ETLA ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 358-9-609 900
Telefax 358-9-601 753 World Wide Web: http://www.etla.fi/

Keskusteluaiheita - Discussion papers

No. 594

Tarmo Valkonen

CORPORATE TAXATION AND INVESTMENT FINANCE IN FINLAND: A GENERAL EQUILIBRIUM VIEW

ISSN 0781-6847

23.04.1997

VALKONEN Tarmo, **CORPORATE TAXATION AND INVESTMENT FINANCE IN FINLAND: A GENERAL EQUILIBRIUM VIEW**. Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos. The Research Institute of the Finnish Economy, 1997. 32 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; No. 594).

ABSTRACT: This study shows that the effects of the recent Finnish corporate tax reform are markedly different if the firms are allowed to react to the changes in tax rates by shifting their financial policy as suggested by minimisation of the cost of capital. Simulations with a computable general equilibrium model show that this financial policy shift leads to a higher amount of capital but to a lower value of the firms. The overall welfare evaluation of the tax reform is not, however, sensitive to the regime shift: the utility gain for some current generations is modest compared to the utility loss of future generations. These results imply that taxation contributes strongly to the investment and profit distribution decisions and the value of the firms and thereby to the household welfare.

KEY WORDS: corporate tax reform, new view of dividends, old view of dividends, computable general equilibrium model

VALKONEN Tarmo, **CORPORATE TAXATION AND INVESTMENT FINANCE IN FINLAND : A GENERAL EQUILIBRIUM VIEW**. Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos. The Research Institute of the Finnish Economy, 1997. 32 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; No. 594).

TIIVISTELMÄ: Tutkimuksessa tarkastellaan yritys- ja pääomatulojen verotuksen yhteyttä yrityksen rahoitus- ja voitonjakopäätöksiin ja kotitalouksien hyvinvointiin numeerisella yleisen tasapainon mallilla. Jos suomalaiset pörssiyritykset noudattavat pääomakustannuksia minimoivaa rahoituspolitiikkaa, niiden pitäisi vuosien 1987-1994 verouudistuksen jälkeen vähentää voittojen pidättämistä ja rahoittaa laajennusinvestoinnit velalla ja osakeanneilla. Tulosten mukaan tämä siirtymä rahoituspolitiikassa johtaa suurempaan pääomakantaan, mutta alhaisempaan yritysten arvoon ja sitä kautta kotitalouksien varallisuuteen. Yritys- ja pääomatuloverotuksen uudistukseen liittyneiden veroasteiden muutosten hyvinvointivaikutukset eivät tulosten mukaan ole herkät rahoituspolitiikalle: muutamien nykyisten sukupolvien saama hyvinvoinnin lisäys on vähäinen verrattuna pysyviin hyvinvointitappioihin.

ASIASANAT: yritys- ja pääomatulojen verouudistus, yritysten rahoituspolitiikka, numeerinen yleisen tasapainon malli

SUMMARY

The study considers the recent Finnish corporate and capital tax reform, its implications for the cost of capital and financial policy of the firms and induced effects on household welfare. The tax reform is analysed with a dynamic computable general equilibrium model. The main features of the model are that the economy is open, the firms maximise their value taking into account the investment adjustment costs and that the household sector consists of overlapping generations.

There are few areas in economics where the disagreement of the 'right' theory is as large as in the field of corporate taxation. In tax reform studies the choice of the theory more or less determines the main results but is seldom justified by the authors. For policy makers the state of the issue is also more than awkward, because the taxation has potentially considerable effects on saving and capital formation and the competing approaches might lead to opposite policy recommendations.

Typical tax reform simulation exercises do not allow the firm's financial policy to react to the changes in the corporate and capital income tax rates. We consider here minimisation of the cost of capital as the objective determining the firm's financial policy. The tax reform is modelled as a large and equal rise in the interest income and capital gains tax rates, a considerable reduction in the dividend tax rate and a minor hike in the corporate tax rate. From the point of view of the different theories of corporate finance the most interesting feature of the reform is the shift to a full imputation system in which capital gains are taxed more than dividends. The cost of capital minimisation approach supports investment finance with retained earnings and debt before the tax reform. After the reform dividends should be maximised and the investments should be financed with debt and share issues.

The policy shift does indeed increase the optimal capital stock. But it leaves out the tax capitalisation effect, which would have raised the firms' value if the previous policy had been continued. Comparing the welfare effects of the tax reform under the two regimes reveals that a majority of the current shareholders actually gain from not changing the financial strategy. For the future generations this choice would, however, provide lower welfare mainly due to two factors. The first is that the tax capitalisation presents a transfer from future generations to the current ones because the future shareowners do not benefit from the jump in share prices but have to meet the higher tax burden. The second is that the regime shift would provide a smaller drop in wages due to the lower cost of capital and the higher capital stock.

The overall welfare evaluation of the tax reform is not, however, sensitive to the assumptions about the financial policy. The changes in taxation raise the value of the firms, but reduce the optimal amount of saving. The induced consumption boom leaves a markedly higher foreign net debt and taxes, lower wages and weaker terms of trade for the future generations.

This study is a part of a joint project of The Research Institute of the Finnish Economy and the Ministry of Social Affairs and Health. Also the Academy of Finland and the Yrjö Jahnsson Foundation have contributed to the financing of the project. The aim of the project is to build a computable overlapping generations model describing the Finnish economy in order to analyse aspects of social security, taxation and the public debt.

YHTEENVETO

Tutkimuksessa tarkastellaan Suomen yritys- ja pääomatulojen verotuksen, yritysten rahoituspolitiikan ja kotitalouksien hyvinvoinnin yhteyksiä numeerisella yleisen tasapainon mallilla. Keskeisinä piirteinä mallissa ovat talouden avoimuus, se että mallin yrityssektori maksimoi arvoaan ottaen huomioon pääomakannan koon muuttamiseen liittyvät sopeuttamiskustannukset ja että mallin kotitaloussektori koostuu eri-ikäisistä sukupolvista.

Verouudistuksen vaikutuksen analysoimisen tekee vaikeaksi se, ettei yrityksen rahoituksen teoria anna yksiselitteistä suositusta rahoitus- ja voitonjakopäätösten mallittamiseksi. Pikemminkin on niin, että kilpailevat teoriat johtavat hyvin erilaisiin suosituksiin optimaaliseksi verojärjestelmäksi. Tästä huolimatta verouudistustutkimuksissa valitaan usein teoreettinen kehikko vähin perusteluin.

Suomen uuden verojärjestelmän keskeisiä piirteitä ovat pääoma- ja työtulojen erillisverotus, korkotulojen lähdeverotus ja yhtiöveron hyvitysjärjestelmä. Näiden seurauksena myyntivoittojen verotus on noussut kireämmäksi kuin osinkotulojen, samoin korkotulojen verotus on kiristynyt selvästi. Tässä tutkimuksessa on lähtökohtana, että yritykset valitsevat rahoituspolitiikkansa minimoidakseen pääomakustannuksia. Tällä kriteerillä niiden pitäisi vähentää voittojen pidättämistä ja rahoittaa laajennusinvestoinnit velalla ja osakeanneilla verouudistuksen jälkeen.

Simulontitulosten mukaan verouudistus ja rahoituspolitiikan muutos kasvattavat odotetusti pääomakantaa. Politiikan muuttuessa verotuksen kapitalisoituminen yritysten arvoon jää kuitenkin toteutumatta. Nykyisten osakkeenomistajien enemmistölle tämä merkitsee pienempää pääomavoittoa verouudistuksesta. Tulevien sukupolvien kannalta politiikkamuutos on kuitenkin parempi valinta, koska suurempi pääomakanta nostaa reaalipalkkoja ja koska verotuksen kapitalisoituminen on tulonsiirto nykyisille sukupolville.

Verouudistuksen kokonaisarvio ei ole hyvinvointivaikutusten näkökulmasta herkkä oletukselle yritysten rahoituspolitiikasta, vaikka sen valinta vaikuttaakin merkittävästi kokonaistaloudellisten muuttujien kehitykseen. Uudistuksen keskeiset lyhyen aikavälin vaikutukset johtuvat siitä, että kotitalouksien todellinen varallisuus kasvaa pääomakannan arvostuksen lisääntymisen vuoksi mutta halutun varallisuuden määrä alenee korkotulojen verotuksen kiristyessä. Erityisesti keski-ikäiset sukupolvet, joilla on paljon varallisuutta ja suhteellisen lyhyt aika sopeuttaa käyttäytymistään kuluttavat sekä hyödykkeitä että vapaa-aikaa selvästi aiempaa enemmän. Syntyvän kulutusjuhlan jälkeen tuleville sukupolville jää perinnöksi alhaisempi reaalipalkka, korkeampi veroaste, suurempi ulkomainen velka sekä sen hoitamiseen liittyvä heikompi vaihtosuhde.

Tutkimus on osa Elinkeinoelämän tutkimuslaitoksen ja Sosiaali- ja terveysministeriön yhteishanketta, jossa rakennetaan Suomen taloutta kuvaava sukupolvimalli ja analysoidaan sillä sosiaaliturvaan, verotukseen ja velkaantumiseen liittyviä kysymyksiä. Hanketta ovat rahoittaneet edellämainittujen lisäksi Suomen Akatemia ja Yrjö Jahnssonin säätiö.

1. Introduction[1]

There are few areas in economics where the disagreement of the 'right' theory is as large as in the field of corporate taxation. In tax reform studies the choice of the theory more or less determines the main results but is seldom justified by the authors. For policy makers the state of the issue is also more than awkward, because the taxation has potentially considerable effects on saving and capital formation and the competing approaches might lead to opposite policy recommendations.

The aim of this paper is to study the effects of the recent Finnish corporate and capital income tax reform. The tax reform included a large and equal rise in the capital gains and interest income tax rates, a significant reduction in the dividend tax rate and a minor hike in the corporate tax rate. This study shows that the results of the reform are markedly different if the firms react to the changes in tax rates by shifting the financial policy as suggested by minimisation of the cost of capital. Furthermore, simulating the effects of the tax reform with an dynamic computable general equilibrium model reveals that the regime shift leads to a higher amount of capital but to a lower value of the firms. Another paradox is linked to the time span: the change to the cost minimising financial policy reduces the utility gain of currently living generations, but is better for the future generations. These results imply that the policy maker has to take into account both the endogenousness of the firms' financial behaviour and the intergenerational utility redistribution when reforming corporate taxation.

The structure of the paper is as follows. The next section describes the main ideas of the financial regimes. The links to earlier studies are described briefly in the third section. The fourth section includes a presentation of the Finnish tax reform and its effects on the cost of capital. The next section depicts the model used, putting more weight on the corporate finance modelling. In the section six the results of the simulations and their interpretation are presented. The conclusions are presented in the seventh section. The model is described in detail in the Appendix 1.

2. The views of corporate finance

Corporate finance literature separates several approaches which can be used to describe the relation between the cost of capital and taxation. We describe below the main features of the old view, the new view and the neutrality hypotheses and the cost of capital formulas implied[2]. Those formulas will be used later, when the choice of the financial structure of the firm and the dividend distribution decision are considered.

The neutrality hypothesis justifies the choice of the mode of finance purely on basis of the after-tax cost of capital. While in most countries the firms' interest expenditures are deductible

[1] The core economic model used was adopted from Lassila, Palm and Valkonen (1997). I thank Kari Alho, Vesa Kanniainen, Jukka Lassila, Hannu Piekkola, John Rogers, Jouko Ylä-Liedenpohja and the participants of the FPPE seminars for useful comments, Eija Kauppi for her efficient programming and Pasi Sorjonen providing for the calculations of the effective marginal tax rates. Financial support from the Academy of Finland, the Ministry of Social Affairs and Health and the Yrjö Jahnsson Foundation is gratefully acknowledged.

