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Population aging and cross-country redistribution in integrated capital markets*

Thomas Davoine†

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Abstract

Population aging challenges the financing of social security systems in developed economies, as the fraction of the population in working age declines. The resulting pressure on capital-labor ratios translates into a pressure on factor prices and production. While European countries all face this challenge, the speed at which their population ages differs, and thus the pressure on capital-labor ratios. If capital markets are integrated, differences in population aging may lead to cross-country spillovers, as investors freely seek the best returns on capital. Using a multi-country overlapping-generations model covering 14 European Union countries, I quantify spillovers and find that capital market integration leads to redistribution across countries over the long run. For instance, GDP per capita would on average be 2.9 %-points lower in Germany in each of the next 50 years if capital markets were perfectly integrated and public debts kept constants with increases in labor income taxes, compared to a closed economy case; by contrast, GDP per capita would on average be 2.1 %-points higher in France, whose population ages slower than in Germany. I also show that pension reforms can change the cross-country redistribution patterns, some countries losing from capital market integration without the reform but winning with it.

Keywords: population aging, pension reforms, capital markets, cross-country spillovers, overlapping-generations modelling
JEL-Classification: C68, E60, F41, J11

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1 Introduction

Differences in population aging speed lead to differences in capital-labor ratios and returns to capital, ceteris paribus. Integration of capital markets can thus lead to slow changes in the distribution of capital across countries over time. Using a multi-country overlapping-generations model calibrated for 14 European countries, the main goal of this paper is to quantify cross-country spillovers due to population aging and capital market integration. The influence of social security reforms is also investigated.

The old-age dependency ratio is projected to increase from 35% to 60% over the next five decades in Germany, but only from 30% to 47% in France. Everything else equal, population aging should thus increase the capital-labor ratio and depress returns to capital more in Germany than in France. With integrated capital markets, capital should gradually flow from Germany to France, a basic theoretical prediction (Adema et al., 2009). There is empirical support for some of these theoretical predictions, countries with lower dependency ratios having a smaller net foreign asset position (Higgins, 1998; Lane and Milesi-Ferretti, 2002). Assuming integrated capital markets, quantitative simulation studies in general equilibrium find international spillovers across world regions which differ in demographic and institutional characteristics (e.g. Boersch-Supan et al., 2006). Whether differences in population aging are sufficient to generate spillovers between countries with similar institutional setups is however unknown.

The paper also uses general equilibrium quantitative simulations to answer this question. Compared to the existing literature, there are two main differences. First, I consider differences between countries, not only between regions of the world. Existing general equilibrium analyses with endogenous labor supply consider several world regions, all having different economic institutions (including Fehr et al., 2005; Boersch-Supan et al., 2006; Attanasio et al., 2007; Krueger and Ludwig, 2007; and Vogel et al., 2017)[1]. Using a multi-country model calibrated for Europe allows to detect spillovers even if institutional setups are similar. The analysis also provides a practical contribution to the policy debate, policy coordination discussions usually taking place between countries and seldom between regions. Second, I pay particular attention to the role of capital in production, given the focus on capital market integration. Consistent with empirical evidence (Duffy et al., 2004), I assume capital-skill complementarity, the fact that capital is more complementary to high-skilled than low-skilled labor[2]. In related research ignoring population aging (Davoine and Molnar, 2017), we found that capital-skill complementarity indeed increases the magnitude of output spillovers, as variations in capital in the integrated capital market impact the domestic contribution of the most productive type of labor[3].

[1]Some of these models also have one country among several regions. There exist also some general equilibrium quantitative evaluations with multi-country models and endogenous labor supply, as opposed to multi-regions models, but they do not assess the impact of capital market integration (Catalano and Pezzolla, 2016). Other models with exogenous labor supply exist, but only consider variations of the the numerator of the capital-labor supply ratio.

[2]Capital-skill complementarity also helps to account for wage inequality variations over time (Krusell et al., 2000). The approach here has similarities with Jin (2012): allowing usage of capital in production to differ across countries, she provides a theory which can help to rationalize the direction of international capital flows.

[3]A third difference with the existing literature is the focus on redistribution between countries (or

Concretely, the first goal of the paper is to quantify cross-country spillovers due to population aging and capital market integration within the European Union, taking into account major demographic and economic variations in the rest of the world. The second goal is to assess the influence of social security reforms on the spillovers. Policy implications are then derived from these assessments.

To achieve these goals, I use a multi-country overlapping-generations model developed in related research (Davoine and Molnar, 2017). The basis is an Auerbach and Kotlikoff (1987) model with endogenous labor supply decisions, three exogenous skill classes, capital-skill complementarity and detailed social security features. As in Buiter (1981) and Boersch-Supan et al. (2006), labor is assumed to be immobile but capital mobile in perfectly integrated capital markets, which leads to international spillovers. The model is calibrated for a representative sample of 14 European Union countries and two stylized Rest-of-the-world regions, one representing developed countries and the other developing countries.

Simulations show that differences in population aging and capital market integration lead to visible cross-country spillovers, even when institutional settings are comparable. For instance, GDP per capita is projected to be an average of 2.9 %-points lower in each of the next fifty years in Germany when capital markets are integrated and labor taxes increased to keep public debt constant, compared to a closed economy case with separated capital markets. On the other hand, GDP per capita would on average be 2.1 %-points higher in France under integrated capital markets. The reason are aging differences: as the population is projected to age faster in Germany, labor supply will be reduced faster, the capital-labor ratio increased more and thus the returns to capital depressed further; investors will gradually shift their asset holdings away from Germany and towards France, which sustains production there.

I also find that cross-country redistribution patterns depend on social security reforms. For instance, GDP per capita is projected to be 1.9 %-points lower in Denmark with capital market integration when public debts are kept constant by increases in labor income taxes, but 0.8 %-points higher when public debts are kept constant by an increase of the retirement age and a (smaller) increase in labor income taxes (in all countries). In other words, Denmark would be a long-term loser of capital market integration if the unique reform was on the labor tax code, but a winner if retirement age was also increased. The main reason is the current size of the Danish welfare state, which requires a high level of taxation. In the first case, the disincentive effect of higher taxes is strong and dominates other effects. In the second case, the tax increase is milder and the disincentive effect too, so that the slow population aging effect dominates.

As a related result relying on the same mechanisms, I find that capital market integration changes the ranking of pension reform options in some countries. For instance, simulations show that labor tax increases are preferable to a 20% cut in pension benefits

regions) in overall macroeconomic terms. Fehr et al. (2005), Attanasio et al. (2007) and Krueger and Ludwig (2007) also provide information on redistribution, but this information is either not part of the discussion (first two studies) or the discussion is restricted to the impacts on capital markets (last study). By contrast, I consider the overall macroeconomic impact, summarized by the usual GDP per capita indicator.

in Belgium with no integration, but the opposite with full capital market integration: instead of cutting pensions, implementing tax increases leads to an average 0.7 %-points gain in GDP per capita in each of the next 50 years without integration, but a yearly 0.4% loss with integration.

These results have implications for the policy debate, particularly in Europe. Although the creation of the Euro has sped up the integration of capital markets (Lane, 2006), these markets remain partially national. The subprime and sovereign debt crisis in Europe have led to reforms of the economic governance of the European Union and multiple proposals for additional policy reforms. Taking stock of the policy debate, the European Commission makes two concrete policy recommendations and suggests further evaluation of a number of reform proposals (European Commission, 2017). One of these recommendations is the implementation of a Capital Market Union, which should support the integration of capital markets and thus help to absorb country-specific exogenous shocks. This paper and its long-run focus provide a complement to existing analyses, which highlight the important short-run stabilization properties of such a Capital Market Union.

The paper continues as follows. The next section presents the model. Section 3 describes the experiments and provides their results. Section 4 derives policy implications while section 5 concludes.

2 Model

To quantify the cross-country spillovers of population aging and associated social security reforms, I use the multi-country overlapping-generations model presented in Davoine and Molnar (2017). The model links countries through an integrated capital market. Consistent with the literature, only capital is freely mobile, while labor is either immobile or flows across countries in an exogenous fashion.

Concretely, the starting point is an existing single-country overlapping-generations model routinely used for policy evaluation, extended into a multi-country model following the Buiter (1981) procedure[4]. The single-country model is of the Auerbach and Kotlikoff (1987) type. As unemployment varies across countries, the single-country model starts from Jaag et al. (2010), an overlapping-generations model with imperfect labor markets. Because the skill distribution also differs across countries, this basis is extended to include three skill classes with exogenous education decisions, following Jaag (2009). The resulting model is similar to the one in Berger et al. (2016).

I start the description with the single-country model basis, continue with the multi-country extension and finish with calibration[5].

[4]The extension has been used in a number of studies, including Frenkel and Razin (1986) and Boersch-Supan et al. (2006).

[5]The presentation follows Davoine and Molnar (2017). The technical appendix of Berger et al. (2016) contains further technical details on the single-country basis.

2.1 Single-country setting

Demographics: Households go through several stages $a \in \{1, \ldots, 8\}$ in their lives. A stage a lasts several time periods. After birth, households educate, then enter the labor market and retire. Several stages a cover labor market activity, reflecting different productivity levels (typically hump-shaped). Households face a constant, age-dependent probability of dying $1 - \gamma^a$. They differ in skills, birth date and death date[6]. After they are born, they are randomly assigned one of three skill levels, low, medium or high, $i \in \{l, m, h\}$. Medium and high skills are acquired through further education, which has no monetary cost but delays access to the labor market. Education for medium skills takes place in stage $a = 1$, for high skills in stages $a \in \{1, 2\}$. Retirement is defined exogenously and happens some time during stage $a^R = 5$. Stages $a \in \{6, 7, 8\}$ are full retirement stages but with different probabilities of dying $1 - \gamma^a$, to better replicate the empirical age structure of the population. As in Blanchard (1985), a reverse life insurance allocates assets at death[7].

