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The international spillover effects of pension reform

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Abstract

In this paper we explore the international spillover effects of a pension reform. More specifically, we analyse how, in a common capital market, pension reforms in countries with PAYG pension schemes affect countries with funded pension systems. This sheds light on the interesting question whether a country with an extensive funded pension scheme (e.g. the Netherlands) is affected positively or negatively when a country that relies to a relatively large extent on unfunded pensions (for example Italy) reforms its pension system. We use a simple two-country two-period overlapping-generations model, where the two countries only differ in their pension systems. We find that the funded country shares both in the costs and the benefits of the reform. When a government reforms its PAYG system and compensates the first generation of old people completely via government debt, private capital is crowded out and both economies suffer from the pension reform in the long run. When no government debt is created to finance the reform, both economies are positively affected in the long run by the reform. In general we conclude that the international spillover effects of a pension reform depend on the way the pension reform is implemented; whether government debt is used to finance the reform and how much debt is created.

JEL codes: F21, F41, F47, H55, H63

Keywords: international spillover effects, pension reform

1 Introduction

In the coming decades, most developed countries will get a more and more aged population. To prevent contributions from rising to unprecedentedly high rates, countries with PAYG-financed pension systems (where the current working population pays taxes to finance the pension benefits of the current elderly) have begun to switch (or are planning to switch) to a more funded pension system where people save for their own pensions. In a multicountry world, this switch to funding will engender spillover effects to other countries. The aim of this paper is to look at these international spillover effects of a pension reform. More specifically, we will analyse how countries with funded pension systems are affected when countries with PAYG pension schemes reform their pension system. Will a country like the Netherlands (that has an extensive funded pension scheme) be positively or negatively affected when a country like Italy (that relies to a relatively large extent on unfunded pensions) reforms its pension system? We focus on the spillover effects via capital markets.

There are some papers that address pension reform issues in an open-economy framework. Pemberton (2000), for example, contrasts go-it-alone privatization in one country with world-wide privatization. Other papers, like Börsch-Supan et al. (2003) and INGENUE (2001), develop large multi-country overlapping generation models to study the effects of pension reform on international capital flows. In contrast to these papers, we use a simple two-country two-period overlapping-generations model to analyse the open-economy effects when one country reforms its PAYG system, while the other country has a funded pension scheme. We consider several types of pension reforms and derive an analytical solution for the transition path. In that way our analysis differs from Casarico (2001).

One of the crucial issues in pension reform is whether the switch to funding for the younger generations comes together with a compensation for the older generations. In case of a compensation, financed e.g. by debt creation, national savings do not necessarily have to increase after a pension reform. Therefore, we consider two different types of pension reforms. In the first reform there is no compensation: benefits and contributions simultaneously decrease by the same amount. So people that are old at the time of the reform lose and no debt is created. Second, we analyse the effects when there is full compensation: benefits do not change at the time of the reform, while contributions fall. In that case government debt is created.

We use a simple two-country two-period overlapping-generations model. One country has a PAYG pension system and the other country has a fully funded retirement scheme. In all other respects the countries are identical. There is perfect capital mobility between the two countries. This implies that the reform in the PAYG country will spill over to the funded country via the capital market.

When the elderly are not compensated, a pension reform leads to an increasing capital-labour ratio over time in both countries. On the one hand, a higher capital-labour ratio results in higher wages, which enhances the consumption possibilities for the young in the funded country. On the other hand, interest rates decrease when the capital-labour ratio increases. This affects the consumption possibilities of the elderly in the non-reforming country negatively. So the pension reform in the PAYG country increases the consumption gap between young and old people living in the funded country. Overall, in the long run people in the funded country gain from the pension reform in the PAYG country, that is, in the long run utility increases compared to the initial steady state. This means that part of the gain of the pension reform for the PAYG country spills over to the funded country.

In case the government compensates the first generation of old people completely, the created debt crowds out capital, that is, the rise in savings is less than the increase in government debt so that the capital-labour ratio declines after the pension reform. This means that the initial effects on consumption are reversed. The pension reform in the PAYG country leads to less consumption possibilities for the young in the funded country, while the elderly in this country gain. In the long run, people in both countries lose from this reform policy. But, under an integrated capital market, the PAYG country is able to shift part of the losses to the funded country[1].

So the funded country shares both in the costs and the benefits of the reform: in case of integrated capital markets, the benefits *and* the costs of the reform are lower in the PAYG country.

The rest of the paper is organized as follows. Section 2 presents the benchmark model. In Section 3 we analyse the effects of the two different kinds of pension reform. The final section summarizes and concludes.

[1]We also show that it is possible to *partly* compensate the people that are old at the time of the reform in such a way that future generations do not lose compared to the old steady state

2 The model

We will use a two-period overlapping-generations model of an open economy. Following Buiter (1981) and Persson (1985), the world consists of two countries, country P and country F. The only difference between the two countries is the way the pensions are financed. Country P uses a compulsory pay-as-you-go (PAYG) system and country F has a compulsory fully funded retirement scheme. In all other respects the countries are identical. We assume a constant population size[2].

