.20
Norway	53.83	54.06	42.60	30.30
Sweden	57.44	59.80	47.40	53.10
Average	53.03	55.78	43.26	42.16
Continental Europe				
Austria	54.62	55.74	21.48	22.74
Belgium	52.90	54.71	39.50	36.00
France	52.53	56.98	28.40	24.80
Germany	47.07	50.23	31.00	26.50
Italy	43.75	52.76	25.30	34.50
Netherlands	57.25	59.84	29.70	31.90
Spain	37.71	40.92	13.90	20.30
Average	49.41	53.02	27.04	28.11
Anglo-Saxon countries				
Australia	24.90	25.51	44.50	44.40
Canada	33.02	38.89	37.90	49.50
United Kingdom	37.51	35.55	66.50	45.30
United States	32.14	31.12	40.90	41.10
Average	31.89	32.77	47.45	45.08
Japan	27.86	31.74	39.70	43.90
Average for all countries	44.59	47.32	36.99	36.85

Notes: [a] The total effective tax rate on labour income (t) is given by the formula $t = (t^l + t^c)/(1 + t^l)$, where t^l = effective direct tax rate on labour income and t^c = effective tax rate on consumption.

Source: The estimates of effective tax rates on labour income, capital income and consumption are based on the methodology developed by Mendoza, Razin and Tesar (1994); the figures were taken from Daveri and Tabellini (2000) and Volkerink and de Haan (1999).

tax rates presented in Chennells and Griffith (1997) tend to confirm the impression that – averaging across different asset types and different modes of investment finance – the average as well as the *marginal* effective tax rates on capital income in the most important OECD countries have been roughly constant between the mid 1980s and the mid 1990s.

However, this cannot be taken as evidence that tax competition is absent. First of all, the increase in the overall tax burden over time has tended to be concentrated on labour, as indicated by the rising effective tax rates on labour documented in Table 2. This shows that governments do in fact try to shift the tax burden towards the more immobile factor of production. Secondly, the sharp recent drop in statutory tax rates on capital income suggests an increasingly intense tax competition for foreign portfolio investment and for the taxable 'paper profits' of multinational corporations.

4. MODELLING TAX COMPETITION

4.1. The spillovers from capital income taxation

The case for international co-ordination of capital income taxes rests on the fact that such taxes have international spillover effects. When one country changes its source-based capital income tax, it will affect the welfare of other countries via an investment reallocation effect, a saving effect, a tax exporting effect, and an intertemporal terms-of-trade effect. I will now explain these fiscal externalities, dividing the world economy into the domestic economy ('Home') and the rest of the world ('ROW').

4.1.1. The investment reallocation effect. Under source-based capital income taxation, a rise in Home's capital income tax rate will reduce the relative attractiveness of domestic investment, inducing a capital flow from Home to ROW. With a positive capital income tax in ROW, the social (pre-tax) rate of return on the extra investment in the foreign economy will exceed the after-tax rate of return required by private investors. The difference between the social and the private return to the extra capital imports represents a net social gain to ROW which takes the form of an increase in foreign capital income tax revenue, as shown by Wildasin (1989). The inflow of capital to the foreign economy will also tend to drive up the foreign wage rate, thereby stimulating foreign labour supply and employment. If the initial employment level is distorted by a labour income tax, this rise in foreign employment generates a further increase in foreign welfare, reflected in an increase in foreign labour tax revenue. The welfare gain is amplified if initial employment is also distorted for non-tax reasons so that involuntary unemployment prevails in the initial equilibrium. In the absence of co-ordination, the Home government will not take these positive spillovers on the foreign economy into account. Hence the investment reallocation effect implies that capital income tax rates will tend to be inefficiently low under tax competition.

4.1.2. The saving effect. When Home raises its capital income tax rate, the resulting fall in the domestic after-tax rate of return may reduce the volume of domestic saving, thus reducing the outflow of capital to ROW and the concomitant rise in foreign welfare. If the negative effect on domestic saving is sufficiently strong and the international mobility of capital is sufficiently low, it is even conceivable that the net impact on investment in ROW will be negative (see Bettendorf and Heijdra, 1999). The saving effect thus generates a negative international spillover effect of a rise in the domestic capital income tax rate.

4.1.3. The tax exporting effect. Under perfect capital mobility and source-based taxation, investors may escape a domestic tax on the normal return to capital by reallocating investment from the domestic to the foreign economy. However, if part of the return to domestic investment represents pure rents, and if some of these rents accrue

to foreign owners of domestic firms, a rise in Home's capital income tax will have a direct negative impact on the after-tax income of foreign owners. *Ceteris paribus*, this negative international spillover implies that capital income taxes tend to be too high under tax competition where national tax policies do not account for the welfare effects on foreigners (see Mintz, 1994; Huizinga and Nielsen, 1997).

4.1.4. The intertemporal terms-of-trade effect. A rise in Home's source-based capital income tax will reduce the domestic demand for capital. If the domestic economy is large, this will depress the global level of interest rates. By lowering the cost of foreign debt service, the lower world interest rate will benefit foreign countries if ROW is a net debtor to the Home economy. On the other hand, the spillover on ROW will be negative if foreigners have positive net claims on the Home economy (for an elaboration of this intertemporal terms-of-trade effect, see Sinn, 1987, section 7.4; and Depata and Myers, 1994).

Since a higher capital income tax in one country will generate positive as well as negative international spillover effects, it is not clear *a priori* whether source-based capital income taxes will tend to be too high or too low under tax competition. To judge whether there is a need for a co-ordinated rise or a co-ordinated fall in the level of capital income taxation, a quantitative analysis like the one presented in Section 5 is needed.

4.2. Other fiscal spillovers

The capital income tax rate is not the only fiscal instrument with the potential to generate international spillovers. By raising its spending on infrastructure, a government can attract mobile capital because a better infrastructure increases the profitability of domestic investment. Since the resulting reallocation of capital from the foreign to the domestic economy will reduce foreign welfare, the global level of infrastructure spending will tend to be inefficiently high under fiscal competition. One of the purposes of the model set up below is to investigate whether the potential gains from co-ordination of capital income taxation will be nullified by more aggressive infrastructure spending when governments can no longer attract mobile capital by undercutting each other's rates of capital taxation.[5]

4.3. TAXCOM: a model of tax competition and tax co-ordination

To estimate the welfare gains from tax co-ordination, one needs a general equilibrium model of the world economy to allow for the interaction of national tax policies. In this

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[5] Labour taxes may also give rise to spillovers. If the domestic government lowers its labour income tax rate, domestic labour supply may increase, causing a rise in the marginal productivity of domestic investment which will attract capital from abroad. Since national tax policies do not internalize this spillover, it is tempting to conclude that there is a need for an internationally co-ordinated rise in labour tax rates. However, in the TAXCOM model (discussed in Section 4.3) the incentive for governments to keep the labour tax rate too low is held in check by the fact that the capital income tax rate is *also* too low under tax competition. A low capital income tax wedge implies a low efficiency cost of a drop in investment. Given that a higher labour tax discourages domestic investment, the lower efficiency cost of reduced investment under tax competition induces governments to keep labour taxes at an 'appropriate' level even though they neglect the positive international spillover effect of a higher labour tax.

section and in the technical appendix I sketch such a model, called TAXCOM. The model is static, describing a stationary long-run equilibrium. Figure 1 illustrates the structure of the model. In each national economy firms combine internationally mobile capital with immobile labour and a fixed factor to produce a homogeneous internationally traded good. The fixed factor may be thought of as land and natural resources and is supplied in proportion to the exogenous population of the country. This assumption of identical population densities means that small countries have no inherent productivity advantage over large countries, and vice versa. All markets are competitive, and profit maximization implies that labour and capital are paid their marginal products.
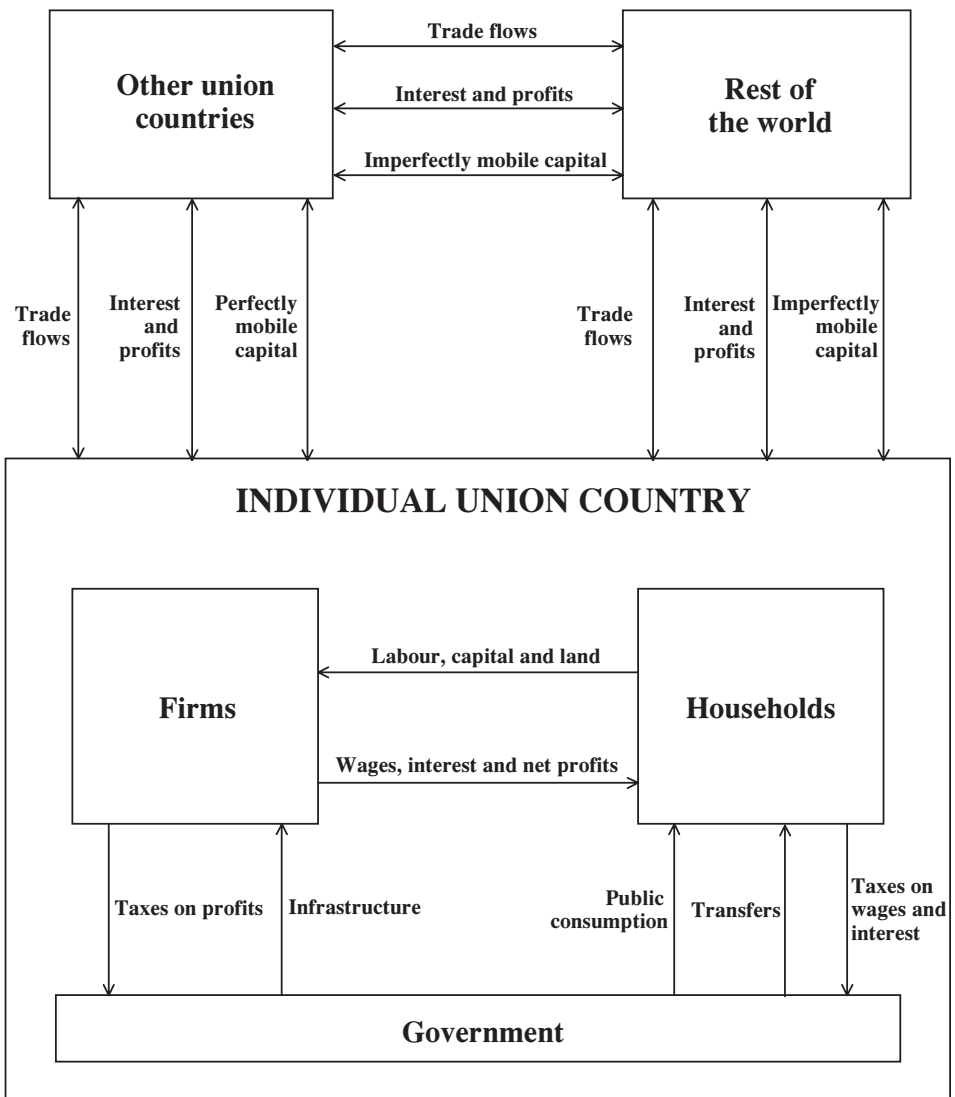

Figure 1. Structure of the TAXCOM model

National income is divided into the wages of labour, the interest on capital, and the pure profits accruing to the owners of the fixed factor.