Labor market: After education, households can enter the labor market. They choose whether to participate or not (at a rate $\delta^{a,i} \in [0, 1]$, which represents the number of time periods of the life-cycle stage with participation). The labor market is imperfect, leading to unemployment. Households who join the labor market start unemployed. Further, households who have a job may be hit by idiosyncratic unemployment shocks with probability $1 - \varepsilon^{a,i}$ in each time period. Depending on search efforts, a job may or may not be found. If unemployed, households choose job search efforts ($s^{a,i} \geq 0$). If they have a job, they decide how many hours to work ($l^{a,i} \geq 0$). Being spared the unemployment shock leads to rents, which are bargained with firms to define the wage, building on the static search and matching setting of Boone and Bovenberg (2002). As in Jaag et al. (2010), non-participation in life-cycle a^R is interpreted as retirement. The sequence of households decisions related to the labor market is summarized in figure 1.

Conditional on labor market participation and employment, gross labor income equals

$$y_{lab}^{a,i} = l^{a,i} \cdot \theta^{a,i} \cdot w^i,$$

where $\theta^{a,i}$ is an exogenous age-productivity profile calibrated with micro-data and w^i is the bargained wage per efficiency unit, assuming separate labor markets for each skill class.

Household maximization: Households make labor decisions $\left(\delta^{a,i}, s^{a,i}, l^{a,i}\right)$ and consumption decisions $C^{a,i}$ to maximize their expected life-time utility $V_t^{0,i}$, where $V_t^{a,i}$ is the expected remaining life-time utility of a household in life-cycle stage a with skill

[6] In the implementation, households also differ in the the speed at which they go through the stages of the life cycle, which reflects differences in appetite for effort, luck or other unobserved attributes, a generalization of Gertler (1999) used in Jaag et al. (2010). For ease of presentation, we ignore this model feature. The complexity arises in numerical simulations. Aggregation results, presented in the on-line appendix of Berger et al. (2016), help to deal with it.

[7] We use an implementation where the average durations of stay in each life-cycle stage correspond to ages 15-19, 20-24, 25-39, 40-54, 55-69, 70-79, 80-84 and 85+. We later use the words "*life-cycle stage*" and "*age group*" interchangeably.

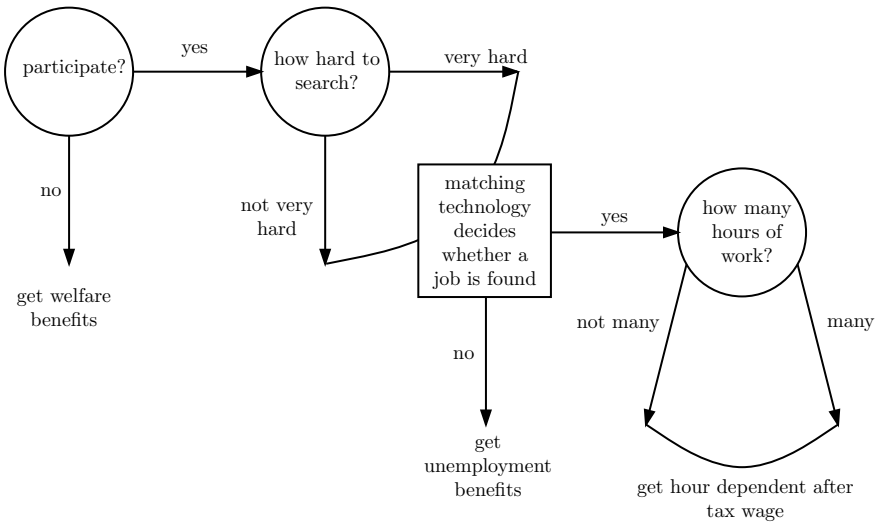

Figure 1: Sequence of households decisions related to the labor market

level i at time t. Preferences are expressed in recursive fashion and restrict households to being risk neutral with respect to variations in income but allow for an arbitrary intertemporal elasticity of substitution:

$$V_t^{a,i} = \max\left[\left(Q_t^{a,i}\right)^{\rho} + \gamma^a \beta \left(GV_{t+1}^{a,i}\right)^{\rho}\right]^{1/\rho},$$

where ρ defines the elasticity of intertemporal substitution $1/(1-\rho)$, β is a time discounting factor, $Q_t^{a,i}$ is effort-adjusted consumption, $G = 1 + g$ is the gross factor of growth by which the model is detrended.

Labor market activity generates disutility. Effort-adjusted consumption $Q^{a,i}$ captures the utility cost of labor market activity expressed in goods equivalent terms, with

$$Q^{a,i} \;=\; C^{a,i} - \bar{\varphi}^{a,i}\left(\delta^{a,i}, s^{a,i}, l^{a,i}\right),$$

and $\bar{\varphi}^{a,i}$ a convex increasing function in all its arguments[8]. Specifically,

$$\begin{aligned}\bar{\varphi}^{a,i} \;=\; & \delta^{a,i}\left[\left(1-u^{a,i}\right)\varphi^{L,i}\left(l^{a,i}\right) + \left(1-\varepsilon^{a,i}\right)\varphi^{S,i}\left(s^{a,i}\right)\right] \;+ \\ & \varphi^{P,i}\left(\delta^{a,i}\right) \;-\; \left(1-\delta^{a,i}+\delta^{a,i}u^{a,i}\right)h^{a,i},\end{aligned}$$

where $u^{a,i} \in [0,1]$ represents the fraction of time in unemployment, $h^{a,i}$ is the value of home production if the household is not working, $\varphi^{L,i}$ captures the disutility of working, $\varphi^{P,i}$ the disutility of participation and $\varphi^{S,i}$ the disutility of job search efforts.

Given the Blanchard (1985) insurance, the budget constraint of households is:

$$G\gamma^{a,i}A_{t+1}^{a,i} = R_{t+1}\left(A_t^{a,i} + y_t^{a,i} - C_t^{a,i}\right),$$

where $A^{a,i}$ represent assets, $y^{a,i}$ net income flows and $R = 1 + r$ the gross interest rate.

[8]This approach for modelling the preference structure is taken from Greenwood et al. (1988) and is applied, among others, in Jaag et al. (2010).

Social security: Before retirement, non-participants receive (net) welfare benefits y^a_{nonpar} while unemployed workers receive (gross) unemployment benefits $b^{a,i} = b^i \cdot y^{a,i}_{lab}$, where b^i is the skill-dependent replacement rate. After retirement, households receive (net) pension benefits $y^{a,i}_{pens} = \nu^a P^{a,i} + P^a_0$, where P^a_0 is a flat part, $P^{a,i}$ represents acquired pension rights and ν^a is a conversion factor between pension rights and pension payments. Pension rights accumulate with labor earnings, following $P^{a,i}_{t+1} = \delta^{a,i}_t \left(1 - u^{a,i}_t\right) y^{a,i}_{lab,t} + P^{a,i}_t$.

Taking labor income taxes and social security contributions $\tau^{a,i}_t$ into account and assuming that each labor market state (i.e. non-participation, unemployment and employment) is visited in each time period[9], net household income amounts to:

$$y^{a,i} = \begin{cases} \left(1-\tau^{a,i}\right)\delta^{a,i}\left[\left(1-u^{a,i}\right)y^{a,i}_{lab} + u^{a,i}b^{a,i}\right] + \left(1-\delta^{a,i}\right)y^a_{nonpar} & \text{if } a < a^R, \\ \left(1-\tau^{a,i}\right)\delta^{a,i}\left[\left(1-u^{a,i}\right)y^{a,i}_{lab} + u^{a,i}b^{a,i}\right] + \left(1-\delta^{a,i}\right)y^{a,i}_{pens} & \text{if } a = a^R, \\ y^{a,i}_{pens} & \text{if } a > a^R. \end{cases}$$

Production: Production is made by a competitive representative firm taking input prices as given, namely wage rates, the interest rate and the price of the output good, which serves as numeraire. Changes in the production process are costly variations in the capital stock, and are subject to convex capital adjustment costs, following Hayashi (1982).

The production function is linear homogenous:

$$Y_t = F^Y\left(K_t, L^{D,i=1}_t, L^{D,i=2}_t, L^{D,i=3}_t\right).$$

The labor inputs $L^{D,i}_t$ from different skill classes are not perfect substitutes. We assume capital-skill complementarity, a feature which can account for wage inequality variations (Krusell et al., 2000) and which is consistent with empirical evidence (Griliches, 1969).

