Population Ageing and the Current Account in Selected OECD Countries

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Abstract

It is well known that over the next several decades, there will be significant changes in the age structure of OECD populations. According to recent demographic projections by the United Nations, the share of the old-aged population is expected to double, on average, over the next 50 years in the major industrialised countries. These demographic changes may have significant fiscal and economic consequences, and pose important public policy challenges for the countries involved.

In this paper, we extend the Hviding and Mérette (1998) computable overlapping-generation (OLG) models to a small economy framework to investigate the possible effects of population ageing on the current account of six OECD countries. The calibration of the new models is such that a direct comparison of our simulation results with those obtained under the original models is possible. The comparison allows a thorough investigation of the potentially role of foreign investment in alleviating the negative macroeconomic effects of ageing populations

Our results show that the globalisation of capital markets may reduce, to some extent, the negative effects of domestic population ageing for small open economies that age more rapidly than the rest of the world. In such a case, the international capital market is able to offer better returns to domestic savings than would otherwise occur in a closed-economy context.

Résumé

C’est un fait reconnu qu’au cours des prochaines décennies, les pays de l’OCDE feront face à d’importants changements démographiques. Selon les projections récentes des Nations Unies, la part des personnes âgées (65 ans et plus) sur l’ensemble de la population totale doublera au cours des 50 prochaines années, dans les pays industrialisés. Ces changements démographiques pourraient avoir des conséquences financières et économiques importantes, et mettent en lumière les défis que devront relever les politiques publiques des pays concernés.

Dans cet article, nous modifions le cadre d’analyse du modèle numérique de Hviding and Mérette (1998) à générations imbriquées pour examiner les effets possibles du vieillissement de la population sur le compte courant pour six pays de l’OCDE. Le calibrage des nouveaux modèles est tel qu’il permet une comparaison directe des résultats de simulations avec ceux obtenus par les modèles originaux. La comparaison nous permet d’évaluer le potentiel que pourrait jouer les investissements étrangers en tant que palliatif aux effets économiques négatifs du vieillissement des populations.

Nos résultats montrent que la globalisation des marchés des capitaux peut permettre de réduire quelque peu les effets néfastes du vieillissement de la population pour une petite économie ouverte qui vieillit plus rapidement que le reste du monde. Dans un tel cas, les marchés internationaux des capitaux sont capables d’offrir de meilleurs rendements à l’épargne domestique que dans le cas d’une économie fermée.

1. Introduction

It is well known that, as the baby-boom generation retires, OECD populations will age rapidly over the next several decades. According to recent demographic projections by the United Nations, the share of the old-aged population is expected to double, on average, in major industrialised countries over the next 50 years and the old-age dependency ratio (ratio of old-age to working-age population) to rise substantially. There is growing concern that these demographic changes will have significant macroeconomic effects and pose difficult fiscal policy challenges.

The potential economic impacts of population ageing have been examined in a number of papers. Some studies have used general equilibrium models with overlapping-generations (OLG) to investigate the effect of ageing on national savings[1]. The results from these studies suggest that population ageing will lead to a sharp reduction in national savings rates and in real output per capita over the next decades. Different ageing patterns across countries may also induce important international capital flow movements and hence affect current account balances. However, there has been very little analysis done so far on the effect of ageing on the current account.

[1] See for example Hviding and Mérette (1998), Miles (1996), Auerbach *et al*. (1989) and Auerbach and Kotlikoff (1987).

In this paper, we extend the Hviding and Mérette (1998) OLG models, that were built for an OECD study[2], to examine the impact of population ageing on the current account. To address this issue, we replace the models' closed-economy assumption with a small open economy assumption. The countries examined are Canada, France, Italy, Japan, Sweden, the United Kingdom and the United States. The extended versions are calibrated with exactly the same parameters as in the original models and, consequently, generate the same initial steady states. Thus, we are in a position to compare our results on economic variables to those obtained by Hviding and Mérette (1998) and hence, to investigate the role of foreign investment in alleviating the negative economic effects of ageing populations.

The models are populated by a series of 15 rational overlapping generations (each period in the model corresponding to 4 years), that optimally choose life patterns of consumption and bequest. The models are of a type similar to that developed by Auerbach and Kotlikoff (1987). To investigate the possible effects of population ageing on current accounts, we assume for convenience that interest rates movements are determined in the world market by the US economy. However, this exercise is only illustrative, since in reality movements in world capital markets are determined through interactions among countries.

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[2] The results of their work were first presented at the Working Party no. 1 on Macroeconomics and Structural Policy Analysis at the OECD, October 1997.

The remainder of this paper is divided as follows: Section 2 discusses the prospective demographic trends for the seven OECD countries and the impact on old-age dependency ratios. Section 3 describes the structure and calibration of the models used for the analysis. Section 4 briefly summarises the baseline simulation results from Hviding and Mérette (1998). Section 5 discusses the impact on current accounts. Finally, Section 6 provides some concluding remarks.

