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Crisis and Pension System Design in the EU

Intergenerational Redistribution and International Spillover Effects via Factor Mobility

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Working paper

Crisis and pension system design in the EU: Intergenerational redistribution and international spillover effects via factor mobility

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Abstract

Many EU states have adjusted pension benefits or reformed the pension system in reaction to the recent economic crisis, while other member states have postponed this type of adjustments. In this paper we analyse the welfare effects of these different reactions to the crisis in an economic union. We show that flexible pension schemes spread the burden of the crisis more evenly over various generations. As production factors are mobile within an economic union, differences in pension adjustments lead to international spillover effects. In particular, countries that respond quickly to the crisis may be harmed by the lingering in other member states. We show that the extent to which this is the case depends crucially on the degree of labour mobility in the short run.

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1 Introduction

The world economic crisis has affected all countries in the European Union (EU). As the response to the crisis is not coordinated in the EU, member states reacted differently. Some countries responded swiftly by reducing pension benefits. For example, in Germany pensions are linked to last year's wage rates, so the pensions were automatically reduced with one year delay, and in Lithuania the pensions were reduced using "solidarity withholdings". Other countries have not yet adjusted pensions, or even increased them. Greece and the UK, for example, have increased old-age payments as a part of an economic stimulus package and Norway and Ireland used public pension reserves for crisis mitigation. This mitigates the effect of the crisis for the current old, but shifts part of the burden to the current young and future generations. An interesting question is which reaction spreads the burden over the generations more evenly. In this paper we analyse this question in an overlapping-generations model of a two-country economic union with capital and labour mobility. We show that a flexible pension scheme that adjusts pension benefits immediately after a temporary crisis leads to a more even distribution of the reductions in lifetime utility over generations than an inflexible scheme that protects the benefits of current retirees.

As production factors are mobile in an economic union, differences in the reactions to the crisis inevitably lead to international spillover effects. That is, the recovery path in countries that respond quickly to a crisis is affected by the postponed policy reaction in other countries, and vice versa. Our model allows for analysing these spillovers effects. The extent to which a country that responds quickly to the crisis is harmed by the lingering in the other member state depends on the degree of labour mobility in the short run. When labour is perfectly mobile, that is, when young workers can migrate immediately after the crisis hits, postponing pension adjustments in one country harms young workers and their children in the other country. When labour is not perfectly mobile in the short run and workers can migrate only in the period after the crisis hits, the generations of workers at the time of the crisis in the country with flexible pensions benefit from the slow policy reaction in other country. In the long run generations in the country with flexible pensions benefit from the lingering in the other country, irrespective of the degree of labour mobility in the short run. So, if countries react differently to the crisis, countries with more flexible pensions will be better off if they can temporary limit immigration from countries that respond more slowly to the crisis. However, assuming that labour is mobile in the longer run, there is no strong argument for coordinating the reactions of pension systems to an economic crisis.

The analysis in the paper is based on a two-country two-generations model with common capital and labour markets. That is, labour and capital are internationally mobile. The countries are symmetrical but produce country-specific intermediate goods that are imperfect substitutes in final consumption and investment and run pension systems which may differ in terms of flexibility in response to the crisis. In countries with an inflexible system, pension benefits

are to a large extent determined by the benefit level in the previous period. In case of flexibility, pension benefits are independent of the benefits in the previous period and completely determined by the system parameters of the pay-as-you-go (PAYG) scheme, which is a mix of pure defined benefit (DB) and pure defined contribution (DC).

Usually, in two-country two-goods models, the presence of international trade eliminates the incentives for factor mobility. However, in models with different technologies, factor mobility may reinforce trade after a switch from autarky to an open economy (Razin and Sadka, 1992). In our model countries employ the same production functions, but the goods produced in the countries are different. In this setting the share of the world capital stock invested in each country is fixed, but capital flows still exist due to differences in savings resulting from asymmetrical pension schemes. The incentives for migration are not nullified either. In particular, the difference in pension flexibility will lead to what Hans-Werner Sinn dubs 'bad' migration, i.e. migration driven by the generosity of the welfare state[2]. Both channels will lead to international spillover effects. To indicate these spillover effects we perform numerical simulation experiments and compare the outcome in case one country has a flexible pension system and pensions in the other country are less flexible with the cases when both countries have the same (flexible or inflexible) pension scheme. In particular, we simulate the effect of an economic crisis modeled as a negative technological shock affecting both wages and the interest rate.

In next section, the model is presented. Section 3 elaborates on the numerical simulation experiments. The fourth section provides a discussion of the results and concludes.

2 The model

The model describes a two-country economic union. To distinguish between the countries, one country will be referred to as "home country" (H), the other being the "foreign country" (F). Each country produces a country-specific intermediate good. The country may export its product and import the good produced in the other country.

Agents consume final goods composed of the intermediate goods produced in both countries and firms invest final goods composed in the same way. Such a framework is often used in the models on different topics of international economics, see Cooper and Kempf (2004) or Colacito (2006). We apply this setting to link pension system design with the international spillovers via international trade and international flows of production factors.

The final good is composed of the intermediate inputs according to a Cobb-Douglas technology:

$$X = x^{\gamma}\tilde{x}^{1-\gamma} \tag{1}$$

[2]See Financial Times , July 12th, 2004

where X is the amount of the final good and x and $\tilde{x}$ are the inputs of the intermediate goods produced in country H and country F respectively. [3]

We take the goods produced in the home country as a numeraire and define p as a price of the intermediate good produced in the foreign country in terms of the intermediate good produced in the home country. This price may also be considered as a real exchange rate (see Amdur 2010 for example).If households and firms choose the input of intermediate products so as to minimize the costs of final consumption and investment goods, this results in

$$x = \gamma PX \tag{2}$$

$$\tilde{x} = (1-\gamma)\frac{PX}{p} \tag{3}$$

where P is the price of the final good in terms of the intermediate good produced in the home country, which is defined as:

$$P = \gamma^{\gamma}\left(\frac{1-\gamma}{p}\right)^{\gamma-1} \tag{4}$$

2.1 Firms

Production of the country-specific intermediate good in the home country (y) is described by a standard Cobb- Douglas function with constant returns to scale:

$$y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \tag{5}$$

where A_t denotes the level of technology at time t, K_t is the stock of capital and L_t stands for the number of young agents working in country H.