Firms make investment I_t and hiring decisions to maximize the flow of dividends they can generate. Formally, the firm maximizes its end of period value W, which equals the stream of discounted dividend payments χ:

$$\begin{aligned} W_t = W(K_t) \quad &= \quad \max_{I_t, L^{D,i}_t}\left[\chi_t + \frac{GW(K_{t+1})}{R_{t+1}}\right], \\ s.t. \qquad &\chi_t = Y_t - I_t - J(I_t, K_t) - \sum_i (1+\tau^{F,a}) w^i_t L^{D,i}_t, \\ &GK_{t+1} = \left(1-\delta^K\right)K_t + I_t, \end{aligned}$$

where $J(\cdot)$ denotes the adjustment costs and $\tau^{F,a}$ the firms social security contribution rate. Labor demands are pinned down by the marginal products and the labor costs, which consist of wage and contribution rates, i.e. $Y_{L^{D,i}} = (1+\tau^{F,a})w^i$. Given an interest

[9]The assumption follows Jaag et al. (2010). Alternatively, one can assume income pooling (perfect insurance) within each age and skill class, as used for instance by Andolfatto (1996) in his real business cycle and unemployment theory.

rate, investment is defined so that the return on financial investments (the interest rate) equals the marginal cost of investment (Tobin's q), which depends on the marginal product of capital, net of capital adjustment costs and depreciation[10].

Government: Government provides welfare benefits, unemployment insurance, pay-as-you-go pensions and investment subsidies. State expenditures also include public consumption, long-term care and health expenditures, all defined exogenously in per capita terms and generating no utility.

To finance expenditures, the government collects consumption taxes, labor and capital income taxes, profit taxes, firm and worker social security contributions. The government can borrow on the capital market (with or without premium on the interest rate) to finance public debt, to meet some exogenously defined target (most of the time kept constant in simulations).

Single-country equilibrium: In a single-country setting, we assume that the gross interest rate $R_{t+1} = 1+r_{t+1}$ is exogenously defined, as for small open economies. Savings can be invested in firms, government debt and foreign assets. Assuming no arbitrage, the net returns on these three types of assets are the same and equal to the interest rate r_{t+1}. The goods market then clears because of trade with the rest of the world:

$$Y_t = C_t + I_t + G_t + TB_t,$$

where C_t is the aggregate private consumption[11], G_t is government expenditure and TB_t is the trade balance. Holding of foreign assets by domestic households evolves with changes in the trade balance:

$$D^F_{t+1} = R_{t+1}\left(D^F_t + TB_t\right).$$

Private household assets A_t are invested in the domestic representative firm W_t, government debt D^G_t and foreign assets D^F_t, so that the asset market clearing condition is satisfied:

$$A_t = W_t + D^G_t + D^F_t.$$

2.2 Extension to a multi-country setting

We follow Boersch-Supan et al. (2006), an extension of the two-country Buiter (1981) procedure to any number of countries and capital adjustment costs. The main assumption is that labor is immobile but capital is perfectly mobile. This assumption can be relaxed by allowing mobility of labor with exogenously defined international flows, as will be done in the quantitative analysis. One also assumes that all countries produce the

[10] In steady-state, the capital stock is stable so that there are no capital adjustment costs. In this case, investment satisfies the standard condition where the interest rate equals the marginal product of capital net of depreciation, $r = F^Y_K - \delta^K$.

[11] So, $C_t = \sum_i \sum_a N^{a,i}_t C^{a,i}_t$ where $N^{a,i}_t$ is the number of households alive at time t, member of age group a and skill group i. Other households-related aggregate variables are defined in a similar fashion, including aggregate financial assets A_t.

same composite good and that they either belong to the same currency union, or that exchange rates are constant. The interest rate is no longer exogenous, but endogenous.

Equilibrium: Under these assumptions, the equilibrium interest rate is the same in all countries. The intuition is as follows. Assume there is an arbitrage opportunity. Investors in the low interest rate country start to invest in the high interest rate country. The capital stock in the first country declines, increasing the marginal product of capital and thus the interest rate in that country. The opposite happens in the second country. This continues until an equilibrium is reached where the two interest rates are identical.

As a whole, the set of countries is a closed economy, where the interest rate adjusts so that the goods market clear. The resulting equilibrium interest rate is thus the unique value such that the goods market clear over all countries. Formally, consider M countries indexed by $j \in \{1, ..., M\}$. Assume that terms of change are fixed and that each variables are normalized so that the numeraire value, after currency-exchange corrections, is the same in all countries. The interest rate is then the unique value such that

$$\sum_{j \in \{1,...,M\}} TB_{j,t} = 0.$$

Rest of the world: We do not consider all countries in the world but restrict policy analysis to a smaller subset[12], too small to be isolated from the world capital markets. Consistent with empirical evidence, the goods market, as a whole, will not clear over this subset. We thus consider a large synthetic *Rest-of-the-world* country (or a small group of Rest-of-the-world countries), which will account for trade with the rest of the world. The goods market will clear over all countries which are either part of the subset, or one of the Rest-of-the-world countries. Compared to a case without a Rest-of-the-world country, the adjustment of the equilibrium interest rate is dampened. This reflects access of all countries to the world capital market.

2.3 Calibration

The basis for the multi-country model is a single country model calibrated for 14 European countries used for policy evaluation. The calibration of the multi-country model is thus inherited from the single country models, with the exception of the Rest-of-the-world country. I first summarize the calibration part which is inherited, then continue with aging-related processes and finish with the calibration of the Rest-of-the-world country.

[12]In the implementation, the subset contains 14 countries member of the European Union, namely Austria, Belgium, Czech Republic*, Denmark, Finland, France, Germany, Italy, The Netherlands, Poland*, Slovakia, Spain, Sweden* and the UK*. In this list, stars identify the four countries whose currency is neither the Euro nor pegged to the Euro, and thus do not meet our assumption of fixed exchange rates. We keep these countries in the list to have broader diversity and because exchange rate variations vanish over the long run. In reality, exchange rate variations absorb some of the country-specific shocks over the short run, reducing the size of cross-country spillovers for these four countries, ceteris paribus.

Calibration of the single country basis: Where available, we take consensual empirical estimates from the literature. Production function specifications are adopted from Jaag (2009). Labor supply elasticities are derived from Immervoll, Kleven, Kreiner, and Saez (2007) and productivity profiles from Mincer wage regressions on EU-SILC microdata. Average participation rates, unemployment rates and working hours per age and skill classes are computed from LFS and EU-SILC datasets. Parameters for institutions are derived using the European Commission MISSOC database and OECD's Tax-Benefit model. Intervivo transfer parameters are calculated to generate life-cycle consumption profiles in line with empirical evidence.

Calibration of aging-related processes: I choose fertility and mortality rates for the 14 European countries in the model to match the demographic projections from Eurostat (2015), which are used in the Ageing Working Group (2015). Fertility and mortality rates for the two Rest-of-the-world countries are chosen to match the projections from the United Nations (2015).

A number of European countries have scheduled pension reforms, in order to deal with the future financing challenges created by an aging population. Typically, the statutory retirement age is scheduled to be increased and pension benefits reduced[13]. In order to quantify cross-country spillovers due to population aging alone and isolate them from policy reforms influences, pension parameters will be kept unchanged in some scenarios. By contrast, scheduled pension reforms, as consolidated by the Ageing Working Group (2015), will be used in other scenarios involving policy reforms.

Public health- and long-term care are also expected to change over time. There is a large debate over cost drivers and how they will change in the future. Unlike pension expenditures however, there are cost drivers which are neither demographic nor economic, such as technological progress. In its reference scenario, the Ageing Working Group (2015) assumes that age-dependent per capita costs will be declining. Because social security policy has little (direct) influence on technological improvements, I follow these projections and apply a gradual age-dependent per capita reduction of health- and long-term care costs[14].

Calibration of the rest of the world: To be able to reflect large economic differences between countries to some extent without including many single countries, we model and calibrate a *North rest-of-the-world* country (NROW) and a *South rest-of-the-world* country (SROW). While we do not analyze impacts outside the EU, we capture the impact of forces coming from outside of the EU, in line with our objective. We choose to aggregate Canada, Japan and the USA to form the stylized NROW country while we choose Brazil, China and India to form the SROW country[15].

[13]Social security contributions rates are seldom scheduled to change, if at all (Ageing Working Group, 2015).

[14]Because the project focuses on demographic and economic components and not on health technology components, which may differ across countries, I apply the same reduction to all countries, taking the projections for Germany from the Ageing Working Group (2015).

[15]With these choices we are capturing close to 60% of the actual real world GDP and five of the eleven most important trade partners of the EU, together reflecting more than 40% of total trade of the EU.

The calibration process rests on macro- and micro-level data, either as direct inputs or as calibration targets. Macro-level data is in general available for all six countries forming the NROW and SROW, in data sources which include the ILO, the OECD, the UNESCO and the World Bank.

Micro-level data on the other hand is not available for all of the six countries. For the sake of consistency, we ignore micro-level data specific to Rest-of-the-world countries. We follow instead a three step approach. First, for each of the six Rest-of-the-world countries, we identify a twin country (or a set of countries) from our sample of 14 calibrated countries whose demographic, economic and policy characteristics are the closest. Second, we use the micro-level data inputs for this twin country in the calibration process of the NROW and SROW. Third, we make stylized corrections to the resulting calibration outcome where there are documented differences.

This approach results in using micro-level calibration inputs from the UK for Canada, Japan and the USA and an average of calibration inputs from the Czech Republic, Slovakia and Poland for Brazil, China and India. The most important stylized corrections are proportional adjustments to the participation and unemployment rates by age and skill classes to match the aggregate participation and unemployment rates[16].

3 Quantitative results

This section presents the experiments performed to quantify cross-country spillovers with aging populations and associated reforms required to ensure the financing of welfare states. The approach is presented first and results for each experiment next.

For ease of reading, results and discussion will be focused on four countries illustrating the range of possible outcomes, namely Belgium, Denmark, France and Germany. Results for the other countries in the sample, provided in appendices, are similar and so are their explanations. I report and discuss evolutions between 2015 and 2065, to allow for comparisons with the benchmark results of the Ageing Working Group (2015)[17].