[2] The descriptions follow closely the approaches of Sinn (1990) and Zodrow (1991). See also Head (1997) and Sörensen (1994) for more recent surveys.

in the corporate taxation, the use of debt is less taxed than the use of equity. Therefore all investments should be financed with debt. If the deductibility is complete and the tax base for corporate taxation is actual profits, the cost of capital for debt-financed investment is not affected by corporate and personal taxation.

The advocates of the other two views agree on the neutrality of debt but claim that the use of debt is limited because of the increasing risk of bankruptcy and therefore the capital stock must be financed at least partly with equity.

The main assumption in the old view is that the shareholders benefit from dividends more than from capital gains. This is justified either by cash preference, by signalling of profitability or by the preference of reducing the managerial discretion over the use of profits. These gains must be evaluated against the generally observed higher effective tax burden of dividend incomes compared to the taxation of capital gains. The preference for dividends is generally expressed as a target dividend/profit ratio. Distributing the dividends leaves less earnings to be retained and therefore the marginal investments of firms are financed by new share issues.

According to the old view the double taxation of profits causes major distortions in investment decisions. This can be seen in the following equation, which is derived by assuming that one dollar is invested either in newly issued shares or in bonds. The bond yields an after-tax interest rate and the share gives the distributed profit taxed both at the corporate and at the personal level:

$$(1) \qquad P = r \times \frac{1-\tau^r}{(1-\tau^{Fd})(1-\tau^D)}$$

where P is required dividends per invested dollar, r is the interest rate, τ^r is the personal tax rate for interest income, τ^{Fd} is the corporate tax rate on distributed profits and τ^D is the personal tax rate for dividends. If the personal tax rates are assumed to be equal, the corporate tax rate determines the difference between the cost of capital and the interest rate. Arguing that the difference is large, the proponents of the traditional view have asked for integration of the corporate and personal income taxation. There is also a later version of the old view[1], which is based on the arbitrage condition between the after-tax yield of debt and equity. It produces also a formula like (1) in the case of maximum distribution of dividends.

The opposing new view supporters claim that, empirically, the amount of share issues is small and retained earnings dominate equity finance. This dominance is a result of minimising the cost of equity capital[2]. The lower cost of capital is due to the low tax rate for capital gains and the neutrality of dividend tax when investments are financed with retained earnings.

The neutrality argument is based on the fact that dividend taxes are avoided when earnings are retained. The present value of these tax savings is at the margin as large as the future dividend tax payments which are generated by investing the retained earnings and distributing the yield as dividends. Now the corresponding equation for the required dividend per invested dollar is (see e.g. Sinn 1990 for the derivation):

1 See Poterba and Summers (1983) and Goulder and Summers (1989).

2 They do not accept the old view justifications for the dividend preference. See e.g. Sörensen (1994) for some of the critiques against these preference arguments.

$$(2) \qquad P = r^d \times \frac{1-\tau^r}{(1-\tau^{Fr})(1-\tau^g)}$$

where τ^{Fr} is the corporate tax rate for retained earnings and τ^g the personal tax rate for capital gains. The amount of dividends is a residual from the firms' cash flow equation remaining after the investments have been financed by retaining earnings. Shareholders value the after-tax dividends and capital gains equally.

Now the policy recommendations are significantly different. If the tax rate for dividends is lowered, it has no effect on the costs of the marginal investment and on the profit distribution, but gives a windfall capital gain to the owners of the shares. The weakness of the new view is that it assumes the earnings of the firms to be eventually distributed to shareholders in the form of taxable dividends. But if firms repurchase their shares, the distributed profit is taxed at capital gains tax rates, not at dividend tax rates.

Comparing the equations (1) and (2) shows that the cost of capital under both views is equal only when the personal capital income tax rates are equal as well as the corporate tax rate on distributed and retained earnings. Generally they differ and therefore the validity of the views is important. Unfortunately, empirical tests have not given unanimous support to either of them[1]. The cost of capital calculations above are derived from a partial equilibrium model. The modifications for our dynamic open economy general equilibrium model are presented in section 5.2.

3. Corporate tax reforms and dynamic CGE models

It is not a new idea to use a dynamic computable general equilibrium model when the effects of corporate taxation is studied (see e.g. the survey by Pereira and Shoven 1988), but the development of the models has given new insights. At least three major advancements in the models should be mentioned. The first is inclusion of the adjustment costs of investments, which spur a Tobin's q theory type of investment behaviour. Another is to model the household sector using overlapping generations instead of one infinitely living household[2]. The third innovation is to model foreign trade, originally often assuming that the domestic economy is small and behaves as a price taker in the international markets of goods and capital (see e.g. Söderlind 1990).

Our model has some additional features which improve its ability to imitate the observed behaviour of the Finnish economy. We have modified the life cycle of the households by using a hump shaped working efficiency time profile, a pension system and 'joy of giving' bequests. Foreign agents are allowed to participate in the markets of the domestic good and bond markets, but do not determine the prices: in goods trade the Armington assumption[3] is used and the supply of foreign financial capital depends on the domestic interest rate[4]. Foreigners are

[1] The old view has gained somewhat more empirical support, see Zodrow (1991) for a survey. For the case of Finland, see Sorjonen (1988).

[2] The first applications were made by Summers (1981a) and (1981b). Auerbach and Kotlikoff (1987) used both these features in a dynamic CGE model.

[3] See Armington (1969).

[4] Goulder and Eichengreen (1989) and Perraudin and Pujol (1991) are among the few that have endogenised also the interest rate in an open economy CGE model.

not allowed to own domestic firms, which ensures that the required rate of return for firms' capital is determined from the point of view of a domestic investor, who is affected by the domestic taxation.

The earlier CGE studies have not devoted much attention to the justification of the modelled financial policy[1], even though the policy affects the results profoundly. In most cases some stylised version of either the old view, the new view or the hierarchical financing scheme have been adopted.

The simplest new view CGE models finance all investments with retained earnings and distribute the rest of the income to the shareholders (see Frederiksen 1994 and Söderlind 1990). This leads to a volatile dividend behaviour and the dividends can turn out to be negative. A more developed version finances investments with retained earnings and debt using a fixed debt to capital ratio (see Jensen et al. 1993).

Goulder and Summers (1989) used also a fixed debt ratio formulation, but in their model the other source of marginal finance is share issues. Dividends were determined as a fixed ratio of the book profit. This old view formulation has been used later by Keuschnigg (1991) and Offerdahl (1991).

Broer and Westerhout (1993) and Hasselman (1991) modelled endogenous financing decisions, where retained earnings, share issues and debt are all used. In these models the agency costs of increased use of the debt financing lead to a hierarchy-of-financing scheme[2]. First the retained earnings are used together with the debt. When retained earnings are exhausted, debt is the sole financing method. When the cost of debt rises high enough, also share issues will be used. The financial structure varies with the growth rate of the economy.

In our study the firms' debt-to-capital ratio is fixed. We focus on choosing the optimal amounts of external and internal equity finance and dividend distribution policy. Originally, the criteria for optimality is the cost of capital before and after the tax reform. The simulations show, however, that the regime shift from the new view to the old view type of corporate finance implied by the cost minimisation do not necessarily lead to the maximisation of the firms' stock market value and utility of the currently living households.

[1] The few exemptions are Fullerton and Mackie (1989), who compare the results of the U.S. tax reform using different assumptions about the financing structure, and Hutton and Kenc (1995), who compare the effects of tax proposals under the new view, the old view and the endogenous determination of the debt-equity ratio.

[2] The hierarchical scheme can be considered as providing an endogenous financial structure, because the use of the sources of finance depends on the invested amount. It leads to a new view type of investment financing with low investment rates and to an old view type of financing with high investment rates if dividends are more heavily taxed than capital gains. The approach is, however, difficult to justify if dividends are taxed with a markedly lower rate than capital gains. The relation between the interest rate and the indebtedness of the firm is not straightforward either because debt provides both non-tax costs and benefits. See also Hansen (1994) for empirical support of the target debt-to-capital ratio compared to the pecking-order theory in the Finnish case.

4. Finnish tax reform and the cost of capital

4.1 Tax rates before and after the reform

The Finnish tax system was changed radically during the years 1987-1994. Very high marginal tax rates were lowered and the tax bases widened in income taxation. Also the shift from sales tax to value added tax broadened the tax base. The motivations for the reform were both external and internal. Domestically the most compelling reasons were the need to improve the efficiency of allocation of capital and promote neutrality in taxation of industrial branches, types of capital, sources of financing and investing sectors (Myhrman et al. 1995). Also possibilities for tax arbitrage had emerged as a result of deregulation of the credit markets (Ministry of Finance 1991). International pressures came through deepening economic integration to the other parts of Western Europe and the wave of tax reforms carried out there, which intensified tax competition.

The capital income taxation before the reform was complicated. The main principle was to tax the capital incomes at marginal rates of personal income taxation, which varied generally between 60 and 70 per cent. The majority of bank deposits and government bonds were, however, exempt from taxation and there were also tax-exempt ceilings in the personal capital income. It was also possible to include rent and dividend income in this tax-free quota[1].

Capital gains from financial assets were also exempt from taxation if the holding period exceeded five years[2]. The different treatment of the different investor groups, like personal investors, corporations and foreign investors, added to the complexity of the system. The marginal tax rate depended heavily on the invested amount, on the length of the holding period and on the investing sector. The average effective tax rates were, however, fairly low. Accordingly, it is assumed that the tax rate before the reform was zero both for interest income and capital gains.

The marginal average dividend tax rate, 13 per cent for the year 1987, was calculated as follows[3]: Statistics of income and property 1987 gives the number of persons, amount of capital income and deductions used in 22 income brackets. It has been assumed that in each bracket the capital income deduction was first used to reduce the taxable interest and secondly to decrease the taxable dividend income. If the deduction had been used first for the interest income and next for rental income and the rest were used to reduce the taxable dividends, the marginal rate for dividends would have been 31 per cent[4].

The nominal corporate tax rate was very high before the reform (50 per cent in 1987), but the generous allowances like inventory and investment reserves and accelerated fiscal deprecia-

1 In 1987 the tax-exempt ceiling for interest incomes was FIM 3600 per person, for dividends FIM 5200 per person and for rental income FIM 7200 per person, while the aggregate tax-free tax-exempt ceiling was also FIM 7200 per person.

2 Also the long-term capital gains exceeding FIM 1 mill. per year were partly taxable in 1987, but the tax could be avoided by realisation of the gains during several years.

3 These calculations were provided by Pasi Sorjonen. See also Ylä-Liedenpohja (1987).

4 Because the tax statistics do not provide enough information to find out the utilisation of the tax-free quotas in various types of capital incomes, the choice for the relevant marginal dividend tax rate is difficult. Using the lower of the two rates in simulations is justified by noting that the average tax rates were even lower.

tion reduced considerably the corporate taxes collected. In the simulation model the depreciation allowances are assumed to correspond to the true economic depreciation and all other tax allowances have been included by using average effective corporate tax rates. We do not consider the effects of tax debt on the cost of capital. Myhrman et al. (1995) use average tax rates of 25 per cents to describe the tax burdens of both the distributed and retained earnings before the tax reform[1]. This is also the rate used in our simulations.