Consumers have identical preferences, and each individual consumer is endowed with a predetermined stock of human as well as non-human wealth. These initial endowments are *unevenly distributed*, providing governments with a motive for redistributive taxation. A consumer may consume his initial non-human wealth right away, or he may invest it in the capital market at a rising marginal transaction cost. In the latter case he accumulates a capital stock earning an interest which may be consumed along with the principal at the end of the period. The transaction cost may be thought of as the cost of financial intermediation; its role is analogous to the role played by consumer time preference in an explicitly intertemporal model. Weighing the transaction cost against the return to capital, the utility-maximizing consumer chooses to increase his capital supply ('savings') as the after-tax real rate of interest increases. In other words, although *endowments* are exogenous, the supply of productive *capital* is endogenous. Because of rising marginal disutility of work, utility maximization also implies that labour supply rises with the after-tax real wage rate per unit of human capital.

An exogenous fraction of domestic firms is owned by foreign residents, so a similar fraction of domestic profits accrues to foreigners. At the same time domestic residents receive a share of the profits generated in other countries. Within each country, the individual consumer's share of total profits equals his share of initial wealth.

Governments impose a tax on labour income which may be interpreted to include personal income taxes, social security taxes, payroll taxes, and a uniform VAT. In addition, governments levy a proportional tax on interest and profits. Interest and profits are taxed at the same rate because of administrative problems of distinguishing pure profits from the normal return to capital. Tax revenues are used to finance public consumption generating consumer utility; spending on infrastructure serving to raise total factor productivity, and lump sum transfers paid out in an equal amount to all consumers. Since the unequal distribution of initial wealth implies that factor incomes are unequally distributed, the government transfer evens out the distribution of disposable incomes. The combination of the lump sum transfer with the flat tax rate on labour income is equivalent to assuming that labour income is subject to a progressive linear income tax.

The TAXCOM model is designed to highlight the effects of regional tax co-ordination among a subgroup of countries. This region is referred to as the 'union' and may be thought of as the EU. Regional tax co-ordination may be motivated by the fact that the co-ordinating countries are economically more integrated with each other than with the rest of the world. In the context of Economic and Monetary Union in Europe it seems reasonable to assume that the EU countries are particularly deeply integrated. For example, the econometric study by Devereux and Griffith (1998) found that the decisions of US based multinationals to locate production in Europe rather than in the US have not been significantly affected by taxation, whereas differences in effective tax rates across European countries have had a significant impact on the location of

American-owned firms *within* Europe, once the decision to invest in Europe has been made. More recently, Portes and Rey (2000) have found strong evidence that cross-border equity flows decrease with the geographical distance between national markets, and that distance is a proxy for the information and transaction costs of investing abroad. These empirical studies are consistent with the view that the degree of capital mobility is higher within Europe than across the Atlantic. The TAXCOM model therefore assumes that capital is perfectly mobile within the union area whereas capital mobility between the union and the rest of the world is *imperfect*. Technically this is modelled by specifying the stock of capital owned by individual households as a CES-aggregate of assets located in the union and assets located in the rest of the world, with a finite elasticity of substitution between the two asset types. This captures the idea that households face rising marginal transaction costs when they switch assets between the union and the non-union area in their efforts to maximize the net income from their total capital stock. The limiting case where capital becomes perfectly mobile between the union and the rest of the world is obtained when the elasticity of substitution between union and non-union assets approaches infinity.

A general equilibrium in the TAXCOM model is achieved when all firms maximize their profits, all consumers maximize their utilities, and all markets are clearing. In the absence of international exchange of information, the governments of residence countries cannot enforce taxes on foreign-source interest and profit income. The source principle of capital income taxation therefore prevails under pure tax competition. In equilibrium, perfect capital mobility then implies that the *after-tax* interest rate is equalized within the union whereas imperfect capital mobility vis-à-vis the rest of the world implies a different after-tax rate of return on non-union assets.

4.4. Social welfare and political economy

The fiscal policy instruments in the TAXCOM model are endogenously determined by optimizing government behaviour. This may be given a conventional welfare-theoretic interpretation in which the policy maker maximizes a social welfare function of the following form:

Social welfare = average utility − $a \cdot$ (standard deviation of individual utilities)   (1)

The policy maker is seen to be concerned about the *average* level of individual welfare and about the *dispersion* of individual utilities around this mean. In the special case where the parameter $a = 0$, the policy maker is a classical utilitarian striving to maximize the sum of individual utilities, which is equivalent to maximizing average utility when population size is exogenous. In the general case the policy maker is averse to inequality, implying a positive value of the parameter a. The optimal national policy is found by maximizing (1) with respect to the domestic fiscal policy instruments, subject to the government budget constraint plus the constraints implied by optimizing private sector behaviour. In the absence of co-ordination, the outcome is a non-cooperative (Nash) equilibrium in which

each national government has optimized its own fiscal instruments, given the policies chosen by other governments.

Traditional welfare economics is often criticized for failing to specify a democratic political process through which the 'optimal' policy can be implemented. The TAXCOM model is not vulnerable to this criticism. As demonstrated in the appendix, the social welfare function (1) is identical to the indirect utility function of the consumer with an initial wealth endowment of $1 - a\sigma$, where σ is the standard deviation of individual wealth levels around their normalized mean value of unity. Following Osborne and Slivinsky (1996) and Besley and Coate (1997), we may therefore imagine that fiscal policy in the TAXCOM model is made by a 'citizen candidate', that is, an ordinary citizen who is voted into office and simply implements the policy which will maximize his own individual utility. Each consumer's preferred policy depends on his initial wealth endowment, and simulations with the TAXCOM model have shown that the individual voter's utility will always be higher, the closer his wealth level is to the wealth level of the elected citizen candidate determining policy. With simple majority voting, this means that the citizen with the *median* level of wealth will be able to win any election in which candidates campaign on the basis of their own preferred policies. We may therefore interpret the policy maker's objective function (1) as the indirect utility function of the voter endowed with the median level of wealth. This conforms with the democratic norm that any policy maker elected through majority voting has the right to define 'social welfare'.

Apart from capturing the equity-efficiency trade-off in a simple manner, the objective function (1) thus allows a synthesis of traditional welfare-theoretic policy analysis and modern political economy analysis.

To understand the policy simulations below, it is important to note that public consumption goods will never be underprovided in the TAXCOM model. At the margin, the policy maker may always choose to reduce the uniform lump sum transfer by one unit in order to provide one more unit of public consumption goods. In this sense it is as if public consumption is financed by a lump sum tax. Moreover, in the TAXCOM model all consumers have the same marginal utility from private as well as public consumption. The combination of lump sum finance and identical preferences implies that all voters will want the government to provide the first-best level of public consumption goods. By contrast, because there are international spillovers from public infrastructure spending and from the capital income taxes financing (part of) the redistributive transfer, government spending on infrastructure and transfers will be distorted in the absence of international cooperation.

4.5. Calibration and world equilibrium with tax competition

Let us now consider the quantitative properties of the general equilibrium emerging under tax competition. The TAXCOM model relies on simple functional forms, allowing calibration of key elasticities and income shares by appropriate choice of a few

structural parameters. Descriptive realism has been subordinated to the goals of simplicity and transparency. The model should therefore be seen only as 'theory with numbers': it attempts to estimate the rough order of magnitude of the welfare gains from tax co-ordination, assuming reasonable values of those key parameters which according to theory should be crucial for the effects of co-ordination.

The model is calibrated such that the initial model equilibrium with tax competition roughly replicates the level and structure of taxation in Western Europe and the United States. Based on the estimated effective tax rates in Table 2, Western Europe is divided into three subregions: the Nordic countries with high taxes on capital as well as labour; Continental Europe with high labour taxes but relatively low taxes on capital, and the UK with low labour taxes but high taxes on capital. The rest of the world is represented by the US where labour taxes are lower than anywhere else while capital taxes correspond roughly to the level in the Nordic region and in the UK.

Countries within each subregion are assumed to be symmetric. The parameter values for each region are given in the upper part of Table 3 where the symbols in brackets refer to the parameters introduced in the appendix. The resulting tax rates etc. implied by the model are reported in the lower part of Table 3 where the corresponding empirical estimates are indicated in brackets.

To replicate the observed level of capital income taxation within the framework of the TAXCOM model, it is necessary to assume a fairly high pure profit share of GDP, giving governments an incentive to maintain positive capital income taxes despite high capital mobility. Pure profits are interpreted to include all quasi-rents in addition to conventional natural resource rents. While quasi-rents in any given firm or sector are wiped out by competition in the long run, new quasi-rents keep popping up as a result of continuing technological and structural change. Hence quasi-rents are never eliminated at the macro level in a real-world dynamic economy. The fairly high pure profit share in the static TAXCOM model is a pragmatic way of accounting for this.

To explain the higher level of capital taxation in the Nordic countries and in the UK compared to Continental Europe, I assume that the two former subregions have slightly higher profit shares and higher foreign ownership shares, as shown in Table 3. The relatively low foreign ownership share in the US reflects that foreign ownership is less prevalent in the large US economy. For the US the degree of capital mobility vis-à-vis Europe is an important determinant of the level of capital taxation. The elasticity of substitution between European and US assets is chosen so as to generate a realistic value for the US capital income tax rate.