3.1 Approach

I use the multi-country overlapping-generations model presented in section 2 to perform simulations. Under population aging, I consider several scenarios which ensure the financial sustainability of the welfare state over the long run and compare two cases. In the first case, capital markets are perfectly integrated. In the second case, capital markets are not integrated. Instead of assuming small open economies, I assume in the second case that trade with foreign countries remains constant in per capita terms, which corresponds to isolated closed economies[18],[19]. I avoid the small open economy

[16] For details on the calibration of the Rest-of-the-world countries, see Davoine and Molnar (2017).

[17] For technical reasons, simulations are made over 200 rather than 50 years, to allow for a stationary steady state at the end of the period. Results over the first 50 years are not influenced.

[18] In the second case, a standard single-country model can be used. The same model is used for simulations in the two cases however, either in its multi-country version (with integrated capital markets) or in its single-country version (without capital market integration).

[19] I choose to keep constant trade per capita rather than no trade at all, as in strictly closed economies, because I want economies to be the same at the start in the two cases, to be able to compare outcomes.

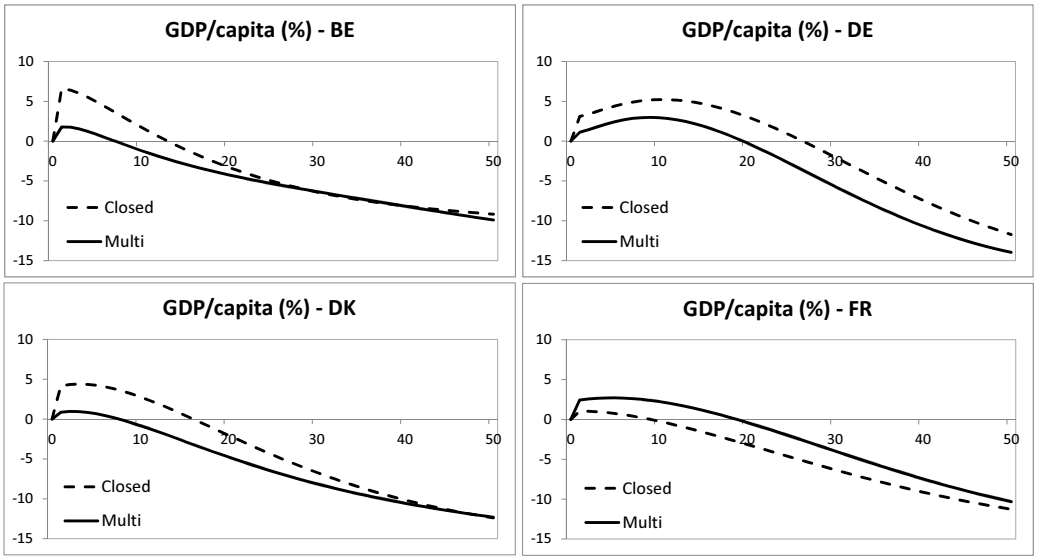

Figure 2: Aging and labor tax reforms, GDP per capita variations, 2015-2065

assumption because it leads to a bias (see Davoine, 2017). The comparison of outcomes in the two cases will allow to identify benefits (or losses) from capital market integration under an aging population.

I consider three types of simulations. In the first, countries perform no social security reforms. In the second kind, countries increase the retirement age. In the last kind, countries change pension benefits. Details of the scenarios will be presented below. The only constant element in all scenarios is the use of labor income taxes to keep public debt constant: if a particular reform is insufficient to avoid an increase in debt, taxes are increased on top of it[20].

3.2 Results with no social security reforms

Population aging creates a financing challenge for welfare states, as the proportion of households in working age is reduced: without any reforms, social security revenue declines while expenditures for public pay-as-you-go pensions, healthcare and long-term care increase, threatening the financial sustainability of welfare systems (Ageing Working Group, 2015). In the first scenario presented here, we assume that no social security reforms take place, so that labor income taxes need to be increased to finance the social security system. Specifically, taxes are adjusted so that public debt remains constant.

Figure 2 and table 1 provide the results for the two cases, in a multi-country environment where capital markets are integrated and in a single-country closed environment where capital markets are separated for each country[21].

The key finding is as follows:

[20] If a reform would bring so much gains that debt would decrease, then taxes are lowered to keep public debt constant.

[21] In all figures and tables, GDP per capita figures represent deviations from the long run growth trend.

	Belgium			Denmark			France			Germany		
	2015	2065		2015	2065		2015	2065		2015	2065	
		CE	MC		CE	MC		CE	MC		CE	MC
Dependency ratio	0.29	0.41	0.41	0.29	0.42	0.42	0.30	0.47	0.47	0.35	0.60	0.60
Retirement age	59.6	59.6	59.6	62.7	62.7	62.7	60.2	60.2	60.2	60.6	60.6	60.6
Pension benefits*	0.0	-1.1	-3.6	0.0	0.6	-1.8	0.0	-1.5	0.1	0.0	11.8	8.0
Labor tax	0.15	0.29	0.30	0.29	0.52	0.51	0.10	0.28	0.28	0.09	0.29	0.30
Labor/capita*	0	-10	-10	0	-14	-14	0	-13	-12	0	-16	-18
Interest rate*	-53	-40	-36	-22	-39	-36	0	-26	-36	-10	-59	-36
Capital/capita**	0.0	2.6	-2.0	0.0	4.8	-1.2	0.0	-2.0	2.1	0.0	10.4	2.0
GDP/capita**	0.0	-3.6	-4.9	0.0	-4.1	-6.1	0.0	-4.9	-2.8	0.0	-1.2	-4.1
GDP/capita gap***			-1.3			-1.9			2.1			-2.9

Legend: * = variation in 2065, compared to 2015 (in %); ** = average variation over years 2015 to 2065, compared to 2015 (in %); *** = average percentage points variation over years 2015 to 2065, compared to 2015; *Pension benefits* = average pension expenditure per retiree; *Labor tax* = average labor income tax for employed workers; *Labor/capita* = effective worked hours per capita; *GDP/ capita gap* = difference between CE and MC cases; *CE* = single-country with closed economy; *MC* = multi-country with perfect capital market integration.

Table 1: Aging and labor tax reforms, 2015-2065

Finding 1. *Capital market integration with an aging population and variations in labor income taxes to keep public debt constant lead to international spillovers and redistribution across countries over the long run: some countries benefit from capital market integration (up to 2.1 %-points higher GDP per capita on average in each of the next 50 years, compared to a closed economy) while others lose (up to 4.8 %-points lower GDP per capita).*

For instance, table 1 shows that the GDP per capita should drop 4.9% in yearly average between 2015 and 2065 in France when capital markets are not integrated (corresponding to a closed economy case) but only 2.8% when capital markets are integrated (in a multi-country setting). In yearly average thus, the GDP per capita is 2.1 %-points higher with capital market integration. By contrast, all other countries reported in the table lose from capital market integration, average GDP per capita being 1.3 %-points lower in Belgium, 1.9 %-points lower in Denmark and 2.9 %-points lower in Germany. In our sample, the biggest gain is in France and the largest loss in the Netherlands (at 4.8 %-points, see appendix A).

The main explanation is differentials in demographic dynamics. The old-age dependency ratio in Germany is projected to increase from 0.35 to 0.60 over the next 50 years for instance, but only from 0.30 to 0.47 in France over the same time span. The rapid decline in labor supply in Germany increases the capital-labor ratio fast, and thus depresses returns on capital investment faster than in France (and other countries). In an integrated capital market, investors thus modify their portfolio over time, shifting investments from Germany to France (until the unique international interest rate is equalized). The capital stock thus drops in Germany and increases in France, relative to a closed economy case. GDP per capita variations follow. Figure 5 in appendix B

illustrates the explanation chain with the transition path of key variables.

This explanation applies to France, Germany and most of the countries in our sample. There are however a few exceptions, namely Belgium, Denmark and Italy. The first two are aging slowly so should benefit from capital market integration, yet lose. The opposite applies to Italy. Another factor also plays a role in all three cases, namely taxation and its associated Laffer curve effect. I take the example of Denmark to illustrate.

Denmark ages slowly, its dependency ratio being projected to increase from 0.29 to 0.42 over the next five decades. One would expect Denmark to benefit from capital market integration, as France. However, its initial level of taxation is so high that the necessary increase in taxes to finance increasing social security expenditures has a strong negative impact on labor supply incentives (Laffer curve effect). To finance its large welfare state indeed, Denmark needs to set labor income taxes and social security contributions at a cumulated effective rate of 40% for employed workers (while the second highest rate is 30% in our sample and the average is 25%). The effect is strong enough to dominate the benefits from a slowly aging population, relative to other countries. Taking all margins into account (demographics, working hours,...), the net labor supply drops more in Denmark than the average in other countries. As for Germany then, the capital-labor ratio increases faster, returns to investment decline more and thus capital moves overtime from Denmark to other countries, which are aging slowly and have a milder exposure to Laffer curve effects.

The following remark will play a role in the discussion of policy coordination. In this scenario and for our sample, there are winners and there are losers, but the weighted average GDP per capita gains and losses is close to zero: five countries benefit from capital market integration (for an average GDP per capita gain of 1.2 %-points) and nine countries lose from it (for an average loss of 1.8 %-points; see appendix A). Capital market integration is, in this sense, a zero sum game.