2. Ageing and Demographics

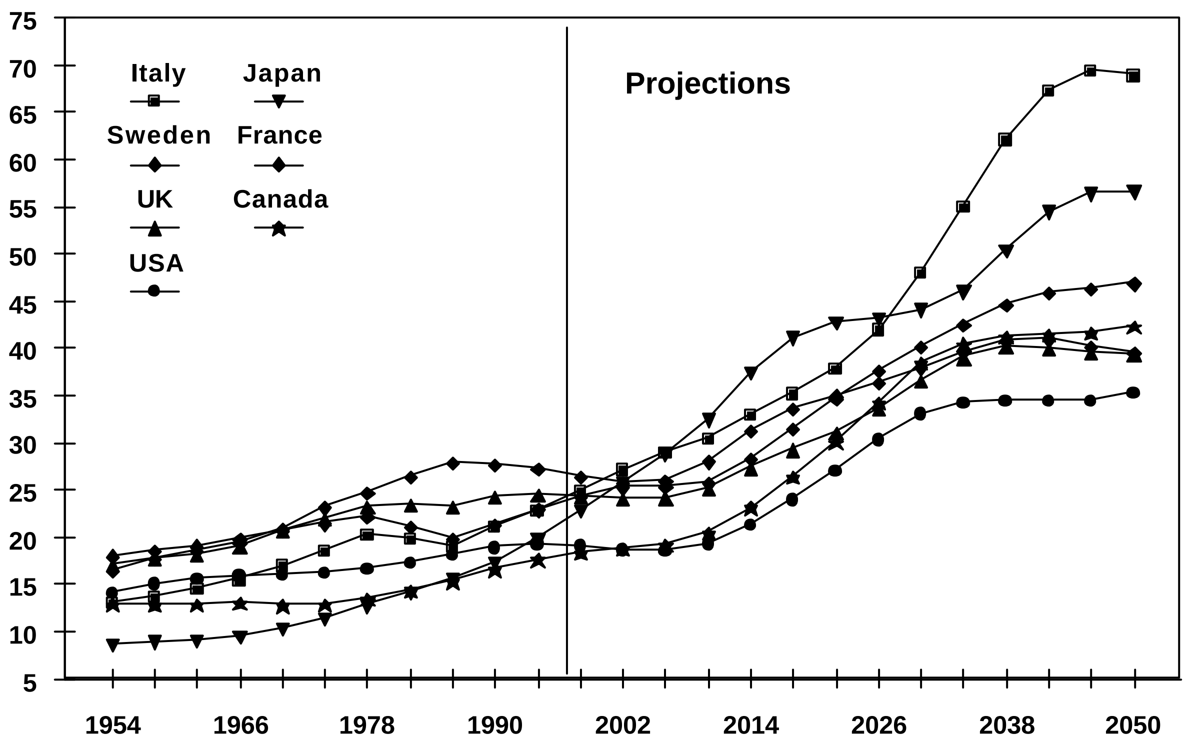
An increase in life expectancy or a drop in the fertility rate (the expected number of births over a woman's life span) are the two major reasons why average population age can increase. In most industrialised countries, a declining fertility rate is the principal source of ageing. In the case of Japan, however, increased life expectancy is also a relatively important factor. According to recent demographic projections by the United Nations, the proportion of the elderly is expected virtually to double over the next 50 years. Of the seven countries examined, Italy and Japan are projected to experience the largest increases in the proportion of old-aged people (see Table 1). Ageing is projected to be least dramatic in Sweden. Canada, France, the US, and the UK rank in the middle of the countries considered.

Table 1
Share of Old-Age Population
(as a Percent of Total Population)

	1996	2050
Canada	12	24
France	15	24
Italy	17	34
Japan	15	30
Sweden	17	22
United Kingdom	15	23
United States	13	21

Source: United Nations

Chart 1
Old-Age Dependency Ratios for Seven OECD Countries



Source: United Nations

The old-age dependency ratio shown in Chart 1 also illustrates the impact of the bulge in the age structure. In Japan and Italy, the dependency ratio is already increasing rapidly and is projected to rise even faster in the future, rising by 190% and 170% respectively between 1996 and 2050. For the other five countries, the rise in the dependency ratio is more gradual until 2010, but increases at a much faster rate thereafter. For Canada, France and the US, the dependency ratio is expected to increase by 130%, 100% and 90% respectively, over the same period, compared to 60% and 50% for the UK and Sweden.

3. The Models

The models are based on the life-cycle theory of savings behaviour. In the models, there are 15 generations living side by side at each point in time. Each new generation has 15 periods to live, with each period corresponding to 4 years of life. The 15 generations included in the model are 16 to 75 years of age.[3] Individuals are assumed to work until age 63, so 12 of the 15 generations are members of the active population. Population growth rates are exogenous. The structure of these and Hviding and Mérette (1998) models is similar to that of Auerbach and Kotlikoff (1987), with the exception that the labour supply is exogenous and bequest motives are included. The models are calibrated as in Hviding and Mérette (1998). The small open economy assumption is incorporated such as the benchmark steady states of the different economies are similar[4].

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[3] The structural equations of the model are presented in Appendix I.

[4] The calibration results are presented in Appendix II.

However, the small open economy assumption implies that the adjustment in the capital market will differ following an ageing shock. It is an international flow of capital (current account balances) that re-equilibrate the capital market rather than the domestic capital return as in Hviding and Mérette (1998).

Technologies and Firm Behaviour

The final goods sector production depends on physical capital and effective labour. All firms are identical. Technology is assumed to be Cobb-Douglas. Physical assets can be accumulated as forgone consumption, which is equivalent to assuming that physical capital goods are produced in a separate sector that has the same technology as the final-output sector.

Factor demands stem from profit maximisation by firms. Firms rent physical capital at the market rental rate and hire labour at the market wage rate per unit of effective labour, up to the point at which their marginal products equal their marginal costs. Since population growth is exogenous, the labour force increases at the rate of labour augmenting technical progress and evolves from one period to the next with the changing age composition of the population. The effective wage rate is equal to the marginal product of effective labour. The firm's wage bill is thus the product of the gross effective wage rate times the stock of effective labour supplied by all living individuals.

Cohort Behaviour

There is a representative individual for each generation. Each individual chooses final goods consumption and a bequest to maximise an intertemporal (constant elasticity of substitution) utility function, subject to physical capital accumulation conditions. Bequest motives are specified as in Blinder (1974). Bequests are distributed at the end of each generation's lifetime and are received equally by all working generations. A generation's lifetime profile of wage income is calibrated similarly in all models. Each generation's interest income is determined by its stock of physical wealth.

Government Behaviour

The pension system is assumed to be pure "pay-as-you-go" (PAYG) and is fully integrated into government accounts. The government has the responsibility to maintain the solvency of the pension fund by obtaining sufficient contributions from each generation. The public-sector debt-to-GDP ratio is assumed to be constant and the PAYG pension plan is financed through a wage-income tax. Government expenditures are restricted to pensions, spending on public goods and interest payments on the public debt. Public good expenditures affect neither private consumption nor production in the model. The government collects three types of taxes from each generation: on wage income, capital income and consumption. Tax rates on capital income and consumption are kept exogenous. The government's debt instruments are one-period bonds that pay the prevailing market interest rate in the current period and the principal in the next period.

Capital Market

In a small open economy framework, foreign debt equals the sum of domestic physical capital and government debt, minus domestic private wealth. Capital inflows finance the difference between final output and aggregate consumption, government consumption, domestic investment and interest payments on the foreign debt. Foreign debts are calibrated such as to keep private wealth and domestic capital equal to that in Hviding and Mérette (1998). As Buiter (1981) shows, current account imbalances are possible along a balanced growth path in a one-good overlapping generations model. He demonstrates that to generate current account imbalances in a two-period two-country version, it is only necessary to assume that the countries differ in their pure rate of time preference. In a many-period model, such as the one used in this paper, a domestic ageing process that diverges from the rest of the world is equivalent for saving behaviour to differences in pure rates of time preference. A faster ageing country behaves as if its "representative agent" was relatively more impatient. Consequently, such a country will experience a larger decline in private savings as does the country with the greater rate of time preference in Buiter (1981).