The main aim of the capital and corporate tax reform was to separate capital income from earned income and to use lower, flat, equal statutory rates and a wider tax base. The tax rate is now 28 per cent (in the case of no inflation) regardless of whether the tax base is rental income, interest income, dividend income, capital gains or corporate income.

Because of the full imputation system, the effective dividend tax rate for a private individual is zero[2]. In corporate taxation the effective rate is now close to the statutory rate because most allowances have been abolished and possibilities to use accelerated tax depreciation rates have been reduced. Therefore also the tax neutrality between industries has increased. The corporate tax rate is the same for both distributed and for retained earnings. The following table describes the tax rates used before and after the tax reform.

Table 1. Effective tax rates before and after the reform

	before	after
Corporate tax	25	28
Interest income tax	0	28
Dividend tax	13	0(28)
Capital gains tax	0	28

The tax reform is thereby modelled as a large and equal rise in the interest income and capital gains tax rates, a considerable reduction in the dividend tax rate and a minor hike in the corporate tax rate. From the point of view of the different theories of corporate finance the most interesting feature of the reform is the shift to the full imputation system in which capital gains are taxed more than dividends.

[1] Also the evaluation of the effective average or marginal corporate tax rates before the reform is very difficult. The 25 per cent tax rate for retained earnings is the average of the years 1981-1990 from the non-financial sector. The yearly variation was large. The corporate tax rate on dividends distributed on new equity, also 25 per cent (when the source of distribution was the fiscal period income), was low because of the applied dividend deduction system.

[2] The imputation system is applied to listed companies. For the other companies the 28 per cent dividend tax rate is applied up to the amount of dividends corresponding to a 15 per cent yield on the net wealth of the firm. Higher dividends are taxed with marginal tax rates of personal taxation, which has motivated shareholders to retain the rest of the earnings. We do not either include in the model the system of compensatory taxation and tax surpluses, which allows for a tax-free smoothening of the dividend distribution over a business cycle.

4.2 Cost of capital before and after the reform

Applying the above rates to the equations (1) and (2) on page 2 gives the required dividend yield before taxes for both the views. The yield for retained earnings before the reform is:

$$(3) \qquad P = r\frac{1-\tau^r}{(1-\tau^{Fr})(1-\tau^g)} = r\frac{1-0}{(1-0.25)\times(1-0)} \approx r\times 1.33$$

While the tax rate for interest income and for capital gains is zero, the gap between the interest rate and the cost of capital is generated solely by the corporate tax.

After the tax reform the corresponding calculation gives:

$$(4) \qquad P = r\frac{1-0.28}{(1-0.28)\times(1-0.28)} \approx r\times 1.39$$

In this case the hikes in the interest income tax rate and in the capital gains tax rate cancel each other out, and the remaining increase in the corporate tax rate raises slightly the required rate of return.

The required return for investments financed with share issues before the tax reform is:

$$(5) \qquad P = r\frac{1-\tau^r}{(1-\tau^{Fd})(1-\tau^D)} = r\frac{1-0}{(1-0.25)\times(1-0.13)} \approx r\times 1.53$$

The tax reform abolishes, however, the distortions because of the full imputation of the distributed profit and the equalisation of the interest income and corporate tax rates:

$$(6) \qquad P = r\frac{1-0.28}{(1-0)\times(1-0.28)} = r$$

In both cases the required rate of return for debt financed investment is the interest rate. If we consider the minimisation of the cost of capital as the criteria for selecting the means of marginal investment finance, it suggests that before the reform debt should have been preferred and after the reform both debt and share issues. The use of debt is, however, restricted because of the collateral costs. Therefore some equity finance is also necessary and the above figures show that before the reform, the other marginal source of finance should have been retained earnings and after the reform it should be share issues. This is precisely the way the corporate finance has been implemented in the simulation model described below.

The possibility to make the regime shift leads immediately to another conclusion: the required return for marginal investment is now lower and the optimal capital stock higher than before the reform, if the other factors of the economy do not change. The final judgement should not, however, be made before the general equilibrium effects of the reform are studied. Studying these indirect effects is especially interesting in a computable OLG model.

5. Computable OLG model and corporate finance

5.1. Main features of the simulation model

The model is an Auerbach-Kotlikoff-type perfect foresight numerical overlapping generations model. There are five sectors: households, enterprises, a government, a pension fund and a foreign sector. The labour, goods and capital markets are competitive and prices balance the demand and supply period-by-period. There is no money or inflation in the model.

The household sector consists of 12 overlapping generations. The households enter the model at the age of 20, participate in the labour markets until they are 60 years old, and live as pensioners the next 20 years. They make utility maximising lifetime plans for consumption, labour supply and bequests when they enter the model. After a simulated shock every household cohort revises its plans for the remaining lifetime. The dying generation leaves bequests to their 50-55 year old descendants. The utility from giving bequests is not linked to the utility of the inheriting generation.

The enterprise sector consists of small listed forward looking companies which maximise the value of their shares. The representative firm decides about investments and the use of labour. Investments cause adjustment costs and therefore the investment decisions are based on a tax-adjusted Tobin's q-theory.

The public sector collects taxes and uses them to hire workers and to pay the interest costs of the public debt. The model allows for several possibilities to balance the public sector receipts and expenditures. In the simulations the value added tax rate adjusts except in the first period, when the public debt adjusts. This is because in the first period the large increase in revenues from capital gains taxation would cause undue variation in the VAT rate and consumer prices.

The pension institution finances pensions with contributions and capital income from the pension fund. The pension system is balanced period-by-period with the employers' contribution rate. Pensions are indexed partly to the wages and the pension wage is determined with a heavy weight on the last working period's earnings.

The households' working efficiency first increases and then decreases with age, which induces a hump-shaped life cycle earnings profile. The efficiency wage is formed in labour markets where the aggregate labour supply meets the exogenous public sector demand and the enterprises' demand which is determined from the marginal productivity of labour rule.

There are two 'basic' goods in the model, one imported and one domestically produced. The goods are imperfect substitutes and are combined with a CES structure to form cost minimising composite intermediate, investment and consumption goods. The domestic good is also exported. The export demand depends on the real exchange rate with a constant price elasticity. The price of the imported good is fixed and used as a numeraire in the price system.

In the bond markets the issuers of debt are firms and the government and the investing sectors are households, a pension fund and foreigners. The domestic interest rate deviates from the

foreign rate whenever net foreign debt deviates from its target level[1]. The implicit monopoly power of the country in the international capital and goods markets cannot be utilised by single decision makers, because they are too small to have any effect on aggregate quantities and prices. In the markets of domestic firms' shares the domestic households are the sole owners.

A more detailed description of the model can be found in Appendix 1. Appendix 2 includes the list of variables and values of the parameters. The model is calibrated to imitate the main features of the Finnish economy. The given values for elasticity parameters are in line with most econometric studies. They represent the long-term elasticities, because the unit period in the model is five years.

5.2 Modelling corporate finance

In the following we present the way how the financial policy regimes were implemented in the model and study their interaction with the new and old view literature.

In a taxless world with perfect foresight and well functioning capital markets, the financial decisions of the firm have no effect on the cost of capital and the value of the firms. Taxation changes the picture profoundly: it can lead to situations where the tax arbitrage can increase the value of the firms indefinitely. If capital gains are taxed with a lower rate than dividends, shareholders benefit if firms repurchase their shares and finance this by reducing dividends. If the dividend tax rate is lower, firms should issue shares and distribute the returns as dividends. Also debt can be used in a similar way. These results imply that to keep the model tractable some restrictions must be set to the choices of the sources and uses of finance[2].

We assume that the firms' debt stock B_t^F at the end of period t is restricted to a fixed ratio b to the replacement value of the firm's capital stock[3]. This imitates the practise of using the capital stock as collateral for loans, or a target debt-to-capital ratio:

$$(7) \qquad B_t^F = bp_t^K K_t$$

The other source of marginal finance is either retained earnings or share issues. When the share issues are preferred, the maximum amount of dividends is restricted to the earnings net of actual depreciation. When retained earnings are preferred, the dividends can exceed actual profits if the capital stock falls.

Determination of the firm's value is based on an arbitrage condition, which says that the expected after-tax yield on investment in firms' shares must be equal to the after-tax interest rate:

$$(8) \qquad r_t^d(1-\tau_{t+1}^r)V_t = (1-\tau_{t+1}^D)D_{t+1} + (1-\tau_{t+1}^g)(V_{t+1}^E - V_t - V_{t+1}^N)$$

[1] This option was not in use in the following simulations to make the interpretations more transparent. The domestic interest rate was fixed to the foreign rate. For the effects of this choice see Valkonen (1996).

[2] There are restrictions also in a real world: In Finland share repurchases are forbidden and if distributed dividends are larger than actual profit, they will be taxed with compensatory tax if the sum of retained actual profits from previous years (tax surplus) does not cover the extra dividends distributed.

[3] Another possibility would have been to use the market value of the capital. This could have led, however , e.g. to situations where the amount of debt increases and the capital stock decreases. When the capital stock is valued with replacement cost, these anomalous situations are less likely.

where the left-hand side describes the returns when amount V_t is invested in bonds at the end of period t. The interest income is paid and taxed with the rate τ^r_{t+1} in the beginning of period $t+1$. Investment in firm's shares gives dividend income D_{t+1} and expected capital gains $(V^E_{t+1} - V_t - V^N_{t+1})$, which are taxed respectively with tax rates τ^D_{t+1} and τ^g_{t+1} during the same period[1]. Expected capital gains consists of the change in the firm's value $V^E_{t+1} - V_t$ net of share issues V^N_{t+1}. In the case of the new view of corporate taxation, the latter term is zero.

Solving the equation forward and ruling out bubbles gives the value of the firm as a discounted sum of tax-adjusted values of future dividends:

$$(9) \qquad V_t = \sum_{s=t+1}^{\infty} \left(\frac{1-\tau^D_s}{1-\tau^g_s} D_s - V^N_{s+1}\right) \prod_{v=t+1}^{s} \frac{1}{1+r^d_{v-1}\left(\frac{1-\tau^r_v}{1-\tau^g_v}\right)}$$

Again, in the case of the new view, the share issues are not there to be subtracted from the flow of dividends.

The next phase is to define the dividend policy. Let's start with the definition of the firm's after-tax earnings:

$$(10) \qquad E^A_t = (1-\tau^F_t)\left[p^F_t(F_t - G_t) - (1+\tau^l_t) w_t L^F_t - r^d_{t-1} B^F_{t-1}\right] + \tau^F_t d\, p^K_{t-1} K_{t-1}$$

Inside of the brackets are first the value added of the firm net of investment adjustment costs[2]. Earnings are reduced by labour costs and the interest costs of the firm's debt. The last term after the brackets is the depreciation allowance, which corresponds to the real depreciation. All other allowances are included by using an effective average corporate tax rate.

According to the new view the dividends are a residual from the firm's cash flow identity:

$$(11) \qquad D_t = E^A_t + (B^F_t - B^F_{t-1}) - p^K_t I_t$$

Where the sources of finance are after-tax earnings and an increase in the firm's debt. The proceedings are used to finance investment costs and the rest is distributed as dividends.

According to the old view the firm pays a minimum amount of dividends to the shareholders. Here it is modelled as a fixed ratio a to the earnings net of depreciation costs[3]:

$$(12) \qquad D_t = a(E^A_t - d p^K_{t-1} K_{t-1})$$

In the old view case the amount of share issues is solved from the firm's cash flow identity:

$$(13) \qquad V^N_t = p^K_t I_t + D_t - E^A_t - (B^F_t - B^F_{t-1})$$

1 Taxing the capital gains on accrual simplifies the analysis considerably. The effects on the tax revenues have been spread out over time by letting the public debt adjust in the first simulation period.