Capital depreciates in one period. The wage rate and the interest rate are expressed in the intermediate good and equal to the marginal returns of labour and capital, respectively:

$$w_t = (1-\alpha)A_t K_t^{\alpha} L^{-\alpha} \tag{6}$$

$$1 + r_t = \alpha A_t K_t^{\alpha-1} L^{1-\alpha} \tag{7}$$

$$\tag{8}$$

The production structure in the foreign country is identical.

2.2 Households

Every agent lives for two periods, so there are two overlapping generations in the model: young and old. When young, agents inelastically supply one unit of

[3] Throughout the paper, variables without a ˜ refer to the home country, variables with a ˜ indicate the corresponding variable in the foreign country. We use small letters to indicate variables in terms of the intermediate good produced in the country and capitals stand for variables in terms of the final good and for the labour force.

labour. They decide at the beginning of their industrious life where to live and work and cannot migrate at a later stage. Agents get pension benefits from the country they worked in, so there is no reason to migrate when old.

Utility of an agent working in the home country in period t is described by:

$$U_t = log(C_t^y) + \frac{1}{1+\rho} log(C_{t+1}^o) \tag{9}$$

where C_t^y is consumption when young and C_{t+1}^o is consumption when old (both in terms of final goods) and ρ is a discount factor. The budget constraints for this agent are:[4]

$$P_t C_t^y = w_t(1-\tau_t) - P_t S_t \tag{10}$$

$$P_{t+1} C_{t+1}^o = (1+r_{t+1}) S_t + b_{t+1} \tag{11}$$

where τ_t is the contribution to the pension scheme, b_{t+1} is the pension benefit received when old and S_t is the amount of savings expressed in final goods.

The home country runs a PAYG pension scheme:

$$L_t \tau_t w_t = b_t L_{t-1} \tag{12}$$

Pension benefits are determined according to the following formula:

$$b_t = \phi w_t \left(\xi \frac{L_t}{L_{t-1}} + (1-\xi) \right) (1-\eta) + \eta b_{t-1} \tag{13}$$

Usually defined benefit pension schemes are modeled as $b_t = \phi w_t$, with the replacement rate ϕ, $0 < \phi < 1$ (see Casarico (2001) for example). In that case, the tax rate is endogenous. If a country has a DC pension scheme, b_t is usually assumed as $\phi w_t L_t / L_{t-1}$ and the PAYG tax rate is constant and equal to ϕ. Taking a weighted average of these two systems with the weights ξ and $1-\xi$ we construct a hybrid pension system. Furthermore, we assume that the government may meet frictions adjusting the pension system, which is modeled via the parameter η. When η is equal to zero the country has a flexible pension system design, and when η is equal to unity, the government cannot adjust pension benefits. The intermediate case implies that the government adjusts the pension system, but not very flexibly.

Substituting constraints (10) and (11) into utility function (9) and differentiating it with respect to S_t, we get the equation for the optimal intertemporal allocation of consumption:

$$C_{t+1}^o = \frac{1+r_{t+1}}{(1+\rho) P_{t+1}} C_t^y \tag{14}$$

The equations for the foreign country are analogous, the only difference being that the parameters for the pension scheme differ.

[4]Here we have used the fact that the return on savings is equal, irrespective of the country in which savings are invested (see equation (15)).

2.3 Equilibrium

Financial capital is perfectly mobile. That is, savings can freely move from one country to the other, implying that the anticipated return on savings is equal in both countries. As we assume rational expectations, this also implies that the actual return on savings is equal:

$$1 + r_t = p_t(1 + \tilde{r_t}) \tag{15}$$

except for the period in which an unexpected shock hits the economy. This exception is due to the assumption that physical capital is not mobile. That is, once it is invested in a country, savings can not be reallocated again when an unexpected shock arrives. As a result, in case of an unexpected event, the realized return at that point in time differs from its anticipated value and may differ between the countries. As savings will immediately adjust, the anticipated return in the subsequent periods and - in the absence of further shocks - also the realized return in these periods will be equal again.

Labour mobility implies that agents migrate to the country where lifetime utility is highest. Hence, rational expectations imply that, in the absence of unanticipated shocks, lifetime utility in both countries is equal:

$$U_t = \tilde{U}_t. \tag{16}$$

As a larger budget allows agents to reach higher utility, this condition may be rewritten as an equality of present values of expected lifetime income in both countries. Whether this equality also holds in case of unexpected shocks depends on whether the shock is realized before or after the migration decision is taken. We allow for both cases. In case of *perfect labour mobility* workers born in the period that a shock hits the economy can choose the country to live after the shock is realized. Consequently, in this setting, expected lifetime utility of the young in both countries is always equal. In case of *imperfect labour mobility* in the short run workers choose their country before the shock is realized and cannot migrate when the crisis is revealed. So in this case, lifetime utility of a worker in the period of a shock may differ in both countries. Of course, in the subsequent periods expected lifetime utility should be equal again. Also note that realized lifetime utility for the generation that is old at the time of the shock may differ both from its anticipated value and between countries, as we assume that retirees cannot migrate.

Total investment in the union equals total savings:

$$K_{t+1} + \tilde{K}_{t+1} = L_t S_t + \tilde{L}_t \tilde{S}_t \tag{17}$$

Total demand for final goods in the union (D) is the sum of total investment (savings) and consumption:

$$D_t = L_t(S_t + C_t^y) + L_{t-1}C_t^o + \tilde{L}_t(\tilde{S}_t + \tilde{C}_t^y) + \tilde{L}_{t-1}\tilde{C}_t^o \tag{18}$$

Using equations (2) and (3) equilibrium on the intermediate goods markets can be written as:

$$y_t = \gamma P_t D_t \tag{19}$$

$$\tilde{y}_t = (1-\gamma)\frac{P_t D_t}{p_t} \tag{20}$$

From this we can derive an equation for the real exchange rate:

$$p_t = \frac{1-\gamma}{\gamma}\frac{y_t}{\tilde{y}_t} \tag{21}$$

This equation allows us to rewrite the equilibrium condition for the capital market (15). Observing that $y_t = K_t(1+r_t)/\alpha$ this equation implies:

$$\frac{\tilde{K}_t}{K_t} = \frac{1-\gamma}{\gamma}. \tag{22}$$

Equilibrium condition (22) describes the allocation of the total capital stock in the union to the countries. Note that the allocation depends on preference parameters only; fiscal factors such as the design of the pension scheme play no role.