Production per young individual is described by a standard neoclassical constant-returns-to-scale production function, $f(k_t^i)$, where k_t^i stands for the amount of capital per young individual in period t in country i, $i = P,\ F$. Perfect competition among producers gives the usual equilibrium conditions, $r_t^i = f'(k_t^i) - \delta$ and $w_t^i = f(k_t^i) - k_t^i f'(k_t^i)$, where r_t^i is the interest rate, w_t^i denotes the real wage, and δ is the depreciation rate of capital. There is perfect capital mobility between the two countries, but labour is immobile. Since capital can freely move across countries, the interest rates will be equalized, i.e., $r_t^P = r_t^F = r_t,\ \forall t$. And because both countries are endowed with the same production technology, we have $k_t^P = k_t^F = k_t$, and consequently $w_t^P = w_t^F = w_t$.

We assume that initially the government in country P runs a balanced PAYG pension system, that is, the pension benefits of the elderly (z_t^P) are covered by lump-sum taxes of the young (τ_t^P)[3]:

$$z^P = \tau^P \tag{1}$$

A pension reform leads to a lower contribution level and lower benefits. We model this as follows:

$$\tau_t^P = \mu_t\, z^P \tag{2}$$

$$z_t^P = \lambda_t\, z^P \tag{3}$$

where $\mu_t < 1$ and $\lambda_t \leq 1$. During the reform it may happen that $\mu_t < \lambda_t$, in that case part of the pension reform is financed by government debt (b_t^P). But after a while the PAYG system should be balanced again, that is, $\mu_t = \lambda_t < 1$. Moreover, when the government creates debt during the reform process, at a certain point in time it should introduce an extra tax (τ_t^B) to finance the interest obligations on the debt, so as to keep debt per worker

[2]Throughout this paper, we assume both economies to be dynamically efficient.

[3]By omitting time subscripts we denote the initial steady state value of the respective variable.

constant. With debt, the budget constraint of the government (public debt dynamics) in per capita terms is:

$$b_{t+1}^P = (1 + r_t)b_t^P + z_t^P - \tau_t^P - \tau_t^B \tag{4}$$

It is assumed that the government issues one-period debt, which yields the same rate of interest as capital.

In country F the government invests the contributions of the young (τ_t^F) and returns them with interest in the next period in the form of transfers to the then old agents (z_{t+1}^F):

$$z_{t+1}^F = (1 + r_{t+1})\,\tau_t^F \tag{5}$$

Lifetime utility of a representative individual born at t is given by the following utility function:

$$U\left(c_t^{y,i}, c_{t+1}^{o,i}\right) = \log c_t^{y,i} + \frac{1}{1+\rho}\log\left(c_{t+1}^{o,i}\right) \tag{6}$$

where $\rho > 0$ stands for the (constant) pure rate of time preference of an individual, $c_t^{y,i}$ is consumption when young, and $c_{t+1}^{o,i}$ is consumption in the second period of life.

Young agents inelastically supply one unit of labour. The consolidated lifetime budget constraints in the two countries are as follows:

$$c_t^{y,P} + \frac{c_{t+1}^{o,P}}{1+r_{t+1}} = w_t - \tau_t^P - \tau_t^B + \frac{z_{t+1}^P}{1+r_{t+1}} \tag{7}$$

$$c_t^{y,F} + \frac{c_{t+1}^{o,F}}{1+r_{t+1}} = w_t - \tau_t^F + \frac{z_{t+1}^F}{1+r_{t+1}} \tag{8}$$

and the individual optimal savings in both countries are given by:

$$s_t^P = \frac{1}{2+\rho}\left[w_t - \tau_t^P - \tau_t^B\right] - \frac{1+\rho}{2+\rho}\,\frac{z_{t+1}^P}{1+r_{t+1}} \tag{9}$$

$$s_t^F + \tau_t^F = \frac{1}{2+\rho}\,w_t \tag{10}$$

Note that optimal savings in country F do not depend on the interest rate. The reason for this is that with logarithmic utility, the intertemporal substitution elasticity is equal to one. For the same reason, optimal savings in country P only react to the interest rate because it changes the net present value of the pension benefit.

People invest their savings either in their own country or abroad, their portfolios will be composed such that interest rates are equalized. Equilibrium in the international capital market is given by:

$$s_t^P + s_t^F + \tau_t^F = 2k_{t+1} + b_{t+1}^P \tag{11}$$

From equations (9) and (10) it can be seen that country F has higher savings than country P, implying that country F exports capital abroad.

3 Pension reform

This section investigates the effects of a pension reform in country P. We will analyse different types of reforms, using the following general framework. At $t = -1$ the government in country P announces that it will reform its PAYG pension system in the next period ($t = 0$). So individuals can already take into account the economic consequences of the reform when they make their optimizing decisions in period $t = -1$. The pension reform implies that both contributions *and* benefits will fall, according to eq. (2) and (3). The government may decide to keep the benefits constant for a while or let them fall less than the contributions. In that case part of the benefits has to be financed by government debt. This cannot go on forever, and we assume that after a while benefits match contributions again, i.e. the benefits should have decreased as: $\lambda_t = \mu_t < 1$. So the PAYG system is balanced again, but at a permanent lower level. The processes for μ_t and λ_t are given by:

$$\mu_t = 1 + \pi g_t \tag{12}$$

$$\lambda_t = 1 + \pi f_t \tag{13}$$

where $g_t < 0$ and $f_t < 0$ describe the time pattern of a perturbation of μ_t and λ_t from their steady-state values and π reflects the magnitude of this perturbation.