2 Note that investment adjustment costs are deductible in taxation.

3 This is a simplified version of the formulation used by Goulder and Summers (1989).

If a = 1, the share issues and the increase in debt are in the steady growth path just large enough to finance the increase in the capital stock. If a < 1, more earnings are retained than necessary to finance the replacement of the depreciated capital stock and the value of the firms' shares increases. If a > 1, dividends are financed partly with share issues.

Firms choose the optimal amount of investments and use of labour to maximise the price of the firms' shares. The problem can be presented as maximising in the beginning of period t the tax-adjusted dividends net of share issues plus the value of the firm at the end of the period subject to the accumulation condition of the capital stock:

$$(14) \qquad \mathrm{Max}_{L,I,K} \quad \frac{1-\tau_t^D}{1-\tau_t^g} D_t - V_t^N + V_t$$

subject to:

$$(15) \qquad K_t = K_{t-1}(1-d) + I_t$$

The first order conditions for the maximum of the firm's value are described more closely in Appendix 1, but they can be expressed verbally as follows:

1. The shadow value of one unit of capital λ_t equals the costs of purchasing and installing the capital unit.

2. The value of the marginal product of capital equals the user cost of capital.

3. The value of the marginal product of labour equals labour costs.

4. The discounted value of the capital stock approaches zero when time goes to infinity (Transversality condition).

Looking more closely at the first condition gives insight into the links between taxation, Tobin's marginal and average q and the investment decisions. In the new view case, the firm's value is maximised when investments are carried out until:

$$(16) \qquad \lambda_t = \frac{1-\tau_t^D}{1-\tau_t^g}\left[p_t^K + p_t^F (1-\tau^F)\xi \frac{I_t}{K_{t-1}} \right]$$

The first term in the brackets is the purchasing price of a unit of capital and the second term describes the after-tax investment adjustment costs. Dividing both sides by the price of the capital gives Tobin's marginal q:

$$(17) \qquad \text{Tobin's marginal q} = \frac{\lambda_t}{p_t^K} = \frac{1-\tau_t^D}{1-\tau_t^g} + \frac{1-\tau_t^D}{1-\tau_t^g} \frac{p_t^F}{p_t^K} (1-\tau^F)\xi \frac{I_t}{K_{t-1}}$$

Assuming away the effects of the adjustments costs (the second term on the right-hand side) gives an expression which is familiar to the new view analyses: the market valuation of the marginal unit of capital in the firm is the same as the ratio of the two tax terms. It has two interesting interpretations. The first is that it is an arbitrage condition for the two possible uses

of the earnings: the amount p_t^K can either be distributed as dividends yielding after tax $(1-\tau^D)p_t^K$ or retained and invested, which gives an after-tax capital gain of $(1-\tau^g)\lambda_t$. The shadow value of the capital unit λ_t adjusts to preserve the equality when either of the tax rates changes. In other words, the taxes are capitalised in the market value of capital.

The second interpretation follows from the usual assumption that dividends are more heavily taxed than capital gains. It means that the firm's value is maximised when Tobin's marginal q is smaller than one i.e. the marginal unit of capital in the firm is valued in the markets less than the repurchase price. The critics of the new view note that in this case firms should never build new capital but acquire it via taking over other companies.

In our case the shadow value of capital captures both the tax capitalisation effect and the effects which are due to the investment adjustment costs. The latter include effects of the installing technology, the effect of the corporate tax rate via the deductibility of the adjustment costs and the effect of the ratio of the price of output and the price of capital. All these factors affect the optimal amount of investments, which is determined in the model using a transformation of the equation (16).

The link between the average and the marginal Tobin's q is now:

$$(18) \qquad \frac{V_t}{p_t^K K_t} = \frac{\lambda_t}{p_t^K} - \frac{1-\tau_t^D}{1-\tau_t^g} b$$

This equation says that the average Tobin's q is lower than the marginal one because of the partial debt financing of the firm's capital stock (parameter b gives the debt-to-capital ratio in the model). This link has been derived using the homogeneity of production and capital installation technologies[1].

In the old view case the dividend preference parameter a complicates the corresponding marginal q equation somewhat:

$$(19) \qquad \text{Tobin's marginal q} = \frac{\lambda_t}{p_t^K} = 1 + (1 + \frac{1-\tau_t^D}{1-\tau_t^g} a - a) \frac{p_t^F}{p_t^K} (1-\tau^F) \xi \frac{I_t}{K_{t-1}}$$

If there were no investment adjustment costs in the steady growth path, the equilibrium value for Tobin's marginal q would be one. This describes one of the main old view assumptions: retaining a unit of earnings raises the market value of the firm with the same amount irrespective of taxation. The adjustment costs bring about new results. The market valuation of a marginal unit of capital is higher than one except in the very rare case of negative investments. Another point is that personal capital income taxation affects now the valuation if dividends are distributed.

The old view average q is now:

$$(20) \qquad \frac{V_t}{p_t^K K_t} = \frac{\lambda_t}{p_t^K} - b$$

[1] see Hayashi (1982).

Transforming equation (19) somewhat gives an investment equation which tells that the investments will be positive as long as the Tobin's marginal q is larger than one.

The effects of taxation on the optimal amount of capital stock can be studied by analysing the second first order conditions in the steady growth path. In the new view case the condition can be written as:

$$(21) \quad p^F(F_K - G_K) = p^K\left[d + br^d + (1-b)r^d \frac{1-\tau^r}{(1-\tau^g)(1-\tau^F)} \right] + p^F\xi(r^d \frac{1-\tau^r}{1-\tau^g} + d)(\eta + d)$$

The left-hand side describes the value of the marginal product of capital (taking into account that additional unit of capital reduces the future investment adjustment costs). The right-hand side includes the costs of the finance. The value of the last term, which is linked to the adjustment cost, is small. The important parameters are inside the square brackets, where there is first the depreciation rate d, then the interest cost of debt financed share of the capital br and last the cost of capital financed by retained earnings[1]. The cost of retained earnings increases when the capital gains tax rate or the corporate tax rate is raised and decreases when the tax on interest income is raised. The dividend tax does not have any effect on the costs in the steady state. The terms of trade affect through the price of the capital unit p_t^K, which is a composite of the domestic and the imported good. A rise in the relative price of the domestic good raises the incomes from a unit of capital more than costs because part of the unit is imported.

The corresponding steady growth path equation for the old view is:

$$(22) \quad p^F(F_K - G_K) = p^K\left[d + br^d + (1-b)r^d \frac{1-\tau^r}{a(1-\tau^D)(1-\tau^F)+(1-a)(1-\tau^g)(1-\tau^F)} \right] +$$

$$p^F\xi(r^d \frac{1-\tau^r}{1-\tau^g} + d)(\eta + d)$$

The dividend distribution decision now has an influence on the cost of the equity-financed portion of the capital. When $a = 1$, the dividend tax rate has replaced the capital gains tax rate (leading to the original old view version of cost of capital). If $a = 0$, no dividends are distributed and the dividend tax is neutral. In this case the earnings are distributed via share repurchases and the cost of capital is exactly the same as in the new view case. In the following we will set $a = 1$ implying that in the current Finnish tax system shareholders prefer dividends to capital gains, because they are taxed less. Therefore we do not need the justifications generally supplied by the old view for the dividend preference, but have to rule out excess dividend distribution financed with share issues, i.e. not allowing a to be larger than one.

[1] In the case of b = 1 the corporate tax is neutral with respect to the optimal capital stock , but when there are investment adjustment costs also in the steady state path, the personal capital gains and interest income taxes are not.

6. Simulation results

6.1 Tax reform with the regime shift

The base case simulations include large changes in tax rates and a shift from the new view type of behaviour to the old view behaviour[1]. The tax changes include a minor hike in the corporate income tax, a big drop in the dividend income tax and even larger but equal increase in interest income and capital gains tax rates. The shift in the behaviour means that the firms starts to use share issues together with debt as sources of finance for the marginal investments, finances replacement investments due to depreciation by retaining earnings and distributes the rest of the earnings as dividends.

Some of the responses of the firms and households to the tax reform can be seen even before running the general equilibrium simulation, just by looking at the equations described above. The equal increases in the interest income and capital gains tax rates cancel each other out in the cost of capital equation as they do also in the discounting factor of the equation describing the firm's value. Both the fall in the dividend tax rate and the rise in the capital gains taxation raise, however, the valuation of the capital stock, which leads to a large jump in the value of the firms and thereby in the wealth of households[2]. On the other hand, the significantly higher interest income tax rate reduces the optimal amount of saving for households.

These two effects induce a huge incentive for households to increase consumption, being relatively more intense the older the household is. This is true especially for the middle-aged households, which are at the top of the life-cycle wealth hump and still of working age. These generations consume both goods and leisure more and even though the wage rate also rises, the firms have to adjust to a large aggregate fall in the labour supply by reducing production.

There are two factors which spur a reduction in the initial investments: the minor hike in the corporate tax rate and the diminished labour supply. But the changed financing behaviour in favour of the share issues means that the fall in the dividend tax lowers the cost of capital. An increase in the investment rate is supported by the jump in the price of the domestic good, which increases firms' revenues more than costs.

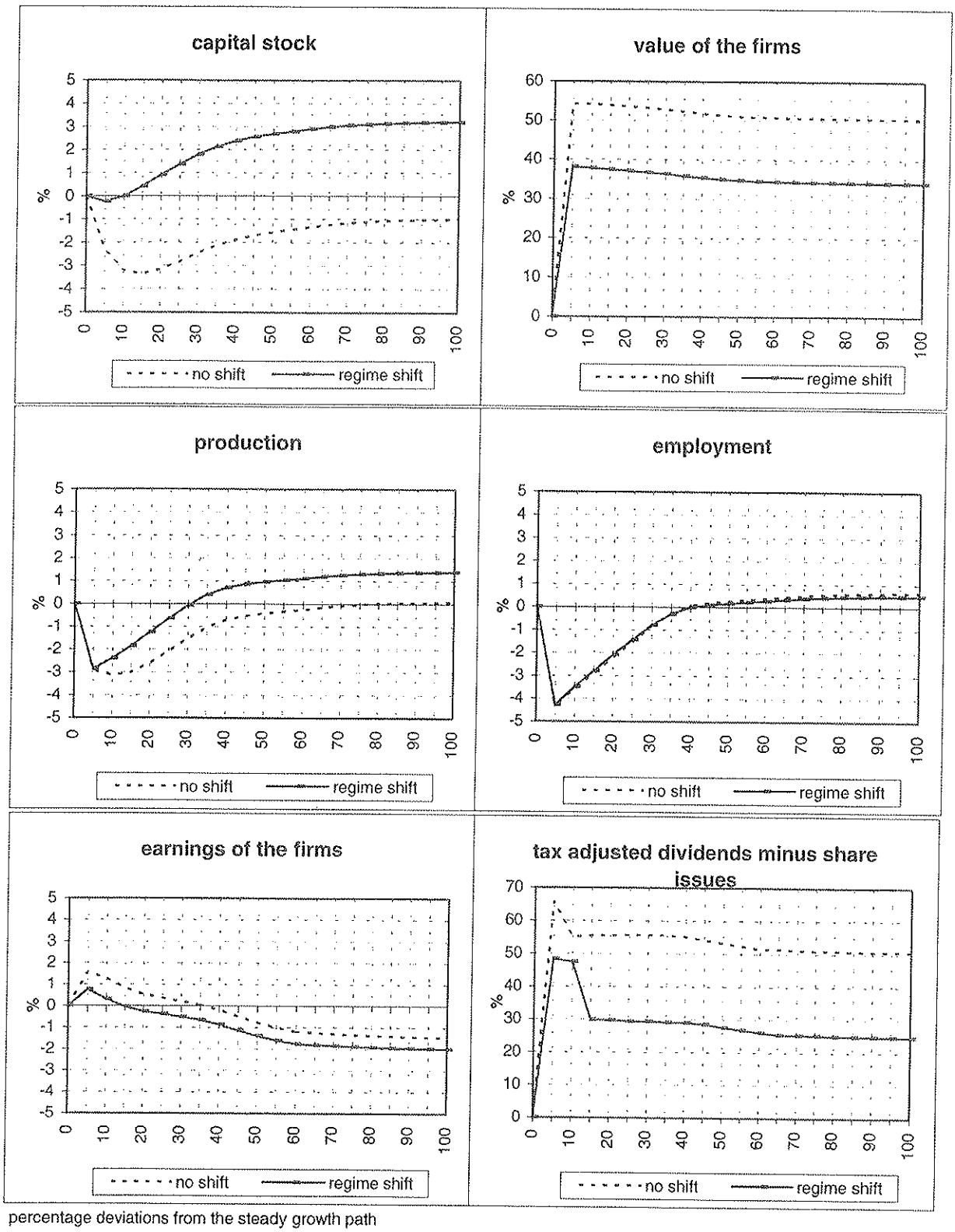
The permanent increase in the investment demand, the initial large jump in consumption and fall in production generates excess demand for both the domestic and the foreign good, which leads to an increase in imports and to a deep fall of exports. The induced deficit in the foreign trade prompts a considerable rise in the net foreign debt.