3 The effects of a crisis

In this section we describe the results of a numerical simulation experiment in order to illustrate the effects of an economic crisis. The system is assumed to be in equilibrium until at time $t = 0$ the crisis arrives. The crisis is modelled as an unexpected adverse technological shock which affects both countries in the union in the same way. That is, both A and $\tilde{A}$ decrease at the same rate, lowering wages as well as interest rates in both countries.

We consider three cases: both countries have flexible pension systems, both countries have inflexible pension systems, one country has a flexible pension system and the other an inflexible pension system.

3.1 Calibration

In the absence of a crisis, both flexible and inflexible pension systems provide the same pension benefits and labour is allocated evenly to both countries. Total population in the union $L_t + \tilde{L}_t$ is assumed to be constant and equal to 100. The initial technological levels are the same: $A_t = \tilde{A}_t = 100$ and temporarily fall to $A_t = \tilde{A}_t = 70$ at the time of the crisis, after which the original level is restored.

In both countries the share of capital in the production function equals $\alpha = 0.3$. This value is widely used in the literature (see, for example, Barro et al. (1995) or Barger (1969)) and it is in line with the empirics (see Maddison (1987)).

The most common choice of the annual discount rate is near 1% (see, for example, Börsch-Supan et al. (2006)). As the period in our model is approximately equal to 35 years the discount rate ρ is set to 0.4166 which corresponds to an annual 1% rate of discount. The parameter γ, which determines the share of goods produced in the home and the foreign country in the composite goods, is set to 0.5. Choosing this parameter value we make the countries exactly the same, except for the flexibility of the pension scheme.

The pension system is characterized by three parameters: ϕ, ξ and η. The parameter ξ, which determines the mix of DB and DC of pension schemes, is set to 0.5. This implies that the pension scheme is a true mix of a DB and DC system. The parameter η is set to zero if the pension system is flexible and 0.5 if there are frictions in adjusting pension benefits. The parameter ϕ is set to 30%. This choice of the value of the parameter ϕ does not affect the results qualitatively, but the values of parameters η and ξ have several implications on the recovery path. In the Appendix we briefly discuss the effects if these parameters have different values.

3.2 Effects on key economic variables

Pension benefits

Figure 1: Pension benefits for different pension schemes (imperfect labour mobility)

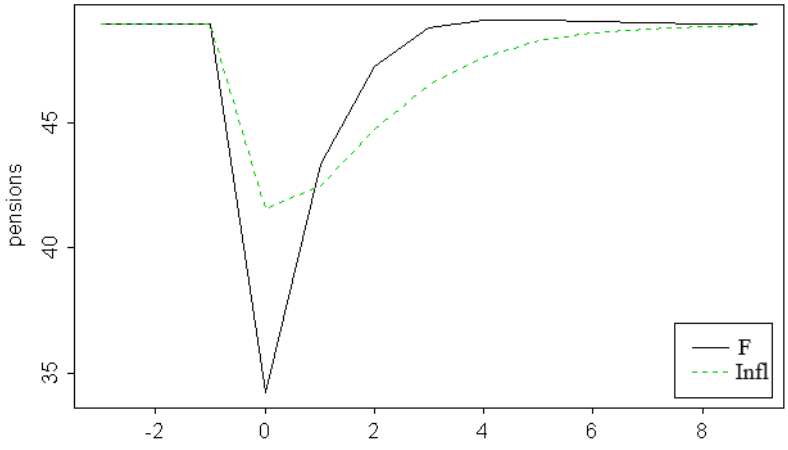


Figure 1 shows how pension benefits change when a country has a flexible or an inflexible pension system. Labour is assumed to be immobile in the short run and the foreign country is assumed to have a flexible pension scheme. With an inflexible pension scheme, the decrease in the pension benefit at the time of the economic crisis is smaller than in case of flexible pensions, but in subsequent periods benefits are lower since they depend on the benefits in earlier periods.

The graph does not change much if the foreign country has inflexible pensions or when labour is perfectly mobile in the short run.

Migration

Figure 2: The share of labour in the home country with perfect and imperfect labour mobility