3.3 Results with retirement age reforms

Increasing the statutory retirement age is one way to ensure the financial sustainability of the social security system with an aging population, as revenue from social security contributions increase and pension expenditures decline.

Two scenarios are considered. In the first one, only one country increases the retirement age. In the second scenario, all countries implement the reform.

3.3.1 Retirement age reform in one country

The main purpose of this scenario, where only one country implements a retirement age reform, is an illustration of the key mechanisms at play. It will also help to articulate policy implications.

Simulations in section 3.2 showed that cross-country spillovers take place because countries age at a different speed, because tax burdens differ and because capital markets are integrated. In particular, investors change their portfolio composition over time to seek the highest returns, generally where the capital-labor ratio is increasing least. Countries, in this sense, compete for capital. There may be thus incentives for strategic

GDP/capita, 2015-2065	Belgium	Denmark	France	Germany
In integrated capital markets ...				
... no retirement age increase**	-4.87	-6.07	-2.77	-4.09
... retirement age increase in Germany**	-4.88	-6.10	-2.78	1.24
... reform impact***	-0.01	-0.02	-0.02	5.33
Under closed economy ...				
... no retirement age increase**	-3.61	-4.14	-4.87	-1.16
... retirement age increase in Germany**	-	-	-	4.00
... reform impact***	-	-	-	5.17
Benefits of integrated capital markets ...				
... retirement age increase in Germany***	-0.01	-0.02	-0.02	0.16

Legend: ** = yearly average variation over years 2015 to 2065, compared to 2015 (in %); *** = average percentage points variation over years 2015 to 2065, compared to 2015; see text for additional details.

Table 2: Aging, retirement age and labor tax reforms, Germany only, 2015-2065

behavior. In order to depress their capital-labor ratio and attract capital, countries may try to be the only (or the first) country to increase their statutory retirement age. Since Germany has the biggest economic size and is one of the countries which suffers most from capital market integration, I select it as the country which seeks strategic advantage, for illustrative purposes. As always, labor income taxes are changed in all countries so that public debts remain constant.

Results are provided in table 2, showing average macroeconomic impacts, measured by yearly average GDP per capita variations over the next five decades in Belgium, Denmark, France and Germany, in four different cases. Two cases have been previously presented, where no country increases retirement age either with integrated capital markets or in closed economies (from section 3.2). Two additional cases appear where Germany is the only country gradually increasing its retirement age by 2.5 years, once with integrated capital markets and once in a closed economy[22]. The table also displays the impact of the German reform with integrated markets and closed economies, and concludes with the benefit which can be derived from capital markets integration when Germany increases its retirement age.

What the simulations show can be summarized in the following way:

Finding 2. *A retirement age increase in an aging population delivers higher gains in an integrated capital market than in autarky when the country is the only one to perform the reform (3%), gains which are offset by losses over the entire set of countries (the GDP/capita would be on average 0.16 %-points higher in each of the next 50 years in Germany if the country is alone to gradually increase its retirement age 2.5 years under integrated capital markets, compared to autarky, equal to 3% of the 5.17 %-points gain in autarky; the GDP/capita in other countries would decrease on average 0.01 %-points).*

[22]Results are provided in the last case (increase in retirement age and closed economies) only for Germany, because other countries are not impacted by a German reform when economies are separated.

Under integrated capital markets and with a retirement age reform, the GDP/capita in Germany is 1.24% higher each of the next 50 years on average, but drops on average 4.09% without the reform. The average reform gain is thus 5.33 %-points. In a closed economy setting, the respective numbers are 4.00%, -1.16% and 5.17 %-points. A perfectly integrated capital market thus increases the gains from the retirement age reform by 0.16 %-points.

The intuition for this result is the following. When Germany increases its retirement age, its capital-labor ratio drops, which increases returns to investments. When capital markets are integrated, foreign investors notice and rebalance their portfolio to increase their investments in Germany. In a closed economy, foreign investors leave their portfolios untouched. Over the long run thus, the capital stock and production are increasing more with a postponed retirement age and integrated capital markets in Germany. This portfolio rebalancing with integrated markets also explains why investments, capital stocks and production decline in other countries.

Note that the magnitude of the gain for Germany is small compared to the loss due to capital market integration with an aging population: 0.2 %-points instead of about 3.0 %-points (see section 3.2). The main reason is that aging differentials lead to larger relative variations in labor supply and thus the capital-labor ratio, compared to variations generated by the retirement age reform.

3.3.2 Retirement age reforms in all countries

I investigate the impact of the same retirement age reform in all countries (except the two Rest-of-the-world countries, which use labor income taxes to finance increasing social security expenditures). Specifically, the retirement age is gradually (linearly) increased by a total of 2.5 years over the next 50 years, the 2.5 years mark corresponding to the average scheduled retirement age increase in the countries from our sample (as per the Ageing Working Group, 2015). This increase may or may not be sufficient to finance all of the increase in social security expenditures. If it is not, labor income taxes are increased so that public debt remains constant.

Figure 3 and table 3 provide the results. The figure reproduces the results from the scenario where aging is financed with labor income taxes only (from section 3.2), which is used as benchmark. Again results are provided for two cases, in a multi-country environment where capital markets are integrated and in a single-country closed economy where capital markets are separated by country.

There are two key findings. The first one is similar to finding 1 in section 3.2. It does not provide new insights but is included for the sake of completeness:

Finding 3. *Capital market integration with an aging population, a gradual increase of the retirement age of 2.5 years in all European countries and variations in labor income taxes to keep public debt constant lead to international spillovers and redistribution across countries over the long run: some countries benefit from capital market integration (up to 3.1 %-points higher GDP per capita on average for each of the next 50 years, compared to a closed economy) while others lose (up to 3.8%-points lower GDP per capita).*

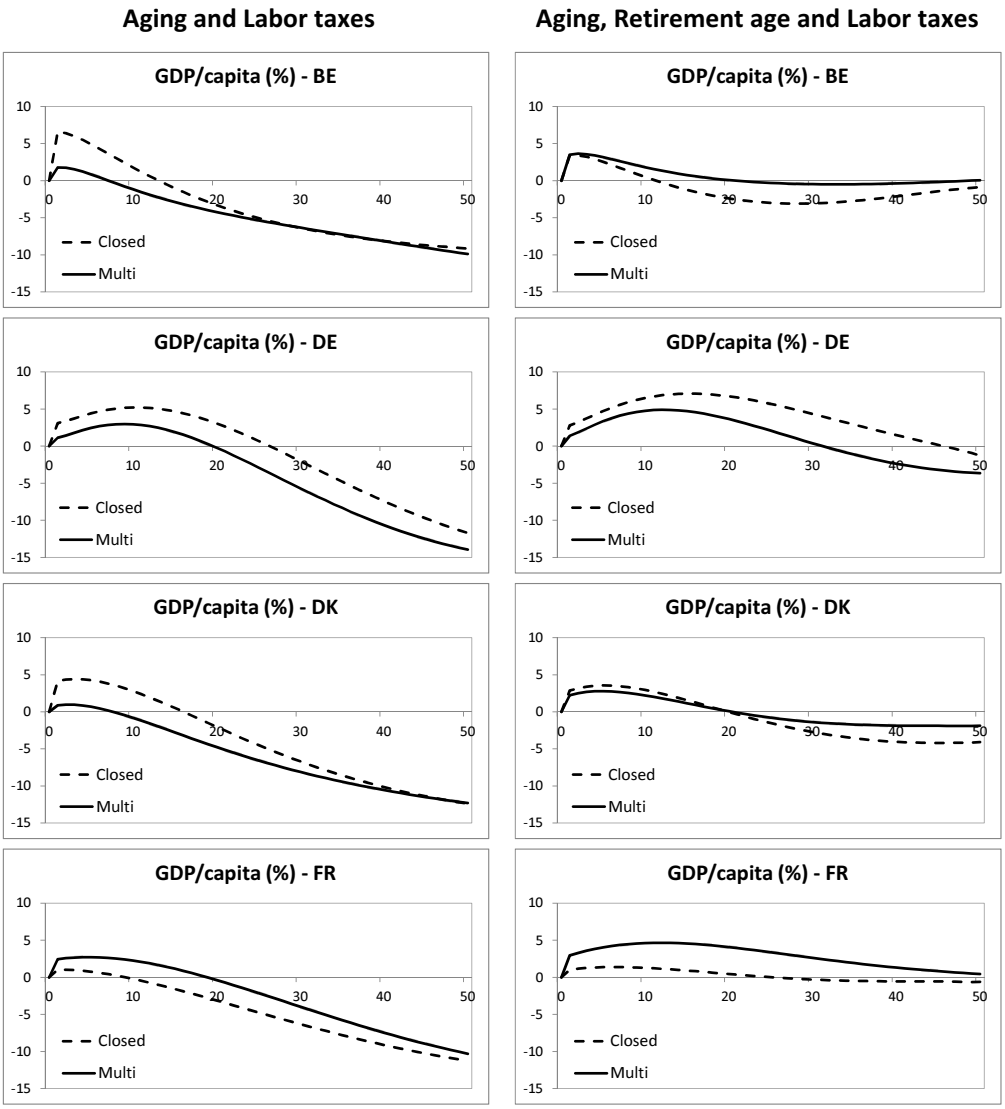

Figure 3: Aging and labor tax reforms without and with retirement age increase, GDP per capita variations, 2015-2065