Because factor incomes are unevenly distributed, they count for less than the evenly distributed transfer incomes in the egalitarian social welfare function. The weight given to factor income relative to transfer income (the parameter $1 - a\sigma$ mentioned in Section 4.4) is therefore less than one. If the relative social weight of factor income is, say, 0.8, the policy maker will impose redistributive factor income taxes up to the point where the last euro of revenue raised (the last euro of transfers paid out) causes a total fall of $1/0.8 = 1.25$ euros in disposable factor income. To achieve a more equitable distribution

Table 3. Benchmark calibration of the TAXCOM model

	Nordic countries[a]	Continental Europe[b]	UK	Western Europe	US
Wage share of GDP (α)	0.70	0.70	0.70	0.70	0.70
Capital income share of GDP (β)	0.13	0.15	0.13	0.145	0.12
Pure profit share of GDP ($1 - \alpha - \beta$)	0.17	0.15	0.17	0.155	0.18
Foreign ownership share (δ)	0.32	0.22	0.34	0.26	0.13
Social weight given to factor income relative to transfer income $(1 - a\sigma)$[c]	0.7	0.73	0.80	0.74	0.89
Wage elasticity of labour supply ($1/\varepsilon$)	0.25	0.25	0.33	0.26	0.25
Interest elasticity of capital supply ($1/\varphi$)	0.5	0.5	0.5	0.5	0.5
Elasticity of factor productivity w.r.t. infrastructure spending (μ_1)	0.1	0.1	0.1	0.1	0.1
Elasticity of substitution between union and non-union assets (ζ)	6	6	6	6	6
Degree of home bias[d] ($\psi/(1 - \psi)$)	75/25	75/25	75/25	75/25	75/25
Share of world population[e] (s)	0.04	0.42	0.10	0.56	0.44
Scale parameter affecting total factor productivity (μ_2)	1.22	0.98	1.09	1.02	1.16
Model equilibrium with tax competition[f]					
Tax rate on labour income (%)	54.5 (55.8)	51.9 (53.0)	37.5 (35.6)	49.8 (52.5)	30.6 (31.1)
Tax rate on capital income (%)	41.0 (42.2)	32.0 (28.1)	41.0 (45.3)	33.8 (34.22)	40.2 (41.1)
Ratio of GNP to GDP	100.0 (97.0)	99.9 (99.5)	100.0 (99.5)	99.9 (98.7)	100.1 (100.4)
Transfers in percent of GDP	33.3	26.4	21.3	26.0	16.3
Infrastructure spending in percent of GDP	10.0	10.0	10.0	10.0	10.0
Public consumption in percent of GDP	7.2	9.5	7.2	8.9	7.2

Notes: The Greek letters refer to the parameters introduced in the appendix.
[a] Denmark, Finland, Norway and Sweden.
[b] Defined here as Austria, Belgium, France, Germany, Italy, Netherlands and Spain.
[c] The magnitude $1 - a\sigma$ may also be interpreted as the median level of individual wealth relative to the mean wealth level.
[d] A degree of home bias equal to 75/25 means that union (non-union) residents will invest 75% (25%) of their capital within the union and the remaining 25% (75%) in the rest of the world if the after-tax rate of return is the same in the two regions.
[e] The Nordic region is divided into 4 equally large countries each comprising 1% of world population. Continental Europe is divided into 7 countries each including 6% of world population.
[f] The figures in parentheses are empirical estimates. The average effective tax rates were calculated on the basis of the data for 1991–95 in Table 2.

of income, the policy maker is thus willing to tolerate an 'excess burden' of $1.25 - 1 = 0.25$ euros arising from the fall in economic activity caused by distortionary taxes. Given the assumed labour supply elasticities, the relative social weights imputed to factor income are chosen such that the model roughly reproduces the effective labour income taxes observed in the various regions. This implies that policy makers in the Nordic countries and in Continental Europe are taken to be more egalitarian than policy makers in the Anglo-Saxon countries, in accordance with popular perceptions.

In the TAXCOM model total factor productivity is determined by an exogenous technological scale parameter and by endogenous government spending on infra-structure. The elasticity of total factor productivity with respect to public infrastructure spending was estimated by Aschauer (1989) to be in the range of 0.3, but other writers have found this to be too optimistic, so I chose the more conservative value of 0.1 for this parameter. The technological scale parameter affects the profitability of domestic investment and may therefore be used to calibrate the country's net foreign asset position which influences its gain from a co-ordinated rise in capital income taxes, as explained in Section 4.1. A positive (negative) net foreign asset position implies that the ratio of GNP to GDP is greater (smaller) than one. For each region in the model the technological scale parameter was chosen so as to produce the empirically observed sign of the net foreign asset position. To generate a negative net foreign asset position for the UK without imputing an unrealistically high level of factor productivity to that country, it is necessary to assume a relatively high UK elasticity of labour supply. With a high labour supply elasticity, the relatively low level of labour taxation in the UK ensures an ample labour supply which attracts foreign capital by increasing the marginal productivity of investment in Britain.

The elasticity of capital supply with respect to the after-tax interest rate is set at 0.5 for all regions. Although Summers (1981) argued that the interest elasticity of savings could be much higher than this figure, most empirical studies have found considerably lower savings elasticities. However, the elasticity of capital supply in the TAXCOM model must capture not only the effect of taxation on aggregate saving, but also the distorting effects of capital income taxation on the *allocation* of capital. In practice it is impossible to ensure a uniform treatment of all types of investment, because of the difficulties of measuring true economic depreciation, and because of the well-known problems of taxing capital gains. Hence the returns to different forms of saving and investment are inevitably subject to different effective tax rates generating differences in capital's pre-tax marginal value product across sectors. When the average level of capital income taxation is raised, these intersectoral distortions reducing capital's aggregate productivity are typically exacerbated. Setting a high value of the after-tax interest elasticity of aggregate capital supply is a rough way of accounting for this effect of taxation on the *effective* supply of capital.

By calculating population-weighted averages of parameter values across the three subregions, we obtain the picture of the average Western European country given in the fourth column of Table 3. This 'synthetic' country will serve as a benchmark for an analysis of tax co-ordination within a tax union of symmetric countries.

5. THE GAINS FROM TAX CO-ORDINATION

As we have seen in Section 4.2, fiscal competition generates fiscal externalities and is therefore likely to be inefficient. This part of the paper applies the TAXCOM model to illustrate the potential welfare gains from international co-ordination of capital income taxation. In accordance with recent proposals in the European policy debate, co-ordination takes the form of an international agreement on a minimum source-based capital income tax rate which is binding for all the co-ordinating countries. This minimum tax rate is chosen so as to maximize the population-weighted sum of the social welfare for the co-ordinating countries, accounting for the fact that national governments will set their remaining fiscal instruments to maximize their own welfare.[6]

5.1. Regional versus global tax co-ordination

Table 4 shows the simulated effects of a minimum capital income tax rate. The table assumes that all Western European ('union') countries are symmetric, with parameter values equal to those stated in the fourth column of Table 3. This unrealistic symmetry assumption is made deliberately to isolate the effect of capital mobility on tax policies in a world without policy co-ordination. By considering the tax competition effects of capital mobility within a group of identical countries, we may gain a better understanding of the implications of the various cross-country asymmetries to be considered in the next section.

The third and the fourth columns of Table 4 assume that tax co-ordination only involves the Western European countries and that the rest of the world (the US) does not change its fiscal policy in response to the policy change in Europe. The union authority sets a common minimum capital tax rate with the purpose of maximizing the population-weighted sum of national welfare levels within the union, taking the fiscal policies of the US as given. Under tax competition the individual union country may use its capital income tax to export part of the domestic tax burden to other union countries. Under regional co-ordination, the union authority internalizes this tax exporting effect. *Ceteris paribus*, this works in favour of lower capital income tax rates under co-ordination. However, regional co-ordination also eliminates the downward pressure on capital income tax rates exerted by intra-European capital mobility, as the union authority exploits the collective market power of European countries in the international capital market, accounting for the fact that the elasticity of capital supply to the union as a whole is much lower than the elasticity of capital supply to the individual union country. This effect of co-ordination outweighs the effect of the internalization of tax exporting and leads to a substantial increase in the level of capital income taxation in Europe, as shown in the third column of Table 4. With a higher capital income tax rate, it becomes

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[6] In game-theoretic terms, the co-ordinating world tax authority plays the role of a Stackelberg leader, with national governments acting as followers in the fiscal policy game.

Table 4. Effects of a minimum capital income tax rate

	Tax competition		Regional co-ordination (no policy response from the US)		Regional co-ordination (optimal policy response from the US)		Global co-ordination	
	Western Europe	US	Western Europe	US	Western Europe	US	Western Europe	US
Policy variables								
Tax rate on capital income and profits (%)	33.8	40.1	46.2	40.1	46.5	42.4	52.2	52.2
Labour income tax (%)	49.8	30.6	48.3	30.6	48.2	30.6	47.5	29.5
Transfers	100	100	107	102	107	104	111	115
Infrastructure spending	100	100	102	100	102	104	104	105
Other variables								
Capital stock per capita	100	100	88	107	89	105	87	96
Employment	100	100	100.3	100.2	100.4	100.2	100.7	100.3
GDP per capita	100	100	99	101	99	101	98.9	100.2
Ratio of GNP to GDP	99.9	100.1	100.5	99.5	100.4	99.6	100.0	100.0
Welfare gain from co-ordination (% of GDP)	–	–	0.16	0.16	0.19	0.16	0.32	0.10

Source: Simulations with the TAXCOM model, based on the benchmark calibration in columns 4 and 5 in Table 3.

optimal for individual union countries to lower their labour income tax rates, because a stimulus to domestic investment brought about by higher labour supply will now generate more revenue from capital taxation. The neutralization of capital income tax competition within the union also induces member states to raise their expenditure on infrastructure in an effort to attract mobile capital. Despite the slightly lower labour income tax rate and the rise in infrastructure spending, the higher capital tax rate suffices to finance an increase in redistributive transfers in the union. The higher taxes on investment in Western Europe induce a reallocation of capital towards the rest of the world which increases economic activity, tax revenue and public transfers outside the union. As a result of these positive fiscal externalities, social welfare increases just as much in the US as in Europe. The welfare gains are fairly modest, amounting to less than 0.2% of GDP. Note that the welfare gain for Europe arises despite a slight drop in European GDP. Hence the gain for Europe is generated by an improved distribution of income, as will be elaborated in Section 5.4.