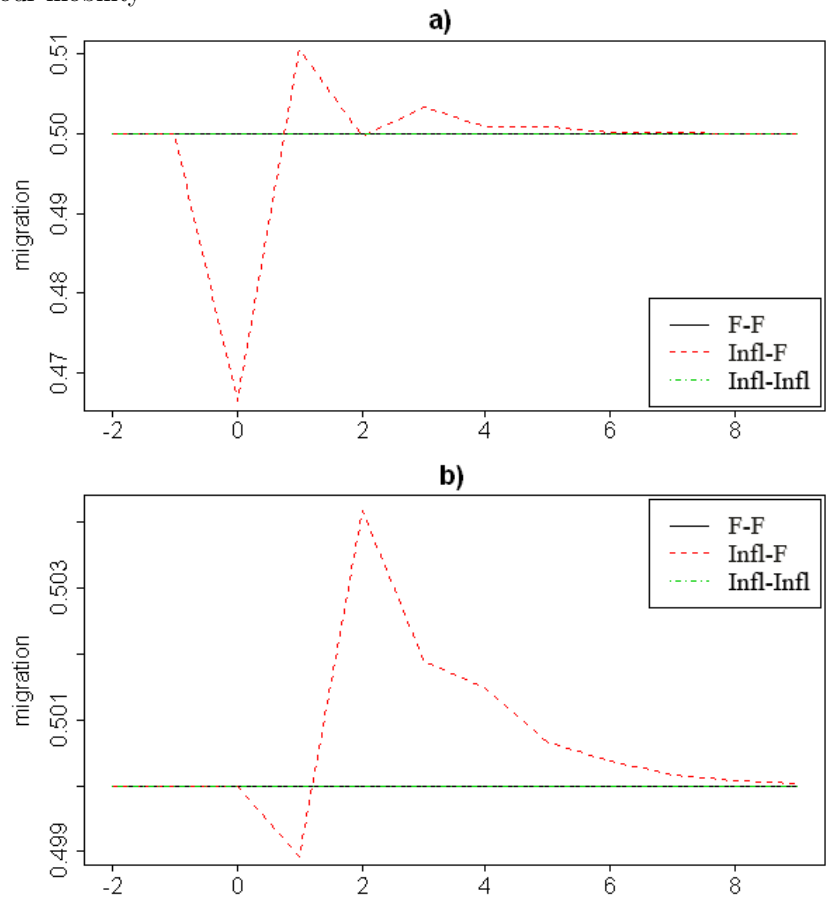


Figure 2 presents the share of world labour concentrated in the home country (country H), both in case of perfect and imperfect labour mobility. If both countries have the same pension system all workers are affected in exactly the same way, therefore, there is no reason to migrate. However, this is not the case when the countries respond differently to the crisis. Let's first consider migration with perfect labour mobility (Figure 2 panel a). Migration then starts immediately after the shock, i.e., at time $t = 0$. At that moment, the inflexible country becomes less attractive for working people, since they need to

pay higher contributions. So, if the neighbouring country has a flexible pension scheme, a part of the working population migrates to it. This results in a relatively large number of pensioners at time $t = 1$ which makes the flexible country less attractive, and there is a significant migration to the inflexible country. In the subsequent periods, the system converges to its equilibrium, but the dynamics are not monotonic. At $t = 2$ the larger number of pensioners leads to an emigration out of the inflexible country, and at $t = 3$ a part of the migrants return to the country with the inflexible pension system design.

Now consider the case with imperfect labour mobility (Figure 2 panel b). When the home country has an inflexible pension system and the other country has a flexible pension scheme, there will be migration at $t = 1$ to the country with the flexible pension scheme. Pension benefits at $t = 1$ are slightly higher in country F, so young agents must pay higher taxes there, which makes the flexible country less attractive. But, at $t = 1$ young agents in the country with flexible pensions expect much higher pension benefits, which outbalances the losses from higher taxes and invokes migration to this country. At time $t = 2$ the young generation has smaller incentives to work in country F, since there are relatively many old people they need to support. Moreover, at time $t = 2$ the gap between pension benefits in the countries is larger, which results in higher taxes in the country with the flexible pension scheme. This leads to migration from country F to country H at $t = 2$. Further, the system continues going to its equilibrium. It shall also be noted that with imperfect mobility flows are much smaller.

The lesson from Figure 2 is that the crisis evokes migration to the flexible country first, and in subsequent periods migrants return to the inflexible country. Of course, the size of the migration flows depends on the parameter values. In particular, migration is larger when when ξ is smaller (see Appendix).

The real exchange rate

The effect of the crisis on the real exchange rate of the home country is presented in Figure 3 panels a and b. Indeed, migration strongly affects the price of the goods produced in country H relative to that of goods produced in the other country. If there is migration to country F, relatively more goods are produced in this country. Hence, the price of goods produced in country F falls and the real exchange rate of the home country rises. If there is migration to country H, the effect is the opposite: the goods produced in country H become cheaper.

Capital

Figure 4 presents the total capital stock in the union. The dynamics is very similar for the cases with perfect and imperfect labour mobility, therefore we only present the latter one. In the "post crisis" period ($t = 1$) the capital stock in the union is lowest when both countries have inflexible pension schemes, while it is largest when both counties have flexible pension schemes. This can easily be explained by the fact that, with an inflexible pension scheme, the

Figure 3: Real exchange rate with perfect mobility and imperfect labour mobility

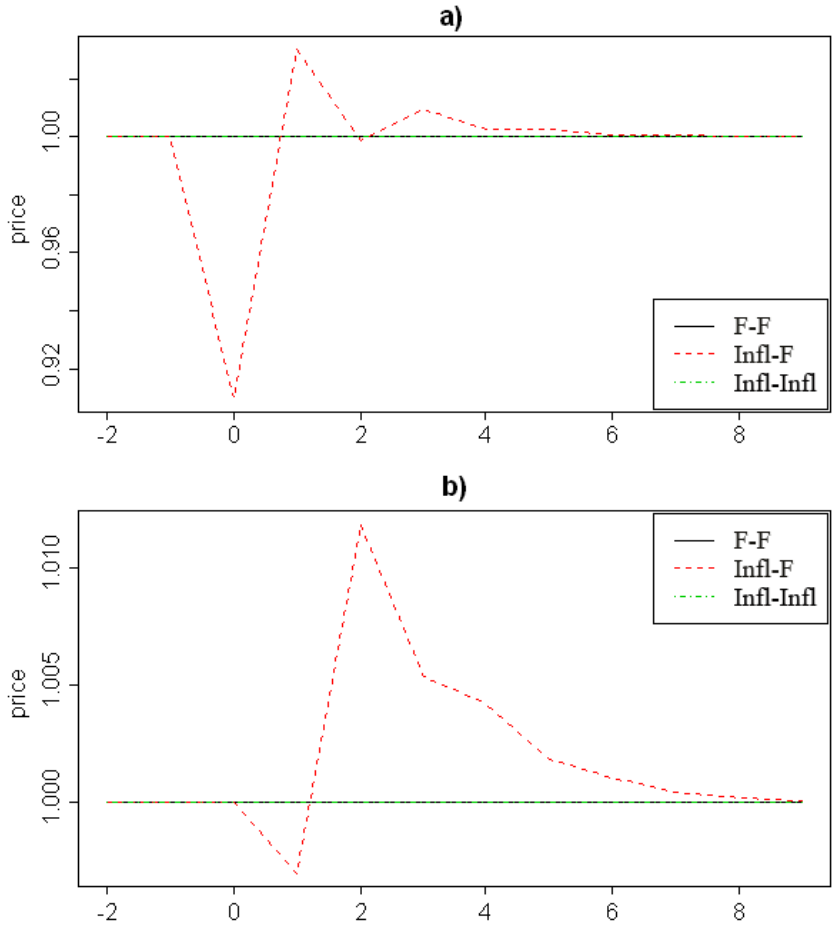
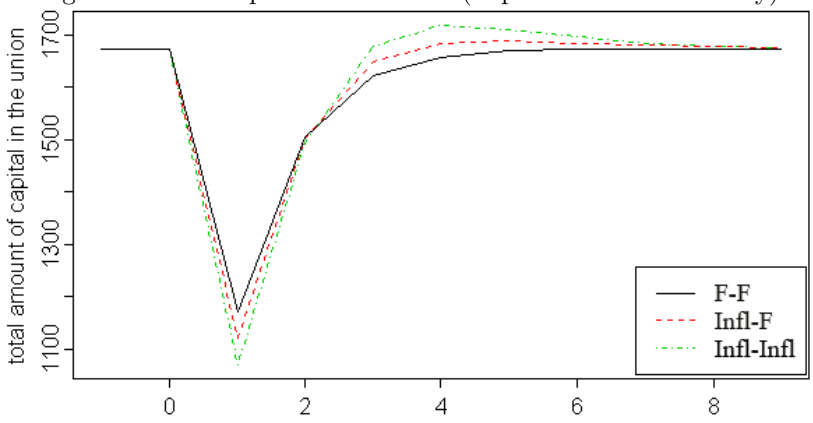


