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CAPITAL INCOME TAXATION AND TAX CRITERIA IN INTERNATIONAL CAPITAL MARKETS

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ABSTRACT: The study analyses the capital income taxation of foreign-source income, where residence and source criteria are the two well-known tax criteria. The study presents a globally optimal tax rule which equalizes the shadow price of capital in the countries and which is assumed to be a weighted average of the return on savings and on investment, i.e. depending on the gross rate of return to the extent that capital contributes to the capital used, and on the net interest rate to the extent that capital displaces savings. Correspondingly, international taxation is a weighted average of domestic and foreign capital income tax rates. The weight depends on savings and investment behaviour, and also on the taxation of pure rents and on the income distribution effects of the tax scheme in the considered overlapping-generations model. The study also considers foreign direct investment and the investment incentives created by the 1993 Capital Income Tax Reform in Finland to foreign direct investment to Finland. Since the home countries of most foreign multinational enterprises apply the territorial principle, the lower capital income tax rate has real positive effects on new capital investment from abroad. The tax reform will have less significance for the acquisition of existing businesses in Finland.

KEY WORDS: capital income taxation, international taxation, tax competition, economic integration

TIIVISTELMÄ: Väitöskirja tarkastelee ulkomailta ansaittujen pääomatulojen verottamista, jossa tunnettuja verotusperiaatteita ovat asuinvaltioperiaate ns. residence principle ja lähdevaltioperiaate ns. source principle. Tutkielmassa näytetään maailmantalouden kannalta optimaalinen verotussääntö, joka saadaan asettamalla pääoman varjohinnat maittain yhtäsuuriksi ja olettamalla, että pääoman varjohinta voidaan esittää painotettuna keskiarvona säästäjien ja investoijien tuotoista; eli reaalisijoitusten tuotosta siinä suhteessa kun pääoman käytetään uusiin investointeihin ja portfoliosijoitusten tuotosta siinä suhteessa kun pääomantuonti vaikuttaa säästämiseen. Ulkomailta saadun pääomatulon veroaste on vastaavasti painotettu keskiarvo maittaisista pääomatulojen veroasteista. Painoihin vaikuttavat säästämis- ja investointikäyttäytymisen lisäksi puhtaitten voittojen verotus, ja verojen tulonjakovaikutukset tarkastellussa limittäisten sukupolvien mallissa. Väitöskirjassa tarkastellaan myös suoria investointeja ja erityisesti Suomen vuoden 1993 pääomavero-uudistuksen vaikutusta ulkomaisiin investointeihin Suomeen. Koska moni-kansallisten yritysten kotimaassa useimmiten noudatetaan lähdevaltioperiaatetta, pääomaveroasteen aleneminen lisää uusinvestointeja Suomeen. Sen sijaan verouudistuksella on vähemmän vaikutusta yritysostoihin.

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Abbreviations

BIAC	Business and Industry Advisory Committee to the OECD
CCIT	Comprehensive corporate income taxation
CEN	Capital export neutrality
CIN	Capital import neutrality
DM	Diamond-Mirrlees
EU	European Union
EVL	Laki elinkeinotulon verottamisesta (Law on Business, Taxation Finland)
FDI	Foreign direct investment
FOC	First-order condition
IBFD	International Bureau of Fiscal Documentation
LIFO	Last in, first out
LDC	Developing Country
MNE	Multinational Enterprise
NBER	National Bureau of Economic Research
OECD	Organisation for Economic Co-operation and Development
OLG	Overlapping Generations Model
TVL	tulo- ja varallisuusverolaki (Income and Wealth Tax Act, Finland)
UN	United Nations
UNCTC	United Nations Centre for Transnational Corporations
UK	United Kingdom
US	United States
USD	US dollar

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Helsinki, September 1995

Hannu Piekkola

1. Introduction

1.1 Background

The integration of economies in Europe and free flow of capital, labor, services and goods across borders give new challenges to public sector finance and taxation. Particularly, the mobility of capital has increased substantially. Tax theory of the past has been mainly derived in a closed economy framework. The oppennes of economies raises the importance of relatively recent topic, namely international tax theory. Higher mobility of factors affects the behavioural, incentive and welfare effects of taxation. International taxation is not separate issue from domestic taxation of factors and goods. It is clear that without any international taxation the domestic tax base will erode. This is most evident in capital income taxation, where capital income taxation of portfolio investment can be currently too easily avoided by investing to foreign "tax heaven" locations.

How capital income taxation will develop in the future in the EC area or in Europe is an open question. It is important part of tax instruments as long as lump sum taxes or other less distortionary taxes are not available to satisfy government revenue needs. [1] In an open economy, there is a clear distinction between the taxation of savings and that of investments. Two polar principles exist in the division of the tax base between the source country where the income accrues and the residence country of taxpayer. Residence-based capital income tax is a tax on savings. Residents pay taxes on their worldwide income

[1] Capital income taxation has also been claimed to create a welfare loss and may hence be eliminated when other taxes are more efficient and equity objectives are achieved by progressive consumption taxation (for criticism of capital income tax, see Feldstein, 1978, Boskin, 1978, Summers, 1981, and Levhari and Sheshinski, 1972, Chamley, 1986, Lucas, 1990 and section 3.4.1). Capital income taxation, on the other hand, can have positive incentive effects on risk taking. I considered savings and risk taking in different tax systems in a closed economy in licentiate thesis (1989).

regardless of the source. Under polar source criteria, all income originating in a country enters the tax base regardless of the place of residence of the recipients. Source-based tax is a tax on investments, since savers can avoid the source-based tax by not investing in the country.

In the taxation of portfolio investment, there has not been a substantial shift to residence-based taxation. Since non-residents, on the whole, do not pay taxes in the foreign country, source-based taxation is not fully effective either. It is unclear whether EU countries will adopt harmonised source-based withholding taxation or whether the taxation of foreign-source income under residence criteria is made more enforceable by increasing information sharing among tax jurisdictions. Analogously for foreign direct investment, the EU directive (EC Commission 1990) allows corporations to choose between source (exemption system) or residence principles (tax credit system) for foreign-source branch income or remitted subsidiary income. International Model Conventions (OECD 1977 and UN 1980) give primary jurisdiction to the country of source. Source and residence principles (or territorial and worldwide principles) are otherwise exhibited on an equal basis.

Besides political factors, one reason for the somewhat unsettled state of prevailing international double tax relief systems can be that globally desirable international taxation has been until recently rather little examined. In the optimal capital income taxation problem, most of the models assume a small open economy. My purpose is to consider international capital income taxation that countries should cooperatively choose from world welfare point of view. Dissertation reconciles the two basic lines of approaches to the optimal international capital income tax problem. The first one is the production efficiency theorem of Diamond and Mirrlees (1971), and the other one is Horst's (1980) representation of shadow price of international investment as a weighted average of gross return on investment and net return on savings. This is done by examining simple rules for optimal international taxation that encompasses both Diamond and Mirrlees and Horst approaches. The shown weigted average rule is also adjusted for the intergenerational income distribution effects of capital income taxation. I consider an overlapping two-generations model, where the policy problem is to weight appropriately short-

term welfare implications for existing old generation against long-term gains from having more intertemporally efficient distribution of welfare.

The latter part of the study examines foreign direct investment. There is a difference between corporate and personal capital income taxes: corporate taxes are currently effectively source-based due to tax deferral, while personal taxes are more often residence-based (at least in principle). I do not consider this tax deferral issue in any greater detail (see survey chapter 2). I also do not consider monopolistic or oligopolistic competition and the interaction between factor and goods trade. [2] Hence, the ideal international capital income taxation should be sometimes be adjusted for the taxation of monopoly profits or for tariffs prevailing in goods trade. After characterizing the adaptation of weighted average rule to the taxation of foreign direct investment, I especially examine Finnish Capital Income Tax Reform 1993 and how it affects foreign investment in Finland, whether new capital investment or takeovers, and how this depends on tax criteria. Foreign direct investment to Finland are divided to new capital investment and mergers, since territorial (source-based) and worldwide (residence-based) taxation have different effects on them.

[2] Kravis and Lipsey (1988, note 8) cite considerable evidence that foreign direct investments can also have a positive effect on exports and are thus complements to exports in goods trade. Hence, factor and goods trade may not be substitutes but complements, which will also affect the choice of tax criteria. For example, foreign direct investment in a low-tax country may not take place at the expense of domestic activity if they enchance domestic final goods exports. For the interaction between capital income taxation and trade flows, see also Bovenberg (1989).

1.2 Outline of the Study

Part 2 briefly introduces the operation of international tax systems. This includes a survey of the basic arguments made in the choice of tax criteria.

Part 3 deals with capital income taxation, especially as it can be applied to international portfolio investment. Chapter 3.2 considers a tax cooperative solution for international taxation of capital income and is a joint work with Michael Keen, University of Essex. Optimal capital income tax policy relates to savings and investment behaviour. Next chapter 3.3 extends the analysis to an OLG model, which takes into account intergenerational income distribution effects of capital income taxation. I also examine tax competition and whether it achieves the optimal solution for the world as a whole. Chapter 3.3 is published in Journal of Economics (see Piekkola 1995b, forthcoming).

Part 4 starts with a comprehensive study of shareholder and corporate level capital income taxation related to international taxation of dividend payments between foreign subsidiaries and parent companies. Capital income tax burden depends on corporate tax system, on international taxation of dividend payments (between subsidiary and parent) and on economic double tax relieves given to final shareholders. The second part of the fourth chapter deals with the Finnish Capital Income Tax Reform 1993 and its effects on foreign direct investment to Finland. This chapter is published in Finnish Economic Papers (see Piekkola 1995a).

Part 5 is an epilogue that summarizes the conclusions made in the rest of the study.

2. Discourse on Capital Income Taxation and Foreign Investment

2.1 The Choice of Tax Criteria

Introductionary section presented two main principles in international capital income taxation. Residence-based taxes are levied on a nation's savings, whether allocated home or abroad, while source-based taxes are levied on all savings in the tax jurisdiction. Residence criteria satisfy capital export neutrality (CEN); the decision where to invest is not distorted. Source criteria satisfy capital import neutrality (CIN); the tax level does not depend on who makes the investment. [1] Harmonisation of tax structures, together with non-discrimination between home and foreign investments, ensures both CEN and CIN. When this is not possible or desirable, the question arises which one is more conducive for the collective good. Richard Musgrave did not have an unequivocal attitude towards the welfare criterion, when he introduced the terminology of capital export (CEN) and capital import neutrality (CIN) in 1960. Three years later, Peggy Musgrave (1963, former Richman) turned to advocate CEN as the prior efficiency criterion. [2] According to her, it is 'generally correct' as well 'to conceive of a tax neutrality with respect to all investors in one country, so that tax considerations will not influence their decisions to invest at home or abroad'. CIN is important only for benefit taxes that reflect the public goods available in each country. However, income taxes are usually not benefit taxes, and tax differentials do not reflect the differences in benefits. Later, Peggy Musgrave (1969, p. 83-84) also gives 'finance neutrality' argument, that the higher taxation of pure profits, and hence the

[1] R. Musgrave (1960) was the first to introduce a distinction between capital export neutrality (CEN) and capital import neutrality (CIN).

[2] She also proposed a deduction system, where tax paid abroad is deducted from the tax liability in the home country.

level of after-tax profits, does not affect to whom the investment accrues. Similarly, Richard Musgrave (1969, p. 249) makes the only reservation that 'the state of import neutrality ... may affect capital flows if preference for internal funds and various market imperfections are taken into consideration'. However, even if equal opportunities for expansion are important in a CIN sense, taxation can be highly non-neutral for international capital flows, unless all tax rates are equal.

The choice of tax criteria has also been considered in view of international version of the basic production efficiency theorem of Diamond and Mirrlees (1971) (see Giovannini, 1988, and Razin and Sadka, 1989, 1990 and for a survey, Keen 1993). If pure profits are taxed at 100 percent and there is perfect competition and no constraints on the other tax instruments the government may use, the taxation of savings (residence criteria) should be preferred over the taxation of investment (source criteria). The optimal tax structure maximizes output, which is then dispersed between consumption and government spending. All factor supplies should be subject to tax and the government should be able to raise an optimal amount of revenue from all resources. Source-based capital income taxes would not raise any additional tax revenue. In contrast, it reduces government revenues by decreasing capital demand.

Some of the basic assumptions resulting to the optimality of residence criteria are worth consideration and this reassessment also forms the basis of the study. The problems may be listed as relating to (i) the enforceability of taxing foreign-source income, (ii) the non-efficient taxation of savings, (iii) the non-full taxation of rents, (iv) country-specific risk and capital export or import constraints, (v) external balance constraints and (vi) differences in portfolio and foreign direct investment. First of all, (i) there may exist some additional constraints in an open economy in the tax menus available to the government. The taxation of foreign-source income is difficult for some factor income, and especially so for capital income earned abroad. Bacchetta and Espinosa (1995) consider information sharing in international investment among tax jurisdictions as part of government strategies. Under pure residence-based taxation countries are indifferent to the amount of information

they transmit. The model does not, hence, indicate full information sharing as part of optimal policy under pure residence criteria. Information sharing and lower tax evasion may rather increase the level of source-based taxes.

Non-taxation of foreign-source income will lead to a loss in tax revenues and capital outflow. Deductibility of interest expenses will also erode the tax base when borrowed funds used for overseas investments do not pay any tax, but the interest expenses are deductible. [3] It may be better to have source-based taxes instead of no taxes on foreign-source income. [4] Dasgupta and Stiglitz (1972) and Munk (1980) show that, if the taxation of some factors is not possible, production efficiency would not necessarily be maintained. Giovannini (1988) adapts this result to capital income taxation and optimal taxation is shown to depend both on savings and investment behaviour. Frenkel, Razin and Sadka (1991, ch. 10) and Giovannini (1989b) show that quantitative restrictions on capital flow can also be one substitute for the direct taxation of foreign-source income which also clearly distorts production efficiency. [5] I do not consider capital income tax evasion in greater detail. Source-based taxation is not, hence, favoured on the basis that it is the only device left for the government when residence-based taxation is not possible. I examine conditions under which source-based taxation or a mixed scheme of residence and source-based tax/subsidies is optimal relating to (ii) non-efficient taxation of savings and to (iii) non-full taxation of rents.

Horst (1980) has shown that, under arbitrary domestic capital income taxation so that the second point (ii) is consequential, international taxation depends on whether users of capital (firms) or suppliers of capital (savers) are

[3] Since this is often the case, only a minority of countries grant full relief for interest incurred in making or acquiring an overseas investment, but this is difficult to enforce in practice (see Ogley, 1992).

[4] An asymmetric case, where only some countries can apply residence-based taxes or other ways to reduce its savings, is also problematic. Enforced residence-based taxation lowers savings, which leads to compensating capital inflow to the capital importing country. If the capital importing countries are comparatively large and absorb significant amounts of tax-exempted foreign investments, a significant loss in tax revenues may accrue to foreign capital-exporting countries.

[5] Bjerksund and Schjelderup (1994) suggest that production efficiency is still important if government can tax foreign-source income derived by firms. Households should not be allowed to export capital if foreign investment of firms are perfect subsitutes for portfolio investment of households.

more sensitive to differences in the price they have to pay or that they receive for their capital. The appropriate tax criterion, the 'substitutability criterion', then compares the welfare losses originating from production distortions with those originating from distortions in the intertemporal terms of trade faced by consumers. Giovannini (1990) suggests, following the empirical studies of Hall (1988), that the losses from intertemporal terms of trade distortions might be second-order relative to the production distortions and, hence, residence criterion is still superior to source criterion. The analysis in the part 3 makes a clear distinction between international taxation when domestic capital income taxation is arbitrary, as in Horst (1980), and when domestic capital income taxation is optimal. The production efficiency theorem of Diamond and Mirrlees (1971) is valid only when all tax instruments can be optimally set.

Besides non-full taxation of foreign-source income and arbitrary taxation of domestic savings, (iii) pure profits are rarely taxed at 100 per cent. Gordon (1992, p. 3) notes the problem in an open economy that a profit tax would induce profitable firms to move elsewhere if profits are not location-specific. The distinction between the optimal taxation under the taxation of pure rents or not is clear in a small open economy model by Bruce (1992) (see also Giovannini, 1988)). If domestic savings can be taxed at optimal rate, international taxation aims at savings in misallocation of capital across countries. Huizinga and Nielsen (1995) show that the shadow price of international investment for the small open economy is a weighted average of gross and net return to capital. The weights, although reflect the relative interest elasticities of savings and the demand for capital, are different than in Horst (1980) where domestic capital income taxation is arbitrary. [6]

The first study in my work, chapter 3.2, aims at reconciling the basic results when all pure rents are not necessarily taxed away and when domestic taxation of savings may be inefficient. The shadow price of capital will depend on tax rates imposed on rent and capital incomes. A tax cooperative solution derived necessitates the equalization of shadow prices of capital across countries. This together with no capital arbitrage opportunities yields the

[6] They show that source-based investment taxes can also be used to shift income away from foreign to domestic citizens when not all profits accrue to domestic capital suppliers.

globally optimal international taxation. In following chapter 3.3, I also consider capital income taxation and intergenerational welfare distribution in an OLG-model, that is less examined in the literature dealing with optimal international taxation of capital income. Optimal national and international capital income can be very different when investment should be taxed for intergenerational welfare distribution reasons. However, the basic weighted average tax rule in international taxation remains the same with only differences in weights.

One important criticism against residence criteria, the fourth point here (iv), is that it is not necessarily synonymous to CEN if there are capital export or import constraints or country-specific risk in investment. Vogel (1990, p. 146-47) considers high-tax capital-exporting countries that have risky location-specific investments in a comparatively small debtor country (e.g. a developing country). The debtor country would bear most of the residence-based tax on the risk premium as an increase in gross interest rate. Vogel concludes from this that the worldwide taxation of portfolio interest income may not ensure CEN, since the tax increases gross returns in the foreign debtor country without any corresponding change in gross return in the capital-exporting country. I am not considering the effects of riskiness of investment on optimal tax rules.

Residence-based taxation may also imply external balance problems (v). Only if there is a passive third player, the rest of the world, the current account deficit of one country has no implications on the current account position of the other country. In his comment on Razin and Sadka (1991a), Stefan Sinn (1990, p. 166-169) argues that the loss of monetary independence, because of integrating international capital markets, leads to larger fiscal policy spillovers across countries. [7] While high capital mobility inhibits the crowding out of a fiscal expansionary policy via a higher interest rate, resulting imbalances in the external account may increase the need for fiscal cooperation among countries. [8] External constraints of a country require

[7] Devereux (1992) also shows that gains from tax harmonization are ambiguous when capital outflow effects on the rest of the world are important.

[8] For the fiscal transmission effects in the EMS and their likely modification in EMU, see Gros and Thygesen (1992, ch. 8).

sound macroeconomic policy to service the foreign debt on a regular basis (Gros and Thygesen, 1992, p. 152, Mintz, 1991, and Spahn and Kaiser, 1991).[9] Source-based taxation may be better suited towards this purpose, since creating offsetting movements in cross-border flows. As the OECD (1991a) simulation of corporate tax cuts shows, a cut in corporate taxation (or source-based personal taxation) enhances local investments, but the increase in wealth also has a positive savings effect and even leads to later savings outflow. The effects on the net asset position of foreign countries remain relatively unchanged in the long run. [10] Gardner (1992, p. 70) finds out that a common withholding tax in the EU would have an ambiguous effect not only on the external balance of the EU vis-a-vis the rest of the world, but also on gross savings. External position of the economies also depend on the sensitivity of exchange rates to current account position and to capital income tax policy. [11] This study does not examine constraints on capital income tax policy created by (prolonged) current account deficits or by volative, uncertain exchange rates.

The sixth point (vi) is that Diamond and Mirrlees production efficiency theory can also give different implications when applied in personal or corporate income taxation. [12] CIN rather than CEN is considered to hold in practice in corporate taxation. [13] Representatives of business often consider taxes as part of an overall economic environment. A foreign company should compete in the local market on equal terms with other companies, which ensures 'competitive neutrality' (BIAC, 1990, p. 197, see also Devereux, 1992). CIN means 'capital ownership neutrality'. Vogel (1990) and

[9] For a relatively large country, e.g. Germany, excess demand for money (current account deficit) may still remain a problem, since this tends to raise interest rates in Germany and in the whole community.

[10] The OLG-model in section 3.3. also confirms that, in the long-run, source-based taxes lower not only investments but also the wealth of savers, which mitigates the net capital demand change.

[11] For the currency valuation and other external effects of US Tax Reform Act 1981, see McLure (1990, p. 3-23) and Sinn (1990, p. 27-42).

[12] See Vogel (1990, p. 136-152), Musgrave, P.(1963, 1969, p. 109-121), Musgrave, R. (1969, p. 247-255), Sato-Bird (1975, p. 406-421) and McLure (1979, p. 204-209).

[13] Devereux and Pearson in the OECD (1991a) report made a distinction between the personal and corporate tax wedge. The personal tax wedge, affecting savings assuming residence criteria and CEN, is shown as positive in all countries while the corporate tax wedge, affecting investments under source criteria and CIN, is negative. The latter is the case especially in finance through dept.

Gandenberger (1984) also criticize the 'finance neutrality' argument for residence-based taxes. Source-based taxation ensures the same tax level for the competing enterprises. This is because the level of after-tax profits affects the method of finance. More particularly, a lower level of after-tax profits diminishes the chances for the enterprise to finance new investments internally. External funding can be more costly than finance from internal funds. Hence, reduced after-tax profits diminish the chances to finance the investment. They also emphasize the fact that corporate tax seldom falls merely on pure profits. As argued by Gandenberger (1984), the neutrality of profit taxes would require the taxation of economic rents only above the "normal rate of return". This corresponds to the situation in debt-finance, where only the rate of return exceeding interest expenses enters the tax base. But income tax laws do not allow for the opportunity cost of equity.

OECD (1991b, p. 41) report also notes the entitlement to capitalize on some economic rents, which arise when foreign capital exploits the host country's production opportunities, e.g. its natural resources. [14] This more generally relates to the taxation of monopolies and their excess returns (as stated, Diamond-Mirrlees production efficiency theorem assumes perfect competition). Keen (1993, p. 29), however, points out that the integration of goods markets is likely to weaken the efficiency of taxing monopolies and their excess profits at the same rate according to CIN. In order to sell in a particular country it may become less important to have a substantial physical presence there. Exporting the product rather than producing it in the country where it is sold avoids source-based (territorial) taxes on monopoly profits.

There is also some criticism related to the deferral of taxes in corporate taxation. Practically no country taxes the profits of foreign-based subsidiaries, only the repatriated income. Hartman (1984, 1985) was the first to point out that taxes on repatriations may have no effect on the subsidiary's incentive to invest when it enjoys (tax-) preference in the deferral of repatriations. This is because taxes on repatriations are unavoidable and their level does not affect the subsidiary's decision whether to repatriate or to reinvest. The investment

[14] OECD (1991b, p. 36) also proposes that reciprocity in source-country tax rates can be a more natural standard of "internation equity" than identical tax treatment. All countries should then impose the same effective tax rate on income accruing to foreigners.

decision depends on local underlying taxes both in the home and host countries. Recent literature often quotes Hartman's (1985) argument (see Slemrod, 1991, Auerbach and Hasset, 1993, and Ault and Bradford, 1990). Sinn (1987, p. 207-209) ends up with the same conclusions, when debt financing is the superior marginal form of investment. Therefore, the tax treatment of equity injections from parent to subsidiary, and subsequent repatriations, does not matter.

I will limit to consider in part 4, that deals with corporate taxation, the taxation of dividend repatriations from foreign subsidiaries under immediate repatriations. I examine the 1993 Capital Income Tax Reform in Finland and foreign direct investment (FDI). Following Auerbach and Hasset (1993), foreign direct investment is divided to new capital investment and acquisitions.

If there is no commonly accepted opinion over the choice between residence and source criteria, at least among the policy makers in general if not among the economists (that more often advocate residence criteria), there is obviously no agreed way to achieve the desired objectives. The two alternatives are tax cooperation, e.g. in the form of tax harmonisation, and tax competition. Tax competition may lead to deduction system proposed by Musgrave (1963), where tax paid abroad is deducted from the taxable income in the home country rather than refunded. When maximizing national welfare, capital-exporting country compares foreign return after foreign taxes to domestic gross return before domestic taxes since, in contrast to foreign taxes, domestic taxes represent merely a transfer between domestic private and public sectors (see also MacDougall, 1960, Kemp, 1962 and Musgrave R. 1969, and Bond and Samuelson, 1989 and section 2.3). This leads to deduction system which also implies residence criteria and capital export neutrality, when it is optimal for capital-importing countries to have no source-based taxes. Razin and Sadka (1991a) argue that this is the case if all countries consider themselves as small and take the tax decisions of others as given. Hufbauer (1992, p. 65) proposes the deduction system for the US precisely because this would encourage foreign countries to abolish source-based taxes. The only role for source-based taxes is as a backup withholding in the furtherance of tax administration.

Residence criteria as the tax competitive solution gives freedom for each

country to set its taxation at a desired level. [15] The fiscal and regulatory policy chosen by one government has no effect on the decision of others. Tax harmonisation of capital income taxes should not be the primary aim at all in an integrating Europe. Each country may individually choose its tax rates, and there is no special incentive to reduce residence-based tax rates due to tax competition. In practice, pure residence-based taxation rarely applies whereas a credit system, where foreign taxes paid are credited in the domestic tax assessment (up to a limit). Tax credit system is difficult to justify on tax competition grounds, since capital exporters have incentive to tax foreign-source income at zero rate when this effectively raises no tax revenues even with non-zero rate; all tax revenue accrue to capital-importing country which taxes foreign investment at maximal creditable rate (usually the tax rate prevailing in capital-exporting country). One reason, however, for tax credit system is the difficulty to tax foreign-source income. Gordon (1992) suggests that a capital exporter by crediting foreign taxes can induce a higher tax rate abroad and so facilitate enforcement of its own domestic capital income taxes.

I do not consider tax competition under tax credit system except in corporate taxation of FDIs. I examine residence-based taxation and a mixed scheme of residence-based and source-based tax/subsidies implying at times taxation according to weighted average rule. Apel (1994) shows that when all rents are taxed away, residence-based taxation is the same under tax competition and cooperation even when countries are large. Bucovetsky and Wilson (1991) assume that pure profits are not fully taxed. They show efficiency of a mixed scheme of residence and source-based taxation in a symmetric Nash equilibrium, where countries are identical. These results extent to my analysis. The first modification is that tax revenues are not used for public spending whereas to intergenerational income distribution in the OLG-model considered. The second extension is the comparison of tax competitive and cooperative solutions under full tax cooperation, i.e no restrictions in the choice of tax instruments and under partial tax cooperation, i.e. a mixed residence- and source-based tax scheme prevails.

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[15] In Razin and Sadka (1991b) they also discuss the problems of capital income tax evasion under residence criteria.

If tax harmonisation is needed, the question remains whether to harmonise tax rates or tax bases. The study by Devereux and Pearson in the OECD (1991b) report indicates that the tax wedges in different investment projects (and methods of finance) often differ more within a country than between countries. Hence, tax bases in different projects are subject to greater variability. [16] Slemrod (1990), however, favours giving priority to harmonising statutory rates over the tax base. Uniform statutory rates would eliminate the opportunities for tax arbitrage through purely financial transactions without requiring countries to harmonise their tax bases that, in any case, is difficult to enforce. I do not consider in any greater detail problems created by differences in tax bases. This issue is less important in the international taxation of portfolio investment that is studied in the first part 3. Exception is part 4, where I have numerical estimation of the effects of Finnish Capital Income Tax Reform (1993) on foreign investment. In this study, different depreciation and tax rates and tax criteria affect the tax bases and foreign investment to Finland.

2.2 Foreign Investment in a World Economy

Foreign investment may consist of the inflow of know-how and enterprise besides the movement of capital. It is therefore problematic to assess what part of all flow is direct investment. Some new forms of investment are not recorded sufficiently in statistics (such as joint ventures, majority local ownership, production sharing, sub-contracting, licensing, franchising, management contracts and turn-key projects). The evaluation of the repatriation of profits is even more difficult to measure. Dividend repatriations are probably the most favoured form of profit distribution from low-tax LDC

[16] Musgrave (1987) recommends both base and tax-rate harmonisation in view of firms' abilities to transfer profits to low-tax and narrow tax-base jurisdictions. Tanzi and Bovenberg (1990) point out that real distortions arise from variations in average tax rates and favour the harmonisation of tax bases around an agreed reasonable standard, and at least partial harmonisation of corporate taxes (see also Sinn, 1990). Cnossen (1991) rather prefers national sovereignty concerning the tax incentives in the long-term accumulation of capital.

countries, but in developed countries there are many other ways to repatriate profits. The distinction between foreign portfolio and foreign direct investment (FDI) is also unclear. [17] In US statistics, direct investment abroad alone represents 25 % of US assets abroad. Borrowing by an affiliate from the parent country is excluded. Debt finance is, however, a substitute for equity finance as in domestic investment, and direct investment abroad is undervalued (Scholl, 1985).

Foreign investment has been of importance since the 15th century. [18] In the early period, portfolio investments such as bonds, shareholdings and lending played the major role. Since the Second World War, foreign direct investment, especially in manufacturing, has accounted for a greater proportion of all foreign investment. The leading nation was the US, which accounted for three-fifths of the accumulated foreign direct investments in the 1960s. The main reason for the leading position of the US was the post-war reconstruction of Europe and its technological advantage. The common tariff barrier in Europe also induced foreign direct investment instead of the direct sale of products. US firms invested roughly equally in developed and developing countries in the 1950s. Canada and Latin America accounted for 30 and 40 per cent of the total stock of direct investments, respectively. By 1986, the share of developing countries had declined to 25 per cent. Foreign direct investments to developing countries nevertheless increased, reaching a peak in 1981. Oil-exporting LDCs account for a considerable proportion of all investment in LDCs (in 1975 45 % of a total of 6.285 billion USD, and in 1985 30 % of a total of 11.474 billion USD, see UNCTC, 1988, p. 507).

Towards the end of the 1970s, Switzerland, Germany, the Netherlands and Japan takes a greater proportion of FDIs. In the 1980s, Europe was the most important outward investor. The outward flows from Europe were double the inward flows. North America then replaced Europe as the most

[17] Both the IMF and the OECD define foreign direct investment (FDI) as an investment that is made to acquire a lasting interest in an enterprise operating in an economy other than that of the investor. In practice the borderline between portfolio and direct investments is typically 10 per cent of corporate shares. The criterion may also be based on directorial representation, participation in decision-making or the provision of long-term loans with preferential interest provision.

[18] The discussion is largely from Alworth (1988). For more recent general representations of foreign investment flow, see OECD (1987) and OECD (1989).

important recipient region. The assets of foreign-owned corporations in the United States quadrupled during the 1980s, and their reported income is one-fourth of the income of domestically-owned corporations (OECD 1991a). A striking growth in foreign direct investments, especially in the form of FDIs to the United States, has been the result of Japanese expansion since the mid-70s. Meanwhile, the relative importance of foreign direct investment in accommodating external balances and compensating insufficient local capital markets has decreased. Indeed, foreign investments in the form of bank lending and security issues increased in importance, especially before the Latin American debt crisis starting in the early 1980s. Portfolio investments have recovered again since the latter half of the 1980s.