The fifth and sixth columns in Table 4 show the effects of regional tax co-ordination within Europe when the US reacts optimally to European co-ordination rather than remaining passive. To understand the US policy response, note that under source-based taxation a lower interest rate raises domestic welfare by raising domestic activity. A large country like the US can drive down the interest rate by lowering the demand for capital through a rise in its capital income tax rate. In the TAXCOM model, the rise in domestic welfare generated by a fall in the interest rate is larger, the lower the initial interest rate.[7] Thus, when the union countries generate a capital inflow to the US lowering the US interest rate, they increase the incentive for the US to raise its capital tax in order to benefit from a further fall in the interest rate. The resulting rise in the US capital income tax in turn generates a positive fiscal externality effect on union countries and induces the union to undertake a further slight increase in its capital tax. Through this *strategic complementarity* of capital income tax rates, the level of capital income taxes is raised a bit further towards the level which would be second-best optimal for the world as a whole. According to the theoretical analysis of Konrad and Schjelderup (1999), regional co-ordination of capital income taxation is sure to improve the welfare of all countries in the world if capital income taxes are strategic complements in the sense explained above. The simulations presented here indicate that such strategic complementarity will indeed prevail.

The scenario with regional co-ordination is of particular interest since co-ordination is more likely to occur within a subgroup of countries like the EU member states with close economic and political links. For comparison, the last two columns of Table 4 show the simulated effects of *global* co-ordination taking the form of a common binding minimum capital tax rate for the US and Europe set so as to maximize the population-weighted

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[7] The TAXCOM specifications of tastes and technology imply that each country's demand for capital is isoelastic. Hence, if K is the capital stock and r is the real interest rate, the capital demand curve is convex to the origin in (K, r)-space. When the interest rate falls, the welfare-improving rise in domestic investment will therefore be larger the lower the initial level of the interest rate.

average global welfare level. The qualitative effects are similar to those of regional co-ordination, but the co-ordinated capital income tax rate is now higher, since global co-ordination eliminates capital income tax competition across the Atlantic. The rise in the US capital income tax rate mitigates the reallocation of capital from Europe to the US and almost doubles the European welfare gain, compared to the scenario with regional co-ordination. By contrast, for the US the welfare gain is *smaller* than the gain occurring when co-ordination only involves Europe, suggesting that the US would not want to commit to global co-ordination. The fact that the US gains so little from global co-ordination is crucially dependent on the assumption that the low observed level of labour taxation in the US reflects a weak social preference for redistribution in America. Because of the stronger preference for redistribution in Europe, the globally co-ordinated capital income tax rate ends up at an suboptimally high level from the American viewpoint. If the US had the same preference for redistribution as Europe, simulations with the TAXCOM model imply that global tax co-ordination would generate a substantial welfare gain for the US. This finding motivates a further analysis of the implications of cross-country asymmetries for the distribution of the gains from tax co-ordination.

5.2. Regional co-ordination among asymmetric countries

To isolate the effects of regionalization, the previous section assumed that countries within the co-ordinating region had identical tastes, technologies and population sizes. However, even within a fairly homogeneous group of nations like the present EU member states, countries differ in several important respects. In Table 5 I start out from the assumption in Table 4 that all union countries are symmetric. In successive steps, I then consider the effects of each of the asymmetries which were introduced in Table 3 to explain the observed differences in tax rates across the three subregions of Western Europe, adding each additional asymmetry onto the others. Table 5 indicates how each type of asymmetry affects the size and distribution of the welfare gain from introducing a minimum capital income tax rate in Europe. When all of the asymmetries are added together in the bottom row of Table 5, I arrive at the asymmetric equilibrium with tax competition summarized in Table 3. The bottom row of Table 5 then shows the effects of regional tax co-ordination on tax rates and welfare when all asymmetries are taken into account. Given the stylized nature of the TAXCOM model and the fact that the calibration of the asymmetries is not based on careful empirical estimates of parameter values for each country, the figures in Table 5 should not be interpreted literally as an estimate of the effects of tax co-ordination for any specific country. Table 5 should rather be seen as an estimate of the likely effects of the particular types of asymmetries considered.

   In theory small countries should be less motivated to undertake a co-ordinated rise in capital income taxes than large countries, because small countries face a higher elasticity of capital supply from the world capital market. The estimates presented in the second

Table 5. Asymmetries and the distribution of the gains from regional tax co-ordination

	Tax competition						Regional co-ordination								
	Nordic countries		Continental Europe		UK		Nordic countries			Continental Europe			UK		
	t	τ	t	τ	t	τ	t	τ	W	t	τ	W	t	τ	W
All union countries symmetric[a]	49.8	33.8	49.8	33.8	49.8	33.8	48.2	46.5	0.19	48.2	46.5	0.19	48.2	46.5	0.19
1: Differences in population	49.8	33.1	49.8	34.1	49.8	34.8	48.1	46.5	0.18	48.3	46.5	0.18	48.4	46.5	0.19
2: 1+differences in preference for redistribution	53.4	34.5	50.8	34.3	43.3	32.7	52.0	46.5	0.28	49.3	46.5	0.21	41.5	46.5	0.03
3: 2+differences in pure profit share	53.4	39.1	50.8	33.2	43.3	36.0	52.6	46.4	0.30	49.1	46.4	0.19	42.0	46.4	0.09
4: 3+differences in total factor productivity	53.4	39.2	50.8	33.0	43.3	36.5	52.6	46.6	0.54	49.1	46.6	0.13	42.1	46.6	0.20
5: 4+differences in labour supply elasticity	54.5	39.2	51.9	33.0	37.5	37.1	53.7	46.6	0.52	50.3	46.6	0.10	36.2	46.6	0.30
6: 5+differences in foreign ownership share=asymmetric equilibrium in Table 3	54.5	41.0	51.9	32.0	37.5	41.0	53.9	46.8	0.53	50.1	46.8	0.07	36.7	46.8	0.35

Notes: t=tax rate on labour income. τ=tax rate on capital income and profits. W=welfare gain from co-ordination in percent of GDP. The differences in parameter values across regions are equal to those stated in Table 3.
[a] All union countries have identical parameter values equal to the population-weighted averages of the parameters for the union countries stated in the fourth column in Table 3. Parameter values for the US are identical to those reported in Table 3.

Source: Simulations with the TAXCOM model.

row of Table 5 suggest that, in practice, cross-country differences in population size of the magnitude found in Europe would not significantly affect the distribution of the welfare gains from regional tax co-ordination.

In contrast, the third row of Table 5 shows that asymmetries in the social preference for redistribution shift the welfare gains from co-ordination away from less egalitarian countries like the UK towards the more egalitarian regions in Northern and Continental Europe (assuming that observed differences in labour tax rates mainly reflect differences in the preference for redistribution). This is in line with the popular view that the Nordic and continental high-tax countries have a stronger interest in protection from the forces of tax competition.

Introducing differences in pure profit shares will shift the gains from co-ordination in favour of those countries where a larger part of the return to capital takes the form of pure profits and where the distortionary effect of the rise in capital income tax rates will therefore be smaller. In the TAXCOM model these countries are represented by the Nordic region and by the UK, but the inter-regional distribution effects of this asymmetry are seen to be minor.

When exogenous differences in total factor productivity are introduced, the stocks of foreign debt are shifted towards the high-productivity countries which are now offering improved investment opportunities. To explain the observed pattern of foreign debt, the TAXCOM model assumes a higher level of factor productivity in the Nordic region and in the UK than in Continental Europe. *Ceteris paribus*, the more indebted countries will reap a larger gain from co-ordination because they will benefit more from the fall in net interest rates induced by higher capital income taxes.

In Section 4.5 I explained that, to generate foreign debt in the UK without postulating an implausibly high productivity level in that country, it is necessary to assume a relatively high UK labour supply elasticity. Since this asymmetry shifts net foreign assets away from the UK, it also shifts the gains from co-ordination in favour of Britain. Finally, because it is assumed to have a relatively large foreign ownership share, the UK also benefits from this type of asymmetry, since the co-ordinated rise in the capital income tax will fall to a smaller extent on domestic residents when a larger share of profits accrue to foreigners.

In summary, Table 5 suggests that cross-country asymmetries in economic structures may imply a rather uneven distribution of the gains from tax co-ordination. Conceivably, some countries may even lose and may hence try to block efforts at co-ordination.

5.3. Sensitivity analysis

Studying the effect of asymmetries in parameter values across countries is one form of sensitivity analysis. To gain further understanding of the role played by the various parameters, this section investigates the effects of varying specific parameters across *all* countries.

Table 6 illustrates the sensitivity of the effects of a regional minimum capital tax rate to changes in the key parameters, returning to the assumption that all union countries

are symmetric. As a benchmark, the first row restates the union's equilibrium under tax competition and under regional co-ordination, given the original parameter values for the 'average' European country reported in the fourth column of Table 3.

In the benchmark scenario the after-tax interest elasticity of effective capital supply is assumed to be 0.5. The second row in Table 6 shows the effects of switching from tax competition to regional co-ordination on the assumption made in much of the tax competition literature that this elasticity is zero so that capital is inelastically supplied to the world economy as a whole. With this assumption the elasticity of capital supply to the union area is also reduced, making it optimal for the union to co-ordinate on a higher level of capital taxation. When capital is inelastically supplied to the world as a whole, the distorting effects of higher capital taxes are smaller, and the welfare gain from a co-ordinated rise in capital income taxes is considerably higher than before. Yet the scope for regional co-ordination remains constrained by the possibility of capital flight to the rest of the world. Thus, under global co-ordination the optimal capital income tax rate would be 100%, because a harmonized tax on the fixed world supply of capital would be non-distortionary, but under regional co-ordination the union's optimal capital income tax rate is only 56%.

The third row of Table 6 shows the effect of lowering the labour supply elasticity from about 0.25 in the benchmark scenario to a value of 0.15 which has been used in many other simulation studies. While a more inelastic labour supply induces governments to set a higher tax rate on labour income, it has no noticeable effect on the gain from co-ordination of capital income taxes. In the fourth row of Table 6 I investigate the role of the elasticity of factor productivity with respect to infrastructure spending. A doubling of this elasticity from 0.1 to 0.2 (which is more in line with the estimates of Aschauer, 1989) induces governments to spend more on infrastructure at the expense of transfers, but hardly affects the choice of tax rates and the welfare gain from co-ordination.