4. Summary of the OECD Secretariat Baseline Simulation Results

Hviding and Mérette (1998) examined the macroeconomic effects of ageing for seven countries. The demographic shock is simulated through changes in the birth rate that begins in 1954. In the long run, it is assumed that the birth rate returns to a steady-state level. This section summarises their baseline results of this ‘pure’ ageing shock. Their main results are presented in Charts 2 to 5. The results in Charts 2 to 4 present the level of the wage-income tax rate, the national savings rate and the real return on capital. In the absence of the shock, these variables remain equal to their 1954 levels. Chart 5 illustrates the percent shock minus control impact of ageing on real GDP.

Chart 2
Wage-Income Tax Rate

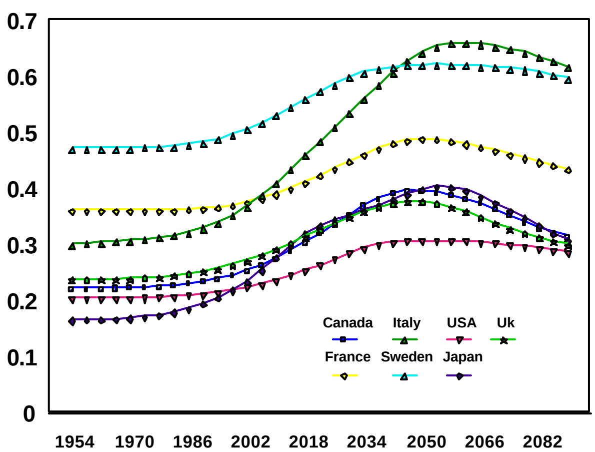


Chart 3
National Savings Rate

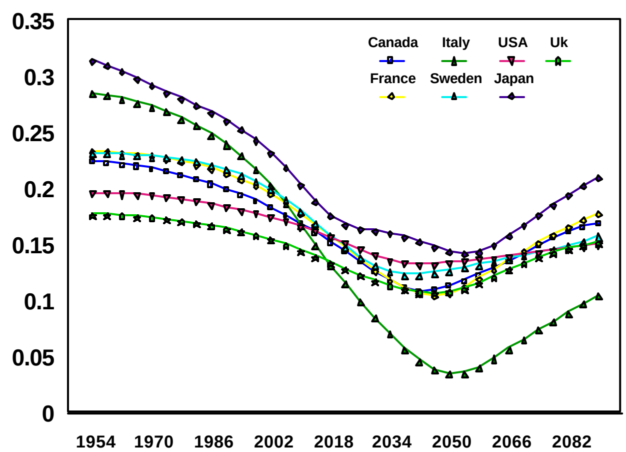


Chart 4
Real Return on Capital

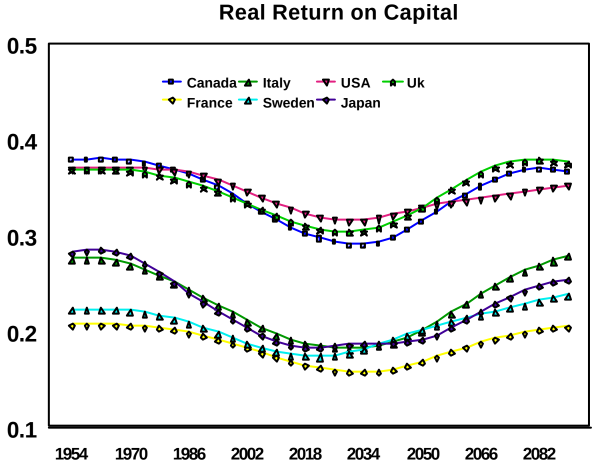
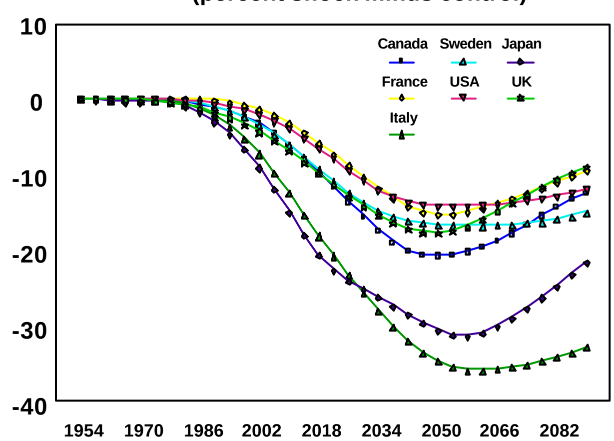


Chart 5
Real GNP per Capita
(percent shock minus control)



In their results, population ageing puts upward pressure on wage income taxes in all seven countries (see Chart 2) because there are fewer workers to finance public pension systems, and tax bases thus diminish. Tax rate increases peak between 2034 and 2050, depending on the size of the demographic shock and the tax structure in each country (see Table 3 in Appendix II).

Population ageing also puts significant downward pressure on private and national savings (see Chart 3). As mentioned in the previous section, the life-cycle theory of savings behaviour is a key assumption of the model and explains the reduction in private savings. Therefore, both capital stock and labour force fall. However, the labour force falls further and as a result, the capital-labour ratio increases, which in turn leads to a reduction in the real return on capital (see Chart 4) and an increase in before-tax real wages. This implies that the reduction in the demand for investment is greater than the reduction in the supply of savings. Finally, real output per capita significantly falls for all seven countries. Italy and Japan are most affected, because their demographic shocks are relatively larger than those of the other countries considered.

5. Ageing and the Current Account Balance

In the context of the world economy, population ageing can significantly affect current account balances, depending on the extent and the evolution of ageing in one country relative to another. By affecting world savings and investment, ageing may induce important changes in world capital markets, affecting capital flow movements across countries and current account balances.