Figure 4: Total capital in the union (imperfect labour mobility)



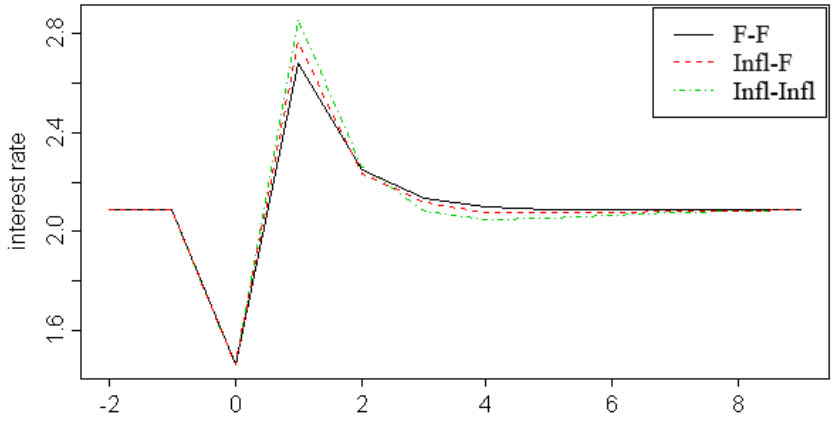
young generation at time $t = 0$ needs to give a larger share of their income to the old, leaving less resources to save compared to the case with a flexible scheme. Everything changes in the opposite way in subsequent periods: the young generation at time $t = 0$ has lower wages and hence, in the case of an inflexible pension system, pension benefits at time $t = 1$ and subsequent periods are lower, which allows for more capital accumulation.

Note that equation (22) implies that the total capital stock remains evenly spread over both countries. This result holds both with perfect and imperfect labour mobility. The economic intuition for this is as follows: migration from country H to country F creates incentives for capital to move in the same direction. However, the decreasing price of goods produced in country F reduces the interest rate and cancels this effect out. So migration from one country to another only changes the price and does not affect the allocation of the capital stock. This result crucially depends on the way capital is constructed. If the assumption that capital and consumption consist of the same composite good is changed, the international allocation of capital will be affected by migration. Note that the fact that the international allocation of the capital stock does not change does not imply that there are no international capital flows. Saving in both countries develops differently, implying that international capital flows are necessary to remain the same international allocation of the capital stock.

The interest rate

Figure 5 presents the time path of the interest rate in case of imperfect labour mobility. At the time of the adverse technological shock ($t = 0$) the capital stock is given and the interest rate decreases by the same amount in all cases. In subsequent periods, there is no direct effect of the shock any more and the development of the interest rates follows from the evolution of the capital stock. In period $t = 1$, for example, interest rates are higher due to a lower capital

Figure 5: Interest rates (imperfect labour mobility)



stock. In the subsequent periods they gradually converge to their steady-state values.

If labour is mobile in the short run, the interest rates may differ at $t = 0$ between the countries, however, the difference is small.

3.3 Spillover effects

Perfect labour mobility

Home country with flexible pensions

Figure 6 panel a shows the effects of crisis on the lifetime utility of agents in country H for different pension designs in foreign country when the home country has a flexible pension scheme and labour is perfectly mobile. The utility of the generation that is old at the time of the shock (i.e., the generation born at time $t = -1$) falls slightly more when the home country has inflexible pensions. In this case, workers at time $t = 0$ migrate to country H which increases the tax base and thus raises pension benefits. However, the inflow of labour also reduces wages at $t = 0$ and what is more important, the price of goods produced in country H decreases. These effects dominate the positive tax-base effect on pension benefits. Furthermore, if the foreign country has an inflexible pension scheme, migration at $t = 0$ from country F to country H raises interest rate in the latter country and reduces it in the former. This implies that the allocation of investment of generation $t = -1$ over both countries is sub-optimal ex-post. The effect of this on lifetime utility is negligible however. So, all together utility of the old at the time of he shock in the home country is smaller when the neighbouring country has an inflexible pension scheme, but the difference is pretty small.

For the generation born at time $t = 0$ in the home country it is better to have a neighbouring country with a flexible pension scheme because an inflexible

pension in country F evokes migration to country H at $t = 0$, reducing wages and the price of goods produced in this country. Furthermore, an inflexible pension scheme in country F reduces the amount of capital at $t = 1$, which drives wages at $t = 1$ down, reducing pension benefits. The effect of migration to the inflexible country at $t = 1$ reduces pensions in the home country, but this is compensated by the increase in price and wages in country H at $t = 1$ so that is does not have a large effect on lifetime utility.