In the benchmark equilibrium governments use the capital income tax as an indirect means of taxing pure rents. If no such rents exist, this motive for capital income taxation vanishes. Under tax competition the only remaining motive for taxing capital is a desire to reduce the international level of interest rates by lowering the world demand for capital, since a lower interest rate causes a welfare-improving rise in domestic activity which outweighs the direct income loss to domestic owners of capital. However, since the individual union country is small, its ability to influence the union interest rate is very limited. Hence its optimal capital income tax rate is close to zero in a tax competition equilibrium with no pure profits, as shown in the fifth row of Table 6. As a group the union countries have a larger impact on the interest rate, inducing them to raise the capital income tax rate under regional co-ordination. The tax increase is almost the same as in the benchmark scenario, but the welfare gain is smaller, since there is no longer any fixed factor to absorb part of the tax increase.

In the benchmark scenario the incentive for countries to lower their source-based capital taxes below the international optimum is counteracted by the incentive to impose

tax on the foreign owners who are entitled to about one fourth of the profits of domestic firms. As shown in the sixth row of Table 6, if there is no foreign ownership of domestic firms, the level of capital income taxation will be much lower under tax competition. Since the absence of foreign ownership intensifies the fiscal competition induced by

Table 6. Effects of a regional minimum capital tax rate: sensitivity analysis

	Tax competition		Regional co-ordination between symmetric union countries		
	Labour income tax (%)	Capital income tax (%)	Labour income tax (%)	Capital income tax (%)	Welfare gain from co-ordination (% of GDP)
Benchmark scenario	49.8	33.8	48.2	46.5	0.19
Sensitivity to factor supply elasticities					
Zero interest elasticity of capital supply	49.8	34.4	47.1	56.2	0.85
Low wage elasticity of labour supply[a]	63.4	33.8	62.2	46.5	0.20
Higher productivity effect of infrastructure[b]	49.8	33.8	48.3	46.2	0.17
Sensitivity to profits and foreign ownership					
Zero pure profits share[c]	49.8	0.9	46.6	15.9	0.12
Zero foreign ownership share	49.8	23.0	47.9	41.0	0.35
Sensitivity to capital mobility					
Low capital mobility between union and rest of the world[d]	49.8	34.4	46.6	60.4	0.48
Perfect capital mobility between union and rest of the world[e]	49.8	33.5	49.0	39.9	0.08
Sensitivity to other factors					
Stronger preference for redistribution[f]	60.5	38.9	58.6	56.7	0.62
Lower weight of the union in the world economy[g]	49.8	33.8	48.3	45.6	0.17

Notes: The figures in the table refer to the symmetric countries forming a tax union. The rest of the world is assumed to undertake an optimal policy response to co-ordination within the union.
[a] The wage elasticity of labour supply is 0.15.
[b] Elasticity of factor productivity with respect to infrastructure (μ_1) = 0.2.
[c] Wage share of GDP = 0.7; capital income share = 0.3.
[d] Elasticity of substitution between union and non-union assets = 1.
[e] Elasticity of substitution between union and non-union assets $\rightarrow \infty$.
[f] Social weight given to factor income = 60%.
[g] Union population = 40% of world population.

Source: Simulations with the TAXCOM model.

capital mobility, the welfare gain from regional tax co-ordination is significantly larger, compared to the benchmark simulation.

The elasticity of substitution between union and non-union assets determines the degree of capital mobility between the two regions. In the seventh row of Table 6 this substitution elasticity is lowered from 6 to 1.[8] With such a low degree of capital mobility vis-à-vis the rest of the world, a co-ordinated rise in capital income taxes within the union generates much less capital flight to the non-union area. Compared to the benchmark scenario, regional co-ordination therefore causes a much larger increase in capital taxation and welfare in the union. In contrast, when the substitution elasticity approaches infinity, implying perfect capital mobility between Europe and the US, the welfare gain from regional tax co-ordination is significantly reduced by a larger outflow of capital from Europe, as shown in the eighth row of Table 6.

According to the ninth row the social preference for redistribution is also an important parameter. When the social weight given to unevenly distributed factor income relative to evenly distributed transfer income is 60% rather than the 74% assumed in the benchmark case, the equity gain from a co-ordinated rise in capital income taxation is valued more highly, raising the welfare gain from co-ordination by a factor of more than three.

In the TAXCOM model the world economy includes only Europe and the US. In accordance with relative population size, Europe is assumed to comprise 56% of 'world' population. If the non-union area were assumed to include all the OECD countries outside Western Europe, the latter region would only represent about 40% of 'world' population. The bottom row of Table 6 shows that such a change in the relative size of the tax union would have little effect on the welfare gain from regional tax co-ordination.

Table 6 leaves the impression that, even under conditions which would seem to imply a strong case for tax co-ordination, the welfare gains from regional co-ordination within a subgroup of countries like the EU are likely to be less than 1% of GDP. Indeed, a gain of 0.5% of GDP may seem an optimistic estimate.[9] As we shall see below, tax co-ordination may nevertheless have significant welfare effects for some groups in society.

5.4. Distributional effects of tax co-ordination

Even if the median voter's gain from tax co-ordination may be small, making tax co-ordination politically difficult to implement unless the political process functions very smoothly, the gains for the poorer sections of society may be quite large. This is the message of Table 7 which divides the population of the representative union country in the TAXCOM model into five quintiles on the basis of their share of total initial wealth. The wealth shares have been proxied by the empirical income shares of the five quintiles

[8] For comparison, the benchmark scenario in the simulation study by Thalman *et al.* (1996) assumed a substitution elasticity between US and European assets equal to 4.

[9] A more systematic sensitivity analysis is presented in a set of tables available at the internet address http://www.econ.ku.dk/pbs/default.htm (see under 'Recent working papers').

Table 7. Effects of regional tax co-ordination on the distribution of welfare in a union country

Quintile	Share of total wealth (%)[a]	Welfare gain from introducing a regional minimum capital tax rate[b]
1	2	2.22
2	7	1.15
3	14	0.37
4	24	−0.20
5	53	−0.85

Notes: Fiscal policies are decided by a policy maker representing the 3rd quintile (the median voter), implying that the social weight given to factor income relative to transfer income is equal to $14/20 = 0.7$ within the tax union. The other parameter values are equal to those stated in columns 4 and 5 in Table 3.
[a] Estimated on the basis of the distribution of factor incomes in Denmark (data provided by Statistics Denmark).
[b] Welfare gain for residents in the representative union country. The welfare gain is measured in percent of the quintile's disposable income under tax competition.

Source: Simulations with the TAXCOM model.

of the Danish population, as recorded by Statistics Denmark, since 'wealth' in the TAXCOM model includes human as well as non-human wealth. Fiscal policy is assumed to be made by an individual from the third quintile which includes the median voter. As explained in Section 4.3, this individual acts as a domestically elected 'citizen candidate', implementing the policy which he prefers, given his place in the wealth distribution.

The welfare gains of each quintile are measured relative to the quintile's disposable income under tax competition. In the benchmark calibration of the TAXCOM model, regional tax co-ordination raising the level of redistributive capital taxes would raise the welfare of the poorest 20% of the population by more than 2.2% of disposable income, at the cost of a fairly modest loss to the richest 40% of the population.

Of course this is nothing but a stylized numerical example. But given that the wealth distribution of many countries (and particularly the distribution of capital income) is much more unequal than the one shown in Table 7, the example does suggest that tax competition could have a non-trivial effect on income distribution and that the poor could have a strong interest in tax co-ordination. The simulations also help to explain why countries have internal political disagreements over tax co-ordination.

5.5. Limitations and caveats

I have already stressed that the simulations presented above should be seen only as 'theory with numbers', giving at best a rough idea of the order of magnitude of the gains from international tax co-ordination. Let me end this paper by discussing some limitations of my analysis.

5.5.1. Endogenous growth. The TAXCOM model describes a long-run equilibrium, so the simulated effects of tax co-ordination on economic activity and welfare should be

interpreted as changes in the equilibrium *levels* of these variables in the context of exogenous steady-state growth. If long-run growth is endogenous, a co-ordinated rise in capital income tax rates may permanently depress the growth rate, potentially with large negative implications for welfare. However, the fact that taxes have manifestly trended upwards whereas growth rates do not trend anywhere suggests that taxes do not matter much for long-run growth, as argued by Jones (1995). Analysing alternative models of endogenous growth, Stokey and Rebelo (1995) also find that taxes have little effect on long-run growth rates for realistic parameter values, confirming the claim by Lucas (1990) and Mendoza *et al.* (1997) that capital taxation does not matter significantly for long-run growth. Surveying the literature on taxation and economic growth, Engen and Skinner (1999) and Myles (2000) likewise point out that empirical studies have not been able to identify strong permanent growth effects of capital income taxation. These studies suggest that the implicit assumption of exogenous growth is not a serious limitation of the present paper.

5.5.2. Imperfect competition. In line with the bulk of the tax competition literature, the TAXCOM model assumes perfect competition in all markets. In a model with imperfect competition, Janeba (1998) has shown that tax competition may play an efficiency-enhancing role when borders are opened to capital mobility. In the absence of capital mobility imperfect competition will induce national governments to subsidize their own firms to enable them to compete more aggressively in the world market, thereby increasing domestic profits at the expense of the profits of foreign firms. When free capital mobility is allowed, Janeba finds that competition among governments will drive the negative tax rates upwards to zero. No country will offer a tax rate below zero, since this would attract foreign firms and imply a transfer of domestic revenue to foreigners. Thus tax competition combined with capital mobility will tend to eliminate globally inefficient subsidies under imperfect competition. This suggests that the usual assumption of perfect competition may bias the analysis in favour of tax co-ordination. Yet, in a European context where the EU Commission imposes limitations on state aids to industry (see Besley and Seabright, 1999), the beneficial effect of tax competition pointed out by Janeba is likely to be minor.

5.5.3. Time inconsistency. This paper implicitly assumes that governments can credibly commit not to raise taxes on capital, once it has been accumulated. As emphasized by Kehoe (1989), such credibility may be difficult to achieve, since a rise in the tax rate on pre-exisiting capital will work like a non-distortionary tax on a fixed factor, giving governments a strong *ex post* incentive to exploit this source of revenue. Fearing that governments will succumb to this temptation, the private sector may end up saving too little. By offering an escape route from domestic taxation, capital mobility and international tax competition may then provide a healthy incentive for private saving in a setting where capital accumulation is hampered by government credibility problems. However, rather than resorting to tax competition, it may be possible to solve this time

consistency problem by electing a 'conservative' (wealthy) policy maker to neutralize the government's incentive to overtax capital, as suggested by Persson and Tabellini (1999, pp. 49–51).