Furthermore, we assume that there is no government debt in the initial steady state ($b^P = 0$), so that τ^B is zero too. The effects of a pension reform can be traced by linearizing the capital-accumulation equation (11) with respect to π around the initial steady state. This results in the following first-order difference equation for the evolution of the capital-labour

ratio:

$$\frac{\partial k_{t+1}}{\partial \pi} = -\frac{2kf''(k)}{\Delta}\frac{\partial k_t}{\partial \pi} - \frac{1}{\Delta}\left(z^P g_t + \frac{\partial \tau_t^B}{\partial \pi} + \frac{(1+\rho)z^P}{(1+r)} f_{t+1}\right) - \frac{(2+\rho)}{\Delta}\frac{\partial b_{t+1}^P}{\partial \pi} \tag{14}$$

with $\Delta \equiv 2(2+\rho) - \frac{(1+\rho)z^P f''(k)}{(1+r)^2} > 0$. The linearized version of equation (4) is:

$$\frac{\partial b_{t+1}^P}{\partial \pi} = (1+r)\frac{\partial b_t^P}{\partial \pi} + \frac{\partial z_t^P}{\partial \pi} - \frac{\partial \tau_t^P}{\partial \pi} - \frac{\partial \tau_t^B}{\partial \pi} \tag{15}$$

where we used the assumption that $b^P = 0$. At a certain point in time the PAYG system should be balanced again: $\frac{\partial z_t^P}{\partial \pi} = \frac{\partial \tau_t^P}{\partial \pi}$, implying that $g_t = f_t$. At the same time an extra tax is introduced to keep debt per worker constant. From that moment on $\frac{\partial \tau_t^B}{\partial \pi}$ is:

$$\frac{\partial \tau_t^B}{\partial \pi} = r\,\frac{\partial b_t^P}{\partial \pi} \tag{16}$$

Equation (14) shows the change in the capital-labour ratio after a pension reform in country P when the two economies have a joint capital market. The same kind of equation can be derived for the situation where country P is a closed economy. In country F nothing happens when it is a closed economy. The international spillover effects of pension reform in case of different pension schemes are then demonstrated by comparing the change in the variables in the open-economies case with the closed-economies case.
We assume that the amount of capital in the initial steady state is always the same in both countries. The reason for this is that we want to focus solely on the international spillover effects when the countries already have integrated capital markets before the pension reform. The changes in all variables can be derived from the change in k_t. The analytical derivations do not produce any additional insight, however. Instead, we produce numerical simulations in order to illustrate the mechanics of the model.

We will consider two different kinds of reforms. In the first reform benefits fall at the same time as the contributions, so that the old at the time of the reform lose and no debt is created. Second, we analyse the effects when benefits do not change at the time of the reform, while contributions fall. In that case government debt is created.

3.1 Pension reform without government debt

At $t = -1$ the government announces that it will decrease both the contributions to the PAYG system (τ_t^P) and the pension benefits (z_t^P) permanently with 50% in the next period ($t = 0$)[4]. So the old at $t = 0$ bear all the costs of the reform.

The change in the capital-labour ratio

The simulation graphs for this pension reform are shown in Appendix A. From equation (14) it follows that, in case of a joint capital market, the change in the capital-labour ratio at $t = 0$ is positive, as $\frac{\partial k_0}{\partial \pi} = -\frac{(1+\rho)z^P}{\Delta(1+r)} f_0 > 0$. At the time of the announcement ($t = -1$), young people living in country P decide to increase their savings because they know that they will receive a lower pension benefit when they are old. These higher savings in $t = -1$ leads to a higher capital-labour ratio at $t = 0$.
The increase in the capital-labour ratio leads to higher wages, which engenders higher savings in both countries. Due to these higher savings the capital-labour ratio continues to rise. In Figure 1 we show the change in the capital-labour ratio for both closed and open economies. Citizens in the PAYG country have an additional incentive to save more, because of their lower benefits and contributions. When the two countries have a common capital market part of these extra savings flow to country F, so that the capital-labour ratio in country P increases less compared to the closed economy case.

The change in consumption and utility

The change in consumption when young in the two countries is displayed in Figures 4 and 6. As explained, individuals in country P and born at $t = -1$ save more, therefore their consumption when young decreases. For individuals born at $t = 0$ wages will go up and taxes go down, so that their consumption when young increases. Wages rise more when the PAYG country is closed, so $c_t^{y,P}$ increases more in that case. It might be emphasized here that as the reform in country P implies an increasing capital-labour ratio and higher wages, also enhances the consumption possibilities for the young in country F.

Figures 5 and 7 show the change in old-age consumption. Obviously, the fall in pension benefits and the lower return on savings cause the consumption of old people living in country P at $t = 0$ to decrease. Because wages and savings increase over time, $c_t^{o,P}$

[4]This means that $g_0 = g_1 = \ldots = g_\infty = -0.5$ and $f_0 = f_1 = \ldots = f_\infty = -0.5$.

increases from $t = 1$ onwards. If country P is closed, the initial decreases of the interest rates will be stronger than if country P is open. The elderly will, therefore, be hurt more. After three periods, however, the stronger wage effect in the closed economy will lead to a stronger increase in old-age consumption.
The fall in the interest rate at $t = 0$ also lowers the return of the savings of old people living in country F, therefore their old-age consumption falls at $t = 0$. In the period after the shock the increased savings in the previous period are not enough to offset the further decrease in the interest rate, so that consumption of the old decreases more. Notice that while in the long run elderly in country P see their consumption increase due to the reform, the elderly in the non-reform country F get less consumption possibilities.