	Belgium			Denmark			France			Germany		
	2015	2065		2015	2065		2015	2065		2015	2065	
		CE	MC		CE	MC		CE	MC		CE	MC
Dependency ratio	0.29	0.41	0.41	0.29	0.42	0.42	0.30	0.47	0.47	0.35	0.60	0.60
Retirement age	59.6	62.1	62.1	62.7	65.0	65.0	60.2	62.7	62.7	60.6	63.1	63.1
Pension benefits*	0.0	-0.2	-0.5	0.0	2.5	1.2	0.0	5.3	7.4	0.0	21.4	17.5
Labor tax	0.18	0.22	0.21	0.30	0.44	0.42	0.10	0.18	0.18	0.09	0.22	0.22
Labor/capita*	0	-2	-1	0	-5	-4	0	-3	-3	0	-8	-9
Interest rate*	-27	-45	-41	-14	-29	-41	0	-37	-41	-9	-84	-41
Capital/capita**	0.0	2.1	2.9	0.0	5.7	4.2	0.0	2.7	7.6	0.0	16.3	7.2
GDP/capita**	0.0	-1.2	0.5	0.0	-0.9	-0.2	0.0	0.2	2.9	0.0	4.0	1.1
GDP/capita gap***			1.8			0.8			2.7			-2.9

Legend: see table 1

Table 3: Aging, retirement age and labor tax reforms, 2015-2065

As shown in table 3 for instance, the GDP per capita should increase 0.2% on average between 2015 and 2065 in France when capital markets are not integrated (corresponding to a closed economy case) and 2.9% when capital markets are integrated (in a multi-country setting). The GDP per capita is thus on average 2.7 %-points higher with capital market integration. By contrast, average GDP per capita is 2.9 %-points lower in Germany with integrated capital markets. Results for our entire sample show that the biggest gain is 3.1 %-points in Italy and the biggest loss 3.8 %-points in the Netherlands (see appendix A).

The explanation for this finding is similar to the explanation for finding 1, based on demographics differentials: labor supply per capita drops faster in countries whose population ages fast, increasing more the capital-labor ratio and thus depressing more returns to investment, triggering a capital flight when markets are integrated, and thus a loss in production capacity in those countries.

The next finding, best visible in figure 3, shows that redistribution patterns created by capital market integration depend on the exact reforms which ensure the financial sustainability of social security systems:

Finding 4. *Losses from capital market integration with an aging population are overturned (into gains) for some (but not all) countries when all European countries increase gradually the retirement age by 2.5 years, rather than relying solely on variations in labor income taxes to keep public debt constant: while the average GDP per capita in Austria, Belgium and Denmark is respectively 0.05, 1.3 and 1.9 %-points lower with capital market integration and a constant retirement age than with separated markets, it is respectively 1.3, 1.8 and 0.8 %-points higher with capital market integration and increased retirement age than with separated markets (yearly averages over the next 50 years).*

The explanation for this finding is similar for all three countries, with a twist for Austria. I take the example of Denmark, continuing on the explanation for finding 1 in section 3.2: Denmark is aging slowly but has a high tax burden, so that the labor supply disincentive effects (Laffer curve) of increased labor taxes dominate the gains from a slowly aging population, relative to other countries. When the retirement age is increased, taxes do not need to be increased so much, so the Laffer curve effects are dampened and dominated by the gains from the slow aging process: relative to the average European country, labor supply per capita does not drop as much, the capital-labor ratio does not increase as much so the returns to investment increase over time in Denmark; capital flows over time to Denmark, boosting production[23].

I conclude this section with a remark. The increase in the retirement age reduces the GDP loss per capita due to aging (and sometimes even transform the loss into gains), as production factors are larger. The outcome, which holds with and without capital

[23]The twist for Austria is the following hypothesis. The aging process in Austria is not particularly slow (but neither fast). Compared to other countries however, Austria makes a relatively strong use of capital in production, which helps to keep returns to investment high there and thus attracts foreign investments.

	Belgium			Denmark			France			Germany		
	2015	2065		2015	2065		2015	2065		2015	2065	
		CE	MC		CE	MC		CE	MC		CE	MC
Dependency ratio	0.29	0.41	0.41	0.29	0.42	0.42	0.30	0.47	0.47	0.35	0.60	0.60
Retirement age	59.6	59.6	59.6	62.7	62.7	62.7	60.2	60.2	60.2	60.6	60.6	60.6
Pension benefits*	0.0	-20.1	-21.3	0.0	-17.7	-19.6	0.0	-19.5	-18.1	0.0	-8.6	-11.7
Labor tax	0.16	0.27	0.26	0.29	0.48	0.47	0.10	0.22	0.22	0.09	0.25	0.26
Labor/capita*	0	-9	-9	0	-12	-12	0	-12	-11	0	-16	-17
Interest rate*	-43	-32	-36	-21	-36	-36	0	-25	-36	-11	-58	-36
Capital/capita**	0.0	0.6	-1.7	0.0	4.9	-0.6	0.0	-1.9	2.3	0.0	10.2	2.1
GDP/capita**	0.0	-4.5	-4.5	0.0	-3.8	-5.5	0.0	-4.6	-2.5	0.0	-1.2	-4.1
GDP/capita gap***			0.0			-1.7			2.1			-2.9

Legend: see table 1

Table 4: Aging, pension benefits and labor tax reforms, 2015-2065

market integration, is well known in the public finance literature (see for instance Jaag et al., 2010).

3.4 Results with pension benefit reforms

The three standard parametric reforms of the pension systems are changes in the retirement age, changes in pension benefits and changes in social security contribution rates. Increases in the retirement age to maintain the financing of the social security system with an aging population have been investigated in section 3.3. Here I investigate cuts in pension benefits[24].

I consider two scenarios, one where all countries perform the same reform and the other where magnitudes of the reforms differ.

3.4.1 Pension benefit reforms of same magnitude

In this scenario, the benefit ratio is gradually decreased over the next 50 years in all European countries of the sample, so that it is 19% lower in 50 years[25]. The figure corresponds to the projected decrease in all countries of the sample, as per the Ageing Working Group (2015). The cuts reduce the pension expenditures but may or may not be sufficient to balance social security expenditures with revenues, as aging unfolds. If they are not, labor income taxes are increased so that public debt remains constant.

Results are provided in figure 4 and table 4 for the two cases, multi-country with capital market integration and single closed economy without integration. As before, the figure reproduces the results from the benchmark scenario where aging is financed with labor income taxes only.

[24]I do not investigate increases in social security contribution rates on their own, because outcomes are in general similar to increases in labor income tax rates, investigated in section 3.2.

[25]Following the Ageing Working Group (2015), the benefit ratio is the average pension as a share of the average wage. In the simulation, I change the pension replacement rate in the same proportion as the benefit ratio is projected to change, ignoring general equilibrium effects (that is, assuming constant average wages). To illustrate, a country where the benefit ratio is 0.500 today would reduce it to 0.405 in 50 years (a 19% drop).

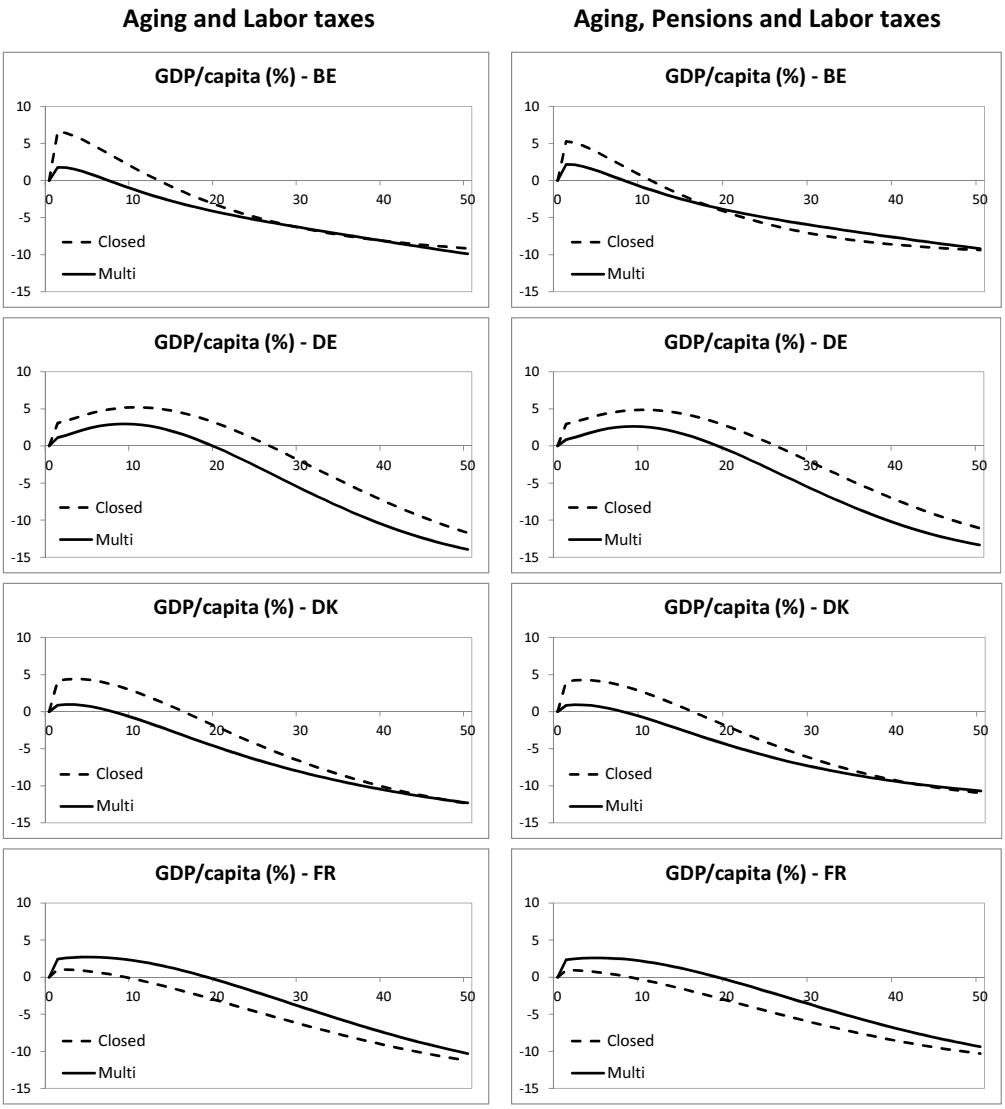

Figure 4: Aging and labor tax reforms without and with pension cuts, GDP per capita variations, 2015-2065

With one exception, outcomes are very similar to the scenario where the welfare state is kept financially sustainable by increases in labor income taxes only, presented in section 3.2. The same finding can be applied here. In the interest of space, I do not repeat it.