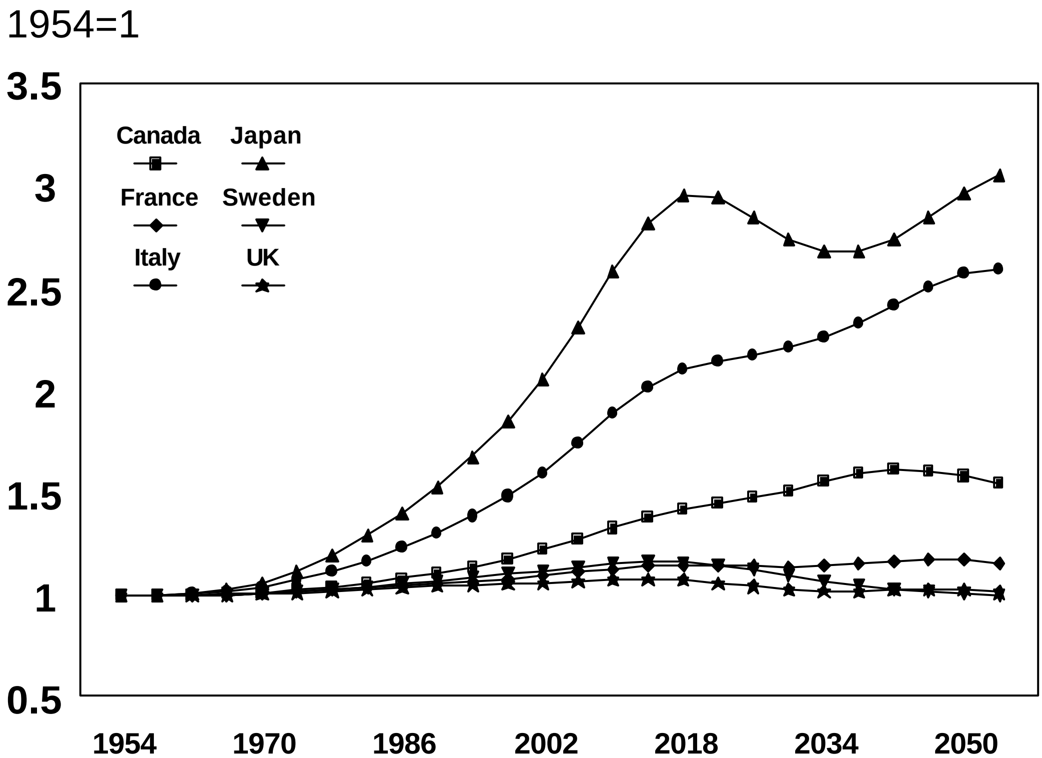
Buiter (1981) used a Samuelson-Diamond type model with two overlapping generations to explain international capital movements for differences in rate of time preference. He showed that a country with a higher rate of time preference has a lower supply of savings and runs a steady-state current account deficit. This suggests that a fast ageing country be expected to run a current account deficit. However, this only accounts for the reduction in savings and ignores the investment side. As shown in the previous section, Hviding and Mérette (1998) found that the demographic shock has a greater negative effect on the demand for investment than on the supply of savings.

To examine the impact of population ageing on the current account, we modify the original Hviding and Mérette (1998) OLG models to reflect a small open economy framework. This modification does not apply to the United States, which is assumed, for convenience, to represent the rest of the world. However, this exercise is only illustrative, since the other countries taken as a whole group or individually likely influence world capital markets.

In the small open economy version of the models, domestic wealth may differ from the domestic capital stock. Domestic physical capital and government debt are equal to private wealth and foreign debt, and firms rent physical capital from domestic and foreign sources at the world rental rate. As noted earlier, we assume that movements in world interest rates are determined by developments in the United States. When we simulate country-specific demographic shocks, movements in US interest rates determine domestic interest rate changes in all the countries. In a closed economy, capital market equilibrium conditions are respected via the capital return adjustment mechanism. In the small open economy case, equilibrium comes from international capital flow adjustments. The dynamic path of each country's current account is closely related to its demographic shock relative to that in the United States. Since private agents in the models are endowed with forward-looking behaviour, they anticipate correctly the changes in rates of returns induced by the demographic shocks.

Chart 6 shows the relative dependency ratios between the six OECD countries and the United States, over the period 1954 to 2050 (normalised to 1 in 1954). The dependency ratios in Japan, Italy and Canada increase much faster than the U.S. dependency ratio (for example, it is about 3 times faster for Japan between 1954 and 2018). In the Hviding and Mérette (1998) models, this implies that these countries' real rates return on capital diverge from those in the United States. However, for France, Sweden and the UK, the dependency ratios are similar to that in the United States, implying a similar impact on the real return on capital.

Chart 6
Dependency Ratios Relative to the United States



In each country, the differential between the real capital return, under the small open economy and closed economy assumptions determines the impact of the demographic shock on the current account. Given that developments in the United States are assumed to drive world interest rates, Charts 7 to 12 illustrate the impact of ageing on the real return to capital in the remaining countries. Results under both closed and small open economy assumptions are presented, and it is important to recall that those for the closed economy case correspond to the Hviding and Mérette (1998) simulations presented in Chart 4. As shown in the previous section, under the closed economy assumption real returns on capital diminish as a result of the demographic shocks.

Chart 7
Real Return on Capital (Canada)

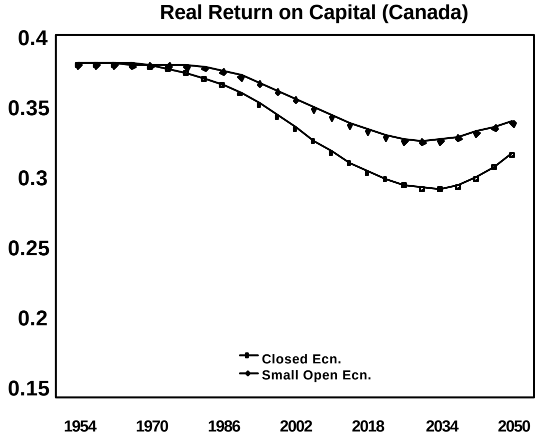


Chart 8
Real Return on Capital (France)

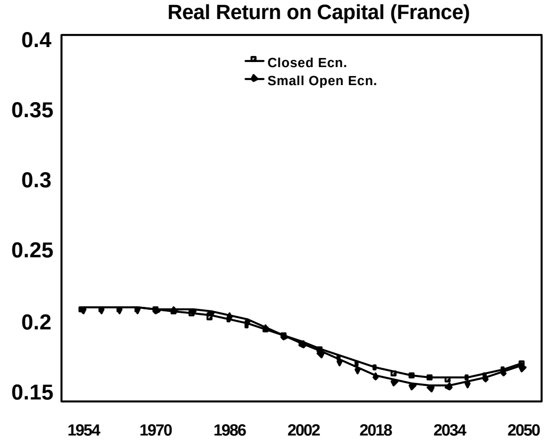


Chart 9
Real Return on Capital (Italy)