When the neighbouring country has inflexible pensions, the generation born at time $t = 1$ in the home country suffers from a smaller amount of world capital which drives wages down. At the same time, workers migrate to country F at $t = 1$, which has a positive impact on wages. The net effect on the real value of pension benefit of the decrease in the tax-base due to emigration and the increase in the price of goods produced in country H is very small again. So, the reduction of world capital dominates and lifetime utility of the generation born at $t = 1$ in country H is lower when the neighbouring country has inflexible pensions.

Generations born in the subsequent periods are better off when the neighbouring country has an inflexible pension scheme. This is because the inflexibility of pension benefits leads to a larger stock of capital in the world. So we may conclude that, when labour is perfectly mobile, the negative productivity shock harms more in the short run when the neigbouring country has the inflexible pension scheme. The other generations gain compared to the case when the neighbouring country has a flexible pension system.

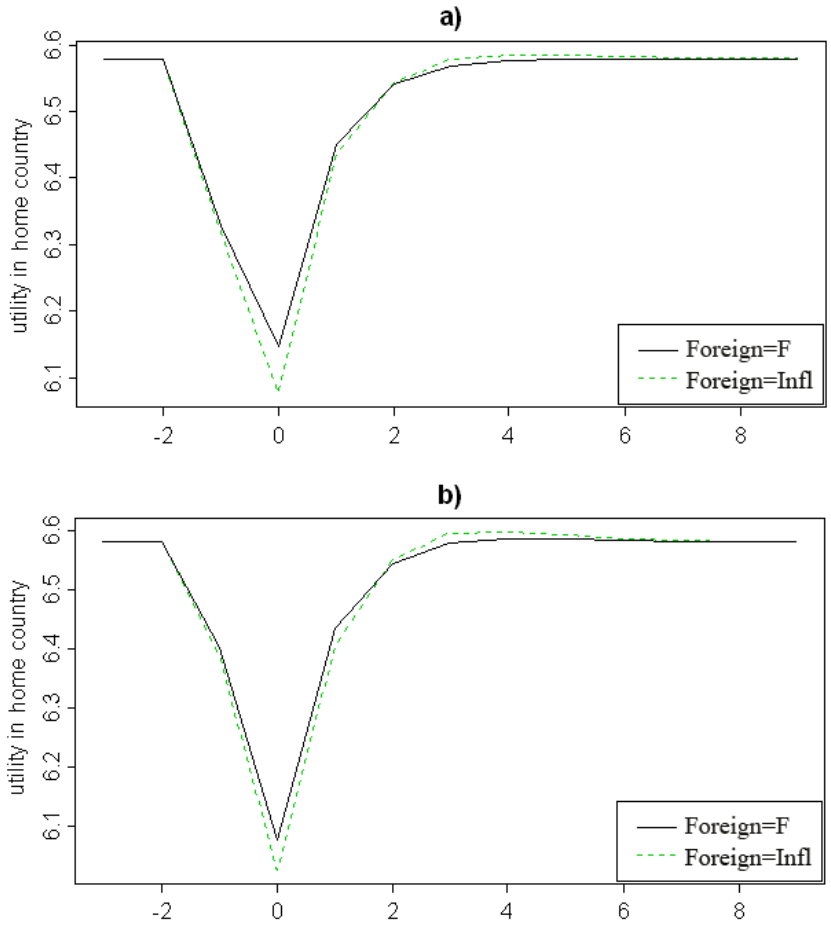
Home country with inflexible pensions

Also when country H has an inflexible pension scheme, the generation born at time $t = -1$ is slightly better off when the foreign country has flexible pensions. In this case emigration out of country H at $t = 0$ reduces pension benefits of the generation $t = -1$. Again, the effects on wage and price have a positive effect and they exceed the negative effect of migration. The generation born at time $t = 0$ is better off when the neighbouring country has flexible pensions as well, for very similar reasons.

The generation born at time $t = 1$ has a larger capital stock at its disposal, but expects a lower interest rate when the neighbouring country has a flexible pension scheme. Furthermore, part of this generation migrates to country F, which raises wages and the price of goods produced in country H. Altogether, this generation is definitely better off when the neighbouring country has a flexible pension system. However, subsequent generations are worse off because the capital stock is smaller.

Conclusion To sum up, when labour is perfectly mobile, the generation born at the time of the shock ($t = 0$) in the home country is harmed by an inflexible pension system design in the neighbouring country, independently of the pension system design in country H. Also the generations born at $t = -1$ and $t = 1$ prefer the neighbouring country with the flexible pension scheme, but generations born in subsequent periods will generally gain from an inflexible pension system design in the neighbouring country.

Figure 6: a)-Home=flexible, b)- Home=inflexible, mobile in short run



These results are quite robust.[5]

Imperfect labour mobility

Home country with flexible pensions

Figure 7 panel a shows the effects of the pension system design in the foreign country on the lifetime utility of agents in the home country in case the home country has a flexible pension scheme and labour is not perfectly mobile. The utility of the generation that is old at the time of the shock (i.e., the generation born at time $t = -1$) does not depend on the type of pension system in country F, since there is no migration at $t = 0$ and the effects on the interest rate and the pension benefits at time $t = 0$ are independent of the pension system abroad.

For the generation born at time $t = 0$ it is slightly better to have an inflexible neighbour because a neighbour with inflexible pension scheme rises interest rate on savings at $t = 1$ (Figure 5). Migration to the home country at time $t = 1$ (Figure 2) raises the number of agents, paying taxes, but reduces their wages, and purchasing power because it reduces the relative price of the good produced in the foreign country. Despite these effects do not cancel out, the overall effect is very small.

When country F has inflexible pensions, the generation born at time $t = 1$ in the home country suffers from a smaller amount of world capital which drives wages down. Furthermore workers migrate to country H at time $t = 1$, which reduces wages even more. The net effect on the real value of the pension benefit of the decrease in the tax-base due to emigration and the increase in the price of goods produced in country F is very small again. So, the decrease in wages dominates and the total effect of having a neighbour with inflexible pensions on lifetime utility of the generation born at $t = 1$ is negative.