The changes in lifetime utility are shown in Figures 2 and 3. This type of pension reform, in which benefits are decreased without compensating, will obviously hurt the elderly in country P at the time of the reform. What is, however, interesting to note that this loss spills over to the elderly in country F as well. Even stronger, the young generation in country F at the time of the reform, $t = 0$, experiences a loss, while this is not the case for the young generation in country P at $t = 0$. Later generations in country F gain from the pension reform in country P, but the consumption gap between young and old people has increased.

3.2 Pension reform with debt creation

In the pension reform described in the previous section pension benefits fell at the same time and with the same amount as the contributions, so that the current elderly bear all the costs of the reform. It is probably more realistic to assume that the government compensates the current old, so that people have more time to adjust their behaviour to the smaller PAYG system. Therefore, in this section we assume that while contributions to the PAYG scheme fall with 50% permanently at $t = 0$, benefits will stay constant in that period. This is again announced one period before the reform actually takes place (at $t = -1$). Moreover, the government also tells people that at $t = 1$ pension benefits will fall as much as the contributions, so that the PAYG system is balanced again from then on[5]. Since taxes are lower than the benefits during one period ($t = 0$), there will be government debt in country P at $t = 1$. At the moment that contributions and benefits are equal again ($t = 1$), the government introduces an extra tax (τ_t^B) to pay the interest obligations on its

[5]This means that $g_0 = g_1 = \ldots = g_\infty = -0.5$ and $f_0 = 0$, $f_1 = \ldots = f_\infty = -0.5$.

debt, such that debt per worker stays constant from then on.

The change in the capital-labour ratio

In Appendix B we show the simulation graphs for this pension reform. In contrast to the pension reform in the previous section, young people living in country P do not change their savings at the time of the announcement ($t = -1$), because their pension benefit will not change. This implies that the capital-labour ratio remains unaffected at $t = 0$.
Young people living in the PAYG country at the time of the reform have to pay lower PAYG taxes and know that they will receive a lower pension benefit. Therefore they save more. However, the unbalance of the PAYG system at $t = 0$ has been covered by government debt, and this debt is larger than the rise in savings at $t = 0$. As a result, part of the initial lower levels of savings will be used for financing the debt, so that the capital-labour ratio actually falls at $t = 1$.
From $t = 1$ onwards, the PAYG scheme is balanced again, but to keep debt per capita constant an extra tax is introduced (τ_t^B) to pay the interest obligations on the debt. This extra tax has a negative effect on savings in country P. Moreover, wages decline, so that the capital-labour ratio continues to decrease.
In Figure 8 it can be seen that the capital-labour ratio falls more when country P does not have integrated capital markets with country F. The reason for this is that in case of open economies part of the government debt of country P can be financed with savings of country F.

The change in consumption and utility

Compared to the previous pension reform scenario, the result is reversed: now the capital-labour ratio falls over time instead of rises. This implies that the effect on the other endogenous variables is also reversed. Actually, all simulation graphs are almost the mirror images of those of the pension reform in Section 3.1, the peaks are only one period later, because people in the PAYG country do not adjust their behaviour at $t = -1$. This means that the pension reform in the country P leads to less consumption possibilities for the young in country F, while the elderly in this country gain (See also Figures 13 and 14).

The changes in lifetime utility are shown in Figures 9 and 10. At the time of the reform the young in country P gain from the lower tax, which enables them to get a higher return than they would have obtained under the unchanged PAYG-tax. All next generations in both

country P and country F, however, experience a lower wage, which makes them the losers of this reform policy. However, the fact that they form a monetary union with country F protects the generations living in country P to some extent, as part of the burden of this reform policy is transmitted to country F via the capital market.

3.3 Intermediate case

One can imagine that it is possible to have a pension reform scenario that is an intermediate case between the pension reform described in this section and the one of Section 3.1, such that in the long run the capital-labour ratio, consumption, and lifetime utility are back at their old steady state values. This is the case for a pension reform where the old people at the time of the reform are *partly* compensated, resulting in a smaller increase in government debt. In Appendix C we show the simulation graphs for the case where the pension benefits fall with 25% at the time of the reform ($t = 0$) instead of holding benefits constant for one period. For the rest, this pension reform is exactly the same as the reform described in this section. This exercise makes clear that it is possible for the government to partly compensate the people that are old at the time of the reform in such a way that future generations do not lose compared to the old steady state. It is not possible, however, to compensate the old people at $t = 0$ completely, without hurting future generations, because in that case too much government debt is created so that private capital is crowded out. So there will always be one generation that suffers from a pension reform.

4 Concluding remarks

This paper focused on the question how a country with an extensive funded pension scheme (e.g. the Netherlands) is affected when a country that relies to a relatively large extent on unfunded pensions (like, for example, Italy) reforms its pension system. To answer this question a simple two-country two-period overlapping generations model was used. The two countries only differ in their pension schemes, one country uses a PAYG system and the other country uses a funded system. Because capital can move freely between the two regions, the reform in the PAYG country spills over to the funded country via the capital market. In this paper, a pension reform means that part of the PAYG pension scheme is privatised, leading to higher savings in the PAYG country. The question is whether this increase in household savings results in a higher capital stock in the next period. Crucial for this is to what extent the government of the PAYG country compensates the elderly

during the transition phase, in other words, how large public dissaving is.