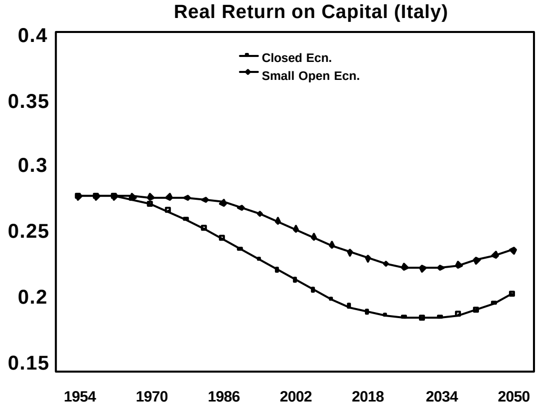


Chart 10
Real Return on Capital (Japan)

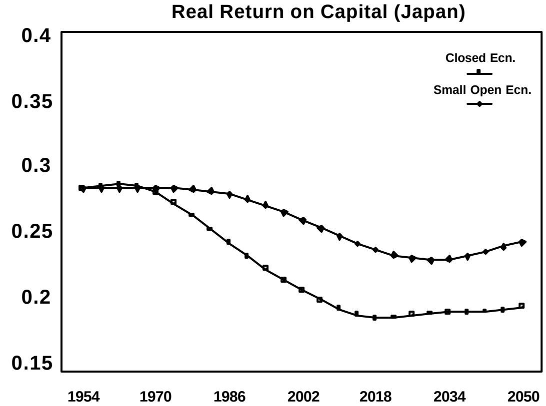


Chart 11
Real Return on Capital (Sweden)

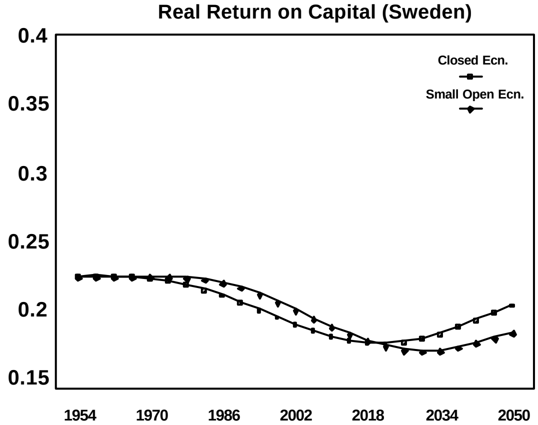
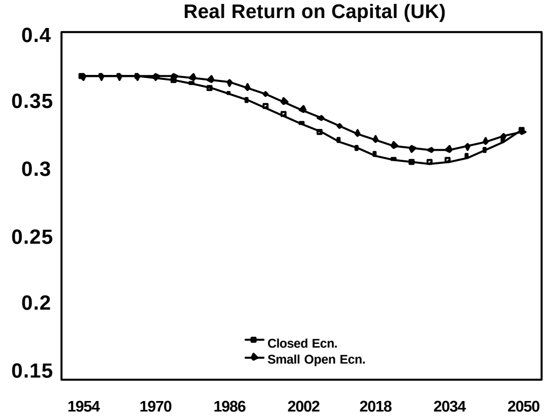


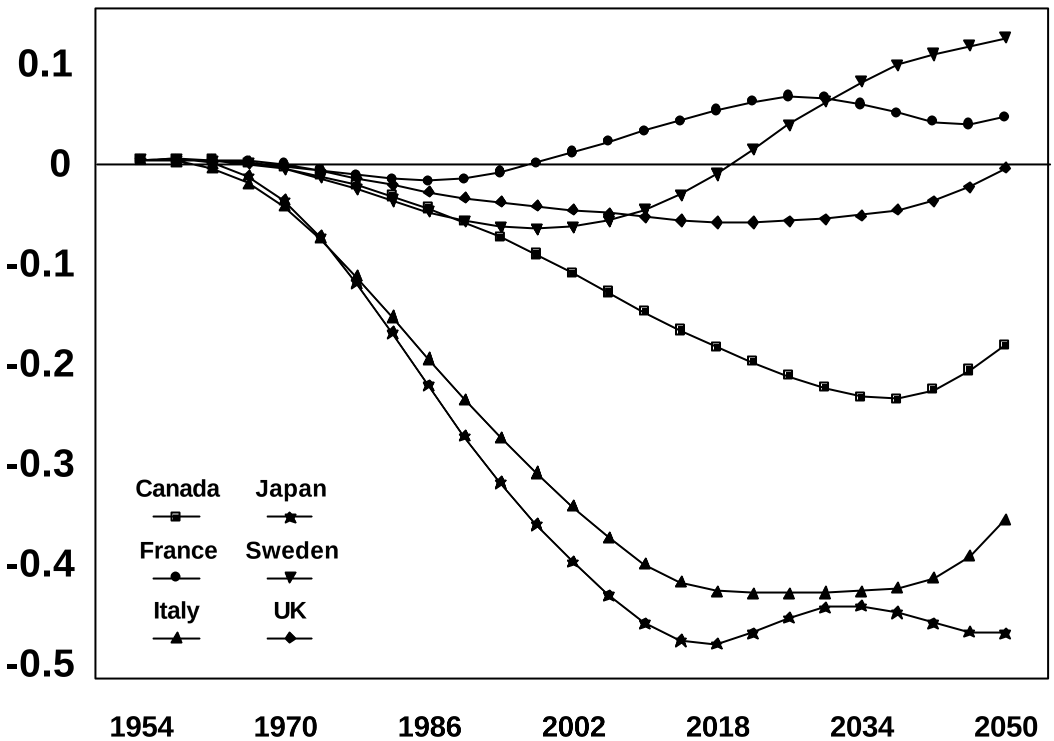
Chart 12
Real Return on Capital (UK)



When we introduce the small open economy assumption, the reduction in the real return on capital is less pronounced for Japan, Italy, Canada and the UK. For Sweden, the reduction in the real return on capital is smaller initially, but larger thereafter, while for France, there is virtually no difference. The differential between the real capital return, under the small open economy and closed economy assumptions increases initially for Canada, the UK and Italy, but eventually diminishes and turns to zero for the UK by 2050. For Japan, the differential continues to increase by 2050, but more moderately. For Sweden, the real capital return differential turns negative after 2018 and the negative differential still increases in an absolute value by 2050. Finally, for France the real capital return differential fluctuates around zero.