5.5.4. Political distortions. As I explained in Section 4.4, the TAXCOM model assumes a well-functioning fiscal policy process respecting individual preferences. In practice, political distortions and rent-seeking may imply a tendency for governments to spend too much. Proponents of tax co-ordination argue that such problems should be addressed through institutional reforms aimed directly at correcting the relevant distortions in political decision-making. In this view tax competition is an odd second-best means of reducing the scope for rent-seeking, since fiscal competition generates its own (economic) distortions. On the other hand, if the required institutional reforms are politically infeasible, the case for co-ordinated rises in the level of capital income taxation is clearly weakened.

5.5.5. Defining and harmonizing the tax base. Inspired by the current tax policy debate in the EU, a large part of this paper has studied the effects of introducing a binding minimum capital income tax rate levied at source. I have assumed the possibility of establishing a floor for the *effective* tax rate on capital income. As pointed out by the Ruding Committee (1992) and recently emphasized by Fuest and Huber (2000), this would require constraints on the ability of governments to define their capital income tax bases as well as constraints on their choice of statutory capital income tax rates. If only statutory rates are constrained, competing governments could still reduce effective tax rates on capital by offering generous depreciation allowances, by exempting certain types of income or activities from tax, or by introducing direct subsidies to capital. Investment subsidies could also take the form of targeted infrastructure spending. Hence it may be necessary to supplement a regime of tax co-ordination by tighter EU controls on state aids to industry. Another assumption of this paper is that income at source is a well-defined concept. In practice the source of income is becoming ever more difficult to determine as the scope for income-shifting across countries increases due to growing intra-firm trade within multinational conglomerates, financial innovations, and the growing importance of electronic commerce and hard-to-value intangible assets. These developments create an increasing need for governments to co-ordinate their transfer-pricing rules and other rules delineating national tax bases, and perhaps a need to resort to so-called 'formula apportionment' in order to allocate the profits tax base of multinationals across national tax jurisdictions, as discussed by Mintz (1998).

5.5.6. Residence taxes versus source taxes. Like most of the literature, I have assumed that residence countries cannot enforce taxes on foreign-source capital income in the absence of international co-operation. This view may be too pessimistic, since most of foreign portfolio investment is channelled through financial intermediaries which may be easier to monitor than private households. On the other hand, foreign direct

investment is subject to the corporate income tax which is mainly based on the source principle, as explained in more detail in Sørensen (1993). Hence, it might be relevant to study tax co-ordination within a framework where portfolio investment is subject to residence-based taxation whereas foreign direct investment is taxed according to the source principle. Ideally such an analysis should account for the fact that portfolio investment is typically more mobile than direct investment. Developing such a framework would be a complicated but interesting challenge for future research.

6. SUMMARY AND CONCLUSIONS

In an integrated world economy the attempts of governments to attract mobile capital may drive capital income tax rates to inefficiently low levels, because capital mobility raises the elasticity of capital supply to the individual country far above the elasticity of capital supply to the world as a whole. On the other hand foreign ownership of domestic firms may tempt national governments to raise corporate tax rates in order to export part of the domestic tax burden to foreigners. This paper has tried to explain and to quantify the fiscal externalities from tax competition and the gains from international co-ordination of capital income taxation.

The potential for tax competition arises because the governments of residence countries have difficulties enforcing taxes on the foreign-source investment income of their citizens. In practice domestic capital income taxes thus tend to fall only on domestic-source income. In an era when capital markets are liberalized, the theory of tax competition suggests that we should observe a fall in the statutory tax rates on interest income, as governments try to avoid an export of highly mobile portfolio investment to foreign tax havens. Theory also suggests that governments would react to growing volumes of foreign direct investment by lowering their statutory corporate income tax rates, to make themselves less vulnerable to the transfer-pricing practices of multi-nationals. In Section 3 we saw that statutory corporate and personal capital income tax rates have indeed fallen substantially in the OECD area from the mid 1980s to the end of the 1990s, a period in which capital mobility increased. At the same time the *effective* capital income tax rates appear to have been roughly constant, due to a broadening of the tax base, but rising effective tax rates on labour income indicate that governments have in fact tried to shift the tax burden towards the more immobile factor of production.

Against this background I presented an applied general equilibrium model (TAXCOM) describing the allocation and distribution effects of tax competition and tax co-ordination within a unified framework. Synthesizing several recent contributions to the tax competition literature, the TAXCOM model incorporates internationally mobile capital combined with immobile labour and a local fixed factor to produce an internationally traded good; endogenous labour supply and an endogenous global supply of capital; international cross-ownership of firms and the existence of pure profits accruing partly to foreigners; productive government spending on infrastructure as well as spending on public consumption goods; an unequal distribution of human and

non-human wealth providing a motive for redistributive taxation; and a social welfare function which may be given a political economy interpretation as the indirect utility function of the median voter. The model is intended to serve as 'theory with numbers', offering a rough estimate of the likely magnitude and distribution of the gains from tax co-ordination.

The TAXCOM model is designed to highlight the differences between regional tax co-ordination within Western Europe and global co-ordination involving all countries in the world. Allowing for deeper economic integration within the EU, the model assumes perfect capital mobility within Western Europe, whereas capital mobility between Europe and the rest of the world is taken to be imperfect. The model is calibrated so as to reproduce the observed level and pattern of taxation in Western Europe and the US as an equilibrium with tax competition.

The analysis focused on the effects of an international agreement on a binding minimum tax on capital income, levied at source and chosen so as to maximize the population-weighted average of national welfare levels. When the agreement only involves the European countries, the welfare gain from co-ordination is estimated to be roughly 0.2% of GDP for the average European country in the benchmark scenario. Since co-ordination raises the level of capital taxation, there is a slight fall in European economic activity, but social welfare nevertheless increases due to an improvement in the distribution of income. The welfare gain is limited by the fact that countries use infrastructure spending and labour taxes more aggressively to attract mobile capital when capital income tax competition is neutralized through co-ordination. The gain for Europe is further limited by the fact that higher European capital taxes drive capital out of Europe, thus benefitting the rest of the world.

If co-ordination involves the US as well as Europe, the TAXCOM model suggests that the welfare gain for Europe increases to more than 0.3% of GDP, since the rise in the US capital tax will limit the outflow of capital from Europe. However, the analysis also suggests that the US would not be motivated to engage in tax co-ordination, since the harmonized level of capital income taxation would be too high from the American perspective, given that the US appears to have a lower social preference for redistribution than Europe.

A sensitivity analysis reveals that the welfare gain from regional tax co-ordination within the EU could be larger than the 0.2% of GDP reported in the benchmark scenario, especially if the interest elasticity of capital supply is very low, as is often assumed. However, even under assumptions most favourable to tax co-ordination, the gains from regional co-ordination are likely to remain below 1% of GDP, according to the TAXCOM model. The model also suggests that the gains from tax co-ordination would be unevenly distributed across European countries, due to asymmetries in economic structures and preferences. For example, the analysis indicated that the Nordic countries would gain disproportionately from tax co-ordination, assuming that the high level of taxation in the Nordic region reflects a relatively strong social preference for redistribution.

Finally, the TAXCOM model indicates that even if the median voter's gain from regional tax co-ordination may be modest, making tax co-ordination politically difficult to implement, the poorer sections of society deriving a large part of their incomes from public transfers are likely to gain significantly. The flipside of this coin is that unfettered tax competition may have a strong negative impact on income distribution.

Discussion

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The contribution of Peter Birch Sørensen is most welcome and represents the first attempt, to my knowledge, of a systematic quantitative study of the impact of a potential harmonization of capital income taxes. In general, I like very much the approach taken in the paper and I admire the author for his courage in undertaking such an ambitious project. At this stage, however, I am less impressed by the results, both for their plausibility and their robustness. In my discussion, I will review some of the basic features of the model and evaluate the main results.

The game-theoretic approach to capital income taxation has mainly been developed in the 1980s. For example, the issue was discussed in *Economic Policy* by Giovannini (1989). Sørensen adopts a modelling structure typical of many papers in the literature, where governments optimally set fiscal variables and compete among themselves. The interaction of many, potentially asymmetric, governments make the issue complex. At the same time, the structure of each economy is highly simplified. This has the advantage of making the analysis more transparent, at the risk of missing some important feature. A distinctive feature of the model is the inclusion of redistributive issues, which are addressed by considering a welfare objective that depends both on average utility and on its dispersion. While the issue of redistribution is a crucial, but complex, aspect in the debate on tax competition, the specific form used in the paper only allows for one dimension of redistribution: the sole impact of individual inequalities is to tilt preferences towards the public sector. This feature has a significant effect on the final results.

Governments control five fiscal instruments to optimize welfare. Given the complexity of the model, it may be worth clarifying the role of each of these instruments in the game. The first, and central, instrument is the capital income tax. Three features characterize this tax. First, it is applied according to the source principle. Secondly, the same rate is applied to all revenue from capital, including pure profits. One might wonder whether these features should really be kept constant in the game and whether the tax base could not be part of harmonization, for example through the exchange of information (see Bacchetta and Espinosa, 2000 for a discussion). The third feature, which is the result of a set of assumptions in the model, is that the capital income tax is too low in a competitive equilibrium. This is a crucial aspect in the analysis, but it does not necessarily hold

empirically. In general, the effect of domestic taxes on foreign welfare goes in opposite directions, such as the capital flight and the tax exportation effects, so that the total effect is ambiguous. There is a consensus that the capital flight effect dominates for portfolio income taxes, but the same is not true for corporate income taxes (e.g., double taxation of international capital flows may reflect too high taxes). Thus, the author needs to be more convincing regarding this mechanism.

The second instrument is public infrastructure. This is an interesting aspect since governments may compete in infrastructure instead of taxes. The outcome of the model is that this type of expenditure is too high in a competitive equilibrium. Here again, theory gives ambiguous predictions and providing some evidence would make the analysis more convincing. The third instrument is a lump-sum transfer, which is determined as a residual variable. Given that capital income taxes are too low and infrastructure expenditure too high, this transfer is too low in the competitive equilibrium. Given the linearity of the model, this instrument plays an important role for redistribution. Thus, tax co-ordination allows the increase of transfers and the reduction of inequalities. The tax on labour income is the fourth instrument available to the government. However, there is no competition in this variable because of the presence of the lump-sum transfer and infrastructure and the linearity of the model. The same is true for the last instrument, public consumption.