When the households have adjusted to the imbalance of current and optimal wealth, the consumption boom weakens and the labour supply revives. The large fall in after-tax capital incomes forces households to increase the labour supply above the initial level. A fall in the price of the domestic good spurs a decline in wages even though the capital stock increases.

[1] The simulation results are presented in the charts on pages 15 and 16. The variables are expressed as relative deviations from the balanced growth path. The results of the simulation with the regime shift are presented with solid lines.

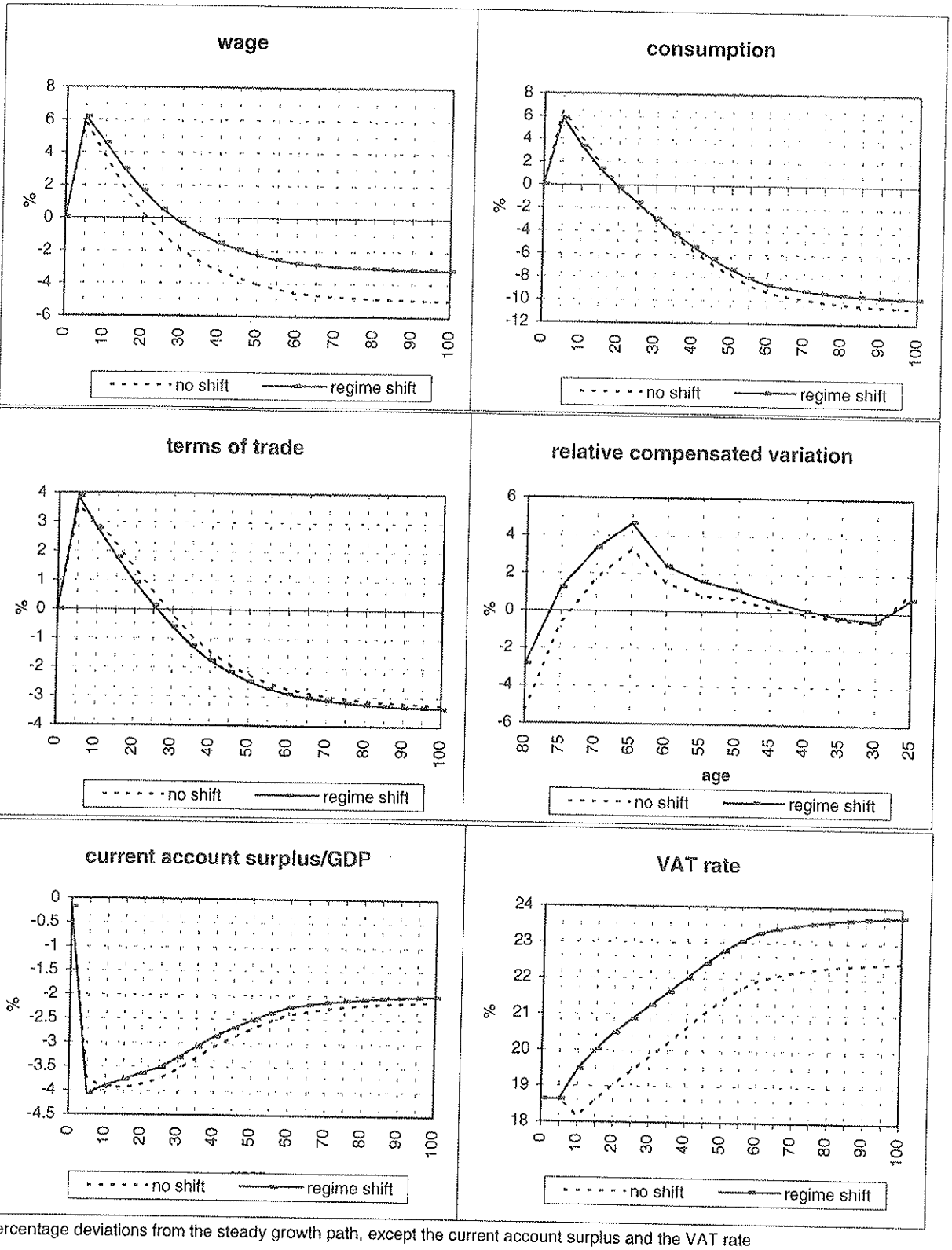
[2] The model misses the effect of unrealised capital gains, which would lower the currently living shareholders' welfare.

EFFECTS OF THE TAX REFORM



percentage deviations from the steady growth path

EFFECTS OF THE TAX REFORM



percentage deviations from the steady growth path, except the current account surplus and the VAT rate

The tax revenues jump in the first period due to the capital gains taxation, which leads to a large fall in the public debt. Later, although the interest expenditures and public sector labour costs are smaller, the decrease in tax bases via the fall in the value of consumption, total wages and household wealth leads to a considerable hike in the value added tax rate to balance the government budget. Therefore the real wages fall even more. Also the purchasing power of pension incomes diminishes.

The dominating short-term welfare effects come, however, via revaluation of the household wealth. It has been assumed that the firms' shares are distributed evenly to the households, but because of the hump-shaped lifetime wealth profile the ownership of bonds differs markedly among generations. Reduction of the dividend taxation gives a large windfall gain to shareholders. The hike in the interest income tax rate reduces, however, the net yield of the bonds providing an even larger welfare loss to the middle-aged generations, who own most of the them.

Those who are near the retirement age gain somewhat from the higher pensions, which are due to the initial jump in the wage rate and the pension wage determination rule. The young generations, who are net debtors, benefit from the deductibility of the interest expenditures. This effect is larger the higher is the growth rate, because with higher growth of future incomes every new generation borrows more in the first years of their active life. The future generations have to accept the low real wage, which reduces both their consumption of goods and leisure.

The utility measure in the chart on page 16 shows relative compensated variations by generations measured as $100*(\ln E_c - \ln E_s)$, where E denotes discounted lifetime consumption expenditure, s refers to the simulation run and c is the consumption necessary to achieve the baseline utility at simulation prices.

6.2 Is minimisation of the cost of capital an appropriate objective?

The base case simulations include both the tax reform and the regime shift. The regime shift was based on minimisation of the cost of capital and it seems to provide the desired results in terms of increasing the capital stock. One should, however, raise a question if this behaviour leads to maximisation of the value of the firms and utility of the households. The optimality of the policy has been checked by simulating the tax reform without the regime shift. The results of these simulations are presented with broken lines in the charts on pages 15 and 16.

The results show that even though the capital stock is lower, the value of the firms is higher, when the firms continue to follow the new view policy. The higher share value is based on the fact that the hike in the capital gains tax rate raises the required rate of return for the new capital financed with the retained earnings. Therefore the old capital is valued more[1]. This tax capitalisation is missing in the old view world, because the new capital units are financed with share issues, possibly together with debt. In our model the capital gains tax will affect the

[1] This result is also noted e.g. by Sinn (1987 ch. 10.6) in a closed economy model and by and Nielsen and Sörensen (1991) in an small open economy model. A similar effect has been noted by Goulder and Thalmann (1990) in a case of the U.S. Tax Reform Act 1986. The reform lowered corporate tax rate and removed investment tax credit thereby lowering the tax burden of old capital and rising the tax burden of investments.

valuation of the marginal capital unit somewhat also in the old view case via the investment adjustment costs, but the overall conclusion is still valid.

The utility comparison is also very interesting. The higher jump in the value of the firms lowers the loss of utility for the currently living generations in the new view case. The future generations suffer, however, more because of the lower capital stock. Is the regime shift in this case really carried out? It seems that the majority of existing shareholders would vote against the regime shift and the future owners are not there to vote[1].

7. Summary and conclusions

Finnish tax corporate taxation has been radically changed during the last ten years. The reform included transformation to a dual income tax system, an implementation of markedly lower, flat, equal statutory tax rates and a wider tax base. Even though the statutory tax rates were high before the reform, the large amount of exemptions, allowances and deductions reduced the effective average and marginal rates radically. Therefore eliminating the tax concessions and roughly halving the statutory rates actually increased the taxation of capital gains and interest incomes significantly. Also the effective corporate tax rate rose somewhat. Only the effective dividend tax rate was reduced to zero because of the adoption of the full imputation system. Now the capital gains are markedly more heavily taxed than dividends, which is not in line with the circumstances where the leading theories of corporate taxation have been created.

When corporate and capital income tax reforms are studied, the relevant theory describing investment finance and dividend distribution decisions must be chosen. This choice is very important because it affects the results profoundly, but it is seldom justified properly in the literature. Our solution is to use minimisation of the cost of capital from the point of view of corporate taxation as a criterion for the optimal financial policy. As is well known, this criterion do not sufficiently restrict the possible choices in a perfect foresight world. The other assumptions used are that use of debt is restricted to a fixed ratio to the capital stock and that profit distribution is based on actual income.

The cost of capital minimisation approach supports investment finance with retained earnings and debt before the tax reform. After the reform dividends should be maximised and the investments should be financed with debt and share issues. The tax reform is therefore modelled both as changes in tax rates and as a shift in the firms' investment financing and profit distribution rules.[2]

[1] This conclusion is even more likely if internal financing is preferred for non-tax reasons, e.g. if external financing is more expensive because of transaction costs or because of the asymmetric information between the insiders of the firm and the outside investors, see Myers and Majluf (1984). See also Lassila and Valkonen (1995) for detailed analysis of majority voting in computable OLG models.