In Finland, internationalization of production and foreign direct investment began at larger scale in the beginning of 1980's. The share of FDI from domestic investment in private sector increased from 5 % in 1985 to 20 % in 1990. The share of FDI stock to GDP is, however, relatively moderate, namely 5 % of GDP in 1987 as compared to around 12 % in Sweden, 10 % in Germany or 22 % in Switzerland (Kinnunen, 1991).

Foreign direct investment to Finland have not followed equal rising path. At the same time, FDIs to Finland have been profitable with relatively high level of dividend repatriations, whereas dividend repatriations from FDI abroad were modest during 1980's. Portfolio investment to Finland have been rising after the capital market liberalization in the latter half of 1980's and especially in 1990's due to heavy public borrowing from abroad. Recent trend in public borrowing has been to substitute domestic for foreign borrowing.

2.3 Taxation of Foreign-Source Income

2.3.1 INTERNATIONAL TAXATION OF FOREIGN DIRECT INVESTMENT

Corporate income taxes ensure at least one-off taxation of final shareholders.

They are also considered necessary as withholding taxes on capital gains. Empirical estimations do not show definite results on an important relationship between corporate tax rate differentials and capital flows (Snoy, 1975, Caves, 1982, Alworth, 1988, and Slemrod, 1991, for a review) or dividend remittance (Kopits, 1972, and Hartman, 1980). The empirical implications, hence, remain so far ambiguous. [19] In the corporate taxation of subsidiary profits, the OECD Model Convention gives the primary jurisdiction position to the source country. The country of residence is the primary jurisdiction concerning other capital income (such as dividends, royalties and interest) going to non-residents (Bird, 1987). Corporate taxes are indeed mainly source-based, and personal capital income taxes residence-based. In corporate taxation, the residence state can subsequently treat profits of subsidiaries in a way that satisfies CEN.[20]

Table 1 presents the corporate tax systems in major OECD countries and the method of double taxation relief for 1995 (from Cnossen, 1995 p. 9, OECD, 1991a, and Alworth, 1988 p. 75). [21] Corporate tax rate CT applies to large corporations. The column labelled "total tax" T shows total tax on distributed profits depending on corporate tax rate, net of tax credits, and on the top marginal personal income tax rate PT, some cases with special personal taxes in distributions (countries with schedular PTs). The classical system gives no special treatment to distributed as opposed to undistributed dividends ($A = 0$), while under schedular lower personal taxes PT on dividends or under imputation system distributed earnings are taxed at a lower rate or taxes are partially or fully credited ($A > 0$). The last two columns give the international taxation of branches and subsidiaries: C and CN denote the tax credit system with and without deferral, respectively, and E describes the exemption method (for a description of the methods, see chapter 4). [22]

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[19] However, Guisinger et al. (1985, p. 6-8), who listed some of the basic investment incentives in LDCs, have, though, a strong result that two-thirds of foreign direct investment decisions under study were influenced by tax incentives.

[20] Cnossen (1987) suggests that the system proposed in the EC directive is conducive to CEN (EC Commission 1980). For Bird (1987), the objective of EC directives according to which 'production costs, the location of investment projects and the return on invested capital in the Member States are not influenced to unduly differing degrees by taxation...' (EC Commission 1980, p. 13) characterizes capital-import neutrality.

[21] For LDC-Developed Country tax relations, see e.g. Viherkenttä (1990), OECD (1990).

[22] No OECD country applies the deduction method except Norway, Portugal and Switzerland on income from non-treaty countries.

Table 1. Corporate taxes and double taxation relief 1995

Countries	CT [1],	PT [2]	A [3]	T total tax [4]	Tax relief	
					Branch	Subsidiary
		Classical system				
Luxembourg	39.4	51.3[a]	0	70.5	CN	C (E)
Netherlands	35	60	0	74	E(partial)	E (partial)
United States	39.2	44.6[a]	0	66.3	CN	C
		Schedular PT				
Belgium	40.2	61.2 (25.8)[a]	136	55.6	E (partial)	C,E(partial)
Denmark	34	64 (40)	129	60.4	CN	C (E)
Greece	35	40 (0)	124	35		C
Japan	51	65 (35)[a]	82	68.2	CN	C
Spain	35.3	56[f]	23	67.9	C	C
Sweden	30	30 (0)[a]	100	30	CN	C (E)
		Imputation or tax credit system				
Finland	25	57.5[a]	100	25	CN	C (E)
France	33	59.2[a]	100	59.2	E[c] (partial)	
Germany	53.3[b]	53	63	60.1	CN(E)[e]	C (E)[e]
Ireland	40-10[g],	48	50	58.4-50.6	CN	C (E)
Italy	52.2	51	69	58.9	CN(E)[d]	E(partial)[d]
UK	33	40	41	51.8	CN	C

1 SG–CTs are levied in Germany (15 %), Italy (16.2%), Japan (18.5%), Luxembourg (10%), United States (6.5%); average or representative rates are shown;

2 in parenthesis special PT in distributed profits;

3 relative dividend relief: $A = (T_{without\ relief} - T_{actual})/(T_{without\ relief} - T_{with\ full\ relief})$;

4 total tax $T = CT + PT(1 - CT)$ minus any credit if available.
C tax credit with deferral, CN tax credit without deferral, E exemption system, (E) under tax treaties usually provides for full exemption, in Finland in agreements made before 1976; (partial) in Belgium 90%, in France 95% and in Italy 60% of repatriated profits credited

a including local municipal taxes and special surcharges

b the effective rates shown in the table take account of the tax-exclusive, deductible SG-GT in the split rate system (50/30)

c in cases of foreign permanent establishments, foreign-source dividends and interest subject to credit system

d a refund of the excess foreign tax credit

e taxes paid abroad above the allowable credit deductible as expenses

f 10 % credit

g CT = 10, T = 50.6 apply to profits of qualifying manufacturing and service companies.

The general trend in recent years has been a cut-down of statutory tax rates on corporate income, while corporate tax base has evolved in a much less

uniform way. Corporate taxes CT range from 10% in Ireland to 53.3% in Germany. The Finland and Sweden have the lowest general rate (30 % corporate tax rate in Sweden, and 25 % rate in Finland) and United Kingdom and France have the second lowest general rate in EU area, namely 33%. The corporate tax system interacts with the personal income tax system except in Luxembourg and Netherlands, where the classical system applies ($A=0$) and corporates and shareholders are two separate entities. Belgium, Denmark, Greece, Spain, Sweden and Japan have lower special personal taxes in distributed profits.

The table shows that distributed profits are discriminated against compared with internal finance. A comparison of the total tax burden on shareholders (T in fourth column) and the corporate income tax rate (CT in first column) shows that almost all countries tax distributed profits at a higher rate than retained profits. A comparison of the total tax burden on dividends (T in fourth column) to the marginal personal tax rate (PT in second column) illuminates the effective tax burden using either equity finance or external debt finance. The lower the marginal personal tax rate and the relative proportion of it in total taxes, the higher the corporate tax burden and the relative benefits of debt finance that the company receives from interest-deductibility of interest expenses in corporate taxation. Debt finance is clearly treated more favourably, which weakens the equity position of firms. In the four largest member states of the European Union, which account for some 80% of the Union's GNP (France, Germany, United Kingdom, Italy), net dividend income as a percentage of distributed corporate source income varies between 39-48.2% (equal to 100 minus the percentage given in the fourth column). Exceptions to the higher taxation of dividend payments are made in Finland and Sweden, where retained earnings and dividends are taxed at the same rate.

Table 1 also shows the usual tax treatment of foreign-source branch and subsidiary income at the corporate level (last two columns). Tax credit without deferral is most common in the tax treatment of branches. In contrast, 9 out of 15 countries (consisting of 13 EU countries and 2 non-EU countries) exempt repatriated profits from subsidiaries. In order to avoid tax exempt repatriations from tax havens, an exemption system is often part of a bilateral

tax treaty. The exemption method and mutual cut-downs in withholding taxes significantly lower the taxes on border-crossing investments (see OECD, 1991a). Six countries follow tax credit with deferral, which has approximately the same effect as the exemption system. Besides corporate tax, the source state usually levies source withholding taxes on profits distributed to foreign parent companies. The philosophy is that the source state cannot impose a personal tax on the dividend income of an individual in his or her residence country. The most common rates vary from 0% to 15% (see Cnossen, 1995, p. 9). The withholding taxes discriminate both CEN and CIN because of the different treatment of foreign and domestic companies and shareholders.

2.3.2 INTERNATIONAL TAXATION OF PORTFOLIO INVESTMENT

In the taxation of international portfolio investment, residence-based taxation is most often applied, but withholding taxes at source are also implemented. [23] Source-based withholding taxes in the origin country ensure at least one time taxation. [24] In most European countries, residence criteria imply that capital income may - if the taxpayer so desires - be declared with general income taxation, in which case the source tax is credited and the residence criterion is fulfilled (especially when the recipient is a corporation). In the European Union, eight member countries apply this kind of system. On the other hand, withholding tax is a final tax in Italy (as in Turkey). In the three European Union countries that do not apply source taxation, the banks often have the

[23] This short presentation is based mainly on OECD (1991b), Price Waterhouse Corporate Taxes: A Worldwide Summary 1989, Cooper & Lybrand International Tax Network 1989, the International Bureau of Fiscal Documentation: Guide to European Taxation Vol I Taxation on Dividends, Royalties, Interest and Tax News Service 1989, and European Taxation (several volumes).

[24] Source-based taxation can also be avoided by means of international capital movements involving circulating the capital income through a country free from source taxes or through a country that gives a fixed compensation/credit for foreign taxes. To list some examples, in Holland a lender can utilize tax credit through an intermediary located there. The intermediary can often further deliver the interest income tax free to the original lender (or the tax on dividends is low, say 5 %, due to double taxation provisions). Another example is Belgium, which gives a tax-credit of 15 % irrespective of the actual withholding taxes paid.

duty automatically to advise the tax authorities of interest paid. This is the case in The Netherlands and Denmark (as in France and the United Kingdom, which may have withholding taxes). In Luxembourg, bank secrecy is secured and only dividends and other profit sharing are liable to source-based taxes.

The following table 2 describes the domestic source taxation of bonds and interest on deposits in the year 1991, unless otherwise indicated. [25] Bonds exclude those which are connected to profit distribution (in taxation often regarded as dividends, see section 2.3.1). In certain countries, taxation can differ from case to case depending on the date of issuance (e.g. Italy and France) and whether the receiver of the capital income is a private person or a corporation.

Table 2. Domestic Withholding Taxes on Residents

	Bonds	Bank deposits		Bonds	Bank deposits
Austria	10 %	10 %	Italy	10.8, 12.5, 30 %	15, 30 %
Belgium			Ireland	35 %	35 %
-individual	10 %	10 %	Luxemburg	–	–
-company	0, 10 %	0, 10 %	Netherlands	–	–
Denmark	–	–	Norway	–	–
Finland (1994)	25 %	25 %	Portugal	25 %	20 %
France	18.1 %	–	Spain	25 %	25 %
Germany (1993)	30 %	30 %	Sweden	30 %	30 %
Greece			Switzerland	35 %	35, 0 %
-private	progr. income tax + 3 %	–	Turkey	20 %	20 %
-company	25 %	–	United Kingdom	–	–
no permanent establishment	40 %	40 %	United States	–	–

As the table shows, source taxation of interest income is widely used, although there are important exceptions. The tax percentage varies from 0 % to 35 %. The tax rate is mostly the same for bonds and bank deposits, unless interest on bank deposits has been totally freed. No source principle of any kind is applied to interest income in The Netherlands and Luxemburg (in

[25] Mainly from OECD (1991b). More detailed information on capital income taxation in Europe is provided, for example, by international auditing companies such as Price Waterhouse and Touche Ross.

Germany before 1993). What is not shown in the table is that interest on small bank deposits can also be free of source tax. Therefore a system of exempting from source taxation is used more often than in the taxation of dividends.

Because of tax havens and various ways to avoid taxes in portfolio investment abroad, countries may agree to exempt foreigners from taxes. For such 'tax competition reasons', and because tax credits are often not complete, the most important West European countries have exempted from source tax interest paid on bonds to non-residents. This practice first used by the United States was followed by Germany (bonds issued 31.7. 1984 and later), France (bonds issued 1.10. 1984 and later) and Japan on YEN eurobonds (1.4. 1985 later). As far as the taxation of other interest payments to non-residents is concerned, there is no source-based tax in Denmark, Finland, Germany, The Netherlands and Norway. Thus, there are large incentives to increase capital flow for tax reasons and the "cross-hauling" of capital between countries. The Commission attempted to introduce a general withholding tax on capital income excluding Eurobonds in the EU area (EC Commission, 1989). [26] The proposal presented by the tax representatives of the council included a minimum source tax rate of 15 %, which would not be compulsory to those living outside the EU. Member countries with automatic information flow on interest paid from banks to the tax authorities are free from source taxation. The proposal was never accepted. [27] Questions concerning increased coordination and the exchange of information between the tax authorities of the source and residence countries are still open.

In Finland, the main rule for the taxation of royalties, dividends and interest from abroad is that they are subject to Finnish taxation and foreign taxes are credited. The upper limit for compensation is the tax for similar income in Finland (ordinary tax credit system). According to agreements between countries, foreign interest income can also be excluded from possible

[26] For the effects of various interest income proposals in the EC area, see Gardner (1992, p. 66-71).

[27] The ministers of Finance in the EC countries assessed the proposal of 13.2. 1986. Luxemburg and Great Britain were in general against the plan. France was strongly in favour of introducing the source tax. Germany was, at this stage, in favour of a 10 % source tax, but the introduction of it in the tax reform of 1.7.1989 was overruled. Thus, because of this changed attitude, the proposal did not go through.

foreign-source taxation and accordingly be normally taxable in Finland (as for UK, Netherlands, Ireland, Austria, Luxembourg, Sweden, Germany, Switzerland, Denmark, US where 6.10. 1986 agreement not ratified). The withholding tax on interest payments was set at 15 % for 1993, and now raised to 25 %. Interest income received from Finland is, under local legislation (TVL 9 §), exempt from taxation (see Vapaavuori, 1991, p. 61-103). In cross-border dividends, the residence countries of the share owners are divided into two categories depending on whether they apply an imputation tax credit system or not. Under a reciprocal tax agreement, Finland gives investment tax credit to shareholders resident in the United Kingdom and Ireland; a tax agreement between Finland and France has not yet been signed. When Finland does not grant imputation credit, international taxation is the same as with countries having the classical system. In the majority of cases, Finnish dividends bear company tax (36 % in 1992 and 25 % in 1993). In addition, double taxation agreements give the right to withhold source tax on dividends as follows (see Söderholm, 1992, 376-385): Austria (10 %), Belgium (5 %, 15 % ownership below 25 %), Denmark (0 %, 15 % ownership below 25%), France (no source tax), Germany (10 %, 15 % ownership below 25 %), Netherlands (0 %, 15 % ownership below 25 %), Norway (0 %, 15 % ownership below 25 %), Sweden (0 %, 15 % ownership below 25 %), Switzerland (0 %, 5 % ownership below 20%), US (5 % control of voting stock 10 %, 15 % in other cases).

2.4 Conclusions

The choice of CEN and CIN is sometimes claimed to be an artificial problem, compared with the national neutrality of taxes. Cnossen (1991, p. 13) states that 'the large country-specific differences in (tax) wedges indicate that domestic tax reforms to improve resource allocation are by no means less important than efforts at tax harmonisation in the Community'. Alworth (1988, p. 31) even takes the view that 'whilst these concepts of neutrality (CEN and CIN) are

useful in so far as the analysis remains at a high level of generality and assists in connecting the taxation of direct investment with more general welfare objectives, they suffer from numerous drawbacks as regards their practical usefulness to the extent that tax practices deviated from theoretical norms'.

My opinion is that CEN and CIN and related choice of residence or source criteria certainly remains an important issue that will also have lot to say about national neutrality of taxes. As section 2.1 showed, the basic choice of tax criteria is an interesting and partly unresolved issue in the theoretical literature. Residence criteria satisfy production efficiency. However, various listed "market imperfections" or administrative concerns can lead to the optimality of source criteria or mixed scheme of residence and source-based taxes. Section 2.3 shows that capital income taxes are likely to remain non-neutral and diverging. Table 1 showed a cut-down of statutory tax rates on corporate income, while corporate tax base has evolved in a much less uniform way. The disparate tax rates also raise the importance of tax criteria. Finally, in portfolio investment, residence-based taxation is most often applied, which does not imply that no source-based tax is also withheld. Table 2 inclines that source taxation of interest income is widely used.

3 Capital Income Taxation and Tax Criteria

3.1 Introduction

Part 3 contains three chapters dealing with capital income taxation and the choice of tax criteria under tax cooperation or competition.

I first examine in chapter 3.2 a double tax relief system when countries cooperate in their tax policies. In the model, optimal capital income tax policy relates to savings and investment behaviour. The choice of tax criteria also depends on whether pure profits are taxable in the economy and whether domestic taxes are arbitrary or not. The study provides a reconciliation between the Horst rule for arbitrary domestic taxes and Diamond–Mirrlees rule for pure rent taxes. The analysis has been carried out jointly with Professor Michael Keen, University of Essex (Keen and Piekkola, 1995).

Chapter 3.3 adapts overlapping-generations (OLG) model, where capital income tax distributes welfare between the older generation (capital income earners) and the younger (wage earners). This chapter is forthcoming in Journal of Economics (Piekkola 1995b). In previous section 3.2 tax revenues are used for additively separable public spending and marginal social cost of public funds is taken as given. In chapter 3.3 government tax revenues are distributed back to households and the marginal utility of government tax revenues depends on the income redistribution scheme. The model is, hence, an extension to chapter 3.2 including intergenerational welfare distribution objectives of capital income tax policy. I also consider tax competition among tax jurisdictions and how this will affect the efficient outcome of international taxation.

3.2 Simple Rules for the Optimal Taxation of International Capital Income

3.2.1 INTRODUCTION

With the growing importance of international capital movements, it is not surprising that increasing attention has been devoted to the optimal taxation of international capital income. What is surprising, however, is that this literature has paid relatively little attention to one of the most central optimal tax questions that naturally arises: the design of tax structures that are optimal from the perspective of the world as a whole. Many contributions have focussed instead on the design of tax systems that are optimal in terms of national self-interest rather than the collective good, often for small economies: this is true, for instance, of Feldstein and Hartman (1979), Gordon and Varian (1989) and Gordon (1992) and, more recently, of Bruce (1992), Huizinga (1995) and Huizinga and Nielsen (1995). Others have focussed on the comparison between polar alternative regimes – the residence and source principles – rather than attempting to characterize fully optimal schemes more generally: this is true, for instance, of Giovannini (1988, 1990).

There are two central results on the collectively optimal taxation of international capital income. One is that of Horst (1980), which builds on the work of Musgrave (1969). [1] Horst's argument, entirely informal, is that optimal taxation requires the social opportunity cost of capital – or, more concisely, the shadow price of capital – to be equated across countries. This shadow price is presumed to be a simple weighted average of the gross return to capital and the net return, with the weight reflecting the relative interest elasticities of savings and the demand for capital: intuitively, capital is valued at the gross rate of return to the extent that it contributes to capital used, and at

[1] See also Findlay (1986).

the net interest rate to the extent that it displaces savings. This rule has several appealingly simple implications: residence taxation is optimal, for example, if the supply of savings is fixed in each country, while source taxation is optimal if it is the demand for capital in each that is fixed. The second central result in the area is essentially an application of the Diamond-Mirrlees (1971) theorem, as developed by, for example, Razin and Sadka (1991a)[2]: if pure profits are fully taxed and there are no restrictions on the distorting tax instruments that can be deployed, then it is optimal to preserve production efficiency (equating pre-tax returns to capital across countries) by taxing on the residence basis. [3]

The Horst and Diamond-Mirrlees (DM) rules both have considerable intuitive appeal. But they cannot both invariably be right. The DM rule has the merit of being the solution to a formal optimisation problem. It rests, however, on an assumption of 100 per cent rent taxation which some might find less than convincing as an approximation to reality, so that it would be helpful to place both in a wider common framework.

The purpose of this section is to provide a relatively simple and general treatment of the collective optimal tax problem. Our aim in so doing is to encompass, clarify and, in particular, extend these previous results. A key feature of the analysis is allowance for restrictions on the ability to tax pure profits. As is well-known, the Diamond-Mirrlees theorem depends sensitively on an assumption that pure profits are fully taxed. Clearly too that will be optimal in the context with which we are concerned. But the practical difficulties of taxing pure profits are also well-known, so that consequences of an inability to do so merit more than passing attention.[4]

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[2] Razin and Sadka (1991a) show tax competition across small countries to lead to efficient residence-based taxation. Apel (1994) extends this to hold also for small identical countries that take world interest rate as endogenous, i.e. for large identical economies.

[3] Note that the reference here is not to the discussion of open economy issues in DM, but to their production efficiency theorem for the closed economy. Note too that that theorem is not precisely applicable to the problem here, since it presumes that all consumers face the same prices: this is not true here, since differential residence-based taxes mean that consumers in the two countries may face different intertemporal prices. But one would expect that such an expansion of the instrument set available to the government would leave the desirability of production efficiency intact, and this is indeed verified below

[4] Huizinga and Nielsen (1995) have recently drawn attention to the importance of such restrictions on profits taxation for problems of national welfare maximisation when pure profits may accrue to foreigners. Our concern here, it should be emphasised, is with the very

Using a standard two-country model of international investment, we start by characterising the optimal taxation of international income given arbitrary restrictions on all other possible tax instruments. It is then shown that the Horst rule emerges only if somewhat peculiar and unappealing restrictions are placed on the tax instruments available: specifically, it presumes that governments are entirely free to finance their expenditures by lump sum taxation but at the same time, for some unexplained reasons, are forced to tax domestic capital income. [5] That the logic of the Horst rule applied only in these strange circumstances – the optimal tax problem (from the collective perspective) being trivial, of course, if lump sum taxes can be used – seems to be becoming part of the folklore of the subject (see, for example, Keen, 1992), but, since the result remains a central reference in the area, the point perhaps deserves wider recognition.

A more natural and interesting optimal tax problem to consider is that which arises when lump sum taxation is precluded but all distorting taxes, domestic and international, are unconstrained. For this case we show that optimal policy can be characterised by a remarkably simple weighted average rule of the same general form as the Horst rule, but with different weights. These weights depend not only on savings and capital demand elasticities but also, and in particular, on the rates at which pure profits are taxed in the two countries. This structure leads to two main conlusions. The first is that while the Horst rule itself holds only under rather uninteresting restrictions, the insights to which it leads are very much more robust: essentially all the conclusions drawn by Horst concerning the relationship between the optimal taxation of international and the responsiveness of savings and capital demand continue to hold in these more compelling circumstances. The second is that the rates at which pure profits are taxed in the two countries has a powerful impact on the optimal international tax regime. It emerges, for example, that, other things being equal, a low tax on pure profits in the capital-importing country tilts the optimal tax regime for border-crossing income towards source

different issue of global efficiency, for which patterns of national ownership are irrelevant.

[5] Trivially, the result will of course, continue to apply if – as would be optimal – domestic capital income taxes are set to zero. But it is then clearly redundant.

criterion: intuitively, this is because there is then a case for source taxation as a proxy for rent. More generally, the optimal taxation of international capital income is seen to be driven not only by the elasticity considerations emphasised by Horst and subsequent authors but also, and potentially in large part, by the implications of capital movements for the effectiveness of imperfect taxes on pure profits. When pure profits are fully taxed, of course, these considerations vanish; and the Diamond-Mirrlees result then falls out very directly as a special case of this general weighted average rule.

Weighted average rules as a general principle of shadow princing are well known in optimal commodity taxation. For tax rates on capital and rent income the same but differing depending on the marginal excess burden of taxation in the otherwise similar countries, the study also suggests optimal international taxation as a weighted average of domestic and foreign capital income tax rates. This benchmark case gives a practical application of the general principle of shadow princing. Under an international double tax relief system rendered by capital-exporting country, the weight determines the share of foreign-source income entering the tax base and the share of foreign source-based capital income taxes credited.

The next section develops the model. Results are in section 3.2.3, and brief concluding remarks in section 3.2.4. Some of the analytics are cumbersome and uninstructive, and so confined to the Appendix 1.

3.2.2 THE MODEL

The world comprises two countries, with a single consumer in each, and lasts for two periods. The preferences of representative individual in home country are given by $U\{C_1, C_2\} + \mu()$, where $U\{\ \}$ is the well-behaved utility function over the first-period C_1 and second-period consumption C_2. $\mu()$ is total utility from (second-period) government spending. Utility is separable in consumption and government spending, which is taken as exogenous by consumers/investors. Periodical budget constraints are

$$C_1 = e_1 - S \tag{3.2.1}$$

$$C_2 = (1 - t_w)R + [1+r(1-t)]S\ , \tag{3.2.2}$$

where the rents R are later determined in eq. (3.2.5). Individuals in capital-importing country allocates first-period exogenous income e_1 to consumption C_1 and to domestic savings S. Second-period consumption consists of rent $(1 - t_w)R$ and capital incomes $[1+r(1-t)]S$, where t_w is the tax levied on rents and t is the tax levied on capital income. The indirect utility is given by

$$V(r_n, A) = max \left\{ U(C_1, C_2) \,\middle|\, C_1 + \frac{C_2}{1+r_n} = A \right\}. \tag{3.2.3}$$

Savings $S(r_n, A)$ are function of net return $r_n = r(1-t)$ and wealth $A(r_n, t_w, t) = e_1 + (1 - t_w)R / (1+r_n)$. Capital is non-depreciable and capital markets are perfect. Production function $f(k)$ is linear homogenous neoclassical type, where k is capital investment and satisfies $f_k > 0$ and $f_{kk} < 0$ on its first and second derivatives, as well as the Inada conditions $f_k(k) \rightarrow 0(\infty)$ for $k \rightarrow \infty(0)$. For a given labour supply, the production function exhibits decreasing returns to scale with respect to capital k. The FOC in investment decision is given by $f_k = r$. The domestic demand for capital by the corporate sector is a function of the rate of return:

$$k\left(\frac{r_n}{1-t}\right), \qquad k_r = \frac{1}{f_{kk}(1-t)} = -\frac{k}{r_n} e_r^k\ , \tag{3.2.4}$$

where we have used the convention of using subscripts to denote partial derivatives and where $e_r^k = - f_{kk}k / f_k$ is the interest elasticity of investment demand. The pure profits ('rents' for short) are determined by

$$R = f_k(k) - f_k k\ . \tag{3.2.5}$$

Consider home country to be capital importer:

$$S\,(\,r_n,\,A(r_n,\,t_w,\,t))\,=\,k\left(\frac{r_n}{1-t}\right)-\Delta\,, \tag{3.2.6}$$

where Δ is capital imports. Later analysis shows that savings and investment elasticities rather than whether the country is capital exporter or importer determines the optimal international tax rule (see proposition 2 later). (3.2.6) may be solved for r_n giving

$$r_n = (1-t)\,f_k\left[\,S(\,r_n,\,A(r_n,\,t_w,\,t))+\Delta\,\right]. \tag{3.2.7}$$

Define $e_r^S = r_n S_r / S$ as the compensated interest elasticity of savings and $e_A^S = A\,S_A / S$ and $e_r^A = r_n A_r / A$ as the wealth effects (see also later footnotes 8 and 9 for the integration of wealth effects into the final results). Making use of (3.2.6) and (3.2.7) [written as $dr_n/d\Delta = -\,(r_n/e_r^k k)\;dk/d\Delta$ and $e_r^S + e_A^S\,e_r^A = -\,e_r^k\,k/S\;-\;d\,\Delta/d\,r_n\;(r_n/S)$], define $\sigma = -\,dS\,/\,d\Delta$ as

$$\sigma \equiv -\,\frac{e_r^S + e_A^S\,e_r^A}{e_r^S + e_A^S\,e_r^A + e_r^k\dfrac{k}{S}}\,, \tag{3.2.8}$$

which in difference to Horst (1980) separates the wealth effects $e_A^S\,e_r^A$. Write $dr_n/d\Delta$ as:

$$\frac{d\,r_n}{d\,\Delta} = -\,\frac{r_n}{S}\,\frac{\sigma}{e_r^S + e_A^S\,e_r^A} \tag{3.2.9}$$

The periodical budget constraints for foreign country are given by

$$C_1^* = e_1^* - S^{H*} - \Delta \tag{3.2.10}$$

$$C_2^* = (1-t_w^*)R^* + [1+r^*(1-t^*)]S^{H*} + [1+r(1-t_N-t_A^*)]\Delta\,, \tag{3.2.11}$$

where foreign variables are represented with a star above a variable so that

S^{H*} is foreign-owned savings invested to foreign country and $R^* = f^* - f_k^* k^*$ is rent income. Capital moves until the net returns to investing at home and abroad are equated. For the foreign investor, this requires that [6]

$$r^*(1 - t^*) = r(1 - t_N - t_A^*)\,, \tag{3.2.12}$$

where t^* is the tax rate levied on foreign residents on their income there, t_N is the taxation of capital exports on the part of home capital-importing country and t_A^* is the taxation of capital exports on the part of foreign capital-exporting country. Substituting the capital arbitrage condition in (3.2.12) gives indirect utility function

$$V^*(r_n^*, A^*) = max\left\{ U(C_1^*, C_2^*) \,\middle|\, C_1^* + \frac{C_2^*}{1 + r_n^*} = A^* \right\}. \tag{3.2.13}$$

Savings supply $S^* = S^*(r_n^*, A^*)$ is a function of foreign after-tax return on savings $r_n^* = r^*(1 - t^*)$ and wealth $A^*(r_n^*, t_w^*, t^*) = e_1^* + (1 - t_w^*)R^*/(1+r_n^*)$. The investment decision for foreign firm is obvious. Foreign country is capital exporter $S^* = K^* + \Delta$, which together with $r_n^* = (1 - t^*)f_k^*$ imply that

$$\sigma^* \equiv \frac{dS^*}{d\Delta} = \frac{e_r^{S*} + e_A^{S*} e_r^{A*}}{e_r^{S*} + e_A^{S*} e_r^{A*} + e_r^{k*} \frac{k^*}{S^*}} \tag{3.2.14}$$

$$\frac{d\, r_n^*}{d\, \Delta} = \frac{r_n^*}{S^*} \frac{\sigma^*}{e_r^{S*} + e_A^{S*}\, e_r^{A*}} \tag{3.2.15}$$

where $e_r^{S*} = r_n^* S_r^*/S^*$, $e_A^{S*} = A^* S_A^*/S^*$, $e_r^{A*} = r_n^* A_r^*/A^*$. In what follows, the

[6] Equilibrium of course also entails another and similar arbitrage condition on the decisions of investors resident in the home country. But this imposes no further constraint on the optimisation problem, and so can be ignored, since two tax instruments additional to those already described – those beasing on incipient capital outflows from the capital-exporting country – can always be set so as to ensure that it is satisfied. For example, a discrimination of capital exports from foreign country (capital exporter here) associates with a favourable tax treatment of co-existing capital imports to foreign country.

analysis of wealth effects S_A, S_A^* is delegated to footnotes. It is seen from footnotes 8 and 9 that wealth effects alter weights in the shown weighted average rule rather than controverting the rule itself. Uncompensated savings elasticity e_r^S should be in the final formula (3.2.22) replaced by a term $e_r^S + \frac{(A - e_1)}{A} e_A^S \; x$, where $x = \left(e_r^S - \frac{R(1-t)}{S(1+r_n)} e_r^k \right) / \left(\frac{R(1-t)}{S\, r_n} e_r^k - \frac{A - e_1}{A} e_A^S \right)$ (see footnote 8).