With this structure in mind, we can turn to the numerical analysis. The first issue is calibration. It seems that the author uses the current situation of tax levels in the European Union to calibrate the model in the competitive equilibrium. One might wonder, however, whether we are already at this level. It seems that current discussions of tax harmonization are particularly important as a preemptive reaction to future competition. As for the results, not surprisingly tax co-ordination leads to higher taxes. The increase in taxes is somewhat mitigated by an increase in infrastructure spending, where the competition is more intense. Overall, however, tax harmonization allows for a large increase in transfers of the order of 11–15%. The quantitative impact on taxes is substantial. This result is an implication of the high tax elasticity of capital flows resulting from the calibration. Is there any indication that this elasticity is realistic? This is a fundamental question for which the author does not provide any supportive evidence.

The implication of tax harmonization is a substantial increase in redistribution thanks to the transfers, at the cost of a decline in output and the capital stock. The welfare impact of this drastic change is significant but not huge. This outcome raises two questions. First, does an increase in welfare and redistribution really require such a capital stock decline? This is where the static nature of the model may be problematic in underestimating the impact of the capital stock. The second question is: if such a redistribution scheme with substantial increases in capital income taxes is optimal, should it be done uniquely by tax harmonization? An alternative would simply be to introduce more left-wing governments with stronger preferences for redistribution (see Persson and Tabellini, 1992 for a discussion of these issues). These would definitely reduce the need for tax harmonization and its welfare gains.

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This paper addresses an important issue for the current process of European integration: the appropriate degree of co-ordination of capital income taxation in a region with integrated capital market. It provides key insights and, in particular, it points to the fact that the benefits of such co-ordination are critically affected by the intra-European capital mobility and the mobility between Europe and the rest of the world.

I want to discuss some points raised by tax co-ordination that complement the analysis. The paper discussed the effect of imposing a minimum tax rate at the European level. Clearly, if member states decided to start a negotiation on these grounds, this would mean that they all agree that capital tax competition is too intense, which doesn't seem to be the case.

Disagreements on whether capital taxes are too high or too low, and why, emerge also in the economic literature. The status of capital income in the redistribution debate is controversial because unlike other sources of income, or consumption, capital is derived from saving on previous incomes, and thus can be viewed as delayed consumption. The taxation of capital thus raises issues of double taxation that must be addressed in a dynamic perspective. When taking this dynamic perspective, one ends up with very different views on the taxation of capital than the one presented in the paper. There are indeed now numerous works that show that in a dynamic general equilibrium growth model, capital should not be taxed in the long run. The results seem to be quite robust, and in particular to redistributive considerations. The key problem in this context is then the inability of governments to commit on future rates of taxation. Indeed, although taxes should be low, governments have short-run incentives to raise current taxes. As there is no credible commitment on future taxes, the dynamic inconsistency problem results in levels of taxation that are too high. There are many reasons for which capital should be taxed in the long run (e.g., imperfect capital markets, risk, intergenerational redistribution or multidimensional individual characteristics), but in any case the dynamic consistency issue remains. From a global perspective, we thus end up with two opposite effects. International tax competition would be solved by the co-ordination of taxes (at higher levels according to the present paper), while dynamic consistency would best be solved by a commitment on lower taxes. In such a dynamic perspective and given the length of the horizon concerned when talking about capital investment, I believe that the issue of the time consistency of taxation policy is a key factor for policy making. If this is the case, tax competition can be viewed as a disciplining device when applied to capital. It provides states with a credible commitment not to raise capital taxes in the future. Put in another way, it ensures investors in one state that if they were to face an increase in tax rates, they will be able to protect their investments by moving to another state. This in turn favours investment in all states. In such a context, deciding to co-ordinate the states on a minimum tax rate may reduce the degree of commitment and create a capital outflow that is much higher than any estimate that results from the levels of mobility observed under the current situation. To take an extreme example, one can

envision for instance what would be the reaction of US investors if they were faced with the announcement that European member states have reached an agreement by which a central body has the right to raise all levels of capital taxes in Europe at any time.

A second aspect of tax co-ordination is the difficulty to co-ordinate while maintaining the adequate level of diversity between states. Diversity follows not only because national preferences toward redistribution vary, but it also reflects differences in factor productivities, in population size and composition, in capital composition, and in the mobility of various types of capital. It also reflects the fact that taxation is used as an industrial policy instrument.

Given that compensatory transfers are difficult to implement, one would rather see a global negotiation allowing for the adjustment of taxes to local conditions than the imposition of some minimal standard. In any case taking into account national specificities will be extremely difficult, much more than for VAT for example. Moreover, monitoring the behaviour of states with complex tax schemes will require costly centralization and will one way or another limit the ability to use differential taxation as a national policy instrument.

Let me conclude by evoking quickly some political economy. A key factor that makes the taxation of capital a very controversial issue in the political debate is the high degree of concentration of capital. At any point in time, the taxation decision then involves a direct conflict of interest between different categories of the population. The resulting taxation scheme is then best being viewed as the outcome of a political contest. Such a political contest involves participants with multiple interests that interact through various representatives, such as politicians, parties, unions and lobbies. Deciding to co-ordinate the taxation of capital then affects the whole process of decision making, as agents reorganize to adapt themselves to the new situation. One may think for example of the co-ordination of pressure groups, political parties or unions at the European level. This means that the political decision to co-ordinate, presumably through some type of central organism, has also direct redistributive effects as different groups may have different abilities to alter the decision process at the central level and the local level. The whole issue is then one of design of institutions and should be addressed as such.

Panel discussion

Several comments in the general discussion centred around the assumptions underlying the TAXCOM model. Jorge de Macedo questioned the assumption of perfect capital mobility within the union because, first, capital mobility is not uniform across the EU, it is much higher in the core countries than in the outer regions. Secondly, capital mobility is also high in many countries outside the EU. Paul Collier added that more empirical work may be necessary as regards the elasticity of capital supply as it will be important to know how much of the capital stock would be lost as a result of increased tax rates.

Georges de Menil pointed out that the model assumes that the tax revenue is well spent. This inherently biases the model in favour of higher tax rates. He argued that it would be easy to switch to a different world with a Leviathan like that recently seen in Eastern Europe. Changing this assumption would also change the results of the model.

David Wildasin pointed out that infrastructure spending can be a perfect substitute to tax competition, depending on how infrastructure investment affects factor productivity. The underlying assumptions made in TAXCOM may be favourable for the case of tax co-ordination. He also noted that there is an important difference between local ownership of capital and non-local ownership. One reason for taxing capital in this model is to capture income that otherwise accrues to people not residing within the jurisdiction. What is the appropriate share for benchmarking the model? The paper uses the share of stocks owned by non-residents on the Denmark stock exchange. He felt that the reasonable share of capital in any country is about half owned by residents and half owned by non-residents. Harry Huizinga asked whether the share of foreign ownership is stable and what might happen five years from now? Transaction costs may go down and financial markets may integrate. He was therefore concerned about how high the foreign ownership share had to be to avoid the need for taxes to be co-ordinated.

Some of the panel members made a distinction between economic efficiency and utility. Paul Collier was concerned that the paper focuses too much on what happens to the capital stock. He argued that if one focuses on what happens to utility, the outcome may easily change in a CGE model. Charles Wyplosz observed that the term welfare can have different meanings. For instance, the Irish have been growing fast but also working hard, whereas the Sicilians have been receiving transfers from the north and enjoying a lot of leisure. It is not clear whether the Sicilians are necessarily worse off than the Irish.

Edmund Phelps pointed out that it is possible to tax wealth without taxing entrepreneurship. This would help to boost employment and to boost entrepreneurship. Research for proving the optimality to tax wealth was defeated by the golden utility rule. It may, however, be optimal in the presence of externalities. If there are transfer payments by the government, as an increasing function of output, perhaps due to tax revenue spending at the golden utility point, a little more output than that would be wasteful, because the government would spend the extra tax revenue in a wasteful way. Thus it may be better to deviate from the usual formulas and tax wealth.

Two remarks on terminology where made. Georges de Menil was concerned that the term 'spillover' leads to the impression that, because there is an externality, intervention is needed. However, the apparent spillover may just be the interaction of competition. Interaction in a game is not necessarily a reason for intervention. Paul Collier felt that it should be tax harmonization, not tax co-ordination.

Michele Boldrin argued that the gains from tax co-ordination in the paper are small and concluded that the paper could be interpreted as evidence against tax co-ordination. He recalled that Lucas found welfare gains from elimination of the business cycle to be

very small – only 1.2%. In the proposed tax co-ordination the gains are even smaller. This view was shared by Charles Wyplosz who was concerned that the welfare gain of only 0.1–0.4% was achieved with a substantial fall of the private capital stock. The message from the paper is that tax co-ordination is important, not for efficiency gains which are small, but for income redistribution. He further argued that a static model should not be used to analyse capital income taxation and preferred the use of a dynamic model. To illustrate this point he gave two examples. First, he pointed out that 70% of regional inequality is due to factor mobility and tax competition is a driving force of factor mobility. Secondly, in a comparison between Ireland and Sicily, Ireland grew faster because of factor mobility. Thus tax competition was a useful tool. He felt, therefore, that there should be no tax co-ordination if one cares about long-run growth. Paul Collier added that, since a diversity of tax rates is observed, there may be a reason for this and, accordingly, a welfare loss from harmonization.

APPENDIX. KEY SPECIFICATIONS IN THE TAXCOM MODEL

The TAXCOM model described in Section 4.3 of the main text is documented in detail in Sørensen (2000). This appendix presents the key specifications in the model. The equations below refer to an individual (potential) union country j, but the country subscript j is omitted to simplify notation when no misunderstanding is possible.