[2] Limiting the analysis to the changes in marginal tax rates (which are assumed also to be the average rates), to the following financial policy shifts and to induced general equilibrium effects is not totally fair to the planners of the tax reform, because there were other elements in the reform which simplified the tax rules, reduced the distortions of taxation and limited the incentives and possibilities to avoid taxes. Taking into account uncertainty could give further results, e.g. a rise in the capital gains tax rate mitigates the risks associated with variation of the value of the firms.

The shift together with the changes in tax rates lower markedly the firms' cost of capital.[1]

Implementing both the tax changes and the policy shift to a dynamic open economy general equilibrium model gives rich results because of the induced changes in saving, labour supply and the terms of trade. The investment adjustment costs and the restricted planning horizon of the households are essential determinants for the magnitude of the short term results. The largest reaction is caused by the generated difference between current and optimal household wealth: the fall in the dividend tax rate and the rise in the capital gains tax rate increase the value of the firms, but the lower after-tax return on the future financial investments reduces markedly the optimal amount of saving. The induced consumption boom leaves markedly higher foreign net debt and taxes, lower wages and weaker terms of trade to the future generations. Also most of the currently living generations suffer a welfare loss: the rise in the value of the firms does not cover the loss created by the interest income taxation to the existing bondholders.

The financial policy shift does indeed increase the optimal capital stock. But it leaves out the tax capitalisation effect, which would have raised the firms' value further if the previous policy had been continued. Comparing the welfare effects of the tax reform under the two regimes reveal that a majority of the current shareholders actually gain from not changing the financial strategy. For the future generations this choice would, however, provide lower welfare mainly due to two factors. The first is that the tax capitalisation presents a transfer from future generations to the current ones because the future shareholders do not benefit from the jump in share prices but have to meet the higher tax burden. The second is that the regime shift would provide a smaller drop in wages due to the higher capital stock.

What is the final evaluation of the modelled tax reform? The justification is weakest, if the firms continue to prefer retained earnings as marginal sources of investment finance. In this case there is a windfall gain to the current shareholders and no positive effect via higher capital stock, just as predicted by the new view literature. If the firms shift to share issue financing in the margin, capital stock rise as suggested by the old view. The negative general equilibrium effects are also mitigated somewhat. The overall conclusion nevertheless remain unchanged: the moderate welfare gains of the few current generations do not justify causing such utility losses to future generations.

How sensitive are these results to the structure and parametrisation of the model? The model structure as well as the chosen parameter values are fairly standard. One aspect that has been studied more closely is the substitutability of domestic and foreign goods and financial capital[2]. As could be expected the induced foreign imbalance remains smaller if the substitutability decreases, but the domestic reactions will be larger. On the other hand, in the extreme case of a small open economy in which foreign investors determine the required rate of return on the firm's shares, the effects of domestic capital income taxation on the investment decisions would have been small.

[1] Various phases of the Finnish corporate and capital income tax reform have been studied earlier. These studies generally agree with us about the effects of the tax reform to the cost of capital. See studies with the King-Fullerton-method by e.g. Hakola (1993), Koskenkylä (1993), Myhrman et al. (1995) and Tähtinen (1992) and with partial equilibrium models by Kanniainen (1991), Kanniainen and Hernesniemi (1994), Piekkola (1995) and Voipio (1991). Ylä-Liedenpohja (1988) and Heinonen and Ylä-Liedenpohja (1992) have simulated the effects with a static general equilibrium model.

[2] Valkonen (1996).

Literature

Armington, P.S. (1969): The Theory of Demand for Products Distinguished by Place of Production. *IMF Staff Papers* 16, pp 159-176.

Auerbach, A.J. and L.J. Kotlikoff (1987): *Dynamic Fiscal Policy*. Cambridge University Press. Cambridge.

Broer, D.P. and E.W.M.T. Westerhout (1993): Taxation in an Intertemporal General Equilibrium Model of a Small Open Economy. *Economic Modelling*, Vol. 10, pp 64-80.

Frederiksen, N.K. (1994): A Dynamic General Equilibrium Simulation Model for Fiscal Policy Analysis. Economic Studies No 1/1994. Economic Policy Research Unit, Copenhagen Business School.

Fullerton, D: and J.M. Mackie (1989): Economic Efficiency in Recent Tax Reform History: Policy Reversals or Consistent Improvements? *National Tax Journal*, Vol. 42, pp 1-13.

Goulder, L.H. and L.H.Summers (1989): Tax Policy, Asset Prices and Growth; A General Equilibrium Analysis. *Journal of Public Economics*, Vol. 38, pp 265-296.

Goulder, L.H. and B. Eichengreen (1989): Savings Promotion, Investment Promotion and International Competitiveness. In *Trade Policies for International Competitiveness*, ed. R. Feenstra. Chicago University Press. Chicago.

Goulder, L.H. and P. Thalmann (1990): Approaches to Efficient Capital Taxation: Leveling the Playing Field vs. Living by the Golden Rule. NBER Working Paper No. 3559.

Hakola, R. (1993): Pääoma- ja yritysverouudistuksen vaikutukset teollisuuden rahoitusrakenteeseen. Bank of Finland Discussion Papers 2/93.

Hansen, S. (1994): A Test of the Pecking Order Theory of Capital Structure; The Case of Finnish Firms. Meddelanden från ekonomisk-statsvetenskapliga fakulteten vid Åbo Akademi, Nationalekonomiska institutionen. Ser. A:417.

Hasselman, B.H. (1991): Investment, Q and Financing. Research Memorandum No. 77, Central Planning Bureau, The Hague.

Hayashi, F. (1982): Tobin's Marginal q and Average q: A Neoclassical Interpretation. *Econometrica*, Vol. 40, pp 213-224.

Head, J.G. (1997): Company Tax Structure and Company Tax Incidence. *International Tax and Public Finance*, No 1, pp 61-100.

Heinonen, A. and J. Ylä-Liedenpohja (1992): General Equilibrium Calculations on a Tax Reform under International Capital Flows. *Liiketaloudellinen Aikakauskirja*, No. 2, pp 3-12.

Hutton, J.P. and T. Kenc (1995): Tax Policy, Corporate Financial Structure and Growth: A Dynamic General Equilibrium Analysis. Paper presented at the 6th CGE Modeling Conference in Waterloo, October 26-28, 1995.

Jensen, S.E.H., S.B. Nielsen, L.H. Pedersen and P.S. Sörensen (1993): Tax Reform, Welfare and Intergenerational Redistribution. Paper presented at the Congress of European Economic Association in Helsinki, August 27-29, 1993.

Kanniainen, V. (1991): Yhtiöveron hyvitysjärjestelmään siirtyminen Suomessa. The Research Institute of the Finnish Economy. B 73. Helsinki.

Kanniainen, V. and H. Hernesniemi (1994): The Effects of the 1993 Finnish Tax Reform on the Stock Prices in the Helsinki Stock Exchange (in Finnish). *Liiketaloudellinen aikakauskirja*, No. 1, pp 69-81.

Keuschnigg, C. (1991): The Transition to a Cash Flow Income Tax. *Swiss Journal of Economics and Statistics*, Vol. 127, pp 113-140.

Keuschnigg, C. and W. Kohler (1994): Modeling Intertemporal General Equilibrium: An Application to Austrian Commercial Policy. *Empirical Economics*, Vol. 19, pp 131-164.

Koskenkylä (1992): Pääomatulojen verouudistus jatkuu: ehdotettu rakenne oikeansuuntainen, mutta taso väärä. *Liiketaloudellinen Aikakauskirja*, No. 2, pp 130-141.

Lassila, J., H. Palm and T. Valkonen (1997): Pension Policies and International Capital Mobility. In Broer, D.P. and Lassila, J. (eds) *Pension Policies and Public Debt in Dynamic CGE Models*. Physiga-Verlag. Heidelberg.

Lassila, J. and T. Valkonen (1995): Policy Credibility in Numerical Overlapping Generations Models. Paper presented at the 51st Congress of International Institute of Public Finance, Lisboa, August 21-24.

Ministry of Finance (1991): Pääomatulojen verotuksen ja yritysverotuksen kehittämislinjat. Valtionvarainministeriön työryhmämuistioita 1991:28. Helsinki.

Myers S.C. and N.S. Majluf (1984): Corporate Financing and Investment Decisions when Firms have Information that Investors do not have. *Journal of Financial Economics*, Vol. 13, pp 187-221.

Myhrman, R., O. Kröger, T. Rauhanen, T. Junka, S. Kari and H. Koskenkylä (1995): *Finnish Corporate Tax Reforms*. VATT-Publications No 20. Government Institute for Economic Research. Helsinki.

Nielsen, S.B. and P.B. Sörensen (1991): Capital Income Taxation in a Growing Open Economy. *European Economic Review*, Vol. 14, pp. 179-197.

Offerdahl, E. (1991): Tax Reform, Capital Allocation and Welfare Gains in Norway. In Don, H., van den Klundert, T. and van Sinderen, J. (eds.) *Applied General Equilibrium Modelling*. Kluwer Academic Publishers.

Pereira, A.M. and J.B. Shoven (1988): Survey of Dynamic Computational General Equilibrium Models for Tax Policy Evaluation. *Journal of Policy Modeling*, 10(3), pp 401-346.

Perraudin, W.R.M. and T. Pujol (1991): European Fiscal Harmonization and the French Economy. IMF Staff Papers, Vol. 38, pp. 399-440.

Piekkola, H. (1995): Foreign Investment, International Mergers and the 1993 Capital Income Tax Reform in Finland. *Finnish Economic Papers*, Vol. 8, pp 25-39.

Poterba J.M. and L.H. Summers (1983): Dividend Taxes, Corporate Investment and 'Q'. *Journal of Public Economics*. Vol. 22, pp 135-167.

Sinn, H-W (1987): *Capital Income Taxation and Resource Allocation*. North Holland, Amsterdam.

Sinn, H-W (1990): Taxation and the Cost of Capital: the "Old" View, the "New" View, and Another View. NBER Working Paper No. 3501.

Sorjonen, P. (1988): The Relative Valuation of Dividends and Capital Gains in Finland. *Finnish Economic Papers*, Vol. 1, pp 105-116.

Statistics of income and property 1987. Income and consumption 1989:4. Central Statistical Office of Finland. Helsinki 1989.

Summers, L.H. (1981a): Taxation and Corporate Investment: A q-theory approach. *Brookings Papers on Economic Activity*, Jan., pp 67-127.

Summers, L.H. (1981b): Capital Taxation and Accumulation in a Life Cycle Growth Model. *The American Economic Review*, Vol. 71, pp 533-544.

Söderlind, P. (1990): The Swedish Tax Reform from an Intertemporal Perspective. Institute for International Economic Studies. Seminar paper No. 465, Stockholm University.

Sörensen, P.B. (1994): Some Old and New Issues in the Theory of Corporate Income Taxation. Economic Studies No 2/1994. Economic Policy Research Unit, Copenhagen Business School.

Tähtinen, T. (1992): Uudistumassa oleva pääomatulojen verotus muuttaa huomattavsti yrityksen rahoituskustannuksia ja investointien tuottovaatimuksia. Bank of Finland Discussion Papers 33/92.

Valkonen, T. (1996): Intergenerational and Macroeconomic Effects of a Corporate and Capital Income Tax Reform in an Open Economy: the Case of Finland. Paper presented at the 52nd Congress of International Institute of Public Finance, Tel Aviv, August 26-29.

Voipio, I. (1991): Kokonaisverouudistuksen vaikutukset osakeyhtiön jakaman voiton verotukseen Suomessa. Government Institute For Economic Research Discussion Papers, No. 10.

Ylä-Liedenpohja, J. (1987): Taxing Real Investment. Working Paper of the Helsinki School of Economics, No. F-166.