The exception is as follows:

Finding 5. *Pension cuts in all European countries do not change the redistribution pattern created by capital market integration under an aging population where variations in labor income taxes keep public debts constant (as outlined in finding 1), with one exception: while Belgium loses from integration without pension cuts (yearly GDP/capita on average 1.0 %-points lower over the next 50 years), the impact of integration is neutral with pension cuts in all European countries (yearly GDP/capita on average neither lower nor higher).*

The finding, which is based on simulation results from tables 1 and 4, is explained as follows. For all countries but Belgium, pension cuts decrease aggregate pension expenditures and do not require as large an increase in labor income taxes, and thus do not depress labor supply incentive as much. But this benefit takes place with and without capital market integration. Demographic differentials thus continue to play a driving role (see section 3.2).

In Belgium, the smaller increase in labor income taxes is sufficient to change the balance of the two factors which dominate variations in effective labor supply. As seen for Denmark in section 3.2, when pension benefits are maintained, the high initial tax burden and large increase in labor taxes lead to strong Laffer curve effects with a large negative impact on labor supply, increasing the capital-labor ratio more than in other countries and thus lowering returns to investments, in spite of a slower aging of the population. When pension benefits are cut, labor income taxes do not need to be raised as much, which reduces the Laffer curve effect. In this case, the balance of the Laffer curve effect and slow population aging is tilted, so that the capital-labor ratio and thus returns to investment in Belgium change in the same proportion as the average of other countries. Capital market integration then has a neutral impact.

3.4.2 Pension benefit reforms of different magnitudes

In this section, I compare the implementation of pension cuts that countries currently plan (as per the Ageing Working Group, 2015), which differ in magnitudes, with implementation of the same average pension cut (as in section 3.4.1). Over the sample of countries considered in this paper, own reform plans range from a 2% cut of the pension benefit ratio over the next 50 years (Belgium) to a 39% cut (Poland), the average being a 19% cut.

Table 5 provides the results, providing outcomes for reforms of own magnitude, of the same average magnitude, when capital markets are integrated and when they are not. Unlike in other result tables, outcomes are provided for Poland but not for Denmark, to better illustrate the variety of impacts.

GDP/capita, 2015-2065	Belgium	France	Germany	Poland
Integrated markets, pension cuts of ...				
... own magnitude	-4.85	-2.44	-4.11	-8.28
... average magnitude	-4.50	-2.53	-4.12	-8.64
Gaps own vs average	-0.36	0.08	0.01	0.36
Separate markets, pension cuts of ...				
... own magnitude	-3.71	-4.57	-1.23	-6.87
... average magnitude	-4.45	-4.64	-1.24	-7.13
Gaps own vs average	0.74	0.07	0.01	0.26

Legend: the table shows average GDP/capita variations over years 2015 to 2065, compared to 2015 (% or percentage points); the average magnitude is -19%; the own magnitude in Belgium is -2%, in France -24%, in Germany -17%, in Poland -39%; see text for additional details.

Table 5: Aging, pension benefits and labor tax reforms, different magnitudes, 2015-2065

As the table shows, outcomes differ when countries implement a reform of different magnitude, which is not a surprise. This result holds whether capital markets are integrated or not. The only exception is Germany, due to the fact that the scheduled pension cuts in Germany (-17%) are very close to the average over the entire sample (-19%). More interesting is the comparison of outcomes when capital markets are integrated and when they are not, which can be summarized in the following fashion:

Finding 6. *In a few countries (Belgium, the Czech Republic, Poland and Sweden), capital market integration changes the gap between pension cuts of own magnitude and pension cuts of the same average magnitude (to an extent comprised between 0.1 and 1.0 %-points of the yearly average GDP/capita variations over the next 50 years); in one case (Belgium), capital market integration even changes which of the two reform scenario is preferable (own cut by a yearly 0.7 %-points margin in separated markets, average cut by a yearly 0.4 %-points margin in integrated markets).*

Outcomes are most striking for Belgium. When capital markets are integrated, its own pension cut of 2% would lead to a yearly average GDP/capita loss of 4.85% over the next 50 years; if all countries implement the average cut of 19%, the yearly loss is 4.50%. According to production criteria, Belgium would thus support a policy coordination measure where all countries implement the same average cut of 19%, which would lead to a yearly average GDP/capita gain of 0.4 %-points in the country. If capital markets were isolated, its own pension cut would lead to a yearly average loss of 3.71%, while the average cut would lead to a yearly average loss of 4.45%. Belgium would not support the same policy coordination if capital markets are not integrated, to avoid a 0.7 %-points yearly average loss of GDP/capita. The overall GDP/capita differential created by capital market integration is a yearly average larger than 1.0 %-points over the next 50 years, a significant number.

The explanation for such an outcome has two steps. Notice beforehand that the

own pension cut of -2% is very small, so that this scenario is close to no pension cut at all, variations in labor income taxes alone ensuring the financial sustainability of social security over the long run. To simplify the exposition, I thus compare a tax hike scenario with the average pension cut scenario. First, tax hikes can be preferable to a 19% pension cut in a closed economy setting, where capital markets are separated. Each of the two options has advantages and disadvantages. Tax hikes directly reduce labor supply incentives. Pension benefit cuts reduce the value of accumulated pension rights in pay-as-you-go pension systems with earnings-related components, so indirectly reduce labor supply incentives. Which of the negative and positive effects dominate depends on the specifics of the tax and pension systems. One remarkable feature in Belgium is that the tax and social security contribution burden is distributed relatively evenly over the life-cycle, retirees being exposed to an average cumulative rate which is 90% of the average cumulative rate of working households. By comparison, the (unweighted) average is 56% in the other countries of the simulation sample. Unlike in other countries, financing with labor income taxes is preferable to financing with pension cuts.

The second step involves capital market integration. Another effect weighs on the balance between tax hikes and pension cuts. The same mechanism operates as in section 3.4.1. Pension cuts move the country away from strong Laffer curve effects, reducing the negative impact of aging on labor supply, pushing down the capital-labor ratio and thus increasing returns to investments. With integrated capital markets, pension cuts lead to capital inflows, sustaining domestic production. Simulations show that this effect is sufficiently strong to change the balance between tax hikes and pension cuts in favor of pension cuts.

The mechanism is the same in the other countries, but smaller in magnitude. In the Czech Republic, Poland and Sweden, there are quantitative but no qualitative changes. Note in particular that own pension cuts in Poland are larger than the average cut, so the signs are reversed: unlike Belgium, own cuts are preferable to average cuts when capital markets are integrated.

4 Policy implications

Before presenting the implications, it is useful to remember that there were restrictions to the international mobility of capital only a few decades ago and that they have been gradually removed, increasing the integration of capital markets. The creation of the Euro has also led to a marked integration of these markets, ahead of the integration of the product markets and far ahead of the integration of the labor markets (Lane, 2006). However, capital markets are not yet fully integrated (Morelli, 2010; Gropp and Kashyap, 2010). Whether full integration takes place is also a matter of policy. There are for instance calls for measures supporting greater integration, both on the policy side (e.g. European Commission, 2017) and the academic side (e.g. Veron and Wolff, 2016).

4.1 Coordination implications

First, capital market integration depends to some extent on policy arrangements, including differences across countries. Investor protection for instance differs across countries. Further integration of the markets thus depends on international coordination of policy reforms. Second, our simulations show that there are cross-country spillovers due to differences in the speed of population aging and to country-specific tax and pension policy. If countries want to tackle jointly the cross-country redistributive effects of aging differentials and social security policy, international coordination is needed.

Implication: capital market integration leads to cross-country spillovers and creates losers and winners over the long run, generating new country coalition patterns.

Section 3.2 leads to this implication. Redistribution generated by capital market integration over the long run is sizable: for instance, when labor income taxes are used to cover the social security costs of population aging, capital market integration leads to yearly average gains in GDP per capita exceeding 2 %-points in some countries over the next 50 years, and yearly losses larger than 4 %-points in other countries. From our sample of 14 countries, five benefit from integration (Finland, France, Italy, Sweden and the UK), one essentially is not impacted (Austria) and eight lose (Belgium, the Czech Republic, Denmark, Germany, the Netherlands, Poland, the Slovak Republic and Spain). In most cases, the first group of countries ages slower and is thus exposed to a slower increase of the capital-labor ratio, leading to higher relative returns to investments and attracting capital from other countries.