Firms

In all countries the representative firm produces the same composite good Y by means of capital K, effective labour input L, and a fixed factor. The supply of the fixed factor to each country is proportional to the country's exogenous population N, with a proportionality factor b. This ensures that large countries have no inherent productivity advantage over small countries, or vice versa. Adopting a Cobb–Douglas production function with multifactor productivity A and constant returns to scale, we thus have

$$Y = AK^{\beta}L^{\alpha}(bN)^{1-\alpha-\beta}, \qquad 0 < \alpha < 1, \quad 0 < \beta < 1, \quad 0 < \alpha + \beta < 1 \tag{A1}$$

Worker i is endowed with a fraction θ_i of the total stock of human wealth which is normalized to equal total population size N. The working hours of worker i – the rate at which his human capital is utilized – are h_i. Hence the effective labour input supplied by worker i is $\theta_i N h_i$, and aggregate effective labour input is

$$L = \sum_{i=1}^{N} \theta_i N h_i, \qquad 0 < \theta_i < 1 \quad \text{for all } i, \qquad \sum_{i=1}^{N} \theta_i = 1 \tag{A2}$$

The competitive firm chooses the inputs of capital and all of the N types of labour to maximize its profits. With the output price normalized at unity, this yields the following first-order conditions, where τ is the capital income tax rate, ρ_u is the after-tax interest rate, $k \equiv K/N$ is capital intensity, $l \equiv L/N$ is average effective labour input per worker, $w \equiv (1/L)\sum_i w_i h_i$ is the average return to

human capital, and $\tilde{A} \equiv Ab^{1-\alpha-\beta}$ is adjusted multifactor productivity:

Demand for capital: $\quad \beta\tilde{A}k^{\beta-1}l^{\alpha} = \dfrac{\rho_u}{1-\tau}$ $\hfill$ (A3)

Demand for labour: $\quad \alpha\tilde{A}k^{\beta}l^{\alpha-1} = w$ $\hfill$ (A4)

Real wage of worker i: $\quad w_i = \theta_i \mathcal{N} w \qquad i = 1, 2, ..., \mathcal{N}$ $\hfill$ (A5)

Consumers

The utility of worker/consumer i is given by the additive utility function

$$U_i = C_i - \theta_i \mathcal{N} \cdot \frac{h_i^{1+\varepsilon}}{1+\varepsilon} + \frac{\gamma_2}{\gamma_1}\, G^{\gamma_1} \tag{A6}$$

$$\varepsilon > 0, \qquad 0 < \gamma_1 < 1, \qquad \gamma_2 > 0$$

where C_i is his private consumption and G is public consumption per capita. The specification of the consumer's disutility from work assumes that his opportunity cost of time spent in the labour market various varies positively with his productivity, proxied by his stock of human capital $\theta_i \mathcal{N}$. As we shall see below, this implies a negative wealth effect on individual labour supply.

At the beginning of the period, the economy is endowed with a total stock of *non-human* wealth normalized to equal its population $\mathcal{N}$. The fraction of aggregate non-human wealth owned by consumer i is θ_i (equal for simplicity to his share of human wealth). The consumer may consume his non-human wealth directly, or he may invest it in the capital market at a transaction cost c_i, thereby building up a capital stock k_i^s earning an average after-tax return ρ. In addition to capital income, labour income and a government transfer T, the consumer receives profit income from domestic and foreign firms. An exogenous fraction δ of domestic firms is owned by foreigners. At the same time consumers in domestic country j receive a fraction $s_j\delta_z/(1-s_z)$ of the profits generated in foreign country z, where s_v $(v=j,z)$ is country v's share of total world population so that $1-s_z$ is the fraction of world population residing outside country z. The profits paid out from each country are thus allocated across all the other countries in proportion to their population shares. Consumer i receives a fraction θ_i of all profit incomes earned by domestic residents, whether from domestic or from foreign sources. Under pure tax competition governments cannot tax capital income and profits from foreign sources, but they tax all domestic-source capital and profit income at the domestic rate τ_v $(v=j,z)$. With these assumptions one can show that consumer i in country j will be subject to the budget constraint

$$C_i = w_i h_i (1-t) + \rho k_i^s + \theta_i \mathcal{N} - c_i + T + \theta_i \mathcal{N}(1-\delta)(1-\tau)\pi + \theta_i \mathcal{N} \sum_{z=1,z\neq j}^{m} \left(\frac{s_z\delta_z}{1-s_z}\right)(1-\tau_z)\pi_z \tag{A7}$$

where t is the labour income tax rate, π and π_z are pre-tax profits *per capita* in the domestic country j and in foreign country z, respectively, and m is the total number of countries in the world.

When the consumer transforms (part of) his initial non-human wealth $\theta_i N$ into business capital k_i^s, his transaction costs c_i relative to his stock of wealth increase more than proportionally with his investment rate $k_i^s/\theta_i N$:

$$\frac{c_i}{\theta_i N} = \frac{1}{1+\varphi} \left(\frac{k_i^s}{\theta_i N} \right)^{1+\varphi}, \qquad \varphi > 0 \tag{A8}$$

The consumer chooses h_i and k_i^s to maximize utility (A6) subject to the constraints (A7) and (A8). The first-order conditions for the solution to this problem imply that

$$h_i = \left[\frac{w_i(1-t)}{\theta_i N} \right]^{1/\varepsilon} = [w(1-t)]^{1/\varepsilon} \tag{A9}$$

$$k_i^s = \rho^{1/\varphi} \cdot \theta_i N \tag{A10}$$

where the last equality in (A9) follows from (A5). Note that $1/\varepsilon$ is the net wage elasticity of labour supply, while $1/\varphi$ may be interpreted as the net interest elasticity of savings.

The total capital stock supplied by consumer i in the representative union country is a CES-aggregate of capital supplied to the union area, k_i^{su}, and capital supplied to the non-union area, k_i^{sn}, where ζ is the finite elasticity of substitution between the two asset types:

$$k_i^s = [\Psi^{-1/\zeta}(k_i^{su})^{(\zeta+1)/\zeta} + (1-\Psi)^{-1/\zeta}(k_i^{sn})^{(\zeta+1)/\zeta}]^{\zeta/(\zeta+1)}, \qquad \zeta > 0, \qquad 0 < \Psi < 1 \tag{A11}$$

The consumer's total income from capital is $\rho k_i^s = \rho_u k_i^{su} + \rho_n k_i^{sn}$, where ρ_u is the after-tax interest rate prevailing within the union (which is common to all union countries because perfect capital mobility within the union), and ρ_n is the after-tax interest rate in the non-union area, and where ρ is the 'average' net rate of return on capital. Having optimized his aggregate capital stock k_i^s in accordance with (A10), the consumer allocates this stock between union and non-union locations so as to maximize his total net income from capital $\rho_u k_i^{su} + \rho_n k_i^{sn}$, subject to (A11). The first-order conditions for the solution to this problem imply that

$$\rho = [\Psi \rho_u^{\zeta+1} + (1-\Psi)\rho_n^{\zeta+1}]^{1/(\zeta+1)} \tag{A12}$$

$$k_i^{su} = \left(\frac{\rho_u}{\rho} \right)^\zeta \Psi k_i^s, \qquad k_i^{sn} = \left(\frac{\rho_n}{\rho} \right)^\zeta (1-\Psi)k_i^s \tag{A13}$$

The portfolio allocation of non-union residents is described by similar equations.

Government

Governments spend their tax revenues on public consumption G, on 'infrastructure' Q, and on a redistributive transfer paid out in an identical amount T to all citizens. Under pure tax competition, taxes are levied according to the source principle, and the government in a union country is subject to the budget constraint

$$T + G + Q = twh + \tau \left(\frac{\rho_u}{1-\tau} \right) k + \tau \pi \tag{A14}$$

where all variables are measured on a per capita basis. Note from (A9) that all workers will supply the same number of work hours $h_i = h = [w(1-t)]^{1/\varepsilon}$, so h is the average working time per worker. The amount of productive government spending per capita (Q) does not yield direct utility, but it increases factor productivity, albeit at a diminishing rate:

$$\tilde{A} = \mu_2 Q^{\mu_1}, \qquad \mu_2 > 0, \qquad 0 < \mu_1 < 1 \tag{A15}$$

Welfare and government policy

Inserting (A7) through (A10) into (A6), we may write the indirect utility of consumer i in country j as

$$U_i = T + \frac{\gamma_2}{\gamma_1} G^{\gamma_1}$$

$$+ \theta_i \mathcal{N} \left\{ \frac{\varepsilon h^{1+\varepsilon}}{1+\varepsilon} + 1 + \frac{\varphi \rho^{\frac{1+\varphi}{\varphi}}}{1+\varphi} + (1-\delta)(1-\tau)\pi + \sum_{z=1, z \neq j}^{m} \left(\frac{s_z \delta_z}{1-s_z} \right)(1-\tau_z)\pi_z \right\} \tag{A16}$$

The government in each country is concerned about the *average* level of individual welfare $\overline{U}$ and about the *dispersion* of individual utilities around this mean, as reflected in the following social welfare function,

$$SW = \overline{U} - a \sqrt{\frac{1}{\mathcal{N}} \left[\sum_{i=1}^{\mathcal{N}} (U_i - \overline{U})^2 \right]}, \qquad a \geqslant 0 \tag{A17}$$

where the square root measures the degree of inequality by the standard deviation of individual utilities, and where the parameter a indicates the degree of government aversion to inequality. Since $\overline{U} \equiv 1/\mathcal{N} \sum_i U_i$ and $\sum_i \theta_i = 1$, it follows from (A16) and (A17) that

$$SW = T + \frac{\gamma_2}{\gamma_1} G^{\gamma_1}$$

$$+ (1 - a\sigma) \left[\frac{\varepsilon h^{1+\varepsilon}}{1+\varepsilon} + 1 + \frac{\varphi \rho^{\frac{1+\varphi}{\varphi}}}{1+\varphi} + (1-\delta)(1-\tau)\pi + \sum_{z \neq j} \left(\frac{s_z \delta_z}{1-s_z} \right)(1-\tau_z)\pi_z \right] \tag{A18}$$

$$\sigma \equiv \sqrt{\frac{1}{\mathcal{N}} \sum_i (\theta_i \mathcal{N} - 1)^2}$$

where σ is the standard deviation of individual wealth levels around the mean value of unity, reflecting the degree of inequality of the initial distribution of wealth. I assume that $a\sigma < 1$ to ensure that an increase in private factor income will always increase social welfare (for given levels of T and G).

From (A16) and (A18) we see that social welfare coincides with the individual welfare of the consumer with an initial wealth endowment $\theta_i \mathcal{N} = 1 - a\sigma$. Hence maximization of (A18) for

different values of $a\sigma$ corresponds to a situation where an elected citizen with endowment $\theta_i N$ is allowed to determine fiscal policy.

For given government policy instruments, a general equilibrium is attained when all private agents optimize their objective functions and national labour markets as well as the union and the non-union capital markets are clearing. Under tax competition the government (the median voter) chooses the policy instruments t, τ, G and Q to maximize the objective function (A18), subject to (A14), (A15) and all the constraints implied by private sector behaviour. If governments choose a common minimum capital income tax rate, the private and government budget constraints are modified in a straightforward manner, and the common capital income tax rate is found by maximizing a population-weighted sum of the social welfare functions of the individual cooperating countries. Sørensen (2000) derives the optimal policy rules under the different policy regimes described in this paper.

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