Ylä-Liedenpohja, J. (1988): Laskelmia korkojen verotuskohtelun muuttamisesta. *Liiketaloudellinen Aikakauskirja*, No 2, pp 65-95.

Zodrow, G. E. (1991): On the "Traditional" and "New" Views of Dividend Taxation. *National Tax Journal*, Vol. 44, pp 497-509.

Appendix 1: The Model

Household behaviour

Households maximise the utility from consumption and leisure in different periods, and a bequest they give. The lifecycle plan is the solution to the following problem.

$$\text{(A 1)} \qquad \max_{c,l,B} \quad \sum_{t=1}^{T} \frac{1}{1-\frac{1}{\gamma}} \frac{U_t^{1-\frac{1}{\gamma}}}{(1+\delta)^{t-1}} + \mu \frac{[B(1-\tau^B)]^{1-\frac{1}{\gamma}}}{(1+\delta)^{T-1}}$$

subject to budget constraint:

$$\text{(A 2)} \qquad \begin{aligned} &\sum_{t=1}^{T_w}(1-l_t)e_t w_t(1-\tau_t^w-\tau_t^e)R_t + \sum_{t=T_w+1}^{T} Z_t(1-\tau_t^w)R_t + R_7 B_7(1-\tau_t^B) \\ &= \sum_{t=1}^{T} c_t p_t^C(1+\tau_t^C) - R_T B_T \end{aligned}$$

and subject also to the determination of pensions Z. U_t is the periodic utility:

$$\text{(A 3)} \qquad U_t = (c_t^{1-\frac{1}{\rho}} + \alpha l_t^{1-\frac{1}{\rho}})^{\frac{1}{1-\frac{1}{\rho}}}$$

and R_t is the discount factor:

$$\text{(A 4)} \qquad R_t = 1 \qquad t = 1$$

$$R_t = \prod_{s=1}^{t-1} \frac{1}{1+r_s^d(1-\tau_{s+1}^r)} \qquad t = 2..T$$

c_t is consumption, p_t^C its price, l_t is leisure, and of the constant parameters γ is the elasticity of intertemporal substitution, δ is the rate of time preference and ρ is the elasticity of substitution between consumption and leisure. The model includes a bequest motive. The households receive a net bequest $B(1-\tau^B)$ at the age of 55 (period 7) and give a bequest B_T before dying. The number of periods T is 12: the unit period is five years. A life-cycle plan is made at the age of 20, people retire at 60 and live until 80. There is also a possibility of liquidity constraints on households, but this option is not used in this study.

The pension system relates pensions to earnings during working years. The normal pension is the share θ of a pension wage, which depends on the wage levels both during the persons' working years and pension years. The share θ depends on the number of working years but is here held constant. Let the normal working time be:

$$\text{(A 5)} \qquad 1 - l^p = \frac{1}{T_w}\sum_{t=1}^{T_w}(1-l_t)$$

and the pension wage:

$$\text{(A 6)} \qquad w^p = \frac{\sum_{t=1}^{T_w} \Phi_t(1-l_t)e_t w_t}{1-l^p} \quad \text{where} \quad \sum_{t=1}^{T_w} \Phi_t = 1$$

The pension Z in period t is now:

(A 7) $$Z_t = \theta(1 - l^p)(w^p)^{\psi}(w_t)^{1-\psi} \quad \text{where} \quad 0 \le \psi \le 1$$

The weights Φ determine the pension rights averaging period. If the worker stays in one firm, the averaging period consists of the last four years, which roughly would mean that Φ_8 is equal to unity and all other weights are zeros. In practise, due to moves between firms and also to some technical reasons all coefficients are positive, but Φ_8 is the largest. The number of working periods T_w is 8 in the baseline scenarios. The term e_t describes work efficiency, which varies with age. It makes the life-cycle wage-income profile hump-shaped. Parameter ψ describes pension indexing: $\psi = 0$ means that pensions are fully indexed to current wages.

The budget constraint says that discounted lifetime wage and pension income equals discounted consumption expenditure. Households start with no wealth and leave no wealth upon death. The terms τ^w, τ^C and τ^r are tax parameters and τ^e is the employees' pension contribution rate. The actual equations of the model are the first-order conditions derived from the optimisation problem.

The household sector consists of 12 households, of different age, in each period. Total consumption, labour supply, pensions received and taxes paid are aggregated from individual household decisions.

Firms

A representative small firm produces the domestic good using capital inherited from the previous period, intermediate goods and labour. Infinite horizon decisions of investment and employment are made to maximise the firm's market value. The firm takes the prices, demand for production and supply of factors at given prices, production technology and taxation as given. Intermediate and capital goods are costs minimising CES composites of domestic and imported goods.

Gross production is a combination of value added F_t, net of investment adjustment costs G_t and the composite intermediate good in fixed proportions:

(A 8) $$Y_t = \frac{F_t - G_t}{1-\zeta}$$

The production function F is a standard CES function of capital and labour:

(A 9) $$F_t = A\left[\varepsilon K_{t-1}^{1/(1-\beta)} + (1-\varepsilon)(\nu' L_t^F)^{1/(1-\beta)}\right]^{\frac{\beta}{\beta-1}}$$

where ν is the rate of productivity growth of labour. In the process of installing new capital some of the production is lost as investment adjustment costs. These quadratic installation costs depend positively on the investments and negatively on the amount of capital.

(A 10) $$G(I_t, K_{t-1}) = \xi \frac{I_t^2}{K_{t-1}}$$

The firm maximises the current period after-tax dividend and the firm's value at the end of the period. If there are no unexpected shocks, there is no need to revise the optimal plan and it will be followed forever. Capital depreciates at a constant annual rate of d. The constraints of the maximisation are the initial capital stock and an equation describing its dynamics. More detailed description for the maximisation problem can be found on pages 10-12.

Three of the four first order conditions of the constrained optimisation are used as model equations. The first implies that investments should be carried out until the marginal benefit from an additional unit of investment is as large as the marginal cost, adjusted for the effects of financial policy. The marginal cost includes the price of a unit of capital plus the installation cost. The condition can be transformed to a q-theory investment equation, which in the new view case can be written as:

(A 11)
$$I_t = \frac{\left(\frac{\lambda_t}{p_t^K}\frac{1-\tau_t^D}{1-\tau_t^g}\right)K_{t-1}}{\frac{1-\tau_t^D}{1-\tau_t^g}(1-\tau_t^F)\xi_t p_t^F}$$

In the old view case the equation is:

(A 12)
$$I_t = \frac{\left(\frac{\lambda_t}{p_t^K}-1\right)K_{t-1}}{(1+\frac{1-\tau_t^D}{1-\tau_t^g}a-a)(1-\tau_t^F)\xi_t p_t^F}$$

The optimality condition of capital says that capital should be installed until the after-tax return of an additional unit is large enough to cover the expenses of carrying the capital to the next period. These expenses include interest, depreciation and the change in the replacement price of capital. This condition is transformed to an equation describing the path of the shadow value of the capital. In the new view case it is:

(A 13)
$$\lambda_t = \left\{\frac{1-\tau_{t+1}^D}{1-\tau_{t+1}^g}\left[(1-\tau_{t+1}^F)(p_{t+1}^F(F_{K_t}-G_{K_t})-r_t^d b p_t^K)-bp_t^K+\tau_{t+1}^F dp_t^K\right]\right.$$
$$\left.+\frac{1-\tau_t^D}{1-\tau_t^g}bp_t^K(1+r_t^d\frac{1-\tau_{t+1}^r}{1-\tau_{t+1}^g})+\lambda_{t+1}(1-d)\right\}\left(1+r_t^d\frac{1-\tau_{t+1}^r}{1-\tau_{t+1}^g}\right)^{-1}$$

and in the old view case:

$$\lambda_t = \left\{\left[1-a+\frac{1-\tau_{t+1}^D}{1-\tau_{t+1}^g}a\right]\left[(1-\tau_{t+1}^F)(p_{t+1}^F(F_{K_t}-G_{K_t})-p_t^K(r_t^d b+d))\right]\right.$$

(A 14)
$$\left.+p_t^K(d-b)+bp_t^K(1+r_t^d\frac{1-\tau_{t+1}^r}{1-\tau_{t+1}^g})+\lambda_{t+1}(1-d)\right\}\left(1+r_t^d\frac{1-\tau_{t+1}^r}{1-\tau_{t+1}^g}\right)^{-1}$$

The third condition says that the marginal benefit of an extra unit of labour should cover wage costs plus the employer's social security contribution:

(A 15) $$p_t^F F_L = (1+\tau_t^l)w_t$$

The fourth condition is a transversality condition ensuring that the discounted shadow value of capital goes to zero as time approaches infinity.

The market value of the firm is linked to the shadow value of the capital in the leveraged firm in the new view case as follows:

(A 16) $$V_t = K_t q_t - \frac{1-\tau_t^D}{1-\tau_t^g} B_t^F$$

where B_t^F is the firm's debt. In the old view case the corresponding equation is:

(A 17) $$V_t = K_t q_t - B_t^F$$

The value of the firm jumps whenever unexpected news about the firm's future profitability comes to the market. Households are the sole owners of the firms and changes in their wealth changes life-cycle plans immediately.

Pension institute

Pensions are financed with contributions collected both from workers and employers and with capital incomes from a pension fund . The employers' contribution rate is endogenous and balances the budget each period. The ratio of the value of the pension fund to the value of the domestic product is determined to be constant in the steady growth path.

Government sector

The government collects various taxes and uses the proceeds to pay interest on outstanding debt and to employ civil servants to produce public services. These services are provided free of charge and are not taken into account in individual utility considerations.

The model includes many possibilities to balance revenues and expenditures of the government every period. An endogenous value added tax rate is used most often, because it induces little changes in the intergenerational incidence of taxation. From the expenditure side it is possible to endogenise the number of government employees. There is also a possibility to let the government run a temporary deficit or a surplus in the budget. The ratio of public debt to the value of the gross domestic product is determined to be constant in the steady growth path.

Foreign sector

The model imitates a small open economy, where the export share of the total demand is large. The amount exported depends on the growth rate of the export markets and the price elasticity of the foreign demand:

(A 18) $$X_t = x_t \nu^t \left(\frac{p_t^d}{p_t^m} \right)^{\sigma^X}$$

A large negative value for the elasticity implies that a small country has to adjust to the price level of international markets. The export markets are assumed to grow at the same rate ν as the domestic productivity of labour.

The imported good is used in consumption, investments and as an intermediate good in production. Its price is determined in the international markets. It is an imperfect substitute for the home-made good. The demand conditions are described with a CES structure.

The supply of foreign capital depends on the domestic interest rate. A fall of the foreign net assets below the initial level lifts the domestic rate above international rates.

(A 19) $$r_t^d = r_t^f - \frac{A_t^f - A_0^f}{\varpi}$$

The extreme values of the parameter ϖ allows, on the one hand, for perfect capital mobility and, on the other, for a financially closed economy. The ratio of the value of the net foreign assets to the value of the domestic product is determined to be constant in the steady growth path.

Markets

The model includes four markets, which balance every period. In the labour markets the firms demand labour following the marginal productivity of labour rule. Households' aggregate labour supply is divided between public and private employment. The wage rate is determined as equating supply and demand in the labour markets:

(A 20) $$L_t = L_t^G + L_t^F$$

In the markets of the domestic good the firms are the sole supplier. The product is used by other firms as a part of the composite intermediate and investment goods, by households as a part of the composite consumption good and by foreign agents. The demand of the domestic agents and the prices of the composite goods are determined by a cost minimising procedure. The following describes as an example the procedure in the case of the consumption good (see e.g. Keuschnigg and Kohler 1994).