Government tax revenues are respectively for home and foreign country written as

$$\begin{aligned} g &= t_w R + t f_k S + t_N f_k \Delta + M \\ &= f(k) - (1 - t_w)R - r_n S - f_k(1 - t_N)\Delta + M \end{aligned} \qquad (3.2.16)$$

$$\begin{aligned} g^* &= t_w^* R^* + t^* f_k^* S^* + t_A^* f_h \Delta - M \\ &= f^*(k^*) - (1 - t_w^*)R^* - r_n^* S^* + f_k^*(1 - t^*)\Delta + t_A^* f_k \Delta - M \,, \end{aligned} \qquad (3.2.17)$$

where second equalities make use of (3.2.5) and (3.2.6) and respective ones for foreign country. Lump sum transfers across tax jurisdictions M are chosen so as to equate the marginal utility of tax revenues in the countries (see 3.2.20). Government tax revenues can be considered for world as a whole. A consolidated budget constraint for tax revenues from home and foreign countries is written as

$$G = f(k) - (1 - t_w)R - r_n S + f^*(k^*) - (1 - t_w^*)R^* - r_n^* S^* \,, \qquad (3.2.18)$$

where used have been made of arbitrage condition (3.2.12). International investment and the taxation of them do not directly enter the consolidated budget constraint.

Savings in the foreign country are allocated abroad until arbitrage condition $(1 - t^*) f_k^* \left[S^*(r_n^*, A^*(r_n^*, t_w^*, t^*)) - \Delta \right] = (1 - t_N - t_A^*) f_k \left[S(r_n, A(r_n, t_w, t)) + \Delta \right]$ is satisfied. This together with $r_n(\Delta, t, t_w)$ and $r_n^*(\Delta, t^*, t_w^*)$ implies that capital imports $\Delta(t_N, t_A^*, t^*, t, t_w, t_w^*)$ can be written as a function

of tax parameters. Rent taxes t_w and t_w^* are taken as fixed throughout the analysis. [7] The indirect utility function $V(r_n(\Delta, t),\ A(r_n(\Delta, t), t))$ from (3.2.3) is written as $V[\Delta(t_N, t_A^*,\ t, t^*), t]$ as a function of tax parameters, and respectively for the foreign country (suppressing t_w and t_w^*). The maximization problem for global welfare is given by:

$$\underset{M,\, t_N,\, t_A^*,\, t,\, t^*}{Max} \quad V[\Delta(t_N, t_A^*,\ t, t^*), t] + V^*[\Delta(t_N, t_A^*, t, t^*), t^*] + \mu(g) + \mu^*(g^*), \tag{3.2.19}$$

where $\mu(g) + \mu^*(g^*)$ is total utility from public consumption. The first-order conditions for the global optimum in terms of lump sum transfers, M, optimal international taxation, t_N, t_A^* and domestic tax rates, t, t^* are given by

$$M: \quad \mu' g_M - \mu^{*'} g_M^* = 0 \tag{3.2.20}$$

$$t_N: \quad \left(V_\Delta + V_\Delta^* + \mu' g_\Delta + \mu^{*'} g_\Delta^*\right) \frac{d\Delta}{dt_N} + \mu' f_k \Delta = 0 \tag{3.2.21}$$

$$t_A^*: \quad \left(V_\Delta + V_\Delta^* + \mu' g_\Delta + \mu^{*'} g_\Delta^*\right) \frac{d\Delta}{dt_A^*} + \mu^{*'} f_k \Delta = 0 \tag{3.2.22}$$

$$t: \quad V_t + \mu' g_t + \left(V_\Delta + V_\Delta^* + \mu' g_\Delta + \mu^{*'} g_\Delta^*\right) \frac{d\Delta}{dt} = 0 \tag{3.2.23}$$

$$t^* \quad V_{t^*}^* + \mu^{*'} g_{t^*}^* + \left(V_\Delta + V_\Delta^* + \mu' g_\Delta + \mu^{*'} g_\Delta^*\right) \frac{d\Delta}{dt^*} = 0. \tag{3.2.24}$$

Lump sum transfers equalize the marginal utility of tax revenues $\mu' = \mu^{*'}$ since $g_M = -g_M^*$ and term $\mu' g_\Delta + \mu^{*'} g_\Delta^*$ can also be written as $\mu' G_\Delta$, where G is from (3.2.18). Eqs. (3.2.20), (3.2.21) and (3.2.22) yield the optimal total international tax, where total international tax $t_N + t_A^*$ has only an indirect

[7] For the problems with which we are concerned, it will always be optimal to tax rents as heavily as possible; thus one might equally well have taken t_w and t_w^* as being objects of choice but subject to an upper bound.

effect on welfare via capital flows. The shadow price of capital for foregone capital investment in the foreign capital-exporting country equals the shadow price of capital imports in the home country:

$$V_\Delta + V_\Delta^* + \mu' G_\Delta = V_r \frac{dr_n}{d\Delta} + V_r^* \frac{dr_n^*}{d\Delta} + \mu' G_\Delta = 0 \,. \qquad (3.2.25)$$

The indirect effect depends on the change in net returns and government tax revenues (see the Appendix 1). This together with capital arbitrage condition (3.2.12) determines the optimal international taxation relative to domestic one (as shown later).

3.2.3 SIMPLE RULES

Consider first international tax regime when capital income tax rates t and t^* are arbitrary. Eq. (3.2.25) is shown in the Appendix 1 to imply that:

PROPOSITION 1: *For arbitrary domestic taxes t and t^*, the optimal taxation of international capital income $t_N + t_A^*$ requires that:*

$$f_k (1-\sigma) + r_n \sigma + \gamma \left(tS - t_w k + \Delta \right) \frac{d r_n}{d\Delta} / (1-t) = \qquad (3.2.26)$$

$$f_k^* (1-\sigma^*) + r_n^* \sigma^* - \gamma^* \left(t^* S^* - t_w^* k^* - \Delta \right) \frac{d r_n^*}{d\Delta} / (1-t^*) \,,$$

where $\gamma \equiv (\mu' - V_A/(1+r_n))/\mu'$, $\gamma^* \equiv (\mu' - V_A^*/(1+r_n^*))/\mu'$ and

where σ and σ^* are given in (3.2.8) and (3.2.14), $dr_n/d\Delta$ and $dr_n^*/d\Delta$ are given in (3.2.9) and (3.2.14). The first two terms correspond exactly to the Horst rule: a unit of capital imports into the home country increases capital employed there by $1-\sigma$ and reduces domestic savings by σ; valuing the

former at the producer price f_k and the latter at the consumer price r_n then gives the Horst weighted average. But Proposition 1 shows that these are not, in general, the only effects to consider. [8] The third term in (3.2.26) captures the marginal impact of capital imports on the welfare cost of the pre-existing distortionary tax structure. To see this, note first that γ measures the social value of a lump sum transfer from the home consumer to the home government, which one would typically expect to be non-negative; somewhat loosely, γ can thus be thought of as a measure of the marginal excess burden of the tax system. The third term in (3.2.26) can then be thought of as valuing the impact on government revenues of the change $d\, r_n/d\, \Delta\ /\ (1-t)$ in the gross return to capital induced by a unit of capital imports: a unit increase in the gross return raises revenues from the tax on domestic savings by tS, reduces receipts from the rent tax by $t_w\, k$ and raises the tax base represented by capital imports by Δ.

As a special case, with γ, $\gamma^* = 0$, (3.2.26) gives

COROLLARY 1: *The Horst rule applies when each government deploys optimal lump sum taxes:* [9]

$$f_k\,(1-\sigma) + r_n\,\sigma \;=\; f_k^*\,(1-\sigma^*) + r_n^*\,\sigma^* \qquad (3.2.27)$$

This is exactly the Horst rule. Corollary 1 also makes it clear that the Horst rule is, in turn, simply an application of a general principle of shadow princing: in general, shadow prices are weighted averages of consumer and producer prices only when lump sum taxes are optimally deployed (see, for example, Dréze and Stern, 1987). Horst rule (3.2.1) and international capital arbitrage condition (3.2.12) give for the optimal international taxation: [10]

[8] It is easily seen that the third term disappears if $t_w = t\,S\,/\,k$, but this will hold only fortuitously.

[9] The assumption that $S_A = 0$ plays a role here. With non-zero wealth effects, it is generally not optimal to take lump sum taxes to the point at which $\gamma = 0$.

$$T = \lambda \frac{\sigma}{\sigma^*} t + (1-\lambda)t^*, \tag{3.2.28}$$

where $$\lambda \equiv \frac{\sigma^*(1-t^*)}{1-t^*\sigma^*}.$$

It is seen that international taxation is a weighted average of tax rates in capital-importing and exporting countries for equal investment and savings elasticities and zero international investment to begin with, giving $\sigma = \sigma^*$. Then, λt shows the tax level implied by capital income tax t in capital-importing country. $(1-\lambda)\, t^*$ shows the tax level implied by capital income tax t^* in capital-exporting country. International taxation depends on the level of international investment, since the weight σ^* is sensitive to this.

Optimal tax design is, of course, essentially trivial if lump sum taxes are available. Suppose then that such taxes cannot be deployed, but that the domestic taxes t and t^* are unconstrained (rather than, as in Proposition 1, fixed at arbitrary levels). The FOC for optimal domestic tax rate (3.2.23) reduces, using (3.2.20) and (3.2.25), to

$$V_t + \mu' g_t = 0, \tag{3.2.29}$$

and equivalently for the tax rate in capital-exporting country. Optimal domestic tax rates are such that capital imports $\Delta\,(t_N, t_A^*, t, t^*)$ may be taken as given since capital imports are already at optimum. FOCs are shown in the Appendix 1 to yield

$$\frac{t}{1-t} = \gamma \left[\frac{1}{e_r^S} + \frac{1-t_w}{1-t} \frac{1}{e_r^k} \right] \tag{3.2.30}$$

$$\frac{t^*}{1-t^*} = \gamma^* \left[\frac{1}{e_r^{*S}} + \frac{1-t_w^*}{1-t^*} \frac{1}{e_r^{k*}} \right]. \tag{3.2.31}$$

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[10] Horst (1980) writes this in our notations as $T = t^* - \frac{(1-t^*)[\sigma^*(t^*-t)+t(\sigma^*-\sigma)]}{1-\sigma^* t^*}$.

Capital income taxes are characterised by inverse elasticity rules of a standard kind (analogous to the optimal taxation of consumption in Pigou, 1947); taxes are inversely related to tax-adjusted averages of savings and investment elasticities. [11] Domestic capital income taxation are as in a closed economy if savings and investment elasticities and marginal excess burdens of the tax systems were the same. In reality, elasticities may vary depending on the openness of the economy. For the international tax regime, the Appendix 1 shows that:

PROPOSITION 2: *When t and t^* are optimally chosen, then the optimal international tax regime satisfies the weighted average rule:* [12]

$$f_k(1-z) + r_n z = f_k^*(1-z^*) + r_n^* z^*, \quad \text{where} \qquad (3.2.32)$$

$$z = \frac{(1-t_w)e_r^S}{(1-t_w)e_r^S + (1-t)e_r^k} \text{ and } z^* \text{ is analogous.}$$

Efficient taxation of domestic savings restores double tax relief close to original weighted average rule of Horst. However, the intuition behind the formula as well as the weights are different. According to Horst formula, capital is valued at the gross rate of return when it contributes to capital used and at the net interest rate to the extent that it displaces savings. According to the formula that considers international tax issue together with optimal domestic tax policy, only savings in misallocation of capital across countries is important (see A1.15 in the Appendix 1). Changes in net return on savings due to international investment have marginally no welfare effects since savings are

[11] The closed form solution for t is from (3.2.30) written as $t = \frac{\gamma + e_r^S}{\gamma e_r^S}\left[\frac{1}{e_r^S} + \frac{1-t_w}{e_r^k}\right]$.

[12] In more general case with $e_A^S = AS_A/S \neq 0$, the equations for equal shadow prices of capital are written as $f_k(1-z) + r_n z = f_k^*(1-z^*) + r_n^* z^*$, $z = (1-t_w)\left[e_r^S + \frac{A-e_1}{A} e_A^S\, x\right] / (1-t_w)\left[e_r^S + \frac{A-e_1}{A} e_A^S\, x + (1-t)e_r^k\right]$, where $x = \left(e_r^S - \frac{R(1-t)}{S(1+r_n)} e_r^k\right) / \left(\frac{R(1-t)}{S\, r_n} e_r^k - \frac{A-e_1}{A} e_A^S\right)$ and z^* is equivalent. The derivations are obtainable from the author. Wealth effects are not clear a priori, since capital income tax not only reduces second-period after-tax investment income, $A_t < 0$, but also discount rate of future investment income, $A_r < 0$.

in optimum. Capital used for investment is, however, valued at net return to the degree that rent income is not taxed. The weight depends besides on savings and investment behaviour also on the relative taxation of capital and rent incomes that affect income received by investors, but is independent of the level of international investment as Horst rule. One final difference is that the weight in Horst rule assumes uncompensated savings elasticity, while (3.2.32) is derived for compensated savings elasticity (abstracting from any wealth effects). Footnote 8 shows the formula with wealth effects.

Consider the explicit formula for optimal total international taxation of international investments $T = t_N + t_A^*$. The shadow price of international investment satisfying a weighted average rule (3.2.32) and capital arbitrage condition (3.2.12) yield: [13]

$$1 - T = \frac{z}{z^*}\lambda(1-t) + \frac{1-z}{1-z^*}(1-\lambda)(1-t^*), \tag{3.2.33}$$

which can be after some manipulation written as

$$T = \frac{z}{z^*}\lambda t + (1-\lambda)t^*, \tag{3.2.34}$$

where $$\lambda = \frac{z^*(1-t^*)}{1-t^*z^*} = \frac{(1-t_w^*)e_r^{S*}}{e_r^{K*} + (1-t_w^*)e_r^{S*}}.$$

It is clear that – just as with the Horst rule – the elasticities of the demand for capital and the supply of savings in the two countries are critical in determining the optimal tax structure. Indeed, all of Horst's influential conclusions regarding optimal tax structures, where these elasticities take extreme values continue to hold: residence-based taxation is optimal if savings

[13] In more general case with $e_A^S = AS_A/S \neq 0$, the weight is given by $\lambda = z^*(1-t^*)/(1-t^*z^*)$, where z and z^* are given in footnote 9. Hence, the wealth effects shift double tax relief towards source criteria when $\frac{A-e_1}{A}\frac{S\,r_n}{R(1-t)}\,e_A^S < e_r^k < \frac{S(1+r_n)}{R(1-t)}\,e_r^S$ (see footnote 8). Note that opposite happens when investments are highly elastic relative to savings.

are completly inelastic in both countries (z, $z^* = 0$), an exemption system is optimal if investments are completely inelastic (z, $z^* = 1$), whilst deduction is optimal if savings are inelastic in the capital-exporting country and the demand for capital inelastic in the capital importer ($z = 1$, $z^* = 0$ and $T = t + t^*(1 - t)$).[14]

But proposition 2 shows that the optimal tax structure is now also critically dependent on a set of considerations that does not appear in the Horst rule: the rates at which rents in the two countries are taxed. To bring out the precise role that they play, consider first the rent tax in the capital-importing (home) country and (3.2.33) written in the form

$$1 - T = \frac{z}{1 - z^* t^*}(1 - t^*)(1 - t) + \frac{1 - z}{1 - z^* t^*}(1 - t^*) . \qquad (3.2.35)$$

Other things being equal, [15] a reduction in t_w (higher z) shifts the balance in (3.2.35) towards a deduction system – and, in that sense, toward a stronger element of source taxation, and increases the combined tax rate T on border-crossing income. The intuition is straightforward: the less heavily rents are taxed in the capital-importing country, the greater the attractions encouraging capital to flow there. The rent tax in the capital-exporting country, on the other hand, affects the level of taxation on border-crossing income more markedly than it does the structure: other things equal, a reduction in t_w^* (higher z^*) increases the optimal tax rate on border-crossing income. The intuition is again straightforward: a low tax on rents in the capital-exporting country decreases the social value of stemming capital outflows from it.

As a corollary, and for completeness:

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[14] A system, that is, under which the residence country applies its domestic tax rate to income from abroad net of foreign taxes. Deduction system is, in fact, an extreme case of more general rule that less elastic investment demand in capital-importing country implies higher weight to taxes paid in capital-importing country.

[15] This, of course, is a fiction: changes in the rates at which rents are taxed will typically induce changes, for example, in the values taken by the various interest elasticities at the optimum. The argument here is informal.

COROLLARY 2: *(Diamond-Mirrlees): When rents are taxed at 100 per cent in both countries – as is indeed optimal – then the residence principle is optimal.*

Rent taxation is a more efficient device for taxing investment income than source-based tax that is an indirect tax on rents distorting investment decision.

Consider, finally, the case, where domestic z and foreign z^* coincide and are between zero and one. This may happen coincidently or when savings and investment elasticities are the same and rent and capital incomes are taxed at uniform rates that may differ depending on the marginal excess burden of the tax systems. International taxation is from (3.2.34) a weighted average of domestic and foreign capital income tax levels depending on the weight λ. Consider investments more sensitive to the taxation of them. Capital income tax levels are lower from (3.2.30) and (3.2.31). The shadow price of capital is higher, as seen from (3.2.32). The weight given to the tax rate in capital-exporting country is higher and double tax relief system is more close to residence criteria. Total tax on international investment decreases if marginal excess burden of the tax system and, hence, tax level is lower in capital-exporting than in capital-importing country ($\gamma^* < \gamma$ and $t^* < t$).

In this benchmark case considered (where $z = z^*$), capital-exporting country may apply an equal double tax relief system with respect to all capital importing countries. The weight λ only depends on taxes in capital-exporting country. The fears expressed in OECD (1991b, p. 39) that tax criteria in a mixed scheme would depend on the tax levels in capital-importing countries are allayed. Double tax relief is also independent of the level of international investment. If international investment level and international taxation were interrelated, world interest rate might be more easily manipulated to improve terms of trade.

Practical application of the weighted average rule depends on the allocation of international tax revenues across countries. [16] The system is most

[16] This will also affect marginal value of tax revenues across countries, unless lump sum tax revenue transfers are assumed, as here.

straightforward when capital importer does not tax differently domestic and foreign investment in its area and $t_N = t$. Under an international double tax relief system rendered by capital-exporting country, the weight $1 - \lambda$ determines the share of foreign-source income entering the tax base and the share of foreign source-based capital income taxes credited. The method is similar to the most usual indirect tax credit method in corporate taxation: the grossed-up dividends method (see Alworth, 1988). The weight given to capital income taxes in capital-exporting country country – corresponding to the value obtained for gross dividends – income ratio in grossed-up method – determines both the taxable income and the allowable credit by capital-exporting country.

3.2.4 CONCLUDING REMARKS

Recent years have seen increasing concern, in the European Union and elsewhere, that some form of international coordination of taxes on capital income may be appropriate. It would therefore be desirable to have a clear understanding of what form such coordination could usefully take. This section has clarified the relationship between two apparently very different view on this – the Horst rule and the Diamond-Mirrlees theorem – and, in particular, developed a more general set of results that encompass both as special cases. Efficient taxation of domestic savings reestablishes double tax relief which is close to original weighted average rule of Horst. However, the weights are different. They depend besides on savings and investment behaviour crucially also on the relative taxation of capital and rent incomes.

3.3 Capital Income Taxation, Tax Criteria and Intergenerational Welfare

3.3.1 INTRODUCTION

This chapter examines optimal capital income taxation in open economies considered, among others, in Giovannini (1989), Horst (1980), Razin and Sadka (1991a), Gordon (1992), Bruce (1992), Huizinga and Nielsen (1995) and in chapter 3.2. The domestic capital income tax and intergenerational income transfer policy is examined alongside international taxation of assets. I adapt a two-period overlapping-generations (OLG) model. The intergenerational transfer process provides a way to convert consumption at old age into consumption at a young age at a rate of population growth. This is intertemporally efficient in the dynamically efficient economy considered, where capital intensity is below the golden rule, and opposite to a pay-as-you-go social security system. [1, 2]

The starting point for the literature on optimal capital income taxation is Diamond-Mirrlees (1970) production efficiency theorem. If pure profits are taxed at 100 percent and there is perfect competition and no constraints on the other tax instruments the government may use, the taxation of savings (residence criteria) should be preferred over the taxation of investment (source criteria). The optimal tax structure maximizes output, which is then dispersed between consumption and government spending. Here, the extension is that the marginal utility of government tax revenues depends on the income redistribution scheme. Intergenerational welfare distribution from old to young takes place optimally using lump sum transfers. This is always superior to using source-based capital income subsidies on domestic investment, as in

[1] For dynamic inefficiency with situations of oversaving, see Phelps (1965) and Koopmans (1965).

[2] A bequest motive on the part of the younger generation is required to support the retired older generation (for other alternatives, see Verbon, 1988).

Dutton (1986). Currently, the old do not benefit from the tax scheme in operation when they were young. Hence, international taxation with transfers to the young is not Pareto improving. Keuschnigg (1994) analyses personal and corporate taxes with intergenerational neutrality so that each succeeding older generation, including the current one, is compensated for the income effects. He does not, however, evaluate the choice of tax criteria.

Besides tax cooperation, I also consider a tax competitive solution. Nielsen and Huizinga (1995) examine incentive to indirectly tax pure profits accruing to foreign country by levying source-based taxes on investment. Otherwise, under taxation of all pure profits accruing to home country, residence-based taxation is optimal and Apel (1994) shows that the tax rate does not depend on whether countries cooperate or not. He implicitly assumes current account balance in the equilibrium; imbalance would give outcomes analogous to the optimal tariff theory in international trade (see also Kemp 1962 and Findlay, 1986). Feldstein and Hartman (1979) also show that capital-exporting country may tax capital exports at higher rate when it is Stackelberg leader and marginal foreign investment lowers average returns in host country. Empirical evidence about world interest rate or terms-of-trade manipulation is, however, not very persuasive. Gordon (1992) notes that capital-exporting countries do not typically have higher levels of capital income taxes than capital importers. [3] Finally, under no taxation of pure profits, a mixed scheme of residence and source-based taxation is required to control both consumer and producer prices. Bucovetsky and Wilson (1991), show that a symmetric Nash equilibrium under the mixed scheme is efficient.

It is shown that if lump sum taxes on old are not possible, the revenue for intergenerational lump sum transfers to younger generation should be raised from capital income taxation based on residence criteria. It is noteworthy that the optimality of residence criteria does not require 100 per cent first-period wage income taxation, equivalent under exogenous labour supply to the taxation of pure rents in Diamond-Mirrlees (1970) production efficiency

[3] Gordon and Bovenberg (1994) later note that empirical studies on the relationship between budget deficit, market interest rate and the current account position of some economies give some evidence of terms-of-trade manipulation (Caprio-Howard, 1984, Summers, 1988, Bayoumi, 1990).

theorem. Countries should adhere to residence principle and refrain from imposing source-based taxes even if wage income is not fully taxed away.

Optimal policy refers to maximization of steady-state utility. Pareto-improving policy by intergenerational transfers to old to compensate the transitory effects, as in Keuschnigg (1990), is not possible in the model described here. First-born old generation cannot be fully compensated for the income effects. An intergenerational neutrality objective may, however, necessitate some tax revenue compensation to the older generation. Domestic capital income tax rate depends besides on savings (as a residence-based tax) also on domestic investment behaviour. Surprisingly, domestic capital income tax level is positively related to investment elasticity. The tax burden on capital income is higher when investment is more sensitive to taxation of its return; thereby a relatively greater share of taxes will be born by old generation. In contrast, in a two-period model considered in chapter 3.2 with no consideration of equity aspects of capital income taxation, the distortions created in investment decision, because of higher investment elasticity, lower the optimal capital income tax level.

In international taxation, consider the benchmark case of countries otherwise identical except in dynamic efficiency. One can show that international taxation follows a weighted average of domestic and foreign capital income tax rates provided that capital and wage tax rates in each country are harmonised. A country with high investment elasticity ascribes a low weight to the high domestic capital income tax rate in its country to improve allocation of capital across countries. The effect on total international tax of higher investment elasticity remains ambiguous since capital income tax rate is higher while the weight attached to it is lower.

I consider tax competition restricting capital income tax instruments available to the government by assuming a mixed scheme of residence and source-based tax/subsidies. This avoids non-discrimination of foreign investment. Tax policy is shown the same in a Nash equilibrium of the residence-based and source-based tax/subsidy scheme and under tax cooperation with no restriction in the domestic and international tax policy if

countries are small, hence not manipulating terms-of-trade, or if large countries are identical. The large country result is similar to that derived in Bucovetsky and Wilson (1991), which shows efficiency of a symmetric Nash equilibrium. It is also shown that tax cooperation solutions with a mixed scheme or with no restriction in the choice of capital income tax instruments are different. In a mixed scheme, domestic capital income tax is not determined in separate from international taxation as under tax cooperation with no restriction in tax instruments.

A global model that incorporates taxation under both principles concerned is presented in section 3.3.2. Section 3.3.3 considers capital income taxes under tax cooperation, and section 3.3.4 a mixed scheme of residence- and source-based tax/subsidies. Section 3.3.5 concludes the paper.

3.3.2 THE OLG MODEL

The overlapping-generations two-country model is adapted from Buiter (1981). The economies are composed of a consumption sector, a production sector and a public sector (see also Diamond, 1965, Persson, 1985, and Sørensen, 1991).

Consumption

Consider the consumption decision undertaken by the younger generation in the home capital-importing country. The population grows at an exogenous rate n, and all variables are written in per capita terms. A generation born in period t supplying labour exogenously allocates income from production (wages) w_t to consumption C_t^t and to domestic savings S_t^H (the possibility to invest abroad in capital-importing country is considered in the end of section 3.3.3). Lump-sum transfers are g_t^t while young and g_{t+1}^t while old. Lifetime utility from private consumption depends on consumption while young C_t^t and on consumption during old age C_{t+1}^t. The periodical budget constraints for a representative household in the home country are

$$C_t^t = (1 - t_w)w_t - S_t^H + g_t^t \tag{3.3.1}$$

$$C_{t+1}^t = S_t^H(1+r_{t+1}(1-t)) + g_{t+1}^t , \tag{3.3.2}$$

where t_w is the lump-sum tax on wage income (or to the sum of wage and pure profits under exogenous labour supply) and t is the capital income tax on domestic savings. I am assuming quasilinear preferences in order to abstract from the analysis any wealth effects that the compensation scheme has on savings. Indirect utility is given by

$$V^t(r_{t+1}(1-t), A^t) = max\left\{C_t^t + U(C_{t+1}^t) \,\middle|\, C_t^t + \frac{C_{t+1}^t}{1 + r_{t+1}(1-t)} = A^t\right\}, \tag{3.3.3}$$

where the elasticity of second-period marginal utility $-U_{CC}\, C_{t+1}^t / U_C$, $U_C = \partial U(C_{t+1}^t)/\partial C_{t+1}^t$, is assumed constant. Wealth $A^t(r_{t+1}(1-t), t_w, t) = (1 - t_w)w_t + g_t^t + g_{t+1}^t/(1+r_{t+1}(1-t))$ includes lump-sum transfers from the government, later to be defined (see 3.3.17). In the maximization of only one generation's utility, each older generation excludes the welfare of the next generation from its utility function. This excludes the "charity-begins-at-home" motive and voluntary private bequests given by the old to the succeeding young generation (see Veall, 1986, and Verbon, 1988, for such an analysis). For the home country, savings supply $S\ (r(1-t))$ is a function of after-tax return and not a function of wealth, where I have dropped subscript to describe the time period. [4] As discussed, due to the assumption of the quasilinear utility function, tax policies have zero wealth effects on the savings (for the dynamics of the model, see section 3.3.4.2). The periodical budget constraints for the foreign country are given by

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[4] Interest elasticity of savings $e_r^S = r_n S_r / S$ is $\frac{r_n}{1+r_n}(1-s)\left(\frac{\varepsilon}{1-s} - \eta\right)$, where $s = C_2/A(1+r_n)$ is the savings rate, C_2 is second-period consumption, $\varepsilon = -\frac{C_2}{S(1+r_n)}\frac{U_{CC}C_2}{U_C}$ is the intertemporal substitution elasticity, and $\eta = A/C_1$ is the wealth elasticity of first-period consumption C_1 (see Atkinson and Stiglitz, 1980).

$$C_t^{t*} = (1 - t_w^*)w_t^* - S_t^{*F} - \Delta_{t+1}(1+n) + g_t^{t*} \tag{3.3.4}$$

$$C_{t+1}^{t*} = [1+r_{t+1}^*(1 - t^*)]S_t^{*F} + [1+r_{t+1}(1 - t_N - t_A^*)]\Delta_{t+1}(1+n) + g_{t+1}^{t*}, \tag{3.3.5}$$

where foreign variables are represented with a star above a variable so that S_t^{*F} is foreign-owned savings invested in the foreign country. n is exogenous population growth and Δ_{t+1} is capital exports or foreign savings allocated to the home country in terms of the population born in period t+1. The capital arbitrage condition is given by

$$r_{t+1}^*(1 - t^*) = r_{t+1}(1 - t_N - t_A^*)\,, \tag{3.3.6}$$

where t^* is the tax rate levied on foreign residents on their income there, t_N is the taxation of capital exports on the part of the home capital-importing country and t_A^* is such taxation on the part of the foreign capital-exporting country. Substituting arbitrage condition (3.3.6) in (3.3.5) gives the indirect utility function

$$V^{t*}(r_{t+1}^*(1-t^*), A^{t*}) = max\left\{ C_t^{t*} + U(C_{t+1}^{t*}) \,\middle|\, C_t^{t*} + \frac{C_{t+1}^{t*}}{r_{t+1}^*(1 - t^*)} = A^{t*} \right\}, \tag{3.3.7}$$

where $A^{t*}(r_{t+1}^*(1 - t^*), t_w^*, t^*) = (1 - t_w^*)w_t^* + g_t^{t*} + g_{t+1}^{t*}/(1+r_{t+1}^*(1-t^*))$ is wealth.