We find that possible gains and burdens occurring in the PAYG country are, at least partly, transmitted to the funded country via the capital market. So the funded country shares both in the costs and the benefits of the reform. In particular, at the time of the reform the elderly in the funded country will be hurt by the reform if their age group in the reforming country is not compensated. The reform also affects the distribution of consumption between young and old individuals at a given time. For example, if the reform engenders positive utility effects, individuals will consume relatively more during their working years. In the funded country the elderly will even consume less in absolute amounts after the reform. So even though overall the funded country gains from the pension reform in the PAYG country, individuals are worse off during retirement.

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A Simulation pension reform without government debt

The graphs in these three appendices are based on simulations with the following production function, $f(k_t) = k_t^{0.3}$. Furthermore, $\rho = 0$ and $\delta = 0$.

Figure 1: Change in k_t

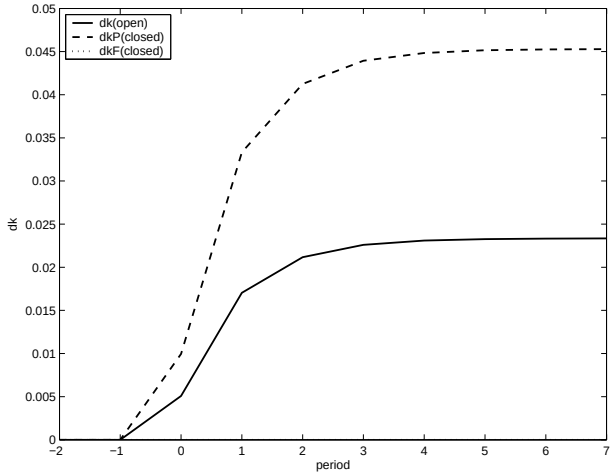


Figure 2: Change in U_t^P

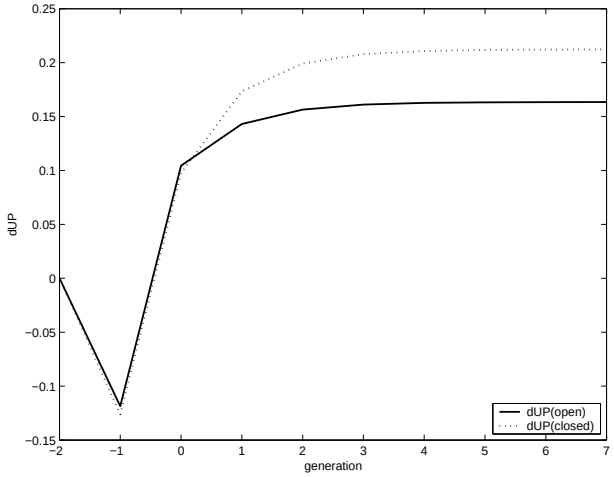


Figure 3: Change in U_t^F

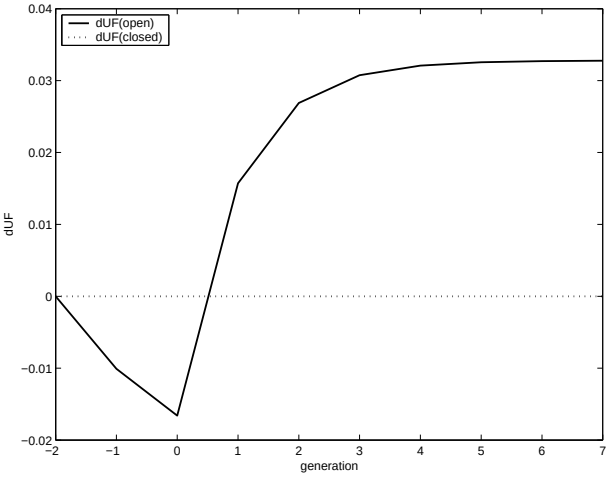


Figure 4: Change in $c_t^{y,P}$

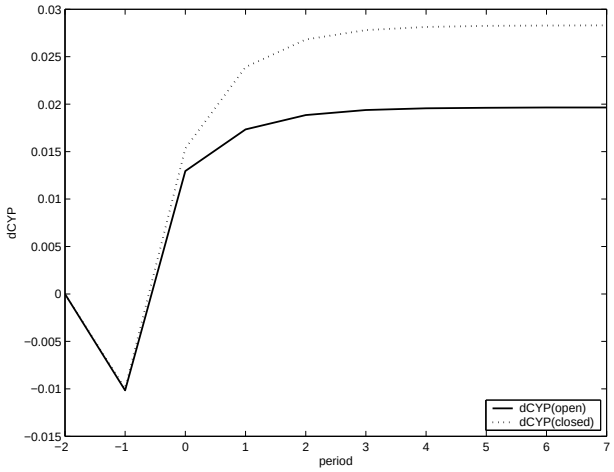


Figure 5: Change in $c_t^{o,P}$

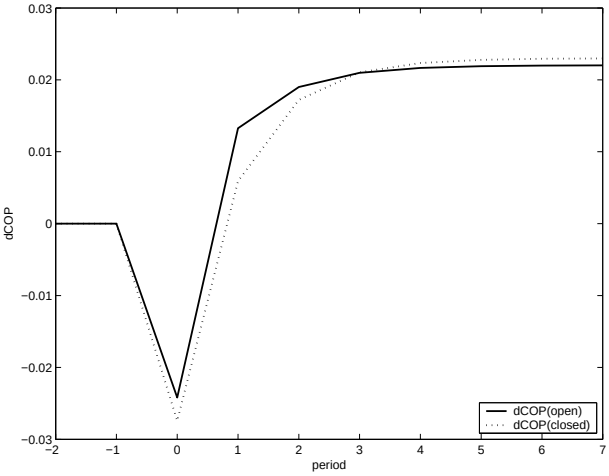


Figure 6: Change in $c_t^{y,F}$

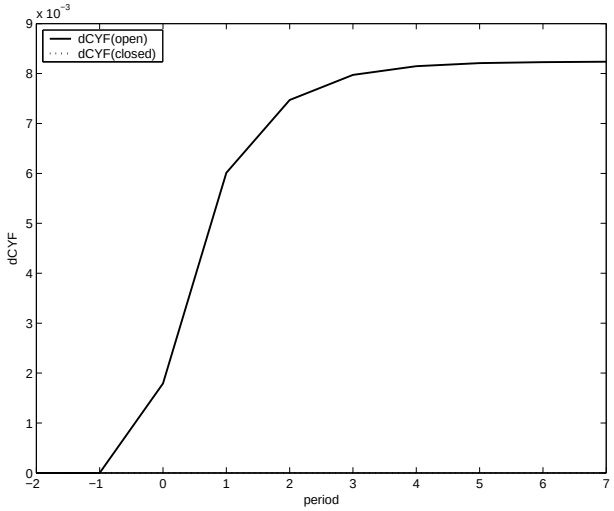
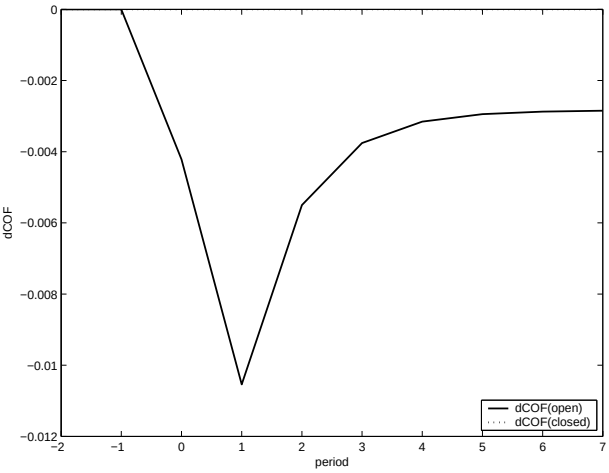