Minimising the unit cost (price) of an composite good:

(A 21) $$p_t^C = \min_{c_t^d, c_t^m} \left\{ p_t^d c_t^d + p_t^m c_t^m \right\}$$

subject to a CES-form substitutability restriction:

$$\text{(A 22)} \qquad \left[\upsilon^C (c_t^d)^{(1-\frac{1}{\sigma^C})} + (1-\upsilon^C)(c_t^m)^{(1-\frac{1}{\sigma^C})} \right]^{\frac{\sigma^C}{(\sigma^C-1)}} = 1$$

leads to the optimal unit cost (price) of the composite good:

$$\text{(A 23)} \qquad p_t^C = \left[(\upsilon^C)^{\sigma^C} (p_t^m)^{1-\sigma^C} + (1-\upsilon^C)^{\sigma^C} (p_t^d)^{1-\sigma^C} \right]^{1/(1-\sigma^C)}$$

Demand for the domestic good per unit of the composite consumption good c_t^d is calculated by differentiating the unit cost function with respect to the price of the domestic good:

$$\text{(A 24)} \qquad c_t^d = \left[\frac{\upsilon^C p_t^C}{p_t^d} \right]^{\sigma^C}$$

The aggregate demand of the domestic good for consumption is respectively $C_t c_t^d$.

The export demand conditions are explained above. The equilibrium condition which determines the price of the domestic good is thus:

$$\text{(A 25)} \qquad Y_t = \zeta Y_t v_t^d + C_t c_t^d + I_t i_t^d + X_t$$

The domestic demand of the fixed-price imported good is also determined by minimising costs of the composite goods. The perfectly elastic supply adjusts to demand in these markets:

$$\text{(A 26)} \qquad m_t = \zeta Y_t v_t^m + C_t c_t^m + I_t i_t^m$$

The price of the imported good serves as a numeraire in the model.

The fourth markets are the capital markets. In these markets savings and investment are balanced. The arbitrage condition of domestic households ensures that they are ex ante indifferent between investing their savings in bonds and in firms' shares. The foreign agents are restricted to participate only in the bond markets. Total savings are a sum of domestic savings and foreign portfolio investments. The domestic interest rate r^d balances the markets.

The parallel stock equilibrium can be written as:

$$\text{(A 27)} \qquad W_t + H_t = V_t + B_t^F + B_t^G + A_t^f$$

where W_t is the household wealth, H_t is the value of the pension fund assets, V_t is the market value of the firm, B_t^F is the firms' debt, B_t^G is the public debt and A_t^f is the net foreign assets of the country.

Appendix 2 List of model variables and parameters

Variables

	FIRMS
K	capital stock of the firms
Y	gross production of the domestic good
G	installation costs
F	value added
p^F	price of the value added
V	value of the firms
D	dividends
B^F	firms' debt
I	investments
E^A	earnings
V^N	share issues
λ	shadow value of the capital
	PRODUCT MARKETS
i^d	demand of the domestic good in investment use
i^m	demand of the imported good in investment use
p^K	price of the composite investment good
c^d	demand of the domestic good in consumption use
c^m	demand of the imported good in consumption use
p^C	price of the composite consumption good
v^d	demand of the domestic good in intermediate use
v^m	demand of the imported good in intermediate use
p^v	price of the composite intermediate good
p^d	price of the domestic good
p^m	price of the imported good
	FOREIGN TRADE AND INTEREST RATE
X	exports
m	imports
A^f	net foreign assets
r^d	domestic interest rate (yearly)
	LABOUR MARKETS
L^F	private employment
L^G	public employment
L	aggregate labour supply
w	wage rate

	HOUSEHOLDS
c	consumption of one household
C	aggregate consumption
l	leisure of one household
U	utility of one household
W	aggregate household wealth
B	bequest
	PENSION SYSTEM
τ^i	employer's pension contribution
l^p	average leisure
w^p	pension wage
Z	pension
H	value of the pension fund's assets
	GOVERNMENT
B^g	public debt
τ^C	value added tax

Parameters

personal income tax	τ^w	0.3
dividend income tax	τ^D	0
interest income tax	τ^r	0.28
capital gains tax	τ^g	0.28
corporate income tax	τ^F	0.28
bequest tax	τ^B	0.1
employee's pension contribution	τ^e	0.05
depreciation rate (yearly)	d	0.09
installation cost parameter	ξ	2
share of the value of firms' capital financed by debt	b	0.6
share parameter of dividend policy	a	1
input-output coefficient for the composite intermediate good input	ζ	0.1
labour share parameter of the value added production fuction	ε	0.2
elasticity of substitution between labour and capital	β	0.7
growth rate of labour productivity (yearly)	ν	0.015
scale parameter for value added	A	2
share parameter of domestic good for consumption	υ^C	0.7

share parameter of domestic good for investment	υ^K	0.7
share parameter of domestic good for intermediate use	υ^v	0.7
elasticity of substitution between imported and domestic good in consumption	σ^C	0.99
elasticity of substitution between imported and domestic good in investment	σ^K	0.99
elasticity of substitution between imported and domestic good in intermediate use	σ^v	0.99
scale parameter of export demand	x	0.6
price elasticity of export demand	σ^X	-4
foreign interest rate (yearly)	r^f	0.05
sensitivity parameter of capital movements	ϖ	3
elasticity of intertemporal substitution of consumption	γ	0.5
elasticity of substitution between consumption and leisure	ρ	0.51
rate of time preference (yearly)	δ	0.015
leisure preference parameter	α	0.81
bequest preference parameter	μ	0.4
age-dependent working efficiency	e	0.5 - 1.3
share of full pension to pension wage	θ	0.6
pension indexing parameter	ψ	0.5

ELINKEINOELÄMÄN TUTKIMUSLAITOS (ETLA)
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
LÖNNROTINKATU 4 B, FIN-00120 HELSINKI

Puh./Tel. (09) 609 900
Int. 358-9-609 900
http://www.etla.fi

Telefax (09) 601753
Int. 358-9-601 753

KESKUSTELUAIHEITA - DISCUSSION PAPERS ISSN 0781-6847

No 567 VENLA SIPILÄ, Suomen ja Venäjän välinen kauppa 1986-1995. 06.09.1996. 100 s.

No 568 EUGEN KOEV, Palkkadiskriminaatio teollisuuden toimihenkilöillä. 11.09.1996. 73 s.

No 569 MARIANNE PAASI, The Inherited and Emerging Absorptive Capacities of Firms - Results of a firms survey in the Estonian electronics industry. 24.09.1996. 26 p.

No 570 TANJA KIRJAVAINEN - HEIKKI A. LOIKKANEN, Efficiency Differences of Finnish Senior Secondary Schools: An Application of Dea and Tobit-analysis. 02.10.1996. 40 p.

No 571 ATRO MÄKILÄ, Teknologian työllisyysvaikutukset - Katsaus kirjallisuuteen. 21.10.1996. 19 s.

No 572 HEIKKI HELLA, On Outliers in Time Series Data. 25.10.1996. 11 p.

No 573 NINA HAUHIO - REIJA LILJA, The Evolution of Gender Wage Differentials Over the Career. 03.12.1996. 18 p.

No 574 HEIDI HAILI, The Forward Exchange Rate as a Predictor of the Spot Exchange Rate, An Empirical Study. 03.12.1996. 88 p.

No 575 ERKKI KOSKELA - MARKKU OLLIKAINEN, Optimal Design of Forest Taxation with Multiple-use Characteristics of Forest Stands. 11.12.1996. 31 p.

No 576 MIKA PAJARINEN, On Possibilities to Construct a Model for Trade Flows and Factors of Production Movements between the EU and Eastern Europe. 30.12.1996. 25 p.

No 577 ERKKI KOSKELA - MARKKU OLLIKAINEN, Tax Incidence and Optimal Forest Taxation under Stochastic Demand. 07.01.1997. 29 p.

No 578 JUSSI RAUMOLIN, Trends in Logistics in Europe. 07.01.1997. 31 p.

No 579 JYRKI ALI-YRKKÖ - SARI SIRVIÖ - PEKKA YLÄ-ANTTILA, Ulkomaiset yritykset Suomessa - onnistuneita yritysostoja vai tehokkaampaa toimintaa? 13.01.1997. 23 s.

No 580 JULIANNA BORSOS-TORSTILA, Foreign Direct Investment and Technology Transfer. Results of a survey in selected branches in Estonia. 27.01.1997. 27 p.

No 581 PASI KUOPPAMÄKI, Joint Implementation and Climate Change: Rationality of joint implementation when energy markets are not well-functioning. 28.01.1997. 43 p.

No 582 THOMAS RIMMLER, Potentiaalisen tuotannon kehitys Suomen kansantaloudessa 1975-1998. 29.01.1997. 61 s.

No 583 KARI ALHO, The Effect of a Devaluation on Output Revisited. 30.01.1997. 15 p.

No 584 ANNICK LARUELLE - MIKA WIDGRÉN, The Development of the Division of Power between EU Commission, EU Council and European Parliament. 03.02.1997. 25 p.

No 585 TIMO KUOSMANEN, Productive Efficiency in the Forest Industry: An International Industry-level Study. 12.02.1997. 89 p.

No 586 REIJO MANKINEN, Hotelli- ja ravintola-alan kehitysnäkymät vuosina 1997-2000. 12.02.1997. 56 s.

No 587 MIKA ERKKILÄ, European Integration and Foreign Direct Investment: Finnish Foreign Direct Investment Flows in 1975-1994 with Emphasis on the Host Implications for EMU Membership. 26.02.1997. 27 p.

No 588 OLLI-PEKKA RUUSKANEN, Menetetyn ajan arvon huomioivat nettokorvausasteet ja kynnyspalkat. 03.03.1997. 24 s.

No 589 SYNNÖVE VUORI, Technology Spillovers and Their Effects - A Review. 03.03.1997. 26 p.

No 590 PEKKA LEHTONEN, Osaamispohjaisen yrityksen menestystie: Analyysi seitsemän suomalaisen yrityksen kehittymisestä oman alansa parhaimmistoon. 14.03.1997. 48 s.

No 591 KAI HUSSO, Investigating the Relationship between R&D and Productivity at the Firm-Level: Case Study of Finnish Manufacturing Industry. 25.03.1997. 48 p.

No 592 MIKA PAJARINEN, Immateriaaliset oikeudet ja niistä saatavan taloudellisen hyödyn jakaminen. 04.04.1997. 42 s.

No 593 PEKKA VISURI, Baltian maiden turvallisuuspoliittinen asema. 11.04.1997. 42 s.

No 594 TARMO VALKONEN, Corporate Taxation and Investment Finance in Finland: A General Equilibrium View. 23.04.1997. 32 p.

Elinkeinoelämän Tutkimuslaitoksen julkaisemat "Keskusteluaiheet" ovat raportteja alustavista tutkimustuloksista ja väliraportteja tekeillä olevista tutkimuksista. Tässä sarjassa julkaistuja monisteita on mahdollista ostaa Taloustieto Oy:stä kopiointi- ja toimituskuluja vastaavaan hintaan.
Papers in this series are reports on preliminary research results and on studies in progress. They are sold by Taloustieto Oy for a nominal fee covering copying and postage costs.

d:\ratapalo\DP-julk.sam/23.04.1997