Production and Capital Market

Production technology is assumed to be of the linear homogenous neoclassical type. In its intensive form, total production $f(k)$ offers capital-per-labour ratio k as an argument ($k = K/L$, where K is capital stock and L is inelastic labour supply), and satisfies $f_k > 0$ and $f_{kk} < 0$ on its first and second derivatives, as well as the Inada conditions $f_k(k) \to 0(\infty)$ for $k \to \infty(0)$. For a given labour supply, the production function exhibits decreasing returns to scale with respect to the capital-per-labour ratio k. Under the assumption of no

depreciation of capital, the user cost of finance from borrowing for the domestic investment and wage rates are given by (dropping the subscripts)

$$f_k = r. \tag{3.3.8}$$

$$w = f(k) - f_k k\,, \qquad w_r = -k\,. \tag{3.3.9}$$

The tax base is neutral concerning the marginal product of capital. The analysis that follows ignores corporate taxation altogether. The domestic demand for capital by the corporate sector is a function of the rate of return:

$$k\left(\frac{r_n}{1-t}\right), \qquad e_r^k = -\frac{r}{k}\frac{1}{f_{kk}} > 0, \tag{3.3.10}$$

where $r_n = r(1-t)$ and $e_r^k = -\frac{\partial k}{\partial r}\frac{r}{k}$ denotes capital demand elasticity with respect to the gross interest rate. The equivalent user cost and capital demand equations for the foreign country are straightforward (not shown). The home country is a capital importer:

$$\frac{S\,(\,r_n,\,A(r_n,\,t_w,\,t))}{1+n} = k\left(\frac{r_n}{1-t}\right) - \Delta\,, \tag{3.3.11}$$

where Δ is capital imports showing current account balance. This may be solved for r_n giving

$$r_n = (1-t)\;f_k\left(\frac{S\,(\,r_n,\,A(r_n,\,t_w,\,t))}{1+n} + \Delta\right). \tag{3.3.12}$$

Making use of (3.3.11) and (3.3.12) [written as $dr_n/d\Delta = -(r_n/e_r^K K)$ $(dS/(1+n)\,/d\Delta + 1)$ and $e_r^S = -e_r^K\frac{K}{S} - d\,\Delta/d\,r_n\,(r_n/S)$], $e_r^S = r_n S_r/S$, define $\sigma = -dS\,/\,d\Delta$ and write $d\,r_n/d\Delta$ as: :

$$\sigma \equiv \frac{e_r^S}{e_r^S + e_r^k\,\frac{k\,(1+n)}{S}} \tag{3.3.13}$$

$$\frac{d\,r_n}{d\,\Delta} = -\frac{r_n}{S/(1+n)}\frac{\sigma}{e_r^S}\,. \tag{3.3.14}$$

The foreign country is capital exporter $S^* = K^* + \Delta$, which together with $r_n^* = (1-t^*)F_K^*$ implies that

$$\sigma^* \equiv \frac{e_r^{*S}}{e_r^{*S} + e_r^{k*}\dfrac{k^*(1+n)}{S^*}} \tag{3.3.15}$$

$$\frac{d\,r_n^*}{d\,\Delta} = \frac{r_n^*}{S^*/(1+n)}\frac{\sigma^*}{e_r^{*S}} \tag{3.3.16}$$

where e_r^{*S} and e_r^{*k} are obvious.

Government

The government budget constraint is written in per capita terms for the home country as (dropping the subscripts)

$$\begin{aligned} g &= t_w w + t\frac{S\,r}{1+n} + t_N\, r\Delta + M \\ &= f(k) - (1-t_w)w - r_n\frac{S}{1+n} - r(1-t_N)\Delta + M\,, \end{aligned} \tag{3.3.17}$$

where second equality makes use of (3.3.9) and (3.3.11) and M shows lump-sum tax transfers across tax jurisdictions. The respective budget constraint for the foreign country is given by

$$\begin{aligned} g^* &= t_w^* w^* + t^* k^* r^* + t_A^*\, r\Delta - M\,. \\ &= f^*(k^*) - (1-t_w^*)w^* - r_n^*\frac{S^*}{1+n} + r^*(1-t^*)\Delta + t_A^* r\Delta - M \end{aligned} \tag{3.3.18}$$

Optimal lump-sum transfers M imply the same marginal utility of tax revenues across countries (see 3.3.24 later). Government tax revenues can be considered for the world as a whole. A consolidated budget constraint for

long-term tax revenues from home and foreign countries is written as

$$G = f(k) - (1 - t_w)w - r_n \frac{S}{1+n} + f^*(k^*) - (1 - t_w^*)w^* - r_n^* \frac{S^*}{1+n}, \quad (3.3.19)$$

where use has been made of capital arbitrage condition (3.3.6). International investments and the taxation of them do not directly enter the consolidated budget constraint.

Compensation scheme

Government revenues from capital income taxation are used for lump-sum transfers to generations. Let $g_{t+1}^{t+1} = \alpha g_{t+1}$ and $g_{t+2}^{t+1} = (1 - \alpha) g_{t+2}$ describe lump-sum transfers to the generation born in period $t+1$, where α is the fixed share of tax revenues given to the younger generation in each period. Since steady-state is achieved in period $t+1$, the compensations remain the same for the generations born in period $t+1$ onwards, and grow at a rate of $1 + n$ so that $g_{t+2} = g_{t+1}(1 + n)$. The long-term indirect utility function for the capital-importing country, from (3.3.3), is given by

$$V = V(r_n, A), \quad (3.3.20)$$

where $A = (1 - t_w)w + \left(\alpha + \frac{(1 - \alpha)(1 + n)}{1 + r_n}\right) g$ and g is from (3.3.17). The current value of transfers is that spent while young αg and the discounted value spent while old $(1 - \alpha) g (1 + n)/(1 + r_n)$. The welfare effect of lump-sum transfers is given by

$$V_G = \left(\alpha + \frac{(1 - \alpha)(1 + n)}{1 + r_n}\right) V_A, \quad (3.3.21)$$

where $V_G = V_g$. I will now concentrate on a dynamically efficient economy, where $r_n \geq n$. The welfare effect of increasing share α going to the younger generation is

$$\frac{\partial V}{\partial \alpha} = \left(1 - \frac{1+n}{1+r_n}\right) g\, V_A = R\, g\, V_A \geq 0 \ (<0) \text{ when } g \geq (<) 0\,, \quad (3.3.22)$$

where $R = (r_n - n)/(1 + r_n) \geq 0$ in a dynamically efficient economy ($\partial S / \partial \alpha$ is zero due to the quasilinear utility function). It is obvious that, for positive tax revenues from capital income taxation, $g > 0$, the optimal value for α is unity and all tax revenue is given to the younger generation (when lump-sum taxes on the older generation are ruled out and α may not exceed unity). Older generations may transfer income to younger generations at the rate $1/(1+n)$ in each period if enforced by law. The current value of second-period income depends on $1/(1 + r_n)$, which is lower when R is positive. Society should hence distribute all tax revenue to the younger generation. However, the first-born older generation may have to pay capital income taxes without having received any compensation while young. I consider both full distribution of tax revenue to the young so that α equals unity and the case where, for intergenerational welfare reasons, part of the tax revenues is given back to the older generation and α is below unity.

3.3.3 TAX COOPERATION

The long-term solution is achieved in the period in which the tax policy is implemented. Since wealth effects ($S_A = S_A^*$) are zero, the rate of return immediately adjusts to clear capital market. There is no further adjustment in the rate of return in subsequent periods. Foreign savers supply capital abroad Δ until arbitrage condition $(1 - t^*)\ F_K^*\big[\, S^*(r_n^*, A^*(r_n^*, t_w^*, t^*, g^*(t_w^*, t^*, t_A^*, M))) - \Delta \,\big] = (1 - t_N - t_A^*)\ F_K\big[\, S(r_n, A(r_n, t_w, t, g(t_w, t, t_N, M))) + \Delta \,\big]$ is satisfied. This together with $r_n(\Delta, t, t_w)$ and $r_n^*(\Delta, t^*, t_w^*)$ imply that capital imports $\Delta\ (t_N, t_A^*, t^*, t, t_w, t_w^*, M)$ can be written as a function of tax parameters. Wage tax rates t_w and t_w^* are taken as fixed throughout the analysis. They should be zero when lump-sum transfers are arbitrary $\alpha < 1$ (when cannot be negative).

[5] The indirect utility function $V\,[r_n(\Delta, t), A(r_n(\Delta, t), t, g(t_w, t, t_N, M))\,]$

from (3.3.3) is written as $V\left[\Delta\left(t_N, t_A^*, t, t^*\right), t, t_N, M\right]$ as a function of tax parameters and respectively for the foreign country (suppressing t_w and t_w^*). In difference to chapter 2, tax policy does not affect public spending since all tax revenues are given back to individuals (see 3.2.21 in chapter 3.2). I neglect the time consistency problems of government policy discussed by Fischer (1980) and Kehoe (1989). The maximization problem of global welfare is given by:

$$\underset{M,t_N,t_A^*,t,t^*}{Max} \; V\left[\Delta(t_N, t_A^*,t,t^*),t,t_N,M\right] + V^*\left[\Delta(t_N,t_A^*,t,t^*),t^*,t_A^*,M\right]. \quad (3.3.23)$$

The first-order conditions for the global optimum in terms of lump-sum transfers across countries, M, optimal international taxation, t_N, t_A^*, and domestic and foreign capital income taxation, t, t^*, are:

$$M: \qquad V_g g_M - V_g^* g_M^* = 0 \qquad (3.3.24)$$

$$t_N: \qquad \left(V_\Delta + V_\Delta^*\right) \frac{d\Delta}{d t_N} + f_k \Delta V_g = 0 \qquad (3.3.25)$$

$$t_A^*: \qquad \left(V_\Delta + V_\Delta^*\right) \frac{d\Delta}{d t_A^*} + f_k \Delta V_g^* = 0 \qquad (3.3.26)$$

$$t: \qquad V_t + V_g g_t + \left(V_\Delta + V_\Delta^*\right) \frac{d\Delta}{d t} = 0 \qquad (3.3.27)$$

$$t^*: \qquad V_t^* + V_g^* g_t^* + \left(V_\Delta + V_\Delta^*\right) \frac{d\Delta}{d t^*} = 0. \qquad (3.3.28)$$

Lump sum transfers across tax jurisdictions equalize the marginal utility of tax revenues $V_g = V_g^*$ since $g_M = -g_M^* = 1$. Term $V_g g_\Delta + V_g^* g_\Delta^*$ can also be written as $V_G G_\Delta$, where G is given in (3.3.19). From (3.3.24), (3.3.25) and (3.3.26), in optimum the shadow price of capital for foregone capital investment in the foreign capital-exporting country equals the shadow price of

[5] The first-order condition with respect to t_w, from (3.3.17) and (3.3.20), is given by $-(1-\alpha)\, R\, w\, V_A$, which is negative when $\alpha < 1$ and zero when $\alpha = 0$.

capital imports in the home country:

$$V_\Delta + V_\Delta^* = V_r \frac{dr_n}{d\Delta} + V_r^* \frac{dr_n^*}{d\Delta} + V_G G_\Delta = 0, \tag{3.3.29}$$

Total international tax $t_N + t_A^*$ has only an indirect effect on welfare via capital flows. This indirect effect depends on the change in net returns and on intergenerational lump-sum transfers (see the Appendix 2).

Consider first tax policy with arbitrary domestic and foreign taxes t and t^*. The FOCs giving (3.3.29) are shown in the Appendix 2 to imply:

PROPOSITION 1: *For arbitrary domestic taxes t and t^*, the optimal taxation of international capital income $t_N + t_A^*$ requires that:*

$$\begin{aligned} &f_k(1-\sigma) + r_n\sigma - \gamma\left(\alpha\frac{S}{1+n} + (1-\alpha)k\frac{1-t_w}{1-t}\right)\frac{dr_n}{d\Delta} = \\ &f_k^*(1-\sigma^*) + r_n^*\sigma^* + \gamma^*\left(\alpha^*\frac{S^*}{1+n} + (1-\alpha^*)k^*\frac{1-t_w^*}{1-t^*}\right)\frac{dr_n^*}{d\Delta}, \end{aligned} \tag{3.3.30}$$

where σ and σ^* are given in (3.3.13) and (3.3.15), $dr_n/d\Delta$ and $dr_n^*/d\Delta$ are given in (3.3.14) and (3.3.16) and $\gamma = (r_n - n) / [\alpha(1 + r_n) + (1 - \alpha)(1 + n)]$ and γ^* analogously abroad. The first two terms in both sides are similar to Horst (1980) rule shown in chapter 3.2. When savings are elastic and $0 < \sigma < 1$ (and not inelastic so that $\sigma = 1$), the marginal benefit of international investment is between after-tax domestic return r_n and marginal product f_k. The remaining terms depend on how net return affects distribution of income between old and young generation. Under current account balance (Δ equals zero), the remaining additional term in LHS is

$$\gamma\frac{S}{1+n}\left(1 + (1-\alpha)\frac{t-t_w}{1-t}\right)\frac{dr_n}{d\Delta}. \tag{3.3.31}$$

The value of income redistribution or the marginal social cost of public funds MSCPF is given by $\gamma = (r_n - n) / [\alpha(1 + r_n) + (1 - \alpha)(1 + n)]$. This is positively related to $r_n - n$, showing dynamic efficiency, and to the share α given to young. The first term in brackets shows a transfer from old to young because of lower net return on savings and higher wage level. The second term in brackets captures the tax revenue change from movement in r_n induced by movement in Δ. It is positive (and also lump sum payments to young) when capital income tax exceeds wage income tax rate. Lower net return induced by capital imports decreases the shadow price of capital imports since the total effect of functional shift from capital to wage income and tax revenue changes are unambiguous (more clearly seen from 3.3.30). This is different than in a two-period model considered in chapter 2, where first term 1 in brackets in (3.3.31) is absent and remaining tax revenue effect depends on the relative tax rates imposed on rents (wages here) and capital incomes.

Consider next the tax policy with optimal domestic and foreign tax rates. Capital imports $\Delta(t_N, t_A^*, t, t^*)$ may be taken as given from (3.3.29). It is shown in the Appendix 2 that the FOC for domestic country, from (3.3.27) and (3.3.29), reduces to

$$V_t + V_g g_t = 0 \tag{3.3.32}$$

and equivalently for the tax rate in foreign capital-exporting country. These are shown in the Appendix 2 to give

$$\frac{t}{1-t} = \gamma\left(\frac{\alpha}{e_r^S} - \frac{1-t_w}{1-t}\frac{1-\alpha}{e_r^k}\right) \tag{3.3.33}$$

$$\frac{t^*}{1-t^*} = \gamma^*\left(\frac{\alpha^*}{e_r^{S*}} - \frac{1-t_w^*}{1-t^*}\frac{1-\alpha^*}{e_r^{k*}}\right). \tag{3.3.34}$$

Domestic and foreign capital income taxation is as in a closed economy if savings and investment elasticities were the same. In reality, elasticities may vary depending on the openness of the economy. In any case, capital income taxes follow familiar inverse elasticity rule; taxes are inversely related to some

tax-adjusted averages of savings and investment elasticities. [6] The difference to two-period model is income distribution because of which more elastic investment has a positive effect on the tax level; thereby a relatively greater share of capital income taxes will be born by old generation. The total tax level also bears a positive relation to the share of tax revenue distributed to young α ($\alpha\gamma$ and $-(1-\alpha)\gamma$ are positively related to α). $\alpha\gamma$ is equal to $R = (r_n - n)/(1 + r_n)$ and $-(1-\alpha)\gamma$ is equal to zero when α receives the optimal value of unity. The optimal residence-based tax rate t_r, for α equalling unity, would be

$$t_r = (1 - t_r)\frac{R}{e_r^S} = \frac{1}{\varepsilon - 1}\frac{r_n - n}{r} \Leftrightarrow t_r = \frac{1}{\varepsilon}\frac{r - n}{r}, \qquad (3.3.35)$$

where $e_r^S = r_n / [1 + r_n](\varepsilon - 1)$ (see footnote 4). I have assumed $r_n - n \geq 0$ under dynamic efficiency, but clearly $r - n > 0$ is sufficient for residence-based taxes to be desirable. Tax rate is inversely related to the intertemporal substitution elasticity $\varepsilon = -U_{CC}C_2/U_C$. Capital-exporting country is more abundant of capital and if this also implies capital intensity closer to golden rule level, then capital income tax rate is lower than in capital-importing country. This is because gross interest rate closer to population growth (lower MSCPF) decreases capital income tax level.

Consider next international tax policy under optimal domestic capital income taxation. The Appendix 2 shows that:

PROPOSITION 2: *When t and t^* are optimally chosen, then the optimal international tax regime satisfies the weighted average rule:* [7]

$$f_k(1 - \tilde{z}) + r_n\tilde{z} = f_k^*(1 - \tilde{z}^*) + r_n^*\tilde{z}^*, \text{ where} \qquad (3.3.36)$$

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[6] $\alpha\gamma = (V_G - (1+n)\tilde{V}_A)/V_G$, $\tilde{V}_A = V_A/(1 + r_n)$ is the MSCPF of using residence-based taxes, and $-(1-\alpha)\gamma = (V_G - V_A)/V_G$ is the equivalent for source-based subsidies, see section 3.3.4.1

[7] The corresponding weight in a two-period model in chapter 3.2 is $z = (1 - t_w)e_r^S / [(1-t)e_r^k + (1-t_w)e_r^S]$ with obvious notation when t_w is the tax on second-period rents.

$$\tilde{z} = -\frac{(1-\alpha)(1-t_w)e_r^S}{\alpha(1-t)e_r^k - (1-\alpha)(1-t_w)e_r^S} < (>0) \text{ for } t > (<0)$$

and $\tilde{z}^*$ analogously .

The issue in question concerns the effects of change in Δ. Since t , t^* are initially optimal, the effects of changes in savings can be ignored (see A2.17 in the Appendix 2). If the government receives all wage income, $t_w = 1$, all these effects are valued at f_k. If $t_w < 1$, some of the effects accrue to the savers, and so are valued at r_n. Even when $t_w = 0$, some of the effects accrue to government through a pre-existing tax wedge, so even in that case some weight is attached to f_k. The LHS of (3.3.36) can also be written as $f_k(1 - \tilde{z}\,t)$, where $-\tilde{z}\,t$ is non-negative irrespective of whether domestic capital income taxes are positive or negative (t is from 3.3.27 and $\tilde{z}$ is shown above). Hence, non-zero $-\tilde{z}\,t$ due to transfers given to the old decrease the shadow price of capital (or increase the shadow price of international investment) irrespective of whether domestic capital income taxes t are positive or negative.

Optimal choice t restores double tax relief close to the weighted average rule under arbitrary domestic tax policy. However, the intuition behind the formula as well as the weights are different. Under arbitrary domestic taxation, capital is valued at the gross rate of return when it contributes to capital used and at the net interest rate to the extent that it displaces savings. According to the formula that considers international tax issue together with optimal domestic tax policy, only savings in misallocation of capital across countries is important. Changes in net return on savings due to international investment have marginally no welfare effects since savings are in optimum. Capital used for investment is, however, valued at net return to the degree that wage income accrues to young generation and α is below unity so that higher wage income is not followed by a fully corresponding decrease in lump sum transfers. Correspondingly, the weight $\tilde{z}$ depends besides on savings and investment behaviour also on the relative taxation of capital and rent incomes and income transfers, but is independent of the level of international

investment. As a corollary, and for completeness:

COROLLARY 2: *When wages are taxed at 100 per cent in a lump-sum manner, or when intergenerational transfers are given to young in both countries, then the residence principle is optimal:*

$$f_k = f_k^* \,. \tag{3.3.37}$$

The weight attached to the net return on savings, $\tilde{z}$, approaches zero as the share of transfers going to young α or the wage tax rate t_w approaches unity. The full taxation of wage income corresponds to the full taxation of rent income under exogenous labour supply. 100 per cent wage taxation is insensible, however, since it is against the initial incentive to support the young working generation. Footnote 5 indicates that wage tax t_w should be zero except under intergenerational transfers only to young, in which case it is irrelevant.

The optimal total international taxation is straightforward from the weighted average formula (3.3.36) and capital arbitrage condition (3.3.6):

$$t_N + t_A^* = \lambda \frac{\tilde{z}}{\tilde{z}^*} t \; + (1-\lambda)\, t^* \,, \quad \text{where} \tag{3.3.38}$$

$$\lambda \equiv \frac{\tilde{z}^*(1-t^*)}{1-t^*\tilde{z}^*} = \frac{-(1-\alpha^*)(1-t_w^*)e_r^{S*}}{\alpha^* e_r^{k*} - (1-\alpha^*)(1-t_w^*)e_r^{S*}} < (>0) \text{ for } t^* > (<0).$$

One benchmark case for the international tax rule is to assume that rent and capital incomes are taxed uniformly at the same rate and to consider countries as similar except in γ and γ^* showing differences in MSCPFs (capital intensities) in the countries. Domestic $\tilde{z}$ and foreign $\tilde{z}^*$ coincide under equal savings and investment elasticities, which simplifies (3.3.38). International taxation is a weighted average of domestic and foreign capital income tax rates, where the weight λ only depends on taxes in capital-exporting country. This

weight λ attached to t is negative and weight $1-\lambda$ attached to (positive) t^* exceeds unity. Higher investment elasticity increases capital income tax rate t^* and lowers weight $1-\lambda$ and the change in total tax on capital-exports is ambiguous. International taxation aims at improving allocation of capital between countries but domestic capital income tax policy and intergenerational income distribution has opposite implications.

The practical application of the weighted average rule depends on the allocation of international tax revenues across countries. When the capital importer applies international tax t_N equal to domestic tax level t (and when this satisfies $V_g = V_g^*$ due to lump-sum transfers M), the capital-exporting country should credit these taxes t at a rate $1-\lambda$, and tax foreign investments at the same rate. Since λ is negative for positive capital income taxes, this requires more than full crediting. A double tax relief system which is alternative to more than full crediting is to have no taxes on the part of capital exporter (t_N equals zero). The capital-exporting country levies a tax at a rate $(1-\lambda)\,t^* + \lambda t$.

As in the two-period model in chapter 3.2, the international taxation of capital exports rather than imports from home country also satisfy the equalization of shadow prices of capital as given by (3.3.35) (not shown explicitly). Denote the optimal total tax on capital imports to home country and capital exports from home country respectively as T $(= t_N + t_A^*)$ and T^*. Arbitrage condition (3.3.6), the corresponding for capital exports from home country and the equalization of shadow price of international investment, from (3.3.36), are given by

$$r^*(1-t^*) = r(1-T) \qquad (3.3.6')$$

$$r(1-t) = r^*(1-T^*) \qquad (3.3.39)$$

$$r\,(1-\tilde{z}\,t\,) = r^*(1-\tilde{z}^*t^*)\,. \qquad (3.3.40)$$

The capital arbitrage equations require $(1-t^*)(1-t) = (1-T)(1-T^*)$,

which is clearly satisfied by $1 - T = (1 - t^*)\ (1 - \tilde{z}\, t)\ / (1 - \tilde{z}^* t^*)$ and $1 - T^* = (1 - t)\ (1 - \tilde{z}^* t^*) / (1 - \tilde{z}\, t)$. Hence, the double tax relief system, where T^* is symmetrical to T, also satisfy two-way capital arbitrage conditions.

3.3.4 TAX POLICY IN A MIXED SCHEME

In this and following section, I am considering international tax policy when tax cooperative equilibrium shown above is not feasible. Tax cooperation allowed the choice of three tax parameters: domestic taxes and international taxation of investment abroad and from abroad. I am assuming that countries adopt non-discrimination rule according to which neither the foreign-source income of domestic residents (under residence criteria) nor the income in the home country of non-residents (under source criteria) can be taxed at a higher rate without raising the tax rate levied on domestic residents on their domestic-source income. This restricts capital income tax instruments to a mixed scheme of residence and/or source-based tax/subsidies. A symmetric Nash equilibrium for identical countries is shown efficient by Bucovetsky and Wilson (1991). When both residence- and source-based taxes on capital income are attainable, both consumer and producer prices can be determined separately from the rest of the world. In addition to this, manipulation of income from foreign investors is not important since net capital imports are zero. I consider tax competition in an OLG model and extend the analysis to a study of small (possibly non-identical) countries.

In Frenkel, Razin and Sadka (1991 p. 26-27), residence– and source–based taxes are modelled as $r(1 - t_s - t_r) = r^*(1 - t_s^* - t_r)$ and $r^*(1 - t_s^* - t_r^*) = r(1 - t_s - t_r^*)$ satisfying two-way capital arbitrage condition only when $(t_s - t_s^*)\ (t_r - t_r^*) = 0$ holds. [8] I assume that the tax base of residence-based tax is gross interest rate net of any source-based taxes paid or source-bases subsidies received. The condition for savings allocated at home and abroad is given by:

[8] Frenkel, Razin and Sadka (1991 p. 26-27) give pure residence criteria or source criteria as the two alternatives. Alternatively, either residence or source-based tax-subsidies should be harmonised cooperatively.

$$(1-t_r)(1-t_s)r = (1-t_r)(1-t_s^*)r^*, \qquad (3.3.41)$$

The arbitrage condition for foreign savers is given by:

$$(1-t_r^*)(1-t_s)r = (1-t_r^*)(1-t_s^*)r^*, \qquad (3.3.42)$$

Eqs. (3.3.41) and (3.3.42) both yield:

$$(1-t_s)r = (1-t_s^*)r^*. \qquad (3.3.43)$$

Two-way capital arbitrage does not restrict the choice of residence- and source-based tax/subsidies. The long-term government budget constraint with no lump sum transfers across jurisdictions is written for domestic and foreign country as

$$g = t_w w + t_r \frac{S\, r(1-t_s)}{1+n} + t_s r\left(\frac{S}{1+n} + \Delta\right), \qquad (3.3.44)$$

$$g^* = t_w^* w^* + t_r^* \frac{S^* r^*(1-t_s^*)}{1+n} + t_s r^*\left(\frac{S^*}{1+n} - \Delta\right) \qquad (3.3.45)$$

where Δ is net capital imports (positive). Source-based taxes/subsidies affect investment which is $k = S/(1+n) + \Delta$ in home country and $k^* = S^*/(1+n) - \Delta$ in foreign country.

3.3.4.1 COUNTRIES BEHAVING AS SMALL OPEN ECONOMIES

Consider first the case when countries behave as having no market power to world interest rate. This is similar to considering countries as too small to manipulate terms-of-trade. The maximization decision under cooperation is obtained by maximizing indirect utility equivalent to (3.3.3):

$$\underset{t_r, t_r^*, t_s, t_s^*}{Max} \; V\left(r_n(t_r),\, A(t_r, t_s, g(t_r, t_s))\right) + V^*\left(r_n^*(t_r^*),\, A(t_r^*, t_s, g(t_r^*, t_s^*))\right), \tag{3.3.46}$$

where $A = (1 - t_w)w + \left(\alpha + \frac{(1-\alpha)(1+n)}{1+r_n}\right) g$ and similarly for A^* and $r_n(t_r)$ $= r(1-t_r)(1-t_s)$, $r_n^*(t_r^*) = r^*(1-t_r^*)(1-t_s^*)$, where $dr/dt_s = r/(1-t_s)$, $dr^*/dt_s^* = r^*/(1-t_s^*)$. Domestic r_n and foreign net returns r_n^* are not function of capital imports when countries behave as having no market power on world interest rate. They depend on residence-based taxes, whereas source-based taxes affect gross returns so that arbitrage condition (3.3.43) is satisfied. Residence-based taxes are, hence, used to control consumer prices and source-based taxes to control gross returns and producer prices. The maximization decisions under tax competition are given by

$$\underset{t_r,\, t_s}{Max} \; V\left(r_n(t_r),\, A(t_r, t_s, g(t_r, t_s))\right), \; t_r^*, t_s^* \text{ given} \tag{3.3.47}$$

$$\underset{t_r^*,\, t_s^*}{Max} \; V^*\left(r_n^*(t_r^*),\, A(t_r^*, t_s, g(t_r^*, t_s))\right), \; t_r, t_s \text{ given} \tag{3.3.48}$$

Foreign welfare $V^*()$ is not function of domestic taxes t_r, t_s and domestic welfare $V()$ is not function of foreign residence-based tax t_r^*, t_s^*. Hence, tax competition yields the same outcome as tax cooperation. Capital income taxes can be determined decentrally. The FOCs are, from (3.3.44) through (3.3.48), given by

$$t_r: \quad -\frac{S\, r(1-t_s)}{1+r_n} V_A + \frac{S\, r(1-t_s)}{1+n}\left(1 - \frac{t_r}{1-t_r} e_r^S\right) V_g = 0 \tag{3.3.49}$$

$$t_r^*: \quad -\frac{S^* r^*(1-t_s^*)}{1+r_n^*} V_A^* + \frac{S^* r^*(1-t_s^*)}{1+n}\left(1 - \frac{t_r^*}{1-t_r^*} e_r^{S*}\right) = 0 \tag{3.3.50}$$

$$t_s: \quad -\frac{1-t_w}{1-t_s}\, k\, r\, V_A + \frac{k\, r}{1-t_s}\left(1-t_w-t_s\, e_r^k\right) V_g = 0 \qquad (3.3.51)$$

$$t_s^*: \quad -\frac{1-t_w^*}{1-t_s^*}\, k^*\, r^*\, V_A^* + \frac{k^*\, r^*}{1-t_s^*}\left(1-t_w^*-t_s^*\, e_r^{k*}\right) V_g^* = 0 \qquad (3.3.52)$$

The FOC for residence-based tax t_r is from $V_{t_r} + \frac{\partial g}{\partial t_r} A_g V_A$ (and respectively for the foreign country). The first term $-S\, r\,(1-t_s)/(1+r_n)\; V_A$ is the welfare effect of taxing the return on savings. It is the sum of changes in present value of wealth (including lump sum transfers) as given by $-\left(\frac{1}{1+r_n}\right)^2 r(1-t_s) C_2 V_A + \frac{(1-\alpha)(1+n)}{(1+r_n)^2}\, r(1-t_s)\, g\, V_A$. The second term $S\, r(1-t_s)/(1+n)\left(1-t_r/(1-t_r) e_r^S\right) V_g$ shows the change in government tax revenues and how this affects wealth when the share α of tax revenues is distributed from old to following young generation. The FOC for source-based subsidy t_s is derived from $V_{t_s} + \frac{\partial g}{\partial t_s} A_g V_A$. [9] Term $-(1-t_w)/(1-t_s)\; k\, r$ shows the decrease in wage level and $k\, r/(1-t_s)\left(1-t_w-t_s\, e_r^k\right)$ the change in tax revenues which will affect welfare depending on V_g. The optimal source-based tax does not depend on current account balance as given by capital imports Δ. There is no "tax-the-foreigner" or "tax competition"-effects as in Persson and Tabellini (1992), where foreign investment is separate from investment financed by domestic savings and can be taxed without any effect on domestic wage income level. Huizinga and Nielsen (1995) assume that part of the rents on capital imports accrue to foreign country in which case indirect taxation of

rents on capital imports through source-based taxes is desirable, too. This would correspond, here, to some wage income accruing to foreigners. The FOCs may be written more simply as

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[9] Eq. (3.3.44) gives $\partial g/\partial t_s = k\, r + \frac{r}{1-t_s}\left(t_s\, k - t_w k + t_s\, k_r\, r\right) = k\, r + \frac{k\, r}{1-t_s}(t_s - t_w)$ $+ \frac{t_s}{1-t_s} k\, r\,(k_r\, r/k) = \frac{k r}{1-t_s}(1-t_w-t_s\, e_r^k)\, V_g$.

$$t_r: \quad \mu_r(t_r, t_s) \equiv \alpha\gamma - t_r/(1-t_r)\, e_r^S = 0 \tag{3.3.49'}$$

$$t_r^*: \quad \mu_r^*(t_r^*, t_s^*) \equiv \alpha^*\gamma^* - t_r^*/(1-t_r^*)\, e_r^{S*} = 0 \tag{3.3.50'}$$

$$t_s: \quad \mu_s(t_s) \equiv -(1-t_w)(1-\alpha)\gamma - t_s e_r^k = 0 \tag{3.3.51'}$$

$$t_s^*: \quad \mu_s^*(t_s^*) \equiv -(1-t_w^*)(1-\alpha^*)\gamma^* - t_s^* e_r^{k*} = 0\,, \tag{3.3.52'}$$

and where $\gamma = -(r_n - n)/[\alpha(1+r_n)+(1-\alpha)(1+n)]$, as before. In (3.3.49), $-V_A/(1+r_n) + V_g/(1+n)$ gives $\alpha\gamma\ V_g/(1+n)$, where $\alpha\gamma = \alpha(r_n-n)/[\alpha(1+r_n)+(1-\alpha)(1+n)]$ yielding (3.3.49'). Welfare is improved if tax base (savings level) is not too largely narrowed and net return on savings exceeds population growth, since the discounted value of the consumption at old age $-V_A/(1+r_n)$ is less than the discounted value of converting consumption between generations $V_g/(1+n)$. In (3.3.51), $-V_A + V_g$ gives $-(1-\alpha)\gamma V_g$ yielding (3.3.51').