Figure 7: Change in $c_t^{o,F}$



B Simulation pension reform with debt creation

Figure 8: Change in k_t

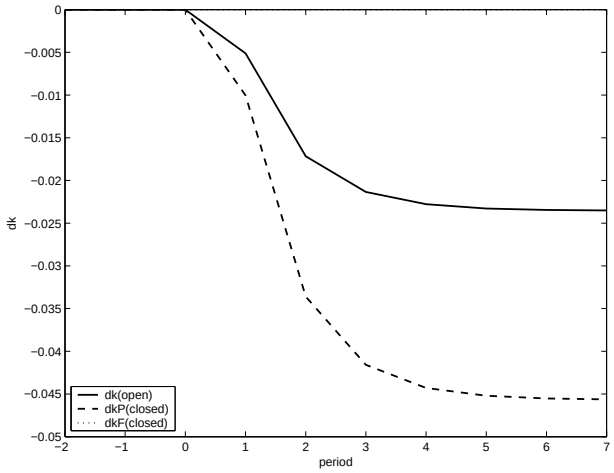


Figure 9: Change in U_t^P

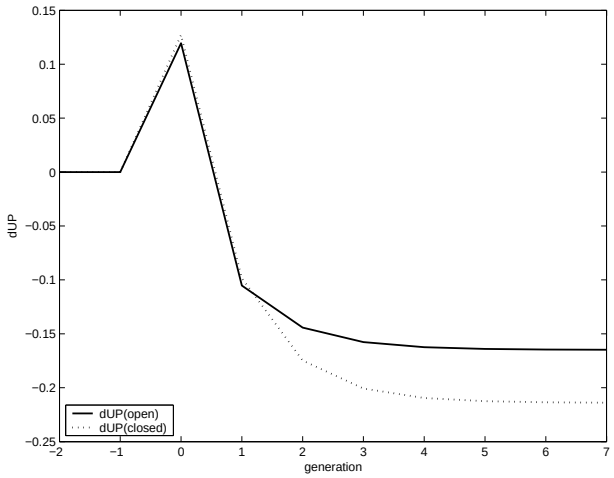


Figure 10: Change in U_t^F

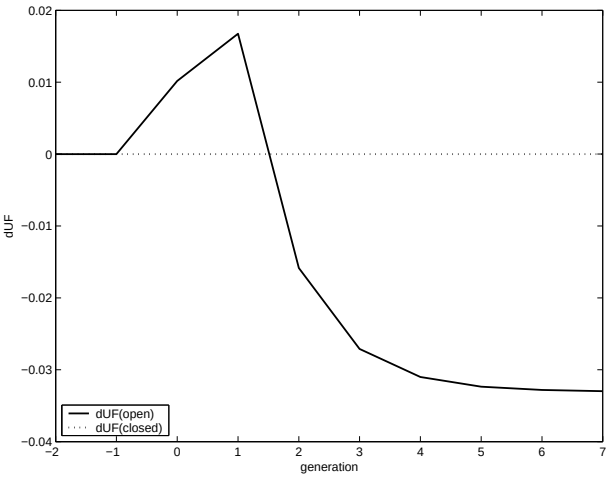


Figure 11: Change in $c_t^{y,P}$

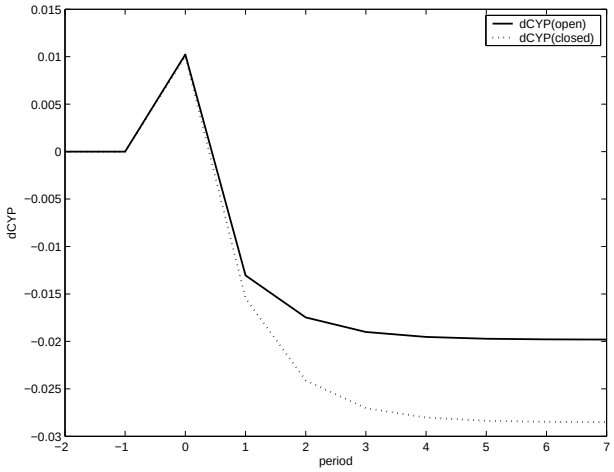


Figure 12: Change in $c_t^{o,P}$

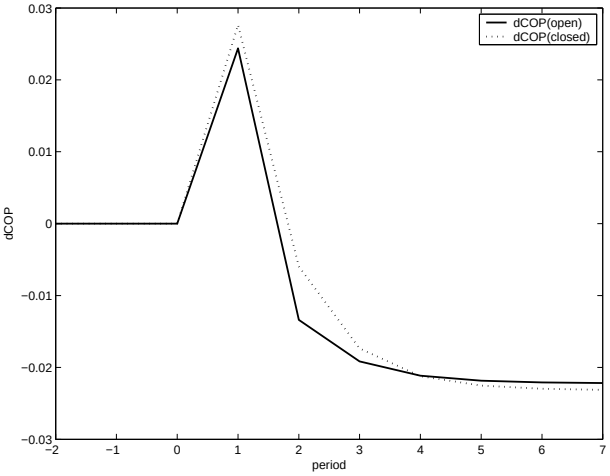


Figure 13: Change in $c_t^{y,F}$

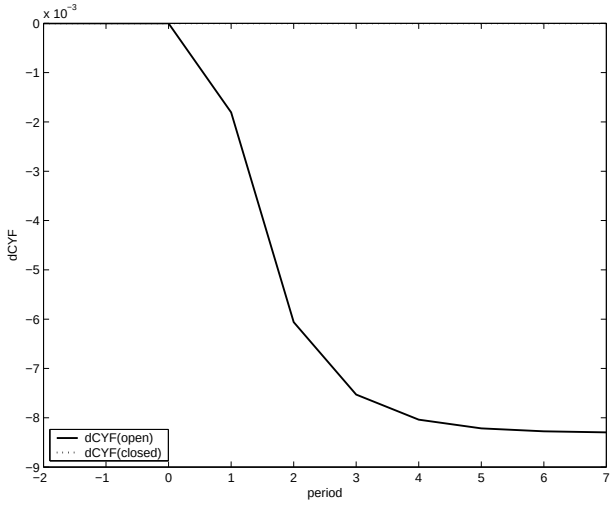
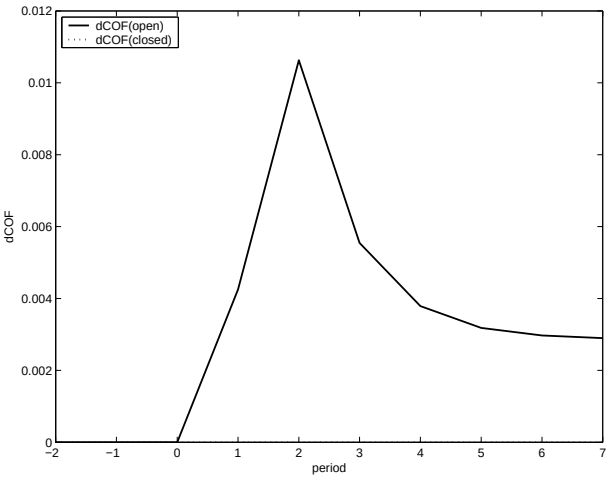