The stock of net foreign debt adjusts according to the change in real capital return differentials between the two scenarios. Under the small open economy assumption, agents from the countries that age more rapidly have an incentive to finance investments abroad, since the demand for investment in the home country falls relative to domestic savings. This, in turn, reduces the net stock of foreign debt as a proportion of GNP in the home country (see Chart 13). For Japan, Italy, Canada and the UK, the stock of net foreign debt diminishes as a proportion of GNP during the period 1954 to 2018 and stabilises for a while, except for Canada where it continues to decline until 2034. After 2034, the stock of net foreign debt begins to increase, with the exception of Japan, because the real capital return differential diminishes. For France and Sweden, the stock of net foreign debt increases slightly during most of the period.

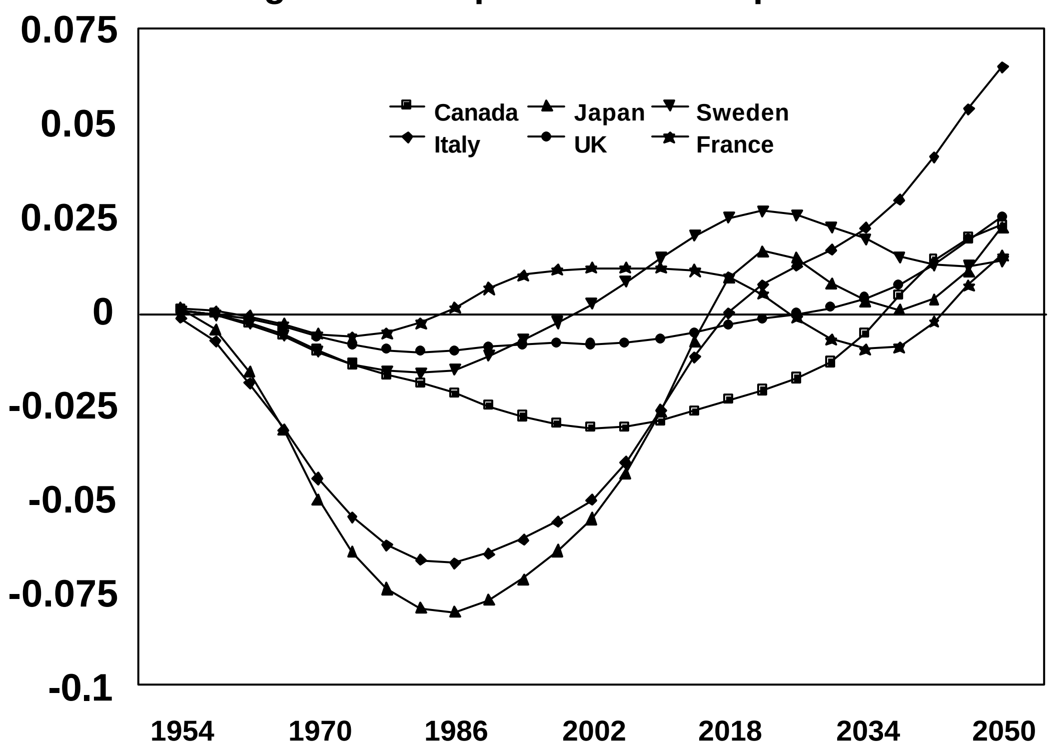
Chart 13
Stock of Net Foreign Debt as a Proportion of GNP



As demonstrated in Chart 14, there is a net capital outflow (positive current account balance) in the countries between 1954 and 2018, except in France where there is a net capital inflow. After a given year, which differs across countries, the current account balance stabilises or reverses in sign, because real capital return differentials stabilise or diminish.

More specifically, the demographic shock in Italy and Japan relative to the demographic shock in the United States has a favourable impact on the Italian and Japanese current accounts, contributing up to 7 and 8 percent of GNP in net capital outflows during the 1980s. However, the impact is less favourable thereafter, since by 2020 the effect of relative ageing leads to a deterioration in their current account.

Chart 14
Change in Net Capital Flows as a percent of GNP



The demographic shock in Canada and the UK relative to the United States also has a favourable effect on the Canadian and British current accounts. For Canada, the positive effect is more persistent than in other countries, peaking at 3 percent of GNP, and not becoming negative until 2034. For the UK, the positive effect is much smaller and less persistent.

The impact on the current account is negative for France until 2026, reaching 1 percent of GNP and, fluctuating around zero thereafter. Finally, the impact is positive in the initial period for Sweden, but becomes negative by 2002 and remains negative in the long term.

Charts 15 to 20 also compare the impact of ageing on real GNP in both closed and small open economy scenarios. The results indicate that the impact of ageing on real GNP is similar for France and Sweden under the small open economy assumption, because the impact on the investment income balance is modest. On the other hand, because Canada, Italy and Japan enjoy an improvement in their international investment position and investment income balance, the negative impact of ageing on real GNP is somewhat smaller than under the closed economy assumption. Finally, for the UK, the impact of ageing on real GNP is similar to the closed economy case initially, but turns slightly worse by 2050 under the small open economy scenario, because of the deterioration in the investment income balance.

Chart 15
Real GNP per Capita (Canada)
(percent shock minus control)

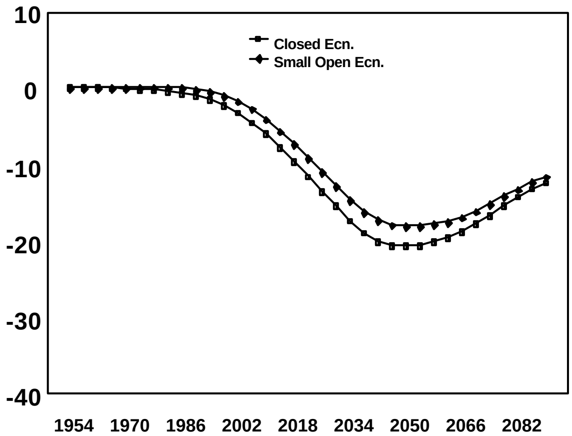


Chart 16
Real GNP per Capita (France)
(percent shock minus control)