Second-order-conditions are complex without further assumptions. When countries are identical (hence $\Delta = 0$) and intergenerational lump sum transfers accrue to young generations $\alpha = \alpha^* = 1$ so that $\alpha\gamma = R = (r_n - n)/(1+r_n)$, $\alpha^*\gamma^* = R^*$ $((1-\alpha)\gamma, (1-\alpha^*)\gamma^* = 0)$, second-order conditions are given by:

LEMMA 1. When savings and investment elasticities $e_r^S, e_r^{S*}, e_r^k, e_r^{k*}$ are positive for constant elasticity of marginal utility ε and the derivative of investment elasticities $\partial e_r^k/\partial r$, $\partial e_r^{k*}/\partial r^*$ are non-positive (as for Cobb-Douglas production function implying $\partial e_r^k/\partial r = \partial e_r^k/\partial t_s = 0$) and optimal t_s is non-positive, then second-order-conditions hold.

Proof. The sign of second-order-condition depends on the derivative $(\partial \mu_r(t_r, t_s)(1-t_s)/\partial t_r)(\partial \mu_r^*(t_r^*, t_s^*)(1-t_s^*)/\partial t_r^*)(\partial \mu_s(t_s)/(1-t_s)/\partial t_s)$ $(\partial \mu_s^*(t_s^*)/(1-t_s^*)/\partial t_s^*)$ (since $\partial \mu_s(t_s)/\partial t_r = \partial \mu_s^*(t_s^*)/\partial t_r^* = \partial \mu_r(t_r, t_s)/\partial t_r^* = \partial \mu_r^*(t_r^*, t_s^*)/\partial t_r = 0$) which is positive since

$\partial \mu_r(t_r, t_s)/\partial t_r = \frac{\partial R}{\partial t_r} - \frac{t_r}{1-t_r}\frac{\partial e_r^S}{\partial t_r} - \frac{1}{(1-t_r)^2} e_r^S = -\frac{1}{1-t_r}\left(\frac{n}{(1+r_n)^2} + \frac{1}{1-t_r} e_r^S\right)$ < 0 and $\partial \mu_r^*(t_r^*, t_s^*)/\partial t_r^* < 0$, $\partial \mu_s(t_s)/\partial t_s = -e_r^k - t_s \partial e_r^k/\partial t_s < 0$ and $\partial \mu_s^*(t_s^*)/(1 - t^*)/\partial t_s^* < 0$, where $\mu_r(t_r, t_s)$ is from (3.3.47') and $\mu_s(t_s)$ from (3.3.49') so that $\frac{\partial R}{\partial t_r} = \frac{\partial (r_n - n)/(1+r_n)}{\partial t_r} = -\frac{1+n}{1-t_r}\frac{r_n}{(1+r_n)^2}$ and $\frac{t_r}{1-t_r}\frac{\partial e_r^S}{\partial t_r} = \frac{R}{e_r^S}\frac{\partial e_r^S}{\partial t_r}$ $= -\frac{R}{(1-t_r)(1+r_n)}$ since $e_r^S = r_n/[1+r_n](\varepsilon - 1)$ under quasi-linearity and $t_r/(1-t_r) = R/e_r^S$.

Positive elasticities ensure that tax rates and tax bases are not positively related. Second-order conditions are more complex for arbitrary intergenerational transfers $\alpha < 1$ and when countries are not identical, and are not shown.

The optimality conditions, (3.3.49') through (3.3.52'), yield for the optimal tax rates:

$$\frac{t_r}{1-t_r} = \frac{\alpha\gamma}{e_r^S} \tag{3.3.53}$$

$$\frac{t_r^*}{1-t_r^*} = \frac{\alpha^*\gamma^*}{e_r^{S*}}, \tag{3.3.54}$$

$$t_s = -\frac{(1-t_w)(1-\alpha)\gamma}{e_r^k} \tag{3.3.55}$$

$$t_s^* = -\frac{(1-t_w^*)(1-\alpha^*)\gamma^*}{e_r^{k*}}. \tag{3.3.56}$$

Residence-based taxes are inversely related to savings elasticities e_r^S, e_r^{S*}. Source-based subsidies are inversely related to investment elasticities e_r^k, e_r^{k*}. These investment subsidies serve to redistribute income from the young to the old (because increased investment drives up the real wages accruing to young) when partly financed by the old generation and there is not a fully corresponding decrease in lump sum transfers α, $\alpha^* < 1$. When source-based subsidies are not financed by old, and lump-sum transfers are optimal α, $\alpha^* = 1$, source-based subsidies are zero $t_s = t_s^* = 0$.

Consider, next, the capital income tax rate that the mixed scheme implies on domestic investment $t_r(1 - t_s) + t_s$ and on capital imports $t_r^*(1 - t_s) + t_s$. The total tax on domestic investment $t = t_r(1 - t_s) + t_s$ is from (3.3.53) and (3.3.55) after some manipulation given by

$$\frac{t}{1-t} = \gamma\left(\frac{\alpha}{e_r^S} - \frac{1-t_w}{1-t}\frac{1-\alpha}{e_r^k}\right). \tag{3.3.57}$$

where $1 - t = (1 - t_r)(1 - t_s)$. This equals the optimal capital income level in the home country as given by (3.3.32) under tax cooperation with no restriction in the choice of domestic and international capital income tax rates. Denote the total tax on international investment to capital-importing country under non-discrimination rule by $T = t_r^*(1 - t_s) + t_s$. Under tax cooperation without any non-discrimination rule, international tax was written as (see 3.3.38)

$$t_N + t_A^* = \lambda\frac{\tilde{z}}{\tilde{z}^*}t + (1-\lambda)t^*, \text{ where} \tag{3.3.58}$$

$$\frac{\tilde{z}}{\tilde{z}^*} = \frac{t^*}{t}\frac{t_s}{t_s^*}, \quad \lambda = \frac{t_s^*}{t_r^*/(1-t_r^*) + t_s^*} = \frac{t_s^*}{t^*}(1-t_r^*)$$

so that

$$T = t_r^*(1 - t_s) + t_s, \tag{3.3.59}$$

where (3.3.34), (3.3.36), (3.3.54) and (3.3.55) is used to define $\tilde{z}/\tilde{z}^*$ and λ in terms of residence and source-based tax/subsidies shown above. It is seen that international tax level is the same. No further proof is needed that

PROPOSITION 3:

For a small open economy, tax policy is the same under tax competition or tax cooperation with a mixed scheme of residence-based and source-based tax/subsidies and under tax cooperation with no restriction in the domestic and international capital income tax instruments.

As a corollary for proposition 3

Corollary 1:

When intergenerational transfers are given to young, then tax competition gives optimal residence-based taxation for small open economies.

It is interesting to see that tax competition yields efficient outcome if there is no terms-of-trade manipulation since countries are small. Also when intergenerational transfers are given to young, residence-based tax is the same as under tax cooperation without non-discrimination rule, as given by (3.3.32) and (3.3.33) when α, $\alpha^* = 1$.

3.3.4.2 TWO LARGE COUNTRIES

Terms-of-trade manipulation is well-known to affect a Nash equilibrium when countries are large enough to have market power on world interest rate. Rather than showing this, this section examines identical countries. In contrast to terms-of-trade manipulation, spillover effects, if any, are symmetrical as related to deviation of capital intensity from golden rule level. Capital market equilibrium of identical countries is given by:

$$k(r^w) - \frac{S(r_n)}{1+n} + k^*(r^w) - \frac{S^*(r_n^*)}{1+n} = 0 \ , \qquad (3.3.60)$$

where $r_n(t_r, r^w) = r^w(1-t_r)(1-t_s)$, $r_n^*(t_r^*, r^w) = r^w(1-t_r^*)(1-t_s^*)$ and $r^w \equiv r = r^*$ from (3.3.43) due to identical country assumption. As discussed earlier, since wealth effects ($S_A = S_A^*$) are zero, the rate of return immediately adjusts to clear capital market and $dr_{t+1}^w / dr_t^w = 0$. There is no further adjustment in the rate of return in subsequent periods. Let $\Omega = -\frac{2k}{r^w}\left(e_r^S + e_r^k\right) < 0$ describe the effect of the world interest rate r^w on the excess demand for capital in (3.3.60). The inverse of Ω hence describes the necessary increase in the interest rate to offset any such excess demand. The relationship between

domestic residence-based capital income taxes (t_r) and the world interest rate and respective elasticity $e^r_{t_r} = \frac{1-t_r}{r^w}\frac{\partial r^w}{\partial t_r}$ are given by:

$$\frac{\partial r^w}{\partial t_r} = -\frac{k}{1-t_r}\frac{e^S_r}{\Omega} = \frac{r^w}{2(1-t_r)}\frac{e^S_r}{e^S_r + e^k_r} \quad \text{and} \tag{3.3.61}$$

$$e^r_{t_r} = \frac{1}{2}\frac{e^S_r}{e^S_r + e^k_r}.$$

Residence-based capital income taxes increase the long-run world interest rate when savings elasticity is positive. Source-based tax/subsidy and international world interest rate are related by

$$\frac{\partial r^w}{\partial t_s} = \frac{k}{1-t_s}\frac{e^k_r}{\Omega} = -\frac{r^w}{1-t_s}\frac{e^k_r}{e^S_r + e^k_r} \quad \text{and} \tag{3.3.62}$$

$$e^r_{t_s} = -\frac{1}{2}\frac{e^k_r}{e^S_r + e^k_r},$$

where $e^r_{t_s} = \frac{1-t_s}{r^w}\frac{\partial r^w}{\partial t_s}$. The world interest rate r^w affects indirect utility by $V_{r^w} = (1-t)V_{r_n} + A_{r^w}V_A$, where $A_{r^w}V_A = (1-t_w)w_r V_A + g_r V_g$. This can be written as [10]

$$V_{r^w} = V^*_{r^w} = \frac{1-t_r}{r^w}\left[-\mu_r(t_r, t_s)(1-t_s) + \mu_s(t_s)\frac{1}{1-t_r}\right] kr V_g . \tag{3.3.63}$$

A higher world interest rate induces a higher net return on savings, equivalent to a decrease in residence-based tax ($\mu_r(t_r, t_s)$ is from 3.3.49'), and higher investment costs, equivalent to an increase in source-based tax ($\mu_s(t_s)$ is from 3.3.51'). Consider first the tax cooperative equilibrium. The

[10] $g_r = t_r\frac{S(1-t_s)}{1+n} + (t_s - t_w)k + t_r(1-t_s)\frac{S}{1+n}e^S_r - t_s k e^k_r = (1-t_r)\left[\frac{1-t_s}{1-t_r}\frac{S}{1+n} - \frac{S(1-t_s)}{1+n} + \frac{t_s - t_w}{1-t_r}k + \frac{t_r}{1-t_r}\frac{S(1-t_s)}{1+n}e^S_r - \frac{t_s}{1-t_r}k e^k_r\right] = \frac{1-t_r}{r}\left[-\frac{Sr(1-t_s)}{1+n}(1 - \frac{t_r}{1-t_r}e^S_r) + \frac{kr}{1-t_r}(1 - t_w - t_s e^k_r)\right], \frac{S}{1+n} = k$ from (3.3.44).

maximization decision is the same as before with the difference that world interest rate is endogenous:

$$\underset{t_r, t_r^*, t_s, t_s^*}{Max} \; V\left(r_n(t_r, r^w), A(t_r, t_s, r^w)\right) + V^*\left(r_n^*(t_r^*, r^w), A^*(t_r^*, t_s^*, r^w)\right) \quad (3.3.64)$$

The FOCs are given by

$$t_r, t_r^*: \quad \mu_r(t_r, t_s)(1-t_s)k_r V_g + \frac{\partial r^w}{\partial t_r}\left(V_{r^w} + V_{r^w}^*\right) = \quad (3.3.65)$$

$$\mu_r^*(t_r^*, t_s^*)(1-t_s^*)k^* r^* V_g^* + \frac{\partial r^w}{\partial t_r^*}\left(V_{r^w}^* + V_{r^w}\right) = 0 \Leftrightarrow$$

$$\mu_r(t_r, t_s)(1-t_s)\left(1 - 2\, e_{t_r}^r\right) + \mu_s(t_s)\frac{1}{1-t_r} 2\, e_{t_r}^r = 0$$

$$t_s, t_s^*: \quad \frac{\mu_s(t_s)}{1-t_s} k_r V_g + \frac{\partial r^w}{\partial t_s}\left(V_{r^w} + V_{r^w}^*\right) = \quad (3.3.66)$$

$$\frac{\mu_s^*(t_s^*)}{1-t_s^*} k^* r^* + \frac{\partial r^w}{\partial t_s^*}\left(V_{r^w}^* + V_{r^w}\right) = 0 \Leftrightarrow$$

$$\frac{\mu_s(t_s)}{1-t_s}(1 + 2\, e_{t_s}^r) - \mu_r(t_r, t_s)(1-t_r) 2\, e_{t_s}^r = 0$$

where $V(\,) = V^*(\,)$ since countries are identical. Substituting $e_{t_s}^r$ from (3.3.61) and $e_{t_r}^r$ from (3.3.62) into FOCs, both (3.3.65) and (3.3.66) can be written as

$$\frac{\mu_s(t_s)}{1-t_s}\frac{e_r^S}{e_r^S + e_r^k} + \mu_r(t_r, t_s)(1-t_r)\frac{e_r^k}{e_r^S + e_r^k} = 0 \quad (3.3.67)$$

Tax cooperative solution for a large open economy is different than for a small open economy, as given by $\mu_s(t_s) = 0$ and $\mu_r(t_r, t_s) = 0$. This is because countries internalize the spillover effects on world interest rate, i.e. the rate of return increase caused by residence-based taxes and source-based subsidies. If investment is more elastic than savings, residence-based taxes are preferred as the relative increase in world interest rate is lower. An exception is optimal residence-based taxation with income transfers to young where $\mu_s(t_s) = 0$, and

(3.3.67) gives $\mu_r(t_r, t_s) = 0$.

Consider next tax competition. The maximization decision under tax competition is given by

$$\underset{t_r,\, t_s}{Max} \quad V = V\left(r_n(t_r, r^w),\, A(t_r, t_s,\, r^w)\right),\ t_r^*,\, t_s^* \text{ given} \tag{3.3.68}$$

$$\underset{t_r^*,\, t_s^*}{Max} \quad V^* = V^*\left(r_n^*(t_r^*, r^w),\, A^*(t_r^*, t_s^*,\, r^w)\right),\ t_r,\, t_s \text{ given} \tag{3.3.69}$$

The FOCs are given using (3.3.49') through (3.3.52') and (3.3.63):

$$t_r,\, t_r^*: \qquad \mu_r(t_r, t_s)(1 - t_s)k\,r V_g + \frac{\partial r^w}{\partial t_r} V_{r^w} = \tag{3.3.70}$$

$$\mu_r^*(t_r^*, t_s^*)(1 - t_s^*)k^* r^* V_g^* \frac{\partial r^w}{\partial t_r^*} V_{r^w}^* = 0 \quad \Leftrightarrow$$

$$\mu_r(t_r, t_s)(1 - t_s)\left(1 - e_{t_r}^r\right) + \mu_s(t_s)\frac{1}{1 - t_r} e_{t_r}^r = 0$$

$$t_s,\, t_s^*: \qquad \frac{\mu_s(t_s)}{1 - t_s} k\,r\, V_g + \frac{\partial r^w}{\partial t_s} V_{r^w} = \frac{\mu_s^*(t_s^*)}{1 - t_s^*} k^* r^* + \frac{\partial r^w}{\partial t_s^*} V_{r^w}^* = 0 \tag{3.3.71}$$

$$\Leftrightarrow \frac{\mu_s(t_s)}{1 - t_s}(1 + e_{t_s}^r) - \mu_r(t_r, t_s)(1 - t_r)e_{t_s}^r = 0\,,$$

where $\mu_r(t_r, t_s)(1 - t_s)k\,r V_g = V_{t_r} + \frac{\partial g}{\partial t_r} A_g V_A$ and $\mu_s(t_s) = \frac{\mu_s(t_s)}{1 - t_s} k\,r\, V_g$ correspond to the welfare effects when country has no market power shown in previous section (see 3.3.49' and 3.3.51'). Second-order-conditions need not concern us if the solution satisfies the optimal solution under tax cooperation. This is indeed the case, since the optimal solution is characterized by

$$\mu_r(t_r, t_s) = \mu_r^*(t_r^*, t_s^*) = 0\,, \quad \mu_s(t_s) = \mu_s^*(t_s^*) = 0\,. \tag{3.3.72}$$

The FOCs are, hence, the same as when countries behave as having no market power. No further proof is needed that

PROPOSITION 4:

For large open economies, a symmetric Nash equilibrium of residence and source-based tax/subsidy scheme, and not the tax cooperative solution, is equal to a tax cooperative tax scheme with no restriction in capital income tax instruments.

As a corollary for proposition 4

Corollary 2:

When intergenerational transfers are given to young, then tax competition and tax cooperation gives equal optimal residence-based taxation for large identical open economies.

If a non-discrimination rule is introduced, tax cooperation implies internalization of spillover effects abroad. These spillovers are related to deviation of capital intensity from golden rule and are hence symmetrical for the countries. This internalization of symmetrical spillover effects is undesirable since spillover should be taken into account separately from domestic tax policy. The only exception is optimal intergenerational transfers to young, where tax policy is efficient irrespective of the degree of tax cooperation. Finally, when countries are not identical, opposite current account balance conditions of the countries implies asymmetric spillover effects related to terms-of-trade manipulation. For countries not identical, there is, hence, a trade of between undesirable internalization of symmetric spillover effects and desirable elimination of asymmetric spillovers under tax cooperation (not considered).

3.3.5 CONCLUSIONS

The first part of the paper deals with optimal capital income taxation for the world as a whole. Residence criteria commonly emerge from the production

efficiency theorem of Mirrlees and Diamond (1971) when all profits can be taxed away. It is not necessarily optimal to tax all first-period wage (profit) income away in the considered OLG model. It is shown that residence criteria is superior also under optimal lump-sum transfers.

Optimal capital income taxation maximizes steady-steady utility and does not imply a Pareto improvement when the transitory effects are taken into account. A policy problem is the weighting of appropriately short-term welfare losses for the existing older generation against long-term gains from having a more intertemporally efficient distribution of welfare. If lump-sum transfers are given to the old, domestic tax depends positively on investment elasticity. The optimal international taxation follows in a benchmark case a weighted average rule. A country with investment sensitive to the taxation of its return should raise substantial amount of its income from capital income taxes. But in international taxation, it ascribes a low weight to the high domestic capital income tax rate. This corresponds to a high weight given to a low domestic capital income tax rate that would prevail without any attention paid to intergenerational welfare distribution.

Tax cooperative solution may be difficult to achieve. Second part of the paper deals with tax competition assuming a mixed scheme of residence-based tax and, hence, a restriction in the tax instruments available for the government. It is shown that when countries are small open economies, residence and source-based tax/subsidies can be decided decentrally under tax competition. Tax policy is the same in a Nash equilibrium of the residence-based and source-based tax/subsidy scheme and under tax cooperation with no restriction in capital income tax instruments.

For large open economies this is unlikely acknowledging the incentive of countries to manipulate terms-of-trade when world interest rate is not given. However, as in Bucovetsky and Wilson (1991), a symmetric Nash equilibrium of large open economies of a residence-based and source-based tax/subsidy scheme is equal to a tax cooperative tax scheme with no restriction in capital income tax instruments. It is shown that tax cooperation instead leads to different solution.

4. International Corporate Taxation

4.1 Basic Remarks

The purpose of this section is to examine the impact of corporate tax system on foreign direct investment and income earned by a subsidiary of a company which is resident in another country. I especially examine alternative international double taxation relief systems in dividend payments from foreign direct investment (FDI).

First chapter 4.2 is an introductionary section. I introduce alternative corporate tax systems and thereafter consider various double tax reliefs adopted in intercompany dividend payments. Corporate tax burden depends on taxation in parent country and host country (where the subsidiary is located), on the taxation of cross-border dividend payments on the part of both host and parent countries and on economic double tax reliefs granted to final shareholders. The four-step taxation of FDIs (or the five-step taxation to include personal taxes paid by final shareholders) is not equally straightforward as the taxation of portfolio investment income.

The final chapter 4.3 deals with the 1993 Capital Income Tax Reform in Finland and foreign direct investment (FDI) and is published in Finnish Economic Papers (see Piekkola 1995a). The most important effect of the Finnish Tax Reform is the decrease in statutory tax rates, leading to an overall cut down in the cost of capital. The Tax Reform should have real effects on new capital investment from abroad, since the host countries of most foreign MNEs apply the territorial principle. Besides "greenfield" FDI, I consider mergers and acquisitions. These are often ignored although they are one of the major forms of FDIs. The reform is likely to affect the marginal conditions for new capital investment and the market value of existing firms in acquisitions differently.

4.2 International Double Taxation Relief in Dividend Payments

4.2.1 INTRODUCTION

The choice of double tax relief depends on the corporate income tax system which, under separate accounting, may be classical, cash-flow or comprehensive corporate income taxation. Corporate tax systems under separate accounting may be subject to thin capitalisation, when the transfer of income between subsidiary and parent affects the total tax burden of MNE. A unitary taxation would avoid this but is not considered (see Musgrave, 1987, McLure, 1989, Gardner, 1992). [1]

Some of the merits of cash-flow taxation are worth attention, although otherwise not considered in greater detail. [2] The taxation of 'pure' profits in cash-flow taxation requires no international double taxation relief nor the integration of personal and corporate taxation. Crediting new equity injections going in to subsidiaries abroad abolishes the distorting effect of taxing the dividends that come out. A vital part of cash-flow taxation is that all capital income is declared. Spahn and Kaiser (1991) propose that non-declared investments are treated as consumption and subject to a flat minimum tax referred to as 'piggy-back' tax. Hence, there is no incentive not to declare. The same idea extends to capital exports. They are treated as consumption and subject to a 'piggy-back' tax unless an equal-treatment clause prevails between

[1] In thin capitalization, subsidiary is debt-financed for transferring income from the high-taxed parent. The multinational gains from the transaction to the extent that the taxes on subsidiary interest payments are lower than the general taxes in the parent country. This is not a problem under unitary taxation, since the financial assets do not enter into the apportioning formula. A major part of all taxes would be paid to the country where the product is manufactured, but each country in which the product is sold, could also extract some corporate tax revenue. An alternative to this is minimum taxes on book profits, taxes that apply to assets rather than income, and minimum taxes on distributed income.

[2] For a presentation of cash-flow corporate income tax, see Meade-Committee (1978), Kay and King (1978), Sinn (1987), King (1987) and Keen (1991).

the countries. There are also some problems associated with the introduction of a cash-flow taxation that differs from corporate taxation in other countries. OECD (1991b, p. 31) highlights forth the fears expressed in the Canadian McDonald Commission report that a possible cash-flow corporation tax paid by foreign-owned companies (operating in Canada) would not be eligible for the foreign tax credits of other countries. [3]

Comprehensive and classical corporate taxation are examined here. Section 4.2.3 considers comprehensive corporate income taxation (CCIT). The majority of countries tax profits on an accrual basis along the lines of CCIT (see table 1 in section 2.3.1). Comprehensive taxation agrees with the 'old' view, where shareholders have preference for distributed earnings and the taxation of their dividend income is important. [4, 5] Personal capital income tax as a final tax maintains progressivity in dividend receipts.

Section 4.2.4 considers corporate taxation with no personal taxation of final shareholders. Corporate tax is, hence, not mere advance tax that should have no economic meaning upon final distribution of income to shareholders. The study includes examination of international taxation that satisfies a weighted average formula in dividend distributions on corporate level. One obvious example is a classical corporate taxation with no personal capital income taxes on dividend income. Classical taxation, as applied in Luxembourg, The Netherlands and United States (see table 1 in section 2.3.1), can also be considered working as if personal capital income taxes are of no importance in the investment decision of firms. Proponents of classical income taxation often support the 'new' view considering retained earnings as an important source of finance. The major part of profit distribution takes the form of capital gains, and taxes on dividends only play a subservient role (see Sinn, 1991, and OECD 1991b). Even if distributions take the form of dividend

[3] Since investment neutrality holds, cash-flow taxation is still a device to tax non-resident shareholders, as argued by Boadway, Bruce and Mintz (1982).

[4] For the exposition of 'old' and 'new' views, see OECD (1991b), and for a summary of the traditional analysis, see Caves (1982).

[5] Gordon and Jun (1993) in their empirical comparison of direct and portfolio investments argue for only personal capital income taxes and no excess tax at corporate level in direct investments when residence-based taxation is not possible and there is only source-based corporate and withholding taxes in portfolio investments.

payments, receivers of dividends from new share issues do not bear dividend taxes as capitalized in the market value of shares. The 'trapped equity view' argues that, once equity capital has been injected into the corporation through the issue of shares, it is "trapped". Provided the tax rate stays constant over time, the dividend tax should not affect the incentive to retain earnings for investment now with the purpose of increasing distributions later.

4.2.2 DOUBLE TAXATION RELIEF

The double taxation of foreign-source income is not an intentional tax policy followed by any country involved in international trade. There is, however, no such thing as an international tax system to enforce a double taxation provision. Double taxation treaty protection in a parent country is a combination of business profits regulations and regulations defining a permanent establishment (see Tomsett, 1989, p. 118). Most OECD member states levy corporate income tax on all "permanent establishments" of corporations operating within their jurisdiction. [6] Countries also impose corporate tax on the repatriated foreign-source income of their "resident" corporations. Hence, both source and residence principles are applied in practice (see table 1 in ch. 2).

Alworth (1987, chs. 3 and 4) carried out a comprehensive study of various systems of company taxation and international double taxation relieves. This study provides the background here. [7] I am considering double taxation relief on dividend distributions between MNE and its subsidiary when shareholders have preference for immediate repatriations and MNE distributes all dividend income earned from subsidiary to its shareholders. Residence criteria may indeed require the current taxation of corporate direct and portfolio investment abroad on accrual bases and, possibly, a corporate tax

[6] The minimum time period for characterizing a project or other temporary activity as a permanent establishment is 6 months in the UN model Convention and 12 months in the OECD Model Double Taxation Convention. A permanent establishment is not protected from tax charges.

[7] For the examination of the tax liability on foreign profits distributed to domestic shareholders, see also Devereux and Pearson (1989), Tanzi and Bovenberg (1990), Viherkenttä (1991) and Suurnäkki (1992).

adjustment for individual portfolio investment abroad. I also show a weighted average formula in dividend payments between subsidiary and parent in corporate taxation although without particular theoretical justification for its optimality. It can approximate the weighted average rule considered in chapter 3.2 when corporate taxes are final taxes (no personal taxes on dividends,) and when portfolio and foreign direct investment are comparable to each other (MNE simply arbitrages capital and MNE moves equity capital from countries where its return is low to countries where the return is high). [8]

A parent (head office) resident in the representative shareholder's country of residence (home country) and an affiliate in a host country form a 'binational company'. Let the subsidiary of the domestic parent company be liable to company tax at a rate τ^* on taxable profits Y^* before redistribution. This rate most usually corresponds to the corporate tax on local companies in the host country. A subsidiary also usually enjoys all the tax provisions available to domestically-incorporated companies. In the parent country, a share $1-\lambda$ of foreign taxable profits is subject to domestic taxes τ, and $1-\lambda$ per cent of the foreign taxes $\tau^* Y^*$ paid can be deducted from home country tax assessment $(1-\lambda)\tau Y^*$. The composite tax rate τ^c that includes the host and home country corporate taxes on the income of a foreign affiliate is written as

$$\tau^c = (1-\lambda)\tau + \lambda \tau^* \qquad (4.2.1)$$

giving also residence $\lambda = 0$ (tax credit system) and source criteria $\lambda = 1$ (exemption system). (4.2.1) is similar to the weighted average formula considered in section 3.2 with the difference that corporate tax rates (τ in parent and τ^* in host country) replace personal tax rates.

Let $D^* = (1-\tau^*)\theta^a Y^*$ describe the repatriated gross capital income after statutory corporate taxes and economic double taxation relief, where θ^a is the opportunity cost of retaining earnings in the affiliate before withholding taxes. θ^a shows the additional dividends, inclusive of any possible tax credit, which shareholders would receive if one unit of profits after corporate tax were

[8] For criticism against this capital-arbitrage hypothesis, see Caves (1982) ch. 2.1. For factors affecting FDIs, see also Haaparanta (1990, p. 8-15).

distributed. Hence, one unit of profits distributed after corporate tax is worth θ^a units in the hands of shareholders. Full imputation $\theta^a = 1/(1-\tau^*)$ implies that dividends equal before-tax profits $D^* = Y^*$ under full distribution. Corporate pays corporate taxes τ^* which are fully credited at a rate $(1 - \theta^a)/\theta^a = -\tau^*$ when income is distributed. The total liability on gross repatriations D^* is given by

$$(1-\kappa)\frac{1-\theta^*}{\theta^*}D^*, \tag{4.2.2}$$

where θ^* includes the withholding taxes τ^w of host country so that $(1-\theta^*)/\theta^* = (1-\theta^a)/\theta^a + \tau^w$.[9] κ describes the percentage of taxes on dividends levied in the host country that can be set against company taxes in the home country. Let $(1-\theta)/\theta D$ describe the liability of dividend distribution in the home country, where θ is the opportunity cost of retaining profits in terms of dividends foregone for the domestic shareholders.

The total tax liability is the sum of corporate taxes on the income of affiliate $\tau^c Y^*$, and taxes on repatriations $(1-\kappa)(1-\theta^*)/\theta^* D^*$ and on domestic dividend distributions $(1-\theta)/\theta D$:

$$T = \tau^c Y^* + (1-\kappa)\frac{1-\theta^*}{\theta^*}D^* + \frac{1-\theta}{\theta}D. \tag{4.2.3}$$

Gross dividends to shareholders D equal the gross dividends less withholding taxes and home country taxes $D = (1-\tau^w)D^* - T_h$, $T_h = (1-\lambda)(\tau-\tau^*)Y^* - \kappa\frac{1-\theta^*}{\theta^*}D^* + \frac{1-\theta}{\theta}D$. Substituting in this $(1-\theta^*)/\theta^* = (1-\theta^a)/\theta^a + \tau^w$ for τ^w and expressing T_h in terms of T yields

$$D = \left(1 - \frac{1-\theta^*}{\theta^*} + \frac{1-\theta^a}{\theta^a}\right)D^* - T_h = \frac{1}{\theta^a}D^* + \tau^* Y^* - T \tag{4.2.4}$$

[9] This reflects the current practice that withholding taxes are not credited and apply to the sum of gross dividends and imputed income.