Figure 14: Change in $c_t^{o,F}$



C Simulation intermediate case

Figure 15: Change in k_t

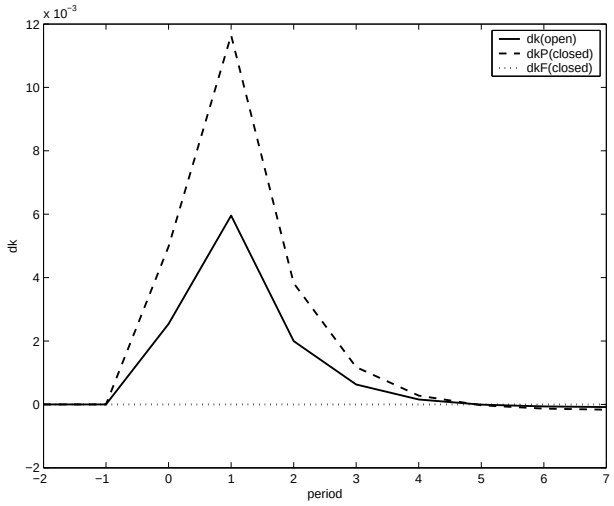


Figure 16: Change in U_t^P

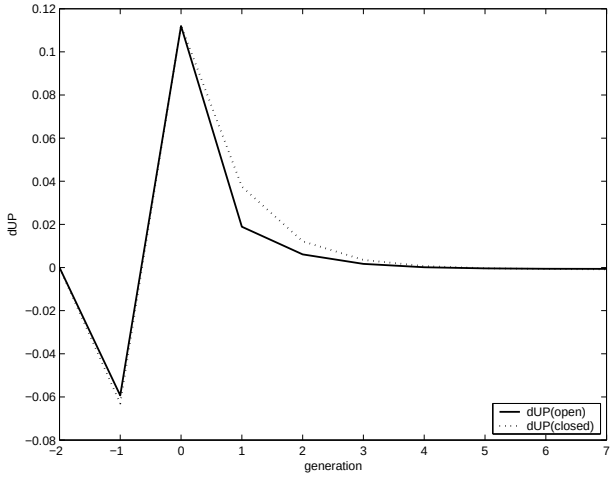


Figure 17: Change in U_t^F

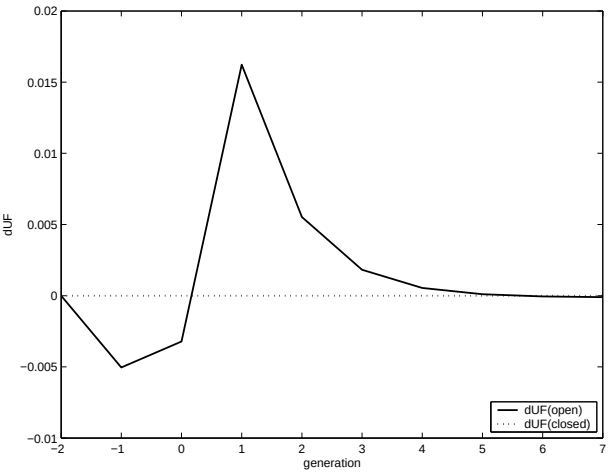


Figure 18: Change in $c_t^{y,P}$

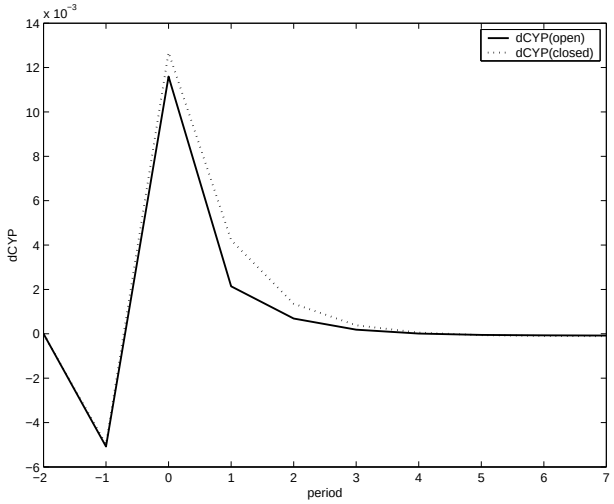


Figure 19: Change in $c_t^{o,P}$

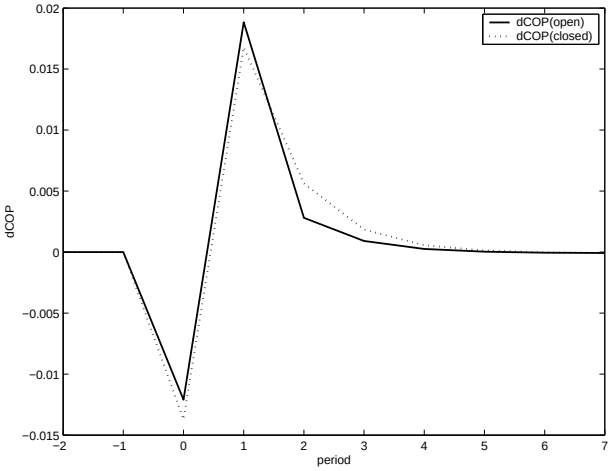


Figure 20: Change in $c_t^{y,F}$

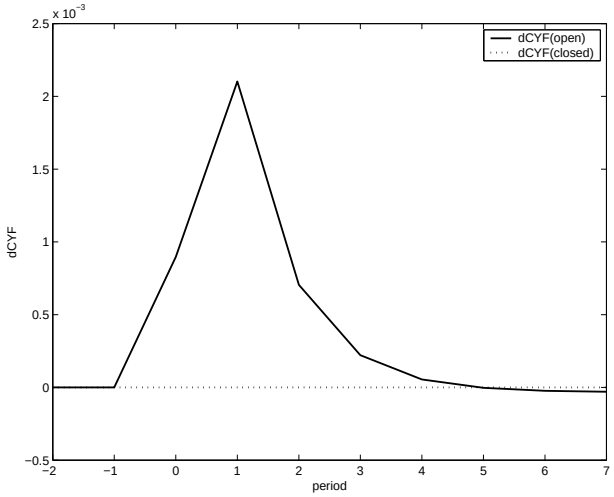


Figure 21: Change in $c_t^{o,F}$