Generations born in the subsequent periods are better off when the neighbouring country has a inflexible pension scheme. This is because the inflexibility of pension benefits leads to a larger stock of capital in the world. So we may conclude that, when labour is not perfectly mobile, the inflexible pension system design harms the generation born at $t = 1$ only. The other generations gain compared to the case when the neighbouring country has a flexible pension system.

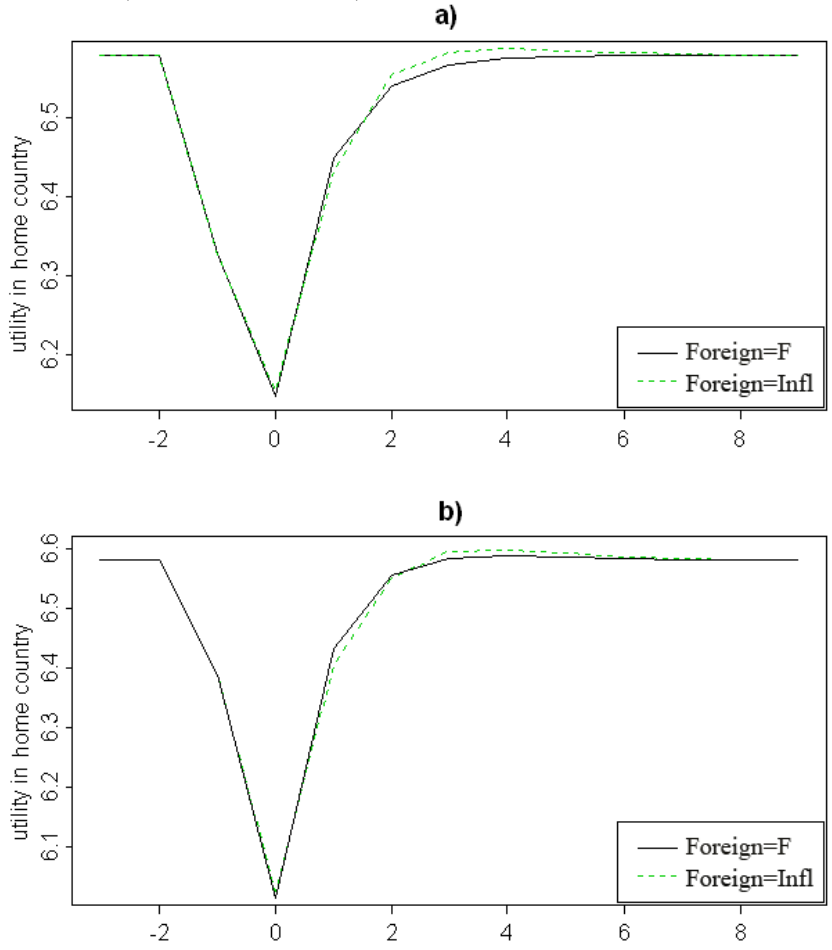
Home country with inflexible pensions

Also in this case, the generation born at time $t = -1$ is not affected by the design of the pension system in country F (see Figure 7 panel b). And just like in case of flexible pensions, the generation born at time $t = 0$ is better off when the neighbouring country has an inflexible pension scheme because of higher interest rates at $t = 1$.

The generation born at time $t = 1$ has a larger capital stock at its disposal, but expects a lower interest rate when the neighbouring country has a flexible pension scheme. Furthermore, part of this generation migrates to country F,

[5] With extreme parameter values (η close to unity for example) it is possible to achieve that the inflexible neighbour leads to lower utility not only for the generation $t = 1$, but also for generation $t = 2$, but the general result remains the same.

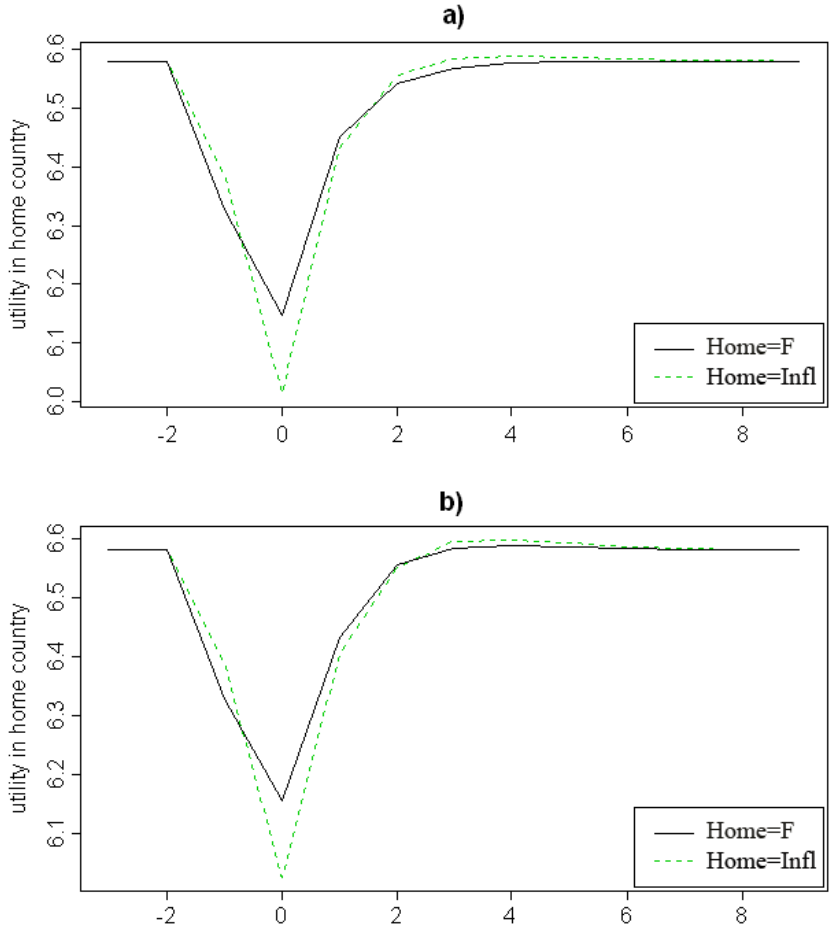
Figure 7: a)- Home=flexible, b)- Home=inflexible, immobile in short run



which raises wages and the price of goods produced in country H. Altogether, this generation is definitely better off when the neighbouring country has a flexible pension system. However, subsequent generations are worse off in this case because the capital stock is smaller.