Substituting this in (4.2.3) gives the general formula

$$T = \left(\theta\tau^c + (1-\theta)\tau^*\right)Y^* + \frac{\theta}{\theta^a}\left(\frac{1-\theta}{\theta} + (1-\kappa)\frac{\theta^a(1-\theta^*)}{\theta^*}\right)D^* \quad (4.2.5)$$

The first term describes the effective taxation at corporate level. This is the sole term in classical corporate taxation and no withholding tax ($\theta = \theta^* = 1$, $\tau^w = 0$). The last term indicates the (complicated) way that the integration of personal and corporate taxation affects the analysis. T should equal zero, when final shareholders only pay personal capital income taxes on dividend income that MNE earns from FDI abroad. The economic double taxation relief alternatives given to final shareholders include split-rate and dividend deduction systems, imputation system and separate entity or classical systems. Economic double taxation relief can take place at company (dividend deduction system) or shareholder (imputation system) level. [10] The split-rate and dividend deduction systems, however, are not analysed. The imputation is given by $\theta = 1/(1-s)$, where s is the rate of imputation. Full imputation, where $s = \tau$ and $\theta = 1/(1-\tau)$, achieves the integration of personal and corporate taxation under CCIT.

4.2.3 COMPREHENSIVE CORPORATE INCOME TAXATION

This section considers comprehensive corporate income taxation CCIT, where final shareholders pay personal taxes on dividends received. All profits are considered to be repatriated. [11] Tax refunds for final shareholders ($\theta > 1$)

[10] OECD (1991b, p. 167-171) states that relief at corporate level may be more neutral in corporate funding from equity and loan finance, and may also reduce the motivation for thin capitalization. Company tax relief can also be varied according to the type and size of the firm. Capital important neutrality may be more easy to achieve under a split rate system which gives the benefit of the lower rate to all shareholders.

[11] Otherwise, full integration requires that full credit is given to shareholders not only in respect of corporate tax paid on distributed profits, but also for that paid on retained profits, so that the corporate tax is merely an advance payment of personal income tax (see OECD 1991b, p. 15).

eliminate the taxation on the corporate level (and $T = 0$ under full elimination). *Full tax credits without deferral* implies that $\lambda = 0$, $\kappa = 1$ and $\tau^c = \tau$ in (4.2.5). The total tax liability is written as [12]

Full tax credit system

$$T = \left(\theta\tau + (1-\theta)\tau^*\right)Y^* + \frac{1-\theta}{\theta^a}D^* \qquad (4.2.6)$$

$$= \left(\theta\tau + 1 - \theta\right)Y^* \text{ (under full distribution)} .$$

It is seen that gross dividends from abroad $D^* = (1-\tau^*)\theta^a Y^*$ depend on the alleviation of economic double taxation in the host country θ^a but the total tax burden is independent of it, since $(1-\theta)/\theta^a D = (1-\theta)(1-\tau^*)Y^*$. Under full imputation $\theta = 1/(1-\tau)$, corporate taxation of affiliate's income, the first term in RHS, and the imputation that gives effective subsidies to the affiliate, the second term in RHS, sum to zero, as seen from the following table

Income	Y^*
Corporate tax	$\tau^* Y^*$
Distributed to parent	$(1-\tau^*)\theta^a(1-\tau^w)\,Y^*$
Received by parent	$(1-\tau)\,Y^*$
Final dividends	$\theta(1-\tau)\,Y^*$

where $\theta(1-\tau)\,Y^* = Y^*$ when $\theta = 1/(1-\tau)$. A problem is whether indirect tax credit is permitted when a legal entity "subsidiary" is separate from the taxpayer "parent" claiming the credit. To begin with, indirect tax credit often requires that the recipient of the dividends holds at least 10 per cent of the shares or of the voting power in the distributing company. Second, indirect tax credit and credit system differ in how credited taxes are defined and calculated. The most usual indirect tax credit method is the grossed-up dividends method

[12] Alworth (1988, p. 76) writes equations in terms of domestic gross dividend distributions implying here $T = \tau Y^* + (1-\theta)/\theta\, D$.

$(1-\lambda = D^*/[(1-\tau^*)Y^*\theta^a]$ and $\kappa = 1)$. Foreign earnings enter domestic tax base only to the extent that foreign taxable profits are repatriated. The taxable profits can be calculated following parent-country legislation as in the US legislation (see section 4.2.2.2 in Suurnäkki, 1992). Hence, the possible different depreciation rates for tax purposes in the countries are taken into account, which is important when they substantially deviate from true economic depreciation. Note that, as discussed in section 3.2 in chapter 3, the method used in the weighted average formula can be similar to grossed-up dividends system when the share of repatriations is considered as the weight. Considering not all dividends to be repatriated leads to an increase in weight of foreign taxes or to relatively lower taxation of foreign taxable profits and lower share of taxable profits that are credited (see also 4.2.1).

Another problem related to the tax credit system concerns minimum corporate tax rule to ensure that corporate taxes have been paid on distributed dividends. This has resulted in various control mechanisms such as equalisation tax, précompte and advance corporation tax. Neutrality requires granting a foreign tax credit against the compensatory tax or the equalisation tax on the distribution of foreign-source income. This is rare and withholding taxes and the cost of equalisation might affect investment decisions. An example of this is the ACT in the UK applied to foreign-source income if dividends are distributed to shareholders. [13]

An *exemption system* is often applied through double taxation treaties (no taxes payable by the parent company on repatriated earnings from the subsidiary). One difference from a full tax credit system is that there is no crowding out for tax incentives in the source country. This can be desirable in FDIs to LDCs. The method often used is to calculate domestic tax on worldwide income and deducting from this the domestic tax liability by a fraction equal to the proportion of foreign-source income in total worldwide income. [14] Exemption system is compatible with the source principle when

[13] On compensatory tax in Finland, see Kanniainen (1991, ch. 6). Since 1993, foreign withholding taxation is allowed to be credited against compensatory tax.

[14] Through this method of "exemption with progression", income from a foreign source is allowed to influence the taxpayer's marginal rate on domestic income when taxes are

there is no imputation system for final shareholders. From (4.2.6), exemption system ($\lambda = 1$, $\kappa = 0$, $\tau^c = \tau^*$) is described as

Exemption system

$$T = \tau^* Y^* + \frac{\theta}{\theta^a}\left(\frac{1-\theta}{\theta} + \frac{\theta^a(1-\theta^*)}{\theta^*}\right) D^* \qquad (4.2.7)$$

$$= Y^*\left(1 - \theta\theta^a (1-\tau^*)(1-\tau^w)\right) \text{ (under full distribution)}$$

Following table shows the income received and distributed on different levels

Income	Y^*
Corporate tax	$\tau^* Y^*$
Distributed to Parent	$(1-\tau^*)\theta^a (1-\tau^w) Y^*$
Final dividends	$\theta(1-\tau^*)\theta^a (1-\tau^w) Y^*$,

where $\theta(1-\tau^*)\theta^a (1-\tau^w) Y^* = Y^*$ if $\tau = \tau^*$, $\tau^w = 0$ and (i) $\theta = 1/(1-\tau)$, $\theta^a = 1$ or (ii) $\theta = 1$, $\theta^a = 1/(1-\tau^*)$. Hence, exemption system can eliminates corporate taxes if corporate tax rates are equal in parent and host countries and withholding taxes are zero. It is seen that an economic double tax relief in host country $\theta^a = 1/(1-\tau^*)$ is an alternative to full imputation $\theta = 1/(1-\tau)$. Giovannini and Hines (1990) introduced a proposal for the EU to preserve the residence principle in an imputation system by following an exemption system in corporate dividends payments. There is no benefit from not declaring income earned abroad as each source country imposes a proportional source-based tax on capital income. The system offers refunds that provide the taxpayer with an incentive for honest declaration (since the source-based taxes are relatively heavy). With no withholding taxes in portfolio income taxation, the effective taxation of the direct ownership of a foreign company and "indirect" ownership through domestic parent company are the same. Hence, the tax burden on multinationals is unavoidably dependent on the nationality of its shareholders. There would be less problem with the right definition of the

calculated according to a progressive schedule.

residence of the transnational firm, which is difficult, as pointed out by Cnossen (1991, p. 22) [15]

It is obvious that an ordinary tax credit system also gives (4.2.7), when foreign taxes are higher than domestic taxes and the company is in an excess tax-credit position. Hence, the tax burden is determined in the host country of subsidiary. Multinationals, on the other hand, have numerous ways of avoiding being in a tax-credit exhausted position as regards repatriated dividends. Carryforward and carryback rules allow the averaging of foreign taxes over time, so that the overall limitation is often subject to longer than a one-year period. In the US, excess taxes can be carried back two years and forward five years. [16] If the host country gives full economic double taxation relief $\theta^a = 1/(1-\tau^*)$, the parent country is also not likely to be tax-credit exhausted. [17] A tax-exhausted firm could also maximize royalties, head office charges and interest payments that are deductible under host country taxation, and minimise dividend payments. The shift of taxable income from the host to the parent country does not increase the domestic tax liability if the firm is tax-credit exhausted (see Horst, 1977, p. 379-380).

Some scholars have advocated a *deduction system* rather than a tax credit system. This is not solely used in any international tax treaty, except as part of the unitary tax system in US federal taxation. It is worth introducing for three reasons. To begin with, it implies national efficiency for capital-exporting countries (see Musgrave, 1972). Foreign net income after foreign taxes paid is compared with domestic gross income. Domestic tax level is unimportant for national welfare, since it merely reflects income transfer

[15] The general rule is that a company is domiciled in the state in which it has been incorporated. It only requires a notary public to move the seat of the company to a low-tax state. To avoid this, some countries, e.g. the United Kingdom, considers the residence of a company to be located where the central management is located. This, together with location according to the place of the main business, are difficult to apply in any case and require international agreement to avoid double taxation.

[16] The US also applies an averaging system (with certain limitations), where all foreign-source income and taxes are summed up in the tax position calculation. Therefore, high-taxes on one source can be set against low taxes on other source, and the probability of being tax-credit exhausted is reduced. The UK applies a source-by-source basis, but an intermediary holding company may be used in dividend payments to average the foreign tax rate suffered.

[17] Finland extends tax credits to UK parent corporates. Neutrality is still not achieved due to advance corporate tax (ACT) if dividends are further distributed to final shareholders.

between the private and public sectors. Second, other costs of acquiring income in the foreign country (foreign taxes other than foreign income taxes) are generally dealt with as deductions. Third, it can also alleviate the taxation of new share issues, when economic double taxation relief exists at the company level and all foreign-source income may not have to enter domestic tax base. In the deduction method with partial exemption, let $1-\vartheta$ describe the portion of foreign income exempted from domestic taxation. Hence, $\tau^c = \tau^* + \vartheta\,\tau(1-\tau^*)$, $1-\kappa = \vartheta(1-\tau)$ and the effective tax burden, from (4.2.5), is written as:

Deduction system

$$T = \left(\tau^* + \theta\vartheta\,\tau(1-\tau^*)\right)Y^* + \frac{\theta}{\theta^a}\left(\frac{1-\theta}{\theta} + \vartheta(1-\tau)\frac{\theta^a(1-\theta^*)}{\theta^*}\right)D^*. \quad (4.2.8)$$

A deduction system always treats foreign-source income less favourably than a tax credit system, unless the host country gives economic double taxation relief to dividend distributions abroad ($\vartheta < 1$). Elimination of corporate taxes requires full imputation on all levels ($\theta = 1/(1-\tau)$, $\theta^* = \theta^a = 1/(1-\tau^*)$).

On the basis of (4.2.6) through (4.2.8) and under full distribution, following table 3 shows the combination of double tax relief system in dividend payments from affiliate and in dividend payments to final shareholders that eliminate all corporate taxes on the shareholder level ($T = 0$). Double taxation relief in dividend payments (row) and required economic double tax relief in the host country θ^a and in distribution to the shareholder θ with no withholding taxes $\tau^w = 0$ (column) are:

Table 3. Double tax relief under CCIT

		θ	θ^a
Full tax credits	$\lambda=0,\ \kappa=1$	$\frac{1}{1-\tau}$	irrelevant
Exemption	$\lambda=1,\ \kappa=0$	$\frac{1}{1-\tau}$, $\tau^*=\tau$	1
Deduction	$\tau^c=\vartheta\tau(1-\tau^*)$	$\frac{1}{1-\tau}$	$\frac{1}{1-\tau^*}$
	$1-\kappa=\vartheta(1-\tau)$		

Full tax credits and full imputation in dividend distributions requires no tax harmonisation up to (possible) limit to credits and imputation credit θ^a is irrelevant. Exemption system eliminates corporate taxes if corporate tax rates are equal in parent and host countries. The deduction system also requires economic double tax relief in the host country. Commission's 1975 proposal envisage an imputation credit in host country and at the same rate as for shareholders having residence there. This combined with deduction system, hence, satisfies CCIT neutrality.

4.2.4 NO TAXATION OF FINAL SHAREHOLDER

This section considers corporate taxation, which is not mere advance tax that should have no economic meaning upon final distribution of income to shareholders. I am assuming no taxation of final shareholders and a weighted average formula in dividend payments between subsidiary and parent. One obvious way to end up to (4.2.1) and a weighted average formula in final taxes is a classical corporate taxation with no personal capital income taxes on dividend income. It is a separate entity system with no economic double tax relieves in parent country, $\theta = 1$, or in host country, $\theta^a = 1$ and $(1-\theta^*)/\theta^* = \tau^w$. Eq. (4.2.5) reduces to:

$$T = \left((1-\lambda)\tau + \lambda\tau^*\right) Y^* + (1-\kappa)\tau^w D^* . \qquad (4.2.9)$$

The corporate-level weighted average formula is straightforward (see the discussion of grossed-up dividends method in CCIT taxation). Earlier papers have mainly dealt with the choice between source or residence principles. Sato and Bird (1974, p. 432) discuss on residence criteria and *full crediting* (including refund) of foreign taxes ($T = \tau Y^*$). The van del Tempel report (1970) advocates source criteria and *exemption system* (described as $T = \tau^* Y^* + \tau^w D^*$). In the exemption system the gross dividend distributed to final shareholders would be net of foreign rather than domestic corporate taxes. As Sato and Bird (1974, p. 431) point out, the report does not put much weight on CEN, but rather on equal fiscal treatment in a CIN sense. The corporate tax burden would also be non-dependent on the timing of the repatriation of profits from the subsidiary. In some circumstances, this may better ensure CEN than a full tax credit system.

Consider next international double tax relief system with partial imputation system in dividend distributions to final shareholders. Economic double tax relief on the shareholder level can be chosen to reflect a weighted average formula. The rate of imputation depends on tax level in parent and host countries. In *current taxation with full tax credits* ($\lambda = 0$, $\kappa = 1$), equating (4.2.1) and (4.2.6) implies for the optimal imputation rate that

Full Tax Credit System

$$\theta = 1 - \frac{\lambda(\tau^* - \tau)Y^*}{(\tau^* - \tau)Y^* + D^*/\theta^a} \qquad (4.2.10)$$

When the residence principle is optimal ($\lambda = 0$), no economic double tax relief is required ($\theta = 1$). When the source principle is optimal ($\lambda = 1$) and tax level is lower in host country $\tau^* < \tau$, final shareholders should receive economic double tax relief ($\theta > 1$). An opposite, of course, holds for higher host country taxes $\tau^* > \tau$. Imputation is hence dependent on the relative tax rates prevailing in the countries.

Under the exemption system ($\lambda = 1$, $\kappa = 0$) and full distribution $D^* = \theta^a (1 - \tau^*) Y^*$ and no withholding taxes $\theta^* = \theta^a$, (4.2.1) and (4.2.7) yield:

Exemption System

$$\theta = \frac{1}{1-\tau^*} \frac{1-(1-\lambda)\tau - \lambda\tau^*}{\theta^a}. \qquad (4.2.11)$$

Source principle ($\lambda = 1$) requires no economic double tax relief (θ^a, $\theta = 1$). Tax harmonisation $\tau = \tau^*$ also leads to relatively simple rule: economic double tax relief in the parent θ relates inversely to economic double tax relief in host country θ^a. An example of this is harmonised classical corporate taxation, where $\theta = \theta^a = 1$ also satisfying $\theta = 1/\theta^a$. Complications arise under non-harmonisation when exempting is not optimal. Before the distribution of dividend income to final shareholders, the effective tax rate depends on the host country corporate tax rate and this requires imputation (the first term $1/(1-\tau^*)$ on the r.h.s.). Distributed income is one minus taxes paid according to the weighted average formula. If residence criteria is optimal ($\lambda = 0$), double tax relieves and tax rates should satisfy $\theta = (1-\tau)/(1-\tau^*)\theta^a$.

In the deduction system, the optimal economic double tax relief, from (4.2.1) and (4.2.8), is given under full distribution $D^* = \theta^a (1 - \tau^*) Y^*$ by

Deduction System

$$\theta = \frac{1-(1-\lambda)\tau - \lambda\tau^*}{\vartheta(1-\tau^*)\left(\theta^a(1-\tau) - \tau^*\right)}. \qquad (4.2.12)$$

In the deduction system, the denominator shows the imputation required so that the distribution of income to the final shareholders may reflect the weighted average formula. If international double taxation relief follows the deduction system, economic double tax relief should be more generous than under the imputation system, unless economic double tax relief in host country ($\theta^a > 1$) alters the result.

4.2.5 CONCLUSIONS

The first part of this section considered comprehensive corporate income taxation. Full imputation system is always essential for the elimination of advance corporate taxes upon payments of dividends to shareholders. Full tax credits in corporate-level dividend payments are unnecessary. Exemption system, however, requires tax harmonisation and deduction system also economic double tax relieves in the host country.

Another way to make the taxation of foreign direct investments coherent to the taxation of portfolio investments is to have corporate taxes as the final levy. The application of the weighted average formula is straightforward without personal taxes on dividends. Grossed-up method used in CCIT is, as a system, similar to weighted average taxation of international investment. Finally, less than complete economic double tax relieves to final shareholders can be chosen so as to achieve efficient non-zero corporate-level taxation of FDIs.

4.3 New Capital Investment and Acquisitions

4.3.1 INTRODUCTION

This chapter addresses the question of how capital income tax reform in a particular country (Finland) and international double tax relief affect foreign investment in the area, whether in the form of new capital investment or takeover. Under the worldwide principle, the tax liability of a multinational enterprise (MNE) is determined in the parent country, which credits foreign taxes paid on operations abroad. As is well known, this ensures capital export neutrality in new capital investment. Under the polar opposite, territorial taxation, subsidiaries of multinational enterprises (MNEs) pay corporate tax in the host country and are exempted from taxation in the parent country. [1] The tax treatment of domestic corporations and foreign subsidiaries in the host country is the same. This relates to capital import neutrality, since the tax level does not depend on the nationality of the corporation that makes the investment. Territorial taxes are capitalised in the price of firms, and foreign MNEs planning to acquire existing firms are indifferent to them.

The focus of the chapter is on new capital investment and acquisitions in Finland and the 1993 Capital Income Tax Reform. The most important effect of the reform has been the decrease in statutory tax rates, leading to an overall cut in the cost of capital (Valtiovarainministeriön työryhmämuistio 1991:28 and Hallituksen esitys 200/1992, 203/1992). Under worldwide taxation, lower taxes on domestic firms and on subsidiaries of MNEs discourage foreign direct investment (FDI). The tax level in host country has no tax consequences for the MNE. The increase in output level lowers the final goods price level and the profitability of FDI. Scholes and Wolfson (1991) argue that, for this reason,

[1] In the taxation of international portfolio investment income, the worldwide principle is referred to as the residence principle and the territorial principle as the source principle.

the Tax Reform Act of 1986 in the US which raised effective tax rates for domestic compared with foreign US investors on certain corporate assets, provided an incentive for foreign multinationals to increase their FDI in the United States. Correspondingly, the Finnish corporate tax reform, which moved in the opposite direction to promote domestic investment, discourages FDI from countries applying the worldwide principle to tax bases. Auerbach and Hasset (1993) present a critical view of the Scholes and Wolfson (1991) hypothesis. They argue that, to begin with, domestic firms were also encouraged to invest in land and structures. Second, the acquisition of existing firms is the major form of FDI and boomed after the 1986 Tax Reform Act. However, lower depreciation rates in US taxation after the tax reform increased the relative price of existing capital. The tax reform worked against acquisitions from worldwide countries.[2]

Auerbach (1989) and Auerbach and Hasset (1993) were a major source of information for this paper. Worldwide, as well as territorial taxation, affects new capital investment and acquisitions differently. This is still the case after the Finnish Tax Reform, which leaves the tax incentives given for new capital investment, i.e. depreciation rates for tax purposes, mainly intact (except in investment in structure). As shown in the study, only when international investment is subject to double taxation rather than to a bilateral double taxation treaty, do lower statutory taxes encourage FDIs irrespective of their form, but this is rare. I also consider partial worldwide principle in which tax expenditure are paid in the host country. Scholes and Wolfson (1991) hypothesis does not also take into account that lower depreciation rates after the US tax reform also affects the taxation of FDI in the area, since partial rather than full worldwide taxation is common in FDI in the US. Taxable profits vary depending on the depreciation allowances and investment tax credits. The divergence in this respect is also higher than in statutory taxes among countries (see OECD, 1991b, ch. 3). [3] The merger decision also raises

[2] Auerbach and Hasset (1993) also argue that it is not clear that there was a relative increase in FDIs from home countries following worldwide taxation compared with territorial taxation. They conclude that factors other than tax, such as exchange rate movements and the liberalization of capital markets, may better explain the boom in FDIs to the US.

[3] Even if the definitions of taxable income were the same as for domestic and foreign-

the question of the treatment of tax losses and credits, and interest deductions (see Auerbach and Reishus, 1988, p. 160). However, these issues are not examined here. Capital gains taxation is borne by shareholders who sell the firm for the foreign MNE. [4] The assumptions regarding territorial firms differ slightly from those in Auerbach and Hasset (1993). Here, it is assumed that territorial and worldwide firms pay the same price for acquired domestic firms. Auerbach and Hasset (1993) assume that territorial firms, like domestic firms, are indifferent to making any additional acquisitions. Any change in taxes is capitalised in the price of existing firms.

Besides worldwide, partial worldwide, exemption systems and the double taxation of FDI, a deduction system in which the parent country tax base consists of after-foreign-tax net income, is examined. With the deduction system and the double taxation of FDIs, the incentive effects of the tax reform also depend on parent country taxation.

Since the host countries of most foreign MNEs apply the territorial principle, the tax reform has real effects on new capital investment from abroad. [5] New investment from countries applying territorial taxation is encouraged. The tax reform will have less significance for the acquisition of existing businesses in Finland. The deduction system combined with partial exemption, as applied by Italy, has effects comparable with those of territorial taxation. The Scholes and Wolfson (1991) hypothesis is not applicable, since only minor amounts of FDI are (directly) made from countries applying worldwide taxation. However, in the few countries which extend the worldwide principle to tax bases (the US here), the tax reform does discourage

source income, the actual differences in the tax expenditure in the two countries might cause deviation from capital export neutrality. Non-discrimination rules in tax treaties do not necessarily apply to tax expenditure (Surray and McDaniel, 1985, p. 170-171).

[4] Gardner (1992, p 52) mentions the problem in international mergers that capital gains attributable to the contributing or acquired company may be taxed at the time of the merger rather than upon realization, as is the practice for domestic mergers. Foreign shareholders may not similarly benefit from the tax advantages of later dividend distributions. For a general discussion of the taxation of share repurchases and acquisitions, see Bagwell and Shoven (1989) and Sinn (1987, ch. 6).

[5] The tax reform also works against local debt finance, which should encourage funding from the parent country. In data, this would show as an increase in FDIs, although not necessarily related to any change in real capital investments.

FDI irrespective of the assets required or the form of direct investment. The reform works especially against acquisitions by foreign corporations. Worldwide taxation is not applied in its pure form to investments from the UK and Japan, and tax bases are subject to changes depending on the place of investment. Tax expenditure follows current Finnish legislation and, since such tax expenditure is permitted at a lower level, the overall negative effects are strengthened.

Section 4.3.2 develops the model for investment behaviour in a host country which undergoes tax reform and where FDI is made. Section 4.3.3 shows the change in FDI. Some FDI implications of the Finnish Tax Reform are given in Section 4.3.4, and brief concluding remarks are made in Section 4.3.5.

4.3.2 THE MODEL

Consider a tax reform in the home country, which is the host country of MNE subsidiaries. There are three kinds of firms: the subsidiaries of the MNEs in the host country, the MNE itself in its parent country and the domestic firms in the host country. Consider first the investment decision of domestic firms investing therein only. Let $F(K)$ denote the real profit gross of depreciation as a function of capital stock K. The total investment cost function at date s is $C(I_s/K_s)I_s$, where the unit investment cost function $C(I_s/K_s)$ includes the adjustment cost of investment, dependent on the rate of investment I_s/K_s. Define p_s as the price level, I_s as investment, K_s as capital stock and τ_s as the corporate tax rate. The price level, taking as given for each individual firm, varies inversely with the level of aggregate production, which ensures equilibrium. Corporations maximize the current value of future cash-flow, discounted at the constant nominal cost of capital r:

$$V_t = \int_t^{\infty} \left(p_s F(K_s) - p_s C(I_s/K_s) I_s - T_s\right) e^{-r(s-t)}\, ds\,, \qquad (4.3.1)$$

where the tax burden at date s is

$$T_s = \tau_s\left(p_s F(K_s) - \int_{-\infty}^{s} \left(p_u C(I_u/K_u) I_u \; \delta' e^{-\delta'(s-u)}\, du\right)\right). \qquad (4.3.2)$$

Depreciation for tax purposes per unit of date u capital expenditure follows a declining balance, where assets are written off at a rate of δ' on a historical cost basis (which varies depending on the asset). Capital costs are part of capital expenditure for tax purposes. Investment and capital are related by

$$I_s = \delta K_s + \dot{K}_s\,, \qquad (4.3.3)$$

where the rate of the economic depreciation of capital is δ. Assume quadratic cost function $C(I/K) = I(1+\frac{1}{2}\phi\, I/K)$, where the adjustment cost ϕ is constant. This gives incentives for smoothing investment over time and hence makes new capital investment less sensitive to the cost of capital. [6] The main results will be rather robust regarding assumptions concerning the adjustment costs of investment. It is only steady-state that is of interest. The total cost function with respect to I is normalized to unity in the steady state. The focus is on the incentive effects of permanent tax changes around the original equilibrium and tax variables are referred to without time subscripts. The equilibrium Euler path is shown in the Appendix 3. Based on (A3.2), the Euler condition for the optimal capital stock path is written as

$$F_K^t + \chi_t = q_t\left(\rho + \delta - \frac{\dot{q}_t}{q_t}\right)\frac{1-\Gamma}{1-\tau}\,, \qquad (4.3.4)$$

where q_t is the relative marginal price of a new capital good, $\rho = r - \dot{p}_t/p_t$ is the real interest rate and

[6] For literature on the adjustment cost of investment, see Hayashi (1982, 1985).

$$\chi_t = \frac{1}{2}\phi\,(I_t/K_t)^2\,\frac{1-\Gamma}{1-\tau} \tag{4.3.5}$$

shows current adjustment costs per unit of investment. This would be absent if the adjustment costs depended only on the level of investment, rather than on the ratio of investment to capital stock. The term Γ in the expressions represents the current value of tax savings per dollar of date s investment:

$$\Gamma = \int_t^{\infty} e^{-r(u-t)}\,\tau\,\frac{\delta'}{r+\delta'}\,du. \tag{4.3.6}$$

Eqs. (4.3.4) and (4.3.5), together with the development of the relative price of capital goods $q = 1 + \phi(\dot{K}/K)$ from (A3.5) in the Appendix 3, yield first-order non-linear differential equations in capital stock K and the relative price of capital goods q. For analytical solutions, consider the incentive effects of (small) tax changes around the steady state, denoted by an asterisk * . The changes that are implemented in the tax reform are assumed to be unanticipated and permanent. The domestic capital accumulation effects of the tax reform are again shown in the Appendix 3, where the following second-order differential equation in capital stock is derived: [7]

$$\ddot{K}_t - \rho\dot{K}_t - \frac{\varphi(\rho+\hat{\delta})}{\phi}\,K_t = -\frac{\varphi(\rho+\hat{\delta})}{\phi}\,K^*\left(1-\frac{a+b}{\varphi}\right), \tag{4.3.7}$$

where

$$\hat{\delta} = \delta(1-\tfrac{1}{2}\phi\,\delta),$$

$$\varphi = -\frac{F^*_{KK}K^*}{F^*_K},$$

$$q^K_t = q^*_t(1-\Gamma) = (q_t - \phi\,\dot{K}/K)(1-\Gamma),$$

$$a = \frac{\tau-\tau^*}{1-\tau^*} - \frac{\Gamma-\Gamma^*}{1-\Gamma^*},$$

$$b = \frac{\rho\left(q^K-q^{K^*}\right)}{(\rho+\hat{\delta})q^{K^*}} - \frac{\dot{q}^K}{(\rho+\hat{\delta})q^{K^*}}.$$

[7] The procedure closely follows Auerbach (1989, p. 942-943). He also discusses other alternative approaches to characterize and solve the problem.

Here, $\hat{\delta}$ is the rate of the economic depreciation of capital stock (of current expenditure on capital). It includes economic depreciation δ and the reduced unit price of capital induced by current expenditure. The term φ is the elasticity of F_K with respect to K, evaluated at the steady-state value K^*. It shows how capital cost changes are turned into capital stock changes. The price of existing capital acquired in a steady-state is given by $q_t^K = q_t^*(1-\Gamma)$. The price would go down due to the accelerated depreciation rates Γ given to new capital. The postponement of tax payments causes an implicit tax liability on existing capital. In other tax terms, a describes the effect of taxes on the market value of new investment (through the linearization of $F_K(1-\tau)/(1-\Gamma)$ around the steady-state). b relates to the relative valuation of existing firms. This is zero for domestic firms, since buying existing capital for q^K or new capital for q results in the same current value.

The characteristic roots of the saddlepoint equilibrium are shown in the Appendix 3. The solution for K_t and q_t as given by (A3.14) and (A3.15) in the Appendix 3 gives the economic meaning of (4.3.7). A marginal decrease in the cost of capital (a goes down) will cause an increase in investment. The relative price of capital goods will initially decrease and then start to move back to its long-term value of unity.

4.3.3 THE FOREIGN MULTINATIONAL

Consider the foreign MNE and its investment in its home country. Assume first that it acquires capital in the form of firms. The price of the capital is not the new capital goods price 1, but the value of the firm. Later, an exogenous share of FDI is new capital investment at price 1 per unit of capital rather than the price of existing old capital. The analytical solution reveals the exact relationship between acquisitions and new capital investment, which would not be apparent in a phase diagram analysis. Any capital gains taxation in the acquisition is ignored. This is possible when deals are structured as acquisitions of stock to avoid corporate-level taxes.