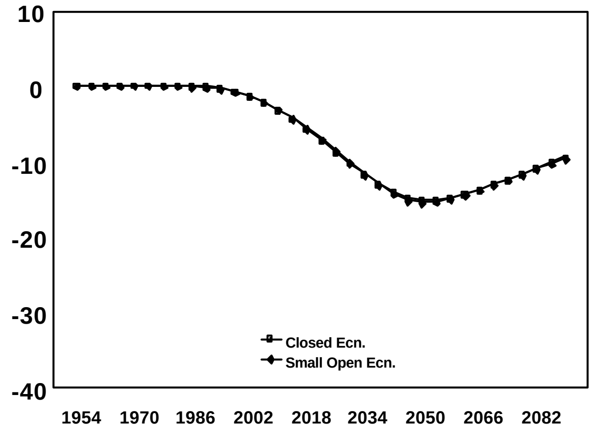


Chart 17
Real GNP per Capita (Italy)
(percent shock minus control)

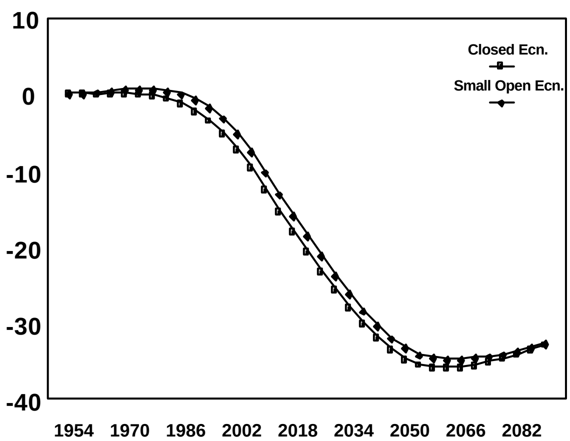


Chart 18
Real GNP per Capita (Japan)
(percent shock minus control)

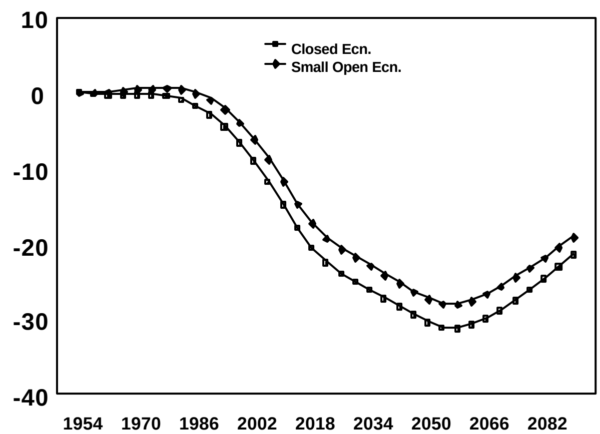


Chart 19
Real GNP per Capita (Sweden)
(percent shock minus control)

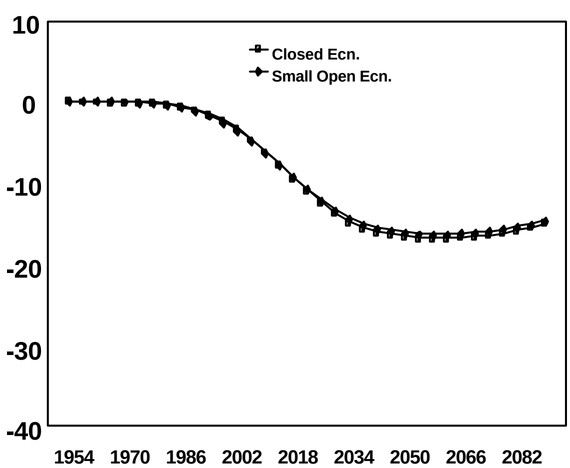
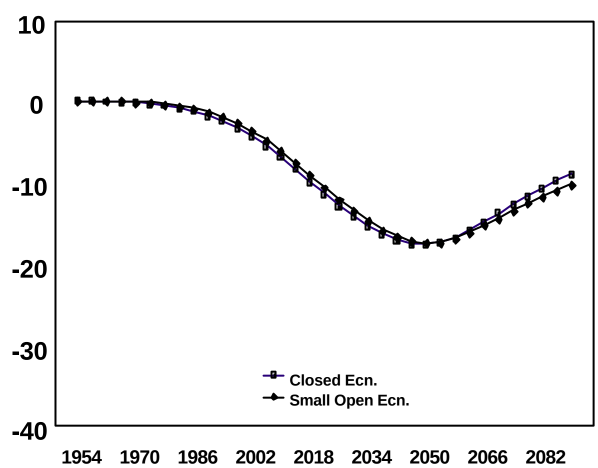


Chart 20
Real GNP per Capita (UK)
(percent shock minus control)



6. Conclusion

In this paper, we have modified the Hviding and Mérette (1998) models to examine the impact of population ageing on the current account for six OECD countries, assuming for convenience that these countries are small open economies. The exercise in this paper does not necessarily apply to the countries examined, since as a group or individually, they likely influence international capital markets. Hence, this exercise is only illustrative. However, from the simulation experiments, we draw the following conclusions.

We have shown that population ageing may have an important impact on world capital markets and current account balances, depending on the extent and the evolution of ageing in one country relative to another. A relatively faster ageing country will experience an improvement in its current account balance, not a deterioration. This is due to a decline in domestic investment demands that is greater than the reduction in national savings. Consequently, the globalisation of capital markets may reduce the negative effects of domestic population ageing for small open economies in which the dependency ratio increases more rapidly. In such a case, the international capital market is able to offer better returns on domestic savings than would otherwise occur in a closed economy context. Consequently, GNP is less affected by domestic population ageing. However, our results also suggest that income from foreign investment would only make a modest contribution to offsetting pressures from the demographic shock.

In a broader context, these results also suggest that population ageing may lead to important international capital flows over the next few decades from countries with an ageing population to countries with a relatively younger population, such as newly industrialised and developing countries. Finally, although this analysis provides a good intuition for the impact of population ageing on the current account, it would be useful in future research to extend the scope of the analysis through the use of an OLG type multi-country model.

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Appendix I: Structural Equations of the Models

Final Goods Production Function

The final goods sector depends on both physical capital and effective labour. All firms are assumed identical. The economy's production technology is represented by a Cobb-Douglas function:

(1) $Y_t = AK_t^e L_{e,t}^{1-e}$,

where Y is real final output, A a scaling variable, K the stock of physical capital, L_e effective labour and e the capital income share.