Conclusion We can sum up that, when labour is not perfectly mobile, the generations born at the time of the shock ($t = 0$)in the home country is not harmed by inflexible pensions in the other country. The only generation which prefers a foreign country with a flexible pension scheme is the generation born at $t = 1$. Generations born at $t \geq 2$ prefer the inflexible neighbouring country. So, when labour mobility is restricted in the short run, it is rather attractive to have a neighbouring country with an inflexible pension scheme. Only the generation born at $t = 1$ would be slightly better off with a neighbouring country with flexible pensions.

Figure 8: a)- Foreign=flexible, b)- Foreign=inflexible, immobile in short run



3.4 Which pension system is better?

The obvious question arises: which pension system design is better for the home country? Figure 8 presents utility in the home country assuming imperfect labour mobility. The results in case of perfect labour mobility are similar, therefore we do not present this case. In panel a) the foreign country is assumed to have a flexible system, in panel b) country F has inflexible pensions. In both cases the generation born at $t = -1$ prefers to have an inflexible pension scheme. The generations born at $t = 0$ and $t = 1$ are better off with a flexible pension scheme but subsequent generations are better off when pensions are inflexible. The conclusion from the figures is that a flexible pension system spreads the burden of the crisis over the various generations more evenly: the generations that are harmed most are better off with flexible pensions. Another advantage of a flexible pension system comes from Figure 7: An inflexible pension scheme produces a positive spillover on the neighbouring country (except for generation $t = 1$), but this spillover comes at the cost of lower utility in the home country. So, in this sense, a flexible pension scheme is better. However, the intergenerational effects of pension system design have a much larger impact than the international spillover effects. This explains that panels a and b in Figure 8 are so similar.

4 Discussion and conclusion

The simulation experiments show that, irrespective of the pension system design in the foreign country and the degree of labour mobility, a flexible pension scheme spreads the burden more equally over generations. This conclusion should be interpreted with some caution, however, as we only looked at the effects on lifetime utility, not on the effects on consumption in specific periods in life. The consumption of the elderly at the time of the shock will significantly decrease because the crisis reduces the return on their pension savings. This implies that utility in the second period of their life is substantially lowered. But because their first-period utility cannot change any more, the reduction in their lifetime utility is much more moderate. So looking at lifetime utility only may underestimate the problem of old-age poverty for the elderly at the time of the shock. On the other hand, lifetime utility seems a reasonable measure to compare the effect on various generations'welfare and for other generations we do not explicitly take into account the way consumption or utility is allocated over the lifetime either.

Another clear conclusion from our analysis is that countries which responded to the crisis by quickly reducing pension benefits should not worry too much about neighbouring countries delaying pension adjustments. Firstly, international spillover effects are relatively small compared to the effects of the internal factors. Secondly, there may indeed be negative spillovers in the short run when labour is perfectly mobile, but then the medium-term spillover effects are positive. Moreover, short-run spillovers are negligible while medium-run spillovers

are positive when labour is not perfectly mobile, i.e., in that case having a neighbour with an inflexible pension scheme is attractive So countries with flexible pension schemes have an incentive to reduce migration from countries with less flexible pension schemes but they do not have strong incentives to influence their pension system.

As discussed more in detail in the appendix, these results are quite robust to parameter changes. One important assumption should be stressed however: we have assumed that the countries do not create government debt. In particular, countries with inflexible pension schemes may be tempted to shift part of the burden of costs of the adverse productivity shock to future generations. However, this leads to crowding out of capital and lowers utility for future generations in both countries in the union. Therefore, the conclusion that having a neighbour with an inflexible pension scheme is advantageous when labour is not perfectly mobile only holds when this neighbour does not raise government debt. So we may conclude that there is no strong argument for coordinating the adjustment in pension benefits in the countries of the union as long as countries with inflexible schemes can be prevented from creating government debt.

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Appendix: Robustness

If the inflexible country has a completely inflexible pension scheme, i.e. $\eta = 1$ then in the case of imperfect mobility there is a positive positive spillover on the generation born at $t = 0$ only, because at $t = 1$ the interest rate is higher. However, spillovers on the generations $t \geq 1$ are definitely negative, because in this case pension benefits in country F are never reduced and the total amount of capital in the union does not overshoot. With perfectly mobile labour the presence of a completely inflexible neighbour is definitely negative, because it shares all the short run losses with the home country and does not over-accumulate capital as it does with $0 < \eta < 1$. With a large η (but $\eta < 1$) the inflexible country F may negatively affect more generations, comparing to the case discussed, but still after a negative short run spillover future generations are affected positively.

The size of the migration flows depends on the parameter values. In both cases when labour is perfectly and imperfectly mobile, migration is larger when ξ is smaller, so the pension system is closer to DB, because then migration to country F reduces taxes there and raises taxes in country H more, which makes the foreign country even more attractive. The case is symmetric for migration to country H. So, in Figure 2 panel b), large migration to country F at time $t = 3$ is followed by relatively small migration at time $t = 4$. In the next period, migration is larger again and so forth. When mobility is perfect (panel a), the overshooting in migration at time $t = 2$ is even larger. So a lower value of ξ leads to a slower convergence to the steady state. However, the direction of migration is the same, and the further results remain unchanged. When ξ tends to unity, the overshooting disappears and the convergence to the steady state is very fast and monotonic. If $\xi = 1$ and the countries run pure DC pension schemes, migration is smaller but still exists.

A different value of the parameters α and ρ affects the results quantitatively but not qualitatively.