The MNE differs from the domestic firm in the host country in that its acquisition policy has no impact on the output price p. The tax effects are dependent on the tax provisions the company faces. Denote the tax variables of the parent country by the superscript f. Equation (4.3.2), showing taxes on date s, can be rewritten for foreign firms as

$$T_s^F = \lambda T_s + (1-\lambda)\tau_s^f \left(p_s F^F(K_s^F) - \int_{-\infty}^{s} \left(p_u C(I_u/K_u) I_u \delta'^f e^{-\delta'^f(s-u)} du\right)\right). \tag{4.3.8}$$

λ is the proportion of taxes paid in the host country which is similar to those paid by domestic firms and T_s is identical to (4.3.2) except that capital stock K_s^F refers to that acquired by the foreign MNE at date s. $1-\lambda$ describes the proportion of foreign taxable profits taxed in the foreign parent country τ^f. As with the domestic firm, as shown by (A3.2) in the Appendix 3, the current value of the future cash flow of the foreign firm can be written as

$$V_t^F = \int_t^{\infty} e^{-r^F(s-t)} p_s \Big[(1-\tau_s^F) F^F(K_s^F) \tag{4.3.9}$$

$$-\left(1-\frac{1}{2}\phi^F\delta+\frac{1}{2}\phi^F\frac{\dot{K}_s^F}{K_s^F}\right)\left(\delta K_s^F+\dot{K}_s^F\right)\left(1-\Gamma_s^F\right)\Big]ds+A_t\,,$$

where $\tau^F = \lambda\tau+(1-\lambda)\tau^f$, $\Gamma^F = \lambda\tau\frac{\delta'}{r+\delta'}+(1-\lambda)\tau^f\frac{\delta'^f}{r+\delta'^f}$ and $A_t = \Gamma_s^F \int_{-\infty}^{t}\hat{\delta}\,e^{-(\delta'+\pi)(t-u)}\,du$. Past assets are written off at a rate δ' or δ'^f on a historical cost basis, and π describes the inflation rate (as in Auerbach and Hasset, 1993). This gives a solution analogous to (4.3.7), when ρ, a and b are replaced by respective foreign variables described by the superscript F. This can be written as:

$$\dot{K}_t^F-\rho^F K_t^F = \frac{\rho^F+\hat{\delta}}{\phi^F}K^{*F}\left(\varphi\left(\frac{K_t-K^*}{K^*}\right)+a^F+b^F\right), \quad (4.3.10)$$

$$a^F = \lambda\frac{\tau^F-\tau^{*F}}{1-\tau^{*F}}-\frac{\Gamma^F-\Gamma^{*F}}{1-\Gamma^{*F}},$$

$$b^F = \frac{\rho^F(q^K-q^{K^*})}{(\rho^F+\hat{\delta})q^{K^*}}-\frac{\dot{q}^K}{(\rho^F+\hat{\delta})q^{K^*}},$$

where τ^{*F} and Γ^{*F} are the steady-state values of the tax parameters. The foreign firm acquires existing firms, implying that $(K_t^F-K^{*F})/K^{*F} = (K_t-K^*)/K^*$. The term a^F is the effect of taxes on the market value of new investment. The tax rules and a^F under differing double tax relief are given by

1) the worldwide principle ($\lambda = 0$)

$$a^F = 0$$

2) the partial worldwide principle ($\lambda = 0$, $\Gamma^F = \Gamma$)

$$a^F = -\frac{\Gamma-\Gamma^*}{1-\Gamma^*}, \text{ where } \Gamma-\Gamma^* = \tau\frac{\delta'}{r+\delta'}-\tau^*\frac{\delta^{*\prime}}{r+\delta^{*\prime}}$$

3) the exemption system ($\lambda = 1$)

$$a^F = \frac{\tau-\tau^*}{1-\tau^*}-\frac{\Gamma-\Gamma^*}{1-\Gamma^*}, \text{ where } \Gamma-\Gamma^* = \tau\frac{\delta'}{r+\delta'}-\tau^*\frac{\delta^{*\prime}}{r+\delta^{*\prime}}$$

4) the deduction system ($\tau^F = \tau + \vartheta\,(1-\tau)\,\tau^f$, $\tau^{*F} = \tau^* + \vartheta\,(1-\tau^*)\,\tau^{*f}$)

$$a^F = \frac{\tau^F - \tau^{*F}}{1-\tau^{*F}} - \frac{\Gamma^F - \Gamma^{*F}}{1-\Gamma^{*F}}, \text{ where } \Gamma^F - \Gamma^{*F} = (\tau + \vartheta\,(1-\tau)\,\tau^f)\frac{\delta'}{r+\delta'} - (\tau^* + \vartheta\,(1-\tau^*)\,\tau^{*f})\frac{\delta^{*\prime}}{r+\delta^{*\prime}}$$

5) the double taxation ($\tau^F = \tau + \tau^f$, $\tau^{*F} = \tau^* + \tau^{*f}$)

$$a^F = \frac{\tau^F - \tau^{*F}}{1-\tau^{*F}} - \frac{\Gamma^F - \Gamma^{*F}}{1-\Gamma^{*F}}, \text{ where } \Gamma^F - \Gamma^{*F} = \tau^F\frac{\delta'}{r+\delta'} - \tau^{*F}\frac{\delta^{*\prime}}{r+\delta^{*\prime}}$$

Under the worldwide principle, a^F is zero since the host country tax level has no economic significance for the MNE because taxes are credited. The partial worldwide principle differs in that full crediting is only given on dividend payments to the parent company. Under a deduction system and the double taxation of FDI, the incentive effects of the tax reform also depend on parent country taxation. Finally, term $\vartheta < 1$ shows the degree of exemption in a deduction system with partial exemption.

Term b^F is similar to the respective variable for domestic firms b, except that the foreign discount rate ρ^F replaces ρ. The foreign firm observes the equilibrium path of q, p, q^K. It is small enough to take the prices of goods p as given in this second stage. The decision of foreign firms to acquire domestic capital hence has no effect on domestic output and investment decisions. A constant elasticity demand specification for output is assumed, i.e.

$$\frac{p-p^*}{p^*} = -\varphi\left(\frac{K-K^*}{K^*}\right). \tag{4.3.11}$$

Market prices determined by the production of domestic corporations evolve according to (A3.10) and (4.3.11):

$$\frac{p-p^*}{p^*} = a\left(1-e^{\lambda_1 t}\right). \tag{4.3.12}$$

(4.3.11) implies that (4.3.10) is a first-order differential equation, where the

solution at $t = 0$ is

$$\frac{\dot{K}_0^F}{K^{*F}} = -\frac{\rho^F + \hat{\delta}}{\phi^F} \int_0^\infty e^{-\rho^F t} \left(a^F - \frac{p - p^*}{p^*} + b^F \right) dt \,. \quad (4.3.13)$$

It is seen that FDI of the MNE relates negatively to tax effect a^F, to lower market prices $(p - p^*)/p^*$ and to higher price of existing capital b^F. The value of existing capital at date t around the steady state is:

$$q_t^K = q_t(1 - \Gamma) + A = q_t(1 - \Gamma) + \frac{\hat{\delta}}{\delta' + \pi} \Gamma \,. \quad (4.3.14)$$

where (4.3.9) is used for A. This and (A3.15) imply that:

$$\frac{q_t^K - q_t^{K*}}{q_t^{K*}} = \frac{\lambda_1 \phi}{\varphi} e^{\lambda_1 t} aB + C \,, \quad \frac{\dot{q}_t^K}{q_t^{K*}} = \lambda_1 \frac{\lambda_1 \phi}{\varphi} e^{\lambda_1 t} aB \,, \quad (4.3.15)$$

$$\text{where} \quad B = \frac{1 - \Gamma}{1 - \Gamma^* \left(1 - \frac{\hat{\delta}}{\delta' + \pi} \right)} \,, \; C = -\frac{(\Gamma - \Gamma^*) \left(1 - \frac{\hat{\delta}}{\delta' + \pi} \right)}{1 - \Gamma^* \left(1 - \frac{\hat{\delta}}{\delta' + \pi} \right)} \,.$$

Hence, b^F from (4.3.10) and (4.3.15) can be rewritten as

$$b^F = \frac{\rho^F - \lambda_1}{\rho^F + \hat{\delta}} \frac{\lambda_1 \phi}{\varphi} e^{\lambda_1 t} aB + \frac{\rho^F}{\rho^F + \hat{\delta}} C \,. \quad (4.3.16)$$

A positive change in investment incentives for new capital investment $\Gamma > \Gamma^*$ lowers the relative value of existing capital (C is more negative). A higher level of capital accumulation partly mitigates the encouragement in acquisitions ($aB < 0$ and the first term is positive in 4.3.16). Substituting b^F from (4.3.16) and $(p - p^*)/p^*$ from (4.3.12) into (4.3.13) gives, after some manipulation,

$$\frac{\dot{K}_o^F}{K^{*F}} = -\frac{1}{\phi^F} \left\{ \frac{\rho^F + \hat{\delta}}{\rho^F} \left(a^F + \frac{a\lambda_1}{\rho^F - \lambda_1} \right) + \frac{\lambda_1 \phi}{\varphi} aB + C \right\} . \quad (4.3.17)$$

Auerbach and Hasset (1993, p. 35) divide acquisitions by the fraction 1 – β of the new capital through the direct purchase of assets. This pays a price of 1 per unit (net of adjustment costs). The last two terms in the outer brackets of (4.3.17) are eliminated, since q^K may be replaced by q. The remaining fraction β describes existing capital purchases at price q^K and depending on the tax term b^F. [8] After this division, and upon recognition that $\lambda_1(\rho-\lambda_1) = -\left(\rho+\hat{\delta}\right)\varphi/\phi$ (see A3.13 in the Appendix 3), (4.3.17) becomes

$$\frac{\dot{K}_o^F}{K^{*F}} = \frac{1}{\phi^F}\left\{\frac{\lambda_1\phi}{\varphi}L\left(a^F + \frac{\lambda_1(a-a^F)}{\rho^F}\right) - \frac{\lambda_1\phi}{\varphi}\beta aB - \beta C\right\}. \quad (4.3.18)$$

$L = \frac{\rho-\lambda_1}{\rho^F-\lambda_1}\frac{\rho^F+\hat{\delta}}{\rho+\hat{\delta}}$ shows the negative relationship of the foreign discount rate ρ^F and capital accumulation effects. It is equal to unity if domestic ρ and foreign discount rates ρ^F are the same. The negative term $\frac{\lambda_1\phi}{\varphi}$ enters all terms except the last one and describes the capital accumulation effects. A high domestic adjustment cost ϕ (relative to the foreign adjustment cost ϕ^F) increases its value. In the inner brackets, the first term a^F is the tax effect. The second term $\lambda_1(a-a^F)/\rho^F$ shows the change in producer prices due to the tax reform and how this affects foreign multinationals. A relatively higher cost of capital for domestic firms, $a > a^F$, would induce a rise in prices coming from the reduction in the scale of domestic operations. Overall, FDI can be written as a function of tax parameters as follows

$$\frac{\dot{K}_o^F}{K^{*F}}\left(\begin{array}{cccc}(-) & (+) & (+) & (-)\\ a^F, & a-a^F & , aB, & C\end{array}\right) \quad (4.3.19)$$

Under the worldwide principle, the total tax rate is independent of host country taxation, and the tax effect, a^F, receives the value zero. A lower statutory corporate tax rate for the domestic company, $a < 0$, would decrease

[8] Hartman (1980) argues that newcomers are likely to base their investment decision more on non-tax factors. Non-tax factors may result in exogenous β and may explain why newcomers possibly give more weight to acquisitions, as suggested by Auerbach and Hasset (1993, footnote 8).

the product price level ($a - a^F \downarrow$), thus discouraging new capital investment. In mergers, there is an immediate increase in the relative price of existing capital, $C > 0$, if the value of depreciation for tax purposes is lower. Acquisitions are also discouraged due to higher level of capital accumulation ($aB < 0$). When the worldwide principle is only partially applied, as is often the case in practice, a^F is positive for tax reform that lowers statutory tax rates and tax expenditure (instead of being zero). The incentive effect of goods price changes, emerging from $a - a^F = (\tau - \tau^*)/(1-\tau^*) < 0$, are also discouraging.

Under the territorial principle, $a = a^F$, and (4.3.18) can be written as

$$\frac{\dot{K}_o^F}{K^{*F}} = \frac{1}{\phi^F}\left\{ a\frac{\lambda_1 \phi}{\varphi}\left(L - \beta B\right) - \beta C \right\} \qquad (4.3.20)$$

Auerbach and Hasset (1993) considered territorial firms to be identical to domestic firms, so that buying existing capital for q^K or new capital for q results in the same current value. This implies that $B = 1$ and $C = 0$, and (4.3.20) is equal to zero when all investment is made in the form of acquisitions ($\beta = 1$) and parent and host country discount rates are equal ($L = 1$). Here, the valuation of existing capital is similar that in worldwide firm ($B \neq 1$ and $C \neq 0$).

4.3.4 THE CAPITAL INCOME TAX REFORM OF 1993 AND FOREIGN INVESTMENT IN FINLAND

A unified flat capital income tax at a rate of 0.25, and the reduction of the corporate tax rate from 0.36 to the same level were the main features of the Finnish Tax Reform Act of 1993. [9] Table 4 shows the major parent countries

[9] The 25 % proportional tax would fall on all interest income (currently at a lower rate), on dividend income and on capital gains on nominal bases. The proportion of inventories taxed on historical cost bases is increased from 0.75 to unity. The current declining-balance depreciation rates for tax purposes for equipment is retained, while that for structure is decreased from 9 % to 7 % (in most cases). Investment reserve provisions are being largely abolished in 1994.

with FDI in Finland (Suomen Pankki, 1991), and the current form of international double taxation relief.

Table 4. Foreign Direct Investments 1985-1990 and double taxation relief

Countries	FDIs	Tax relief
Sweden	59 %	Territorial
Benelux countries	12 %	Territorial
Switzerland [a]	10 %	Territorial
United States	7 %	Worldwide
Denmark	3 %	Territorial
Germany	2 %	Territorial
United Kingdom	2 %	Worldwide
Others	5 %	-

a Under worldwide taxation, a company with a higher than 20% share in another company is entitled to a reduction in corporate tax, which leaves the overall tax treatment of foreign source income as an exemption system.

Most of the countries apply the territorial principle, and repatriated income is exempted from taxation in the parent country. The only countries applying worldwide principle in the list are the United States and the United Kingdom (to which Japan could be added). The fact that foreign companies often use subsidiaries sited in these countries for FDIs to Finland explains the high percentages for Sweden (59 %), Switzerland (10 %) and the Benelux countries (12 %).

The estimated effects of the 1993 Capital Income Tax Reform on foreign direct investment in Finland measure the first year change in the investment-capital ratio. The MNE finances investments from retained earnings, where the discount rate is the gross nominal interest rate. [10] There are two scenarios for discount rate ρ. In the first, the real interest rate is low, and the same goes for domestic and foreign corporations ($\rho = \rho^F = 3.71$ %). [11] In the second, the

[10] All tax considerations can be ignored assuming that capital income and capital gains are taxed at the same rate.

[11] The values given to the variables partly follow those in Hetemäki and Kari (1991).

real domestic interest rate is high (ρ = 8 %), and three percentage points above the foreign real interest rate (ρ^F = 5).

The value of the quadratic adjustment cost is 5. The respective calculations for an adjustment cost of 15 are given in the Appendix 3 (values 5 and 15 are those used by Auerbach and Hasset, 1993). The foreign adjustment cost is unity (for other assumptions concerning the foreign adjustment cost, simply divide the figures by that value). For the four types of assets considered, and for each country type, the fraction of acquisitions β is evaluated from zero to one. In the US, the calculation of profits follows US rules and the indirect tax credit method applied follows the worldwide principle. Under worldwide taxation, the Finnish Tax Reform affects first-year investment in four different kinds of assets, as shown in Table 5.

Table 5. Worldwide taxation

Worldwide principle	$r, \rho^F = 3.71$			$r = 8, \rho^F = 5$		
β	0	0.5	1	0	0.5	1
Equipment	-0.139	-0.199	-0.259	-0.022	-0.080	-0.138
Structure	-0.116	-0.168	-0.220	-0.024	-0.079	-0.133
Land	-0.112	-0.142	-0.172	-0.112	-0.152	-0.191
Inventories	-0.214	-0.184	-0.154	-0.169	-0.180	-0.191
Average	-0.145	-0.173	-0.201	-0.082	-0.123	-0.163

Table 5 gives the values for eq. (4.3.18) under the worldwide principle, where a^F = 0, and under the partial worldwide principle, where $a^F = -(\Gamma-\Gamma^*)/(1-\Gamma^*)$, π = 0.05, $\varphi = 1$, $\tau = 0.25$, $\tau^* = 0.36$. The estimation used for true economic depreciation δ is from Hulten and Wykoff (1981). For equipment $\delta = 0.1225$, $\delta' = \delta'^* = 0.3$; for structure δ = 0.0361, δ' = 0.07 and δ'^* = 0.09; for land $\delta = \delta' = \delta'^* = 0$; for inventories δ = 0, FIFO share of inventories, v ,shifts from 0.25 to 0 and hypothetical values $\delta' = -0.0489$ and $\delta'^* = -0.0439$ are evaluated using King and Fullerton (1984, eq. 2.23 p. 21) [12]. The abolition of the 25 % investment reserve provisions after 1994 is ignored. [13]

[12] From $\tau v\pi = -\tau\frac{\delta'}{r+\delta'}\left(\rho+\hat{\delta}\right)$, where the l.h.s. is the extra cost of the historical basis assessment of intangibles, and the r.h.s. is the equivalent measured as a (negative) declining balance deduction of depreciation. This gives $\delta' = -r\,[(1-v)\pi]/[(1-v)\pi+\rho+\hat{\delta}]$.

Consider first the low real interest rate case ρ, ρ^F = 3.71 and FDI ranging from new capital investment (β = 0) to pure acquisitions (β = 1). The negative sign of average investment (last row,) as well as in each type of asset, shows that the foreign direct investment level goes down under the worldwide principle. This conclusion holds irrespective of the assets required or the form of direct investment. The reform reduces the cost of capital for domestic firms and hence lowers the final goods prices and the profitability of investment. It also implies an immediate increase in the relative price of existing capital. The reason for this is that falling tax rates lower the importance of depreciation for tax purposes. The discouragement is hence the greatest for acquisitions, where the average cutdown in first-year investment is 20 %, especially in equipment where the depreciation rates for tax purposes are largest. Table 5 ignores the fact that the tax reform raises the capital gains taxation of structures. This would have lead to a greater discouragement in acquisitions of structures when capital gains taxes were not entirely born by sellers (as assumed here). [14]

Compare next the low interest case ρ, ρ^F = 3.71 with the high interest case ρ = 8, ρ^F = 5, where the domestic interest rate is relatively higher. Because of the higher foreign interest rate ρ^F, the MNE is less sensitive to the changes in the cost of capital in the host country. This implies a lower weight given to a decrease in the price of goods, which mitigates discouragement of FDI. A higher domestic interest rate also increases the relative investment costs of domestic firms (but also implies a more negative stable root λ_1 and lower adjustment in capital stocks and final goods prices, see A3.13 in the Appendix 3). Finally, Table 5' in the Appendix 3 shows that the higher adjustment cost of investment for domestic firms lowers the disincentive effects, too. It seems fair

[13] The tax-minimizing use of the investment reserve provisions for structures implies that the effective corporate tax rate before 1993 was $[(1-v)\pi]/[(1-v)\pi+\rho+\hat{\delta}] = 0.32$ (at a nominal discount rate of r = 8.71 %) instead of a statutory tax rate of 0.36 (for the incentive effects of investment grants in Sweden, see King and Fullerton, 1984, 100-103).

[14] Before 1993, only 60 per cent (since 1993 100 %) of the realization revenue of structures owned for over 10 years was taxable income, but the possible undepreciated balance was a fully deductible expense up to the taxable gross gain and above the realization revenue (i.e. a deductible loss).

to conclude, however, that the assumptions concerning this parameter value or interest rate do not alter the qualitative results.

Under partial worldwide taxation, tax expenditure follows Finnish legislation. Examples of this are the UK and Japan. Partial worldwide taxation implies that the cost of capital effects are non-zero and given by $a^F = -\frac{\Gamma - \Gamma^*}{1 - \Gamma^*}$, where $\Gamma - \Gamma^* = \tau \frac{\delta'}{r + \delta'} - \tau^* \frac{\delta^{*\prime}}{r + \delta^{*\prime}}$. The resulting figures are given in Table 6.

Table 6. Partial worldwide taxation

Partial worldwide principle	r, $\rho^F = 3.71$			$r = 8$, $\rho^F = 5$		
β	0	0.5	1	0	0.5	1
Equipment	-0.528	-0.588	-0.648	-0.416	-0.478	-0.540
Structure	-0.281	-0.333	-0.385	-0.234	-0.288	-0.342
Land	-0.112	-0.142	-0.172	-0.112	-0.152	-0.191
Inventories	-0.058	-0.028	-0.002	-0.081	-0.092	-0.103
Average	-0.245	-0.275	-0.302	-0.211	-0.252	-0.294

The higher cost of capital due to lower statutory taxes, and hence a lower current value of depreciation rates for tax purposes, implies additional discouragement, especially in investment in equipment and structure. The tax reform has a similar effect on land investment as pure worldwide taxation, and a minor effect on investment in inventories (the latter is because of the decrease in inflationary loss under the FIFO principle). The discouragement in investment is, on average, greater from countries applying the partial worldwide principle than from those applying the pure worldwide principle.

Table 7 shows the effects of territorial taxation and the incentive effects of a deduction system with partial exemption, as currently applied by Italy.

Table 7. Territorial taxation and a deduction system with partial exemption

Territorial principle	$r, \rho^F = 3.71$			$r = 8, \rho^F = 5$		
β	0	0.5	1	0	0.5	1
Equipment	0.037	-0.023	-0.083	0.048	-0.014	-0.076
Structure	0.043	-0.009	-0.061	0.051	-0.003	-0.058
Land	0.060	0.030	0	0.060	0.020	-0.019
Inventories	0.114	0.144	0.174	0.091	0.080	0.069
Average	0.063	0.036	0.008	0.063	0.021	-0.021

Deduction system (Italy)	$r, \rho^F = 3.71$			$r = 8, \rho^F = 5$		
β	0	0.5	1	0	0.5	1
Equipment	0.064	0.004	-0.056	0.059	-0.002	-0.063
Structure	0.033	-0.018	-0.070	0.034	-0.021	-0.076
Land	0.059	0.030	0	0.060	0.020	-0.019
Inventories	0.111	0.141	0.171	0.093	0.082	0.071
Average	0.067	0.039	0.011	0.061	0.020	-0.022

Table 7 records values for eq. (4.3.18) and (4.3.20). In a deduction system with partial exemption (Italy), 0.6 is exempted and the corporate tax rate is 47.8. Other parameter values are those used in the calculations in table 6.

The countries applying the territorial principle when involved in FDI in Finland are the Nordic countries (Sweden, Norway, Denmark), the Benelux countries, Switzerland, Germany, France, Luxembourg and Canada. The positive incentive effects are prevalent in new investment, where the cost of capital is decreased (a is negative for all assets). This is comparable to the incentive effect on domestic firms. As shown in the Appendix 3, with a domestic adjustment cost of 15, all foreign investment except that allocated to equipment, is relatively more encouraged. The average increase in the first-year investment rate is from 6.3 % to 8.4 %. Finally, in Italy, a deduction

system with partial exemption is applied (the corporate tax rate is 47.8 and 60 % is exempted). The effective cut-down in the statutory tax rate is reduced from 11 % to 9 % (from 36 % to 25 %) , but the cost of capital effect a^F remains relatively unaffected. The territorial and deduction systems, hence, have the same kind of incentive effect.

There is no OECD country to which a (bilateral) double taxation treaty does not apply, although foreign countries adopting the territorial principle do not necessarily exempt dividend income from Finland from taxes. Double taxation is shown in table 8 for the simple case in which domestic and foreign taxation is the same to begin with.

Table 8. Double taxation

Double taxation	$r, \rho^F = 3.71$			$r = 8, \rho^F = 5$		
β	0	0.5	1	0	0.5	1
Equipment	0.764	0.705	0.645	0.604	0.546	0.488
Structure	0.459	0.407	0.356	0.376	0.321	0.267
Land	0.281	0.251	0.221	0.281	0.241	0.202
Inventories	0.335	0.365	0.395	0.312	0.301	0.290
Average	0.460	0.432	0.404	0.393	0.352	0.312

The tax reform has the strongest positive incentive effects when lower statutory taxes reduce the double taxation of international investment. Unlike under territorial taxation, the positive incentive effects are also strongly prevalent in acquisitions and mergers.

4.3.5 CONCLUSIONS

Tax reform that cuts down the cost of capital encourages new foreign capital investment from countries applying territorial taxation, but is approximately neutral when the major proportion of foreign direct investment (FDI) is in the

form of takeovers. This holds for the Finnish Capital Income Tax Reform of 1993, where the major change is the cut-down in statutory tax rates. The numerical estimation also shows that the deduction system with partial exemption, as currently applied in Italy, inherits similar incentive effects as territorial taxation. New capital investment from the US, which applies worldwide taxation, would be mildly discouraged, and FDI in the form of mergers and acquisitions more strongly discouraged. In the UK and Japan, the worldwide principle only covers tax rates and does not mean the unification of tax bases. Thus, lower statutory taxes have a negative effect on tax expenditure, leading to additional discouragement. Only when international investment is subject to double taxation rather than to a bilateral double taxation treaty do lower statutory taxes encourage FDI irrespective of their form.

One area for future research would be to take into account the empirically observed relationship between the real discount rate and the market value of existing firms. In conditions of relatively high real interest rates, this market value may decline, encouraging mergers and acquisitions.

5. Conclusions

This dissertation has examined international taxation of capital income; aiming at giving desirable objectives of future double tax relief arrangements. Literature has paid relatively little attention to one of the most central optimal tax questions that naturally arises: the design of tax structures that are optimal from the perspective of the world as a whole. Many contributions have focussed instead on the design of tax systems that are optimal in terms of national self-interest rather than the collective good, often for small economies. Others have focussed on the comparison between polar alternative regimes – the residence and source principles – rather than attempting to characterize fully optimal schemes.

An interesting optimal tax problem to consider is that which arises when lump sum taxation is precluded but all distorting taxes, domestic and international, are unconstrained. For this case we show that optimal policy can be characterised by a remarkably simple weighted average rule of the same general form as the Horst rule, but with different weights. The weights given on gross and net returns in the shadow price of capital depend not only on savings and capital demand elasticities but also on the rates at which pure profits are taxed in the two countries. This structure leads to two main conlusions. The first is that while the Horst rule itself holds only under rather uninteresting restrictions, the insights to which it leads are very much more robust: all the conclusions concerning the relationship between the optimal taxation of international and the responsiveness of savings and capital demand continue to hold. The second is that the rates at which pure profits are taxed in the two countries has a powerful impact on the optimal international tax regime. For full taxation of rent, the optimal tax reform envisages pure residence criteria as the desirable objectives, which is Diamond-Mirrlees production efficiency theorem. Full taxation of rents can, however, be less than convincing as an approximation of reality.

Weighted average rules as a general principle of shadow princing are well

known in optimal commodity taxation. Optimal international tax rate is also shown to be a weighted average of domestic and foreign capital income tax rates for countries as similar except (possibly) for marginal excess burden of taxation. International taxation aims at savings in misallocation of capital across countries. Equalization of investment returns is, however, not optimal when rent income from investment is not fully taxed; hence the weighted average rule with the weights depending on both investment and savings behaviour and on rent and capital income tax rates. This benchmark case is an important example of a practical application of a general principle of shadow princing. Under an international double tax relief system performed by capital-exporting country, the weight determines the share of foreign-source income entering the tax base and the share of foreign source-based capital income taxes credited. The method is similar to the most usual indirect tax credit method in corporate taxation: the grossed-up dividends method.

One important field for study is also the incidence of capital income taxation to heterogeneous population. I consider an OLG model, where population at each period is divided to capital income and wage earners. Intergenerational welfare distribution from old to young wage earners takes place optimally using lump sum transfers. If lump sum taxes on old are not possible but only intergenerational lump sum transfers to younger generation, it is shown that the revenue for these transfers should be raised from capital income taxation based on residence criteria so that the weight given to tax rate in parent country equals unity. It is noteworthy that the optimality of residence criteria does not require 100 per cent first-period wage income taxation, equivalent under exogenous labour supply to the taxation of pure rents in Diamond-Mirrlees (1970) (DM) production efficiency theorem.

However, international taxation with transfers to the young is not Pareto improving since the old do not benefit from the tax scheme in operation when they were young. It may be desirable to give lump sum compensations also to old generation. It is shown that domestic capital income tax rate is then inversely related to savings, but positively to investment elasticity. It is surpricing that the tax burden on savings is higher when investment is more

sensitive to taxation of its return. In contrast, with no consideration of equity aspects of capital income taxation, the distortions created in investment decision, because of higher investment elasticity, lower the optimal tax level. In the benchmark case, international taxation follows a weighted average formula, where the weights also depend on the income transfer scheme. A country with high investment elasticity ascribes a low weight to the high domestic capital income tax rate in its country to improve allocation of capital across countries. The effect on total international tax of higher investment elasticity remains ambiguous, since capital income tax rate is higher while the weight attached to the higher tax rate is lower.

One problem under tax cooperative solution is discrimination of international investment to improve national welfare. I also consider the case where countries are able only to cooperate under non-discrimination rule according to which neither the foreign-source income of domestic residents (under residence criteria) nor the income in the home country of non-residents (under source criteria) can be taxed at a higher rate without raising the tax rate levied on domestic residents on their domestic-source income. Such partial tax cooperation among large open economies implies internalization of symmetric spillovers. Domestic capital income tax is not determined in separate from international taxation. Hence, tax cooperative solution is different than under no restriction in capital income tax instruments. A symmetric Nash equilibrium is more efficient than partial cooperation.

The latter part of the dissertation examines corporate taxation. I first consider comprehensive corporate income taxation, where full imputation system is essential if all advance corporate taxes are to be eliminated from final shareholders. International double tax relief system may follow full tax credit system, exemption system under tax harmonisation, or deduction system if host country also gives economic double tax relieves. It remains to be seen whether member states of the European Community will develop a satisfactory basis for overcoming the problems with the imputation system, which could then be adopted at a wider international level. Another opposite way to arrange the taxation of shareholders is to have corporate tax as a final tax. There are no taxes on dividends at shareholder level. At the same time, the taxation of

intercompany dividend payments can follow a weighted average formula. I have also considered combining international and economic double tax relief to reflect a weighted average rule.

The last section of the study considers new capital investment and acquisitions to Finland. The 1993 Capital Income Tax Reform in Finland is examined. The most important effect of the reform is the decrease in statutory tax rates, leading to an overall cut down in the cost of capital. As expected, there is a positive effect on new investment from countries that apply territorial taxation, which is the most usual case. The tax reform will have less significance for the acquisition of existing businesses in Finland. In the countries that extend the worldwide or partial worldwide principle to tax bases, it can be seen that the tax reform discourages foreign direct investment (FDI) irrespective of the assets required or the form of direct investment. The discouragement is greatest in acquisitions. The study shows the importance of considering tax criteria and FDIs separately in the form of new direct investment and acquisitions. Only when international investment is subject to double taxation rather than to a bilateral double taxation treaty do lower statutory taxes encourage FDIs irrespective of their form, but this is rare.