The productivity of a worker is assumed to be age-related following this quadratic function of the age g:

(2) $ep^g = g + lg - yg^2,\ g,\ l,\ and\ y > 0.$

Furthermore, it is assumed that technical change is exogenous and "labour embodied"; every new generation has a larger stock of technical knowledge than the previous cohort and is more productive by a constant factor h. Thus, the supply of effective labour is growing over time with a constant rate in excess of the growth rate of the working-age population. Consequently, the effective productivity of each age-group at period t is $ep^g h_t^g$, and effective labour supply at period t equals:

(3) $$L_{e,t} = \sum_{g=1}^{12} ep^{g} h_{t}^{g} \, pop_{t}^{g} \ ,$$

where pop^{g}_{t} is the number of people of age g at period t.

Household Behaviour

Each generation maximises its utility function, *U,* of consumption and bequest given its lifetime income. The representative generation's preferences are represented by the following constant intertemporal elasticity of substitution utility function:

(4) $$U = \frac{1}{1-q} \sum_{g=1}^{15} \left(\frac{1}{1+r} \right)^{g} \left(c_{g}^{1-q} + b_{g}^{q} Beq_{g}^{\ 1-q} \right), \quad 0 < q < 1; \ b_{g \neq 15} = 0, b_{g15} > 0,$$

where c is consumption, r the pure rate of time preference, q the inverse of the intertemporal elasticity of substitution, b is a constant parameter and Beq is bequest.

The One-period Budget Constraint

The representative generation budget constraint at each period is:

(5) $$a_{t+1}^{g+1} - a_{t}^{g} \leq w_{t} ep_{t}^{g} h_{t}^{g} (1 - t_{w,t}) + r_{t} a_{t} (1 - t_{k}) - (1 + t_{s}) c_{t} + pen_{t}^{g} \left(1 - t_{w,t}\right) - Beq_{t} + Inh_{t} \ ,$$

where a is physical wealth asset; w and r are the wage rate and interest rate respectively; t_{w}, t_{r} and t_{s} are tax rates on labour and pension incomes, interest income and consumption, respectively; *pen* are pensions and *Inh* inheritances. Inheritances are received equally by the working generations:

(6) $$Inh_t^j \, pop_t^j = \frac{1}{12} Beq_t^m \, pop_t^m \quad , \quad j = 1,2,\ldots,12 \;\; and \;\; m = 15.$$

Finally, the amount of pensions received depend on the replacement rate α of previous wage earnings:

(7) $$pen_t^m = a \cdot \frac{1}{12} \sum_{g=1}^{12} w_{t-m+g} \, ep^g h_{t-m+g}^g \, , \; m=13,14,15.$$

Government

The government needs to finance public expenditures and pensions, using domestic bond issues and taxation. The one-period budget constraint of the government is given by:

(8) $$D_{t+1} - D_t = r_t D_t + G_t + PEN_t - T_t \quad ,$$

where D are government bonds, G government expenditures, PEN is total pensions payments ($PEN = \sum_g pop^g \, pen^g$) and T government revenues out of taxation. Taxation revenue emanates from three sources: labour and pension incomes, capital income, and consumption. Summing over all generations, total government revenue is

(9) $$T_t = t_{w,t} \sum_g \left(w_t ep^g n_t^g + pen_t^g \right) pop_t^g + t_r r_t \sum_g a_{k,t}^g \cdot pop_t^g + t_s \sum_g c_t^g \cdot pop_t^g \; .$$

Equilibrium and Aggregation Conditions

All markets are assumed perfectly competitive. Equilibrium market conditions for factors of production physical capital and labour are respectively:

(10) $r_t - d = eAK_t^{e-1}L_{e,t}^{1-e}$,

(11) $w_t = (1-e)AK_t^{e}L_{e,t}^{-e}$,

where d is the rate of capital depreciation.

To ensure that no resources are wasted, two more equilibrium conditions are introduced. First, physical capital plus government debt equals total private wealth plus the stock of net foreign debt every periods:

(12) $K_t + D_t = \sum_g a_t^g \cdot pop_t^g + NFD_t$,

where NFD is the stock of net foreign debt.

Second, final goods output equals household and government consumption ($C+G$), plus net investment I_t^N and the current account balance NX:

(13) $Y_t = C_t + G_t + I_t^N + NX_t$,

where $C_t = \sum_g c_t^g pop_t^g$, $I_t^N = K_{t+1} - (1-d)K_t$ and $NX_t = -(NFD_{t+1} - NFD_t - r_t NFD_t)$.

APPENDIX II

TABLE 1:CALIBRATION RESULTS

	e	d	h	r	a	***K/Y***	***S/Y***	***D/Y***
Canada	34.5	3.10	2.4	.0047	45.9	2.7	22.4	.27
France	33.2	3.02	1.6	.0002	52.16	4.0	23.3	.08
Italy	34.4	2.58	2.6	.0050	45.4	3.6	28.5	.62
Japan	34.2	4.54	2.4	.0025	53.7	2.9	31.8	.09
Sweden	30.0	2.70	2.4	-.003	49.0	3.6	23.1	-.08
United Kingdom	30.4	2.75	2.9	.0035	24.4	2.5	17.6	.35
United States	32.6	3.52	2.4	.0055	42.0	2.5	19.4	.34

TABLE 2: PARAMETERS COMMON TO ALL COUNTRIES

g = 1; l = .25; j = .012; 1/q = .25;

Source: Analytical Databank, OECD; Auerbach and Kotlikoff (1987).

TABLE 3: AVERAGE EFFECTIVE TAX RATES: 1965-1994[1]

	t_k	t_w	t_c
Canada	41	22	9
France	22	36	18
Italy	25	30	11
Japan	33	16	5
Sweden	51	47	18
United Kingdom	54	23	13
United States	41	20	5

1. For Sweden, the data are averages of 1975-1994.

Source: Leibfritz *et al.* (1997).

Definitions:

e: business sector capital income share (per cent)

d: physical capital depreciation rate (per cent)

h: rate of technical progress (per cent)

K/Y: capital-output ratio

S/Y: gross national saving-output ratio

D/Y: public debt-output ratio

g, l, j : age-related productivity parameter

1/q: intertemporal elasticity of substitution

t_k: average tax rate on capital

t_w: average tax rate on wage income

t_c: average tax rate on consumption

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