The analysis has emphasised, in particular, that previous policy prescriptions rest on assumptions as to the set of tax instruments that might be seen as restrictive, and provides a remarkably simple rule that applies in more general circumstances. On the basis of my study, the shown weighted average rule between the two polar opposites of residence and source criteria has proven to be applicable without any greater difficulty.

Appendices

APPENDIX 1

International Double Taxation Relief and Savings and Investment Behaviour

The partial derivative of wealth $A\ (r_n, t_w, t) = e_1 + (1 - t_w)R\left[k\left(\frac{r_n}{1-t}\right)\right]/(1+r_n)$ is $A_r = -\left(\frac{1}{1+r_n}\right)^2(1-t_w)\left[R + \frac{1+r_n}{1-t}k\right] = -\left(\frac{1}{1+r_n}\right)^2 \frac{1-t_w}{1-t}\left[(1-t)f(k) + k\right]$, $f(k) = w + f_k k$, so that

$$V_r = V_A\left(\frac{1}{1+r_n}\right)^2 C_2 + V_A\, A_r = \qquad \text{(A1.1)}$$
$$= \tilde{V}_A\left\{S - \frac{1-t_w}{1-t}k\right\}$$

The first-order condition for optimal international taxation (3.2.25) is

$$V_\Delta + V_\Delta^* + \mu' G_\Delta = 0\,, \quad \text{where} \qquad \text{(A1.2)}$$

$$V_\Delta = V_r \frac{dr_n}{d\Delta} = \tilde{V}_A\left(S - \frac{1-t_w}{1-t}k\right)\frac{dr_n}{d\Delta}\,,$$

$$V_\Delta^* = V_r^* \frac{dr_n^*}{d\Delta} = \tilde{V}_A^*\left(S^* - \frac{1-t_w^*}{1-t^*}k^*\right)\frac{dr_n^*}{d\Delta}\,,$$

$$G_\Delta = f_k \frac{dk}{d\Delta} - r_n \frac{dS}{d\Delta} - \left(S - \frac{1-t_w}{1-t}k\right)\frac{dr_n}{d\Delta}$$
$$+ f_k^* \frac{dk^*}{d\Delta} - r_n^* \frac{dS^*}{d\Delta} - \left(S^* - \frac{1-t_w^*}{1-t^*}k^*\right)\frac{dr_n^*}{d\Delta}$$
$$= f_k(1-\sigma) + r_n\sigma - \left(S - \frac{1-t_w}{1-t}k\right)\frac{dr_n}{d\Delta}$$
$$- f_K^*(1-\sigma^*) - r_n^*\sigma^* - \left(S^* - \frac{1-t_w^*}{1-t^*}k^*\right)\frac{dr_n^*}{d\Delta}\,,$$

where we have used (A1.1) for V_r and (3.2.11) for $\frac{dS}{d\Delta}$ and $\frac{dK}{d\Delta}$ (and equivalently for the foreign country). This gives eq. (3.2.26) in proposition 1. The relation between government tax revenues and domestic capital income tax rate is given by

$$G_t = \frac{f_k}{f_{kk}}\left(\frac{1}{1-t}\frac{dr_n}{dt} + \frac{r_n}{(1-t)^2}\right) + k(1-t_w)\left(\frac{1}{1-t}\frac{dr_n}{dt} + \frac{r_n}{(1-t)^2}\right) \quad \text{(A1.3)}$$
$$- S\frac{dr_n}{dt} - S\,e_r^S\frac{dr_n}{dt}$$

Evaluate the relation between net return and capital income tax for given capital imports that are in optimum (due to the optimal taxation of international investment considered simultaneously). The change in net return is given by $\frac{dr_n}{dt} = -f_k + (1-t)\,f_{kk}\,S_r\frac{dr_n}{dt}$ so that $\frac{1}{1-t}\frac{dr_n}{dt} + \frac{f_k}{1-t} = f_{kk}\,S_r\frac{dr_n}{dt}$ and

$$\frac{dr_n}{dt} = -f_k(1-\sigma)\,. \quad \text{(A1.4)}$$

Eq. (A1.3) simplifies to

$$G_t = -\left(S - \frac{1-t_w}{1-t}k\right)\frac{dr_n}{dt} + \frac{1-t_w}{1-t}f_k k + \frac{t}{1-t}S\,e_r^S\frac{dr_n}{dt} \quad \text{(A1.5)}$$

The FOC for domestic taxes is from (3.2.29), using (A1.5), given by

$$V_t + \mu' G_t = 0 \;\Leftrightarrow \quad \text{(A1.6)}$$

$$\widetilde{V}_A\left\{-\frac{1-t_w}{1-t}f_k k + \left(S - \frac{1-t_w}{1-t}k\right)\frac{dr_n}{dt}\right\} +$$

$$\mu'\left\{-\left(S - \frac{1-t_w}{1-t}k\right)\frac{dr_n}{dt} + \frac{1-t_w}{1-t}f_k k + \frac{t}{1-t}S\,e_r^S\frac{dr_n}{dt}\right\} = 0 \;\Leftrightarrow$$

$$\frac{t}{1-t} S e_r^S \frac{dr_n}{dt} = \gamma\left\{\left(S - \frac{1-t_w}{1-t} k\right)\frac{dr_n}{dt} - \frac{1-t_w}{1-t} f_k k\right\} \qquad \text{(A1.7)}$$

where $\gamma = \frac{\mu' - \tilde{V}_A}{\mu'}$. When solved for $\frac{t}{1-t}$ this gives, using (A1.4) and (3.2.8), eq. (3.2.30) in the text. The capital income tax rate is the same as in a closed economy since foreign investment has no welfare effect on margin. Optimal international taxation emerges from (A1.2) and (A1.6). For convenience, rewrite (A1.6) using again (A1.3) first as

$$\left(V_r + \mu' G_r\right)\frac{dr_n}{dt} + \left(V_{fk} + \mu' G_{fk}\right)\frac{df_k}{dt} = 0\,, \text{ where} \qquad \text{(A1.8)}$$

$$V_r + \mu' G_r = \mu'\left\{-\gamma\left(S - \frac{1-t_w}{1-t} k\right) + \frac{1}{1-t}\frac{f_k}{f_{kk}} - S e_r^S\right\} \qquad \text{(A1.9)}$$

$$V_{fk} + \mu' G_{fk} = \mu'\left\{\gamma(1-t_w)\, k + \frac{f_k}{f_{kk}}\right\}, \qquad \text{(A1.10)}$$

where we have distinguished between the change in net and gross returns. Hence, $df_k/dt = r_n/(1-t)^2$. Equivalent for the foreign country is

$$\left(V_r^* + \mu'^* G_r^*\right)\frac{dr_n^*}{dt^*} + \left(V_{f_k^*}^* + \mu'^* G_{f_k^*}^*\right)\frac{df_k^*}{dt^*} = 0\,, \text{ where} \qquad \text{(A1.11)}$$

$$V_{fk}^* + \mu'^* G_{fk}^* = \mu'^*\left\{\gamma^*(1-t_w^*)\, k^* + \frac{f_k^*}{f_{kk}^*}\right\}. \qquad \text{(A1.12)}$$

Multiplying (A1.8) by $\frac{dr_n}{d\Delta}\frac{dt}{dr_n}$ and (A1.11) by $\frac{dr_n^*}{d\Delta}\frac{dt^*}{dr_n^*}$ and summing up gives for the optimal international taxation:

$$\frac{dr_n}{d\Delta}\frac{dt}{dr_n}\frac{df_k}{dt}\left(V_{fk} + \mu' G_{fk}\right) + \frac{dr_n^*}{d\Delta}\frac{dt^*}{dr_n^*}\frac{df_k^*}{dt^*}\left(V_{f_k^*}^* + \mu'^* G_{f_k^*}^*\right) = 0, \qquad \text{(A1.13)}$$

since term $\left(V_r + \mu' G_r\right) dr_n/d\Delta + \left(V_r^* + \mu'^* G_r^*\right) dr_n^*/d\Delta$ is zero according to FOC (A1.2). Term $\frac{dr_n}{d\Delta}\frac{dt}{d\,r_n}\frac{df_k}{dt}$ shows the relation between capital imports and marginal product for given optimal level of net interest rate and capital income taxes, hence:

$$\frac{dr_n}{d\Delta}\frac{dt}{d\,r_n}\frac{d\,f_k}{dt} = \frac{r_n}{S}\frac{\sigma}{e_r^S}\frac{1}{f_k(1-\sigma)}\frac{r_n}{(1-t)^2} = -f_{kk} \qquad \text{(A1.14)}$$

where (3.2.09) is used for $\frac{dr_n}{d\Delta}$, (A1.5) for $\frac{dt}{d\,r_n}$ and $\frac{df_k}{dt} = \frac{r_n}{(1-t)^2}$. Eq. (A1.14) can be written as

$$-f_{kk}\left(V_{f_k} + \mu' G_{f_k}\right) - f_{kk}^*\left(V_{f_k^*}^* + \mu^{*\prime} G_{f_k^*}^*\right) = 0 \qquad \text{(A1.15)}$$

Eqs. (A1.9), (A1.11) and (A1.15) yield for the shadow price of capital:

$$f_k\left\{1 - \gamma\frac{1-t_w}{e_r^k}\right\} = f_k^*\left\{1 - \gamma^*\frac{1-t_w^*}{e_r^{*k}}\right\}. \qquad \text{(A1.16)}$$

Substituting in this γ and γ^* from (3.2.30) and (3.2.31) gives

$$f_k\left(1 - tz\right) = f_k^*\left(1 - t^*\,z^*\right), \quad \text{where} \qquad \text{(A1.17)}$$

$$z = \frac{(1-t_w)\,e_r^S}{(1-t_w)\,e_r^S + (1-t)e_r^k},\; z^* = \frac{(1-t_w^*)\,e_r^{S*}}{(1-t_w^*)\,e_r^{S*} + (1-t^*)e_r^{k*}},$$

which is eq. (3.2.32) in the text.

APPENDIX 2

Capital Income Taxation and Intergenerational Welfare

The partial derivatives of $A\,(r_n, t_w, t) = (1 - t_w)w + \left(\alpha + \frac{(1-\alpha)(1+n)}{1+r_n}\right) g$ are $A_r = -\frac{1-t_w}{1-t}\,k - \frac{(1-\alpha)(1+n)}{(1+r_n)^2}\,g$ and $A_t = -\frac{1-t_w}{1-t}\,f_k k$ so that from (3.3.20):

$$V_r = V_A \left(\frac{1}{1+r_n}\right)^2 C_2 + V_A\, A_r = \tag{A2.1}$$

$$= \tilde{V}_A \left\{ S - \frac{1-t_w}{1-t}\,k\,(1+n) - (r_n - n)\,\frac{1-t_w}{1-t}\,k \right\}$$

$$V_t = V_r \frac{d\,r_n}{d\,t} + V_A\, A_t \tag{A2.2}$$

$$= \tilde{V}_A \left\{ -\frac{1-t_w}{1-t}\,f_k k\,(1+n) - (r_n - n)\,\frac{1-t_w}{1-t}\,f_k k \right.$$

$$\left. + \left[S - \frac{1-t_w}{1-t}\,k\,(1+n) - (r_n - n)\,\frac{1-t_w}{1-t}\,k \right] \frac{d\,r_n}{d\,t} \right\}$$

where $\tilde{V}_A = V_A / (1 + r_n)$ and $C_2 = S(1 + r_n) + (1 - \alpha)(1 + n)g$ from (3.3.2). Equivalently for the foreign country:

$$V_r^* = \tilde{V}_A^* \left\{ S^* - \frac{1-t_w^*}{1-t^*}\,k^*(1+n) - (r_n^* - n)\,\frac{1-t_w^*}{1-t}\,k^* \right\} \tag{A2.3}$$

The relationship between welfare and tax revenues are from (3.3.19) given by

$$G_\Delta = f_k \frac{dk}{d\Delta} - r_n \frac{dS/(1+n)}{d\Delta} - \left(\frac{S}{1+n} - \frac{1-t_w}{1-t}\,k \right) \frac{dr_n}{d\Delta} + \tag{A2.4}$$

$$f_k^* \frac{dk^*}{d\Delta} - r_n^* \frac{dS^*/(1+n)}{d\Delta} - \left(\frac{S^*}{1+n} - \frac{1-t_w^*}{1-t^*}\,k^* \right) \frac{dr_n^*}{d\Delta},$$

$$= f_k\,(1-\sigma) + r_n\,\sigma - \left(\frac{S}{1+n} - \frac{1-t_w}{1-t}\,k \right) \frac{dr_n}{d\Delta}$$

$$-f_k^*(1-\sigma^*) - r_n^*\sigma^* - \left(\frac{S^*}{1+n} - \frac{1-t_w^*}{1-t^*}k^*\right)\frac{dr_n^*}{d\Delta},$$

where (3.3.13) is used for $\frac{dS/(1+n)}{d\Delta}$ and $\frac{dk}{d\Delta}$ (and equivalently for the foreign country). The first-order condition for optimal international taxation is

$$V_\Delta + V_\Delta^* = V_r\frac{dr_n}{d\Delta} + V_r^*\frac{dr_n^*}{d\Delta} + V_G G_\Delta = 0\,. \qquad \text{(A2.5)}$$

This, together with (A2.1), (A2.3) and (A2.2.4), yield eq. (3.3.30) in proposition 1. The relation between government tax revenues and the domestic capital income tax rate is given by

$$G_t = \frac{f_k}{f_{kk}}\left(\frac{1}{1-t}\frac{dr_n}{dt} + \frac{r_n}{(1-t)^2}\right) + k(1-t_w)\left(\frac{1}{1-t}\frac{dr_n}{dt} + \frac{r_n}{(1-t)^2}\right) \qquad \text{(A2.6)}$$
$$-\frac{S}{1+n}\frac{dr_n}{dt} - \frac{S\,e_r^S}{1+n}\frac{dr_n}{dt}$$

Evaluate the relation between net return and capital income tax for given capital imports that are in optimum (due to the optimal taxation of international investment considered simultaneously). The change in the net return is given by $\frac{dr_n}{dt} = -f_k + (1-t)f_{kk}\frac{S_r}{1+n}\frac{dr_n}{dt}$ so that $\frac{1}{1-t}\frac{dr_n}{dt} + \frac{f_k}{1-t}$ $= f_{kk}\frac{S_r}{1+n}\frac{dr_n}{dt}$ and

$$\frac{dr_n}{dt} = -f_k(1-\sigma)\,. \qquad \text{(A2.7)}$$

Eq. (A2.6) simplifies to

$$G_t = \frac{1}{1+n}\left\{-\left(S - \frac{1-t_w}{1-t}k(1+n)\right)\frac{dr_n}{dt} + \frac{1-t_w}{1-t}f_k k(1+n) \qquad \text{(A2.8)}\right.$$
$$\left. + \frac{t}{1-t}S\,e_r^S\frac{dr_n}{dt}\right\}$$

The FOC for domestic taxes is, from (3.3.32) and using (A2.2) and (A2.8), given by

$$V_t + V_G G_t = 0 \quad \Leftrightarrow \tag{A2.9}$$

$$\tilde{V}_A \left\{ - \frac{1-t_w}{1-t} f_k k(1+n) - (r_n - n) \frac{1-t_w}{1-t} f_k k + \left(S - \frac{1-t_w}{1-t} k (1+n) \right. \right.$$
$$\left. \left. - (r_n - n) \frac{1-t_w}{1-t} k \right) \frac{d r_n}{d t} \right\} + V_G G_t = 0 \quad \Leftrightarrow$$

$$\frac{t}{1-t} S e_r^S \frac{d r_n}{d t} = \alpha\gamma \left\{ \left(S - \frac{1-t_w}{1-t} k (1+n) \right) \frac{d r_n}{d t} \right. \tag{A2.10}$$
$$\left. - \frac{1-t_w}{1-t} f_k k (1+n) \right\} + \gamma \frac{1-t_w}{1-t} k (1+n) \left(f_k + \frac{d r_n}{d t} \right),$$

where $\gamma = (r_n - n) \frac{\tilde{V}_A}{V_G} = \frac{r_n - n}{\alpha(1+r_n) + (1-\alpha)(1+n)}$ and $\alpha\gamma = \frac{V_G - (1+n)\tilde{V}_A}{V_G}$. When solved for $\frac{t}{1-t}$ this gives, using (A2.7) and (3.3.13) after some manipulation, eq. (3.3.33) in the text. The capital income tax rate is the same as in a closed economy since foreign investment has no welfare effect on margin. The equivalent for the foreign country is straightforward. Optimal international taxation under optimal domestic capital income taxation emerges from (3.3.30) and (A2.9) (and equivalent for the foreign country). For convenience, rewrite (A2.9), using (A2.6), first as

$$\left(V_r + V_G G_r\right) \frac{d r_n}{dt} + \left(V_{fk} + V_G G_{fk}\right) \frac{d f_k}{dt} = 0 \text{ , where} \tag{A2.11}$$

$$V_{fk} + V_G G_{fk} = - (1-t_w) k V_A + V_G \left\{ (1-t_w) k + \frac{f_k}{f_{kk}} \right\} \tag{A2.12}$$

$$= V_G \left\{ \frac{f_k}{f_{kk}} - (1-\alpha)\gamma(1-t_w) k \right\},$$

where $d f_k / d t$ is the change in gross return for a given net return and given by $d r_n/(1-t) / d t = r_n/(1-t)^2$ and $V_r + V_G G_r$ is not shown. The equivalent for the foreign country is

$$\left(V_r^* + V_G^* G_r^* \right) \frac{d r_n^*}{d t^*} + \left(V_{f_k^*}^* + V_G^* G_{f_k^*}^* \right) \frac{d f_k^*}{d t^*} = 0 \text{ , where} \quad \text{(A2.13)}$$

$$V_{f_k^*}^* + V_G^* G_{f_k^*}^* = V_G^* \left\{ \frac{f_k^*}{f_{kk}^*} - (1-\alpha^*)\gamma^*(1-t_w^*)\, k^* \right\}.$$

Multiplying (A2.11) by $\frac{d r_n}{d\Delta} \frac{d t}{d r_n}$ and (A2.13) by $\frac{d r_n^*}{d\Delta} \frac{d t^*}{d r_n^*}$ and summing up gives, for optimal international taxation:

$$\frac{d r_n}{d\Delta} \frac{d t}{d\, r_n} \frac{d f_k}{d t} \left(V_{f_k} + V_G G_{f_k} \right) + \frac{d r_n^*}{d\Delta} \frac{d t^*}{d\, r_n^*} \frac{d f_k^*}{d t^*} \left(V_{f_k^*}^* + V_G^* G_{f_k^*}^* \right) = 0 \text{ , (A2.14)}$$

since the term $\left(V_r + V_G G_r \right) d r_n / d\Delta + \left(V_r^* + V_G^* G_r^* \right) d r_n^* / d\Delta$ is zero according to FOC (A2.5). The term $\frac{d r_n}{d\Delta} \frac{d t}{d\, r_n} \frac{d f_k}{d t}$ shows the relation between capital imports and the marginal product for the given optimal level of net interest rate and capital income taxes, hence:

$$\frac{d r_n}{d\Delta} \frac{d t}{d\, r_n} \frac{d f_k}{d t} = \frac{r_n}{S/(1+n)} \frac{\sigma}{e_r^S} \frac{1}{f_k (1-\sigma)} \frac{r_n}{(1-t)^2} = - f_{kk} \qquad \text{(A2.15)}$$

where (3.3.14) is used for $\frac{d r_n}{d\Delta}$, (A2.7) for $\frac{d t}{d\, r_n}$ and $\frac{d f_k}{d t} = \frac{r_n}{(1-t)^2}$. Eq. (A2.14) can be written as

$$- f_{kk} \left(V_{f_k} + V_G G_{f_k} \right) - f_{kk}^* \left(V_{f_k^*}^* + V_G G_{f_k^*}^* \right) = 0 \qquad \text{(A2.16)}$$

Eqs. (A2.12), (A2.14) and (A2.16) yield, for the shadow price of capital:

$$f_k \left\{ 1 + \frac{(1-\alpha)\,\gamma(1-t_w)}{e_r^k} \right\} = f_k^* \left\{ 1 + \frac{(1-\alpha^*)\,\gamma^*(1-t_w^*)}{e_r^{*k}} \right\}. \quad \text{(A2.17)}$$

Substituting (3.3.33) and (3.3.34) in this, solved for γ or γ^*, gives eq. (3.3.36) in the text.

APPENDIX 3

New Capital Investment and Acquisitions

The Euler condition for the optimal capital stock path

With the help of (4.3.2), (4.3.3) and (A3.1), (4.3.1) may be written as

$$V_t = \int_t^\infty e^{-r(s-t)} p_s \Big[(1-\tau_s) F(K_s) - \left(1 - \frac{1}{2}\phi\,\delta + \frac{1}{2}\phi \frac{\dot{K}_s}{K_s}\right)(\delta K_s + \dot{K}_s)(1-\Gamma_s) \Big] ds + A_t \,, \quad \text{(A3.1)}$$

where

$$A_t = \int_t^\infty e^{-r(s-t)} \tau_s \int_{-\infty}^t p_u C(I_u/K_u) I_u DEP(s, s-u)\, du\, ds \quad \text{(A3.2)}$$

is the present value of tax savings due to the depreciation of investment made before date t, predetermined at date t, and $\Gamma_s = \int_s^\infty e^{-r(u-s)} \tau_u \; DEP(u, u-s)\, du$ represents the current value of tax savings per dollar of date s investment. The Euler condition $dV/dK - \frac{d}{dt}\left(dV/d\dot{K}\right) = 0$ for the optimal capital stock can be written as [1]

[1] For a discussion of the solution technique, see Auerbach (1983)

$$\int_t^{\infty} e^{-r(s-t)} p_t \Big[(1-\tau) F_K^t + \left(\frac{1}{2}\,\phi \left(\frac{\dot{K}}{K} \right)^2 + \frac{1}{2}\,\phi\delta^2 - \delta \right) (1-\Gamma_t) \Big]$$

$$= -\frac{d}{dt} \int_t^{\infty} e^{-r(s-t)} p_t \left(1 + \phi \frac{\dot{K}}{K} \right) (1-\Gamma_t)\, ds\,. \qquad \text{(A3.3)}$$

The model will be linearized around the steady state. Assuming the quadratic cost function, $C(I/K) = 1 + \frac{1}{2}\,\phi\,\frac{I}{K}$ shows average investment costs per unit of investment. Normalize the derivative of the total quadratic cost function $C(I/K)I$ with respect to investment I to unity in the steady state, so that Tobin's q equals one. Investment greater (less) than in the steady state implies that q is greater (less) than 1. This steady-state normalization $C(I/K) + C'(I/K)I = 1$ implies:

$$C(I/K) = 1 - \tfrac{1}{2}\phi\, I/K = 1 - \phi\delta + \tfrac{1}{2}\phi I/K\,, \qquad \text{(A3.4)}$$

where (4.3.3) is used in steady state. The relative marginal price to the corporation of new capital goods, inclusive of adjustment costs, is

$$q = \frac{p\, d[C(I/K)I]/dI}{p} = C(I/K) + I\, C'(I/K) = 1 + \phi(\dot{K}/K)\,, \qquad \text{(A3.5)}$$

where (A3.4) was used for $C(I/K)$ and $C'(I/K)$. Expression (A3.5) can be written as

$$\frac{\dot{K}_t}{K_t} = \frac{q_t - 1}{\phi} \qquad \text{(A3.6)}$$

Using the fact that $\frac{I_t}{K_t} = \delta + \frac{\dot{K}_t}{K_t} = \delta + \frac{q_t - 1}{\phi}$ from (A3.6), current adjustment costs per unit of investment are given by

$$\chi_t = \tfrac{1}{2}\phi\,(I_t/K_t)^2\,\frac{1-\Gamma}{1-\tau} = \tfrac{1}{2}\phi\left(\delta+\frac{\dot{K}}{K}\right)^2\frac{1-\Gamma}{1-\tau}. \qquad \text{(A3.7)}$$

Completing the derivation in the r.h.s of (A3.3), noting $\frac{1}{2}\phi\left(\frac{\dot{K}}{K}\right)^2 + \frac{1}{2}\phi\delta^2 - \delta$ $= \frac{1}{2}\phi\left(\delta+\frac{\dot{K}}{K}\right)^2 - \delta(1+\phi\frac{\dot{K}}{K})$, and using (A3.5) for $1+\phi\frac{\dot{K}}{K}$ and χ_t from (A3.7) gives (4.3.4) in the text.

Domestic capital accumulation

Expressions (A3.5), (4.3.4) and (4.3.5) yield a system of first-order differential equations in the relative capital goods price q_t, and in the capital stock K. With the help of (A3.6), (4.3.4) may be written (dropping off the subscripts) as

$$\dot{q}_t = -F_K\frac{1-\tau}{1-\Gamma} - \frac{1}{2}\phi\left(\delta+\frac{q_t-1}{\phi}\right)^2 + q_t(\rho+\delta) \qquad \text{(A3.8)}$$

Linearize (A3.6) and (A3.8) around the steady state ($q^* = 1$), to give

$$\frac{\dot{K}_t}{K^*} = \frac{q_t-1}{\phi} \qquad \text{(A3.9)}$$

$$\begin{aligned}\dot{q}_t &= -F^*_{KK}\frac{1-\tau^*}{1-\Gamma^*}(K_t-K^*) - \delta(q_t-1) + (\rho+\delta)(q_t-1) \qquad \text{(A3.10)}\\ &\quad + \frac{F_K}{1-\Gamma^*}(\tau-\tau^*) - \frac{(1-\tau^*)F_K}{(1-\Gamma^*)^2}(\Gamma_t-\Gamma^*),\end{aligned}$$

where the steady-state value of a variable is denoted by an asterisk *. Using the steady-state value of (A3.8), which is $F^*_K = (\rho+\delta-\frac{1}{2}\phi\delta^2)\frac{\hat{\delta}}{\delta'+\pi}\Gamma(1-\Gamma^*)/$ $(1-\tau^*)$, and definitions $\hat{\delta} = \delta\left(1-\frac{1}{2}\phi\delta\right)$ and $\varphi = -\frac{F^*_{KK}K^*}{F^*_K}$, (A3.10) gives

$$\dot{q}_t = \varphi(\rho+\hat{\delta})\frac{K_t-K^*}{K^*} + \rho(q_t-1) + (\rho+\hat{\delta})\frac{\tau-\tau^*}{1-\tau^*} - (\rho+\hat{\delta})\frac{\Gamma-\Gamma^*}{1-\Gamma^*}. \qquad \text{(A3.11)}$$

The price of existing capital acquired in the steady-state is given by $q_t^K = q_t^*(1-\Gamma) = (q_t - \phi\,\dot{K}/K)(1-\Gamma)$. Solving this for q_t gives

$$q_t = \frac{q_t^K}{q^{K*}} + \phi\frac{\dot{K}}{K}. \qquad \text{(A3.12)}$$

Substituting q_t from (A3.12) (and its derivative $\dot{q}_t$) into (A3.11) and dropping unnecessary subscripts gives a second-order linear equation in K shown as (4.3.7) in the text, where the characteristic roots are:

$$\lambda_1 = \frac{\rho - \sqrt{\rho^2 + \frac{4\varphi(\rho+\hat{\delta})}{\phi}}}{2}\,;\ \lambda_2 = \frac{\rho + \sqrt{\rho^2 + \frac{4\varphi(\rho+\hat{\delta})}{\phi}}}{2} \qquad \text{(A3.13)}$$

Assuming that the economy is in a steady state initially, and that the tax parameters shift immediately and permanently at that date, the solution for K_t and q_t is, from (4.3.7) and with the aid of the transversality condition,

$$K_t = K^*\left(1 - \frac{1}{\varphi}(1-e^{\lambda_1 t})a\right) \qquad \text{(A3.14)}$$

$$q_t = 1 + \frac{\lambda_1\phi}{\varphi}a\,e^{\lambda_1 t}, \qquad \text{(A3.15)}$$

where λ_1 is the stable root for (4.3.7). (A3.14) and (A3.15) are similar to those presented in Auerbach and Hasset (1991, p. 29).

Tax Reform in Finland, $\phi = 15$

Table 5'. Worldwide taxation, when $\phi = 15$

Worldwide principle	$r,\rho^F = 3.71$			$r = 8, \rho^F = 5$		
β	0	0.5	1	0	0.5	1
Equipment	-0.035	-0.110	-0.185	-0.006	-0.088	-0.169
Structure	-0.082	-0.147	-0.212	-0.016	-0.078	-0.141
Land	-0.083	-0.127	-0.172	-0.079	-0.136	-0.191
Inventories	-0.158	-0.152	-0.145	-0.121	-0.154	-0.186
Average	-0.090	-0.134	-0.179	-0.056	-0.114	-0.172

Table 6'. Partial worldwide taxation, when $\phi = 15$

Partial worldwide principle	$r,\rho^F = 3.71$			$r = 8, \rho^F = 5$		
β	0	0.5	1	0	0.5	1
Equipment	-0.185	-0.260	-0.335	-0.163	-0.239	-0.316
Structure	-0.231	-0.297	-0.361	-0.187	-0.255	-0.324
Land	-0.083	-0.127	-0.172	-0.080	-0.136	-0.191
Inventories	-0.002	-0.005	-0.011	-0.033	-0.066	-0.098
Average	-0.125	-0.172	-0.220	-0.116	-0.174	-0.232

Table 7'. Territorial and Deduction system, $\phi = 15$

Territorial principle	$r,\rho^F = 3.71$			$r = 8,\ \rho^F = 5$		
β	0	0.5	1	0	0.5	1
Equipment	0.033	-0.042	-0.117	0.043	-0.033	-0.109
Structure	0.062	-0.003	-0.067	0.075	0.007	-0.061
Land	0.089	0.045	0	0.092	0.036	-0.019
Inventories	0.170	0.177	0.183	0.014	0.106	0.074
Average	0.089	0.044	0	0.087	0.029	-0.028

Deduction system	$r,\ \rho^F = 3.71$			$r = 8,\ \rho^F = 5$		
β	0	0.5	1	0	0.5	1
Equipment	0.043	-0.032	-0.107	0.043	-0.035	-0.113
Structure	0.054	-0.011	-0.076	0.055	-0.013	-0.080
Land	0.089	0.044	0	0.092	0.036	-0.019
Inventories	0.167	0.173	0.180	0.141	0.108	0.075
Average	0.088	0.044	0.001	0.085	0.024	-0.034

Table 8'. Double taxation

Double Taxation	$r,\rho^F = 3.71$			$r = 8,\ \rho^F = 5$		
β	0	0.5	1	0	0.5	1
Equipment	0.313	0.238	0.163	0.272	0.190	0.109
Structure	0.440	0.375	0.310	0.353	0.290	0.228
Land	0.310	0.266	0.221	0.313	0.257	0.202
Inventories	0.391	0.398	0.404	0.360	0.327	0.294
Average	0.364	0.319	0.275	0.324	0.266	0.208

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