The dividing line between countries which benefit or lose from capital market integration over the long run is not the same as the lines which separate countries on other topics of economic policy. There are different views on social security conditions attached to labor market integration, for instance. Typically, less developed countries are not interested in setting the higher social security standards that more developed countries expect. There are however both less and more developed countries which stand to lose from further capital market integration. Capital market integration thus creates different coalition patterns.

Implication: capital market integration strengthens the need for social security reforms due to population aging in some countries, and reduces it in other countries.

Simulations results summarized in section 3.2 lead to this policy implication. Pension reforms are generally more visible to the voter than the use of the general government budget to finance social security deficits, either through debt or tax increases. On many counts however, the passive approach of relying on the general budget delivers worse economic outcomes than active social security reforms. Section 3.2 presents one such passive case, where labor income tax variations ensure the financing of increasing social security expenditures when populations are aging. The key result is that outcomes are even worse in some countries when capital markets are integrated, because they age

faster, are submitted to a worse drop in labor supply, larger increase in the capital-labor ratio, bigger drop in returns to investment, and thus capital outflows. For instance, GDP per capita in the Netherlands is projected to be an average 4.8 %-points lower in each of the next fifty years with full capital market integration (compared to no integration at all). In that country, integration makes the need for social security reforms bigger. On the other hand, capital market integration helps some countries. GDP per capita is projected to be an average 2.1 %-points higher in France with capital market integration, which thus reduces the need for social security reforms.

Implication: if countries hold coordination discussions on pensions, they should also discuss capital market integration at the same time.

This implication follows from simulation results summarized in section 3.4.2. Currently, European Union countries have scheduled different adjustments of their pension benefit schemes (see Ageing Working Group, 2015). Belgium, for instance, plans a small decrease of 2% of its pension benefit replacement rate, while the average over the 14 countries of the simulation sample is a decrease of 19%. Assume EU countries hold discussions to harmonize the adjustment of pension reforms and consider an option where all countries implement this average 19% cut. Then Belgium would lose a yearly average 0.7 %-points of GDP per capita over the following 50 years if capital markets were not integrated, but gain an average 0.4 %-points if these markets were fully integrated. The yearly average differential is 1 %-point over the next 50 years, a significant number. Whether capital markets are fully integrated or not would change the position of a country like Belgium. Coordination discussions on pension reforms should thus be held at the same time as discussions on the policy measures furthering the integration of capital markets. In the case of pension benefit reforms, the stronger the measures to further integrate capital markets, the larger the support from Belgium to strong cuts of pension benefits[26].

4.2 Social security implications

Every pension reform option comes with advantages and disadvantages. Pension cuts for instance help to keep taxes low and thus labor supply and production high, but increase the risk of old-age poverty. Increases in the retirement age have the most favorable impact on production without detrimental distributional consequences but may not conform with workers preferences. Tax and social security contributions increases may be more in line with these preferences but have a negative impact on labor supply incentives and thus production. These general statements hold whatever the organisation of capital markets. The difference with capital market integration is that the way to rank the different pension reforms options needs to be changed, when one uses impacts on production as evaluation criteria. Governments may thus have to change their reform

[26]It is beyond the scope of this paper to make a comprehensive evaluation of pension reforms coordination options. Analyses of the impact for all countries of the European Union, for each reform type, is left for future research.

evaluations as capital markets become more and more integrated. The implications discussed below provide guidance on evaluation revisions.

Implication: capital market integration makes increases of the retirement age a more interesting reform option in all countries.

This implication is derived from simulation results presented in section 3.3.1. Cross-country spillovers indeed generate rewards for countries increasing retirement age, as is discussed next.

Implication: there are rewards for early implementers of retirement age increases, due to capital market integration and cross-country spillovers.

The simulation results which lead to this implication are summarized in section 3.3.1. The yearly rewards remain moderate, simulations finding an average yearly gain or loss in GDP per capita of around 0.2 %-points over the next 50 years. Accumulated over years or decades, these differences can however become notable. Increases in retirement age before other countries mitigate the drop in labor supply per capita due to aging, compared to other countries. This leads to a smaller relative increase in the capital-labor ratio and larger relative increase in returns to investment, attracting capital from the integrated market[27].

Implication: capital market integration changes the ranking of pension reform options for some countries.

The simulation results behind this implication are summarized in section 3.4.2. For instance, simulations show that labor tax increases are preferable to a 20% cut in pension benefits in Belgium with no (low) integration[28], but the opposite with full (strong) capital market integration: instead of cutting pensions, implementing tax increases lead to an average yearly 0.7 %-points gain in GDP per capita over the next 50 years without integration, but a yearly 0.4% loss with integration. The key reason is that pension cuts have one more benefit under capital market integration: the smaller Laffer curve effect leads to smaller drops in labor supply and returns to investment, whose benefits can only be reaped when foreign investors make use of the integrated capital markets to invest more in Belgium.

Implication: for some countries, the implementation of social security reforms plays a crucial role in maximizing the benefit the country can gain from capital market integration (or reducing the losses it generates).

While simulations in section 3.2 show that Belgium and Denmark lose from capital

[27]Symmetrical conclusions hold: there are penalties of the same order of magnitude for late implementers of retirement age increases.

[28]More specifically, labor taxes increase alone are preferable to a combination of 20% cuts in pension benefits and (milder) increase in labor taxes. See section 3 for details.

market integration when there are no social security reforms, section 3.4.1 shows that these two countries gain from integration when all countries increase retirement age and section 3.2 shows that Belgium no longer loses from integration when pension benefits are cut. Similar patterns hold for other, but not all countries. Some countries lose from integration in any case, but less so when reforms are implemented. For all these countries, the GDP per capita gains from implementing the reform is a yearly average of 1 %-point or more over each of the next 50 years. The implementation of social security reforms - most of the time, an increase of the retirement age - thus plays a crucial role in maximizing the benefit that some countries can gain from the capital market integration (or reduce the losses it generates).

4.3 Other implications and remarks

The discussion of important assumptions and the focus of the research leads to final implications and remarks.

Implication: pro-immigration policies are one way to mitigate the negative consequences of capital market integration in fast aging countries (and increase the benefits in slow aging countries).

An important assumption of the analysis presented in section 3 is that demographic projections are neither influenced by capital market integration nor by economic policy reforms. In reality, migration partially depends on differences in economic conditions between the origin and the destination countries. In a fast aging country, wages should increase faster, as the labor supply per capita drops faster and the capital-labor ratio increases faster. Over time, fast aging countries may become a more interesting immigration destination, which would slow down the aging of the population and the negative impacts of capital market integration. Immigration should thus mitigate the negative consequences of capital market integration in fast aging countries (resp. increase the benefits for slow aging countries). Pro-immigration policies can support this mitigation (resp. enhancement) effects.

Remark: so far, no efficiency gains from coordination have been identified (in production per capita terms), but welfare gains have not (yet) been considered and efficiency gains with other coordination experiments have not been ruled out.

When the gains are measured in efficiency terms (production per capita), experiments carried out in section 3 have not identified any coordination gains. Some countries indeed gain over the long run from capital market integration, other countries lose, but it is a zero sum game: scaling by economic size, the weighted average yearly impact on GDP per capita is close to zero[29]. However, it could be a positive sum game (coordination

[29] One can verify it for instance by a weighted average of values in each of the last columns of the tables in appendix A. The sum might slightly differ from 0 due to precision. See also the end of section 3.2.

gains) with other policy experiments. The research presented here has not ruled out such a possibility.

The point of view of governments, which tend to focus on GDP as main indicator for economic policy, has been taken in this project. The point of view of households, who balance consumption gained through labor with leisure, was out of the scope of the research. Welfare analyses could thus reveal that capital market integration, with or without the social security reforms considered in section 3, deliver coordination gains, measured in welfare terms. For instance, countries with a slowly aging population, which benefit from cross-country redistribution via the integrated capital markets, could increase the retirement age less than other countries, losing some of the capital and production gains but winning with leisure. Welfare gains in all countries might thus be possible. This investigation is left for future research.

5 Concluding remarks

This paper investigates international spillovers due to capital market integration when population ages and the cross-country redistribution that it generates, using a multi-country overlapping-generations model calibrated for 14 European Union countries. The influence of social security reforms on redistribution is also considered.

The first key finding is that differences in population aging speed generate redistribution across countries. When no social security reforms take place and labor income taxes are increased to ensure sustainable public finances, GDP per capita can be more than 4 %-points lower under perfect capital market integration in fast aging countries than under completely separated capital markets, as yearly average over the next five decades. In slow aging countries, GDP per capita can be more than 2 %-points higher. Labor supply indeed drops more in fast aging countries, pushing up the capital-labor ratio more, which depresses returns to investment more and generates capital flows towards slow aging countries, supporting production there.

The second key finding is that tax and pension policy influence redistribution patterns. Some countries lose from capital market integration when no social security reform is implemented, but gain from it when the same reform is implemented in all countries.

Finally, capital market integration influences the relative performance of different tax and social security reforms. In some countries, labor tax increases are preferable to pension cuts under separated capital markets, while it is the opposite with fully integrated capital markets.

An immediate policy implication is that capital market integration increases the need for social security reforms in some countries, but eases it in other countries. Ceteris paribus, capital markets integration makes increases in retirement age a more interesting options for reforming social security. Further, fast aging countries can support immigration to mitigate the negative redistributive effects of capital markets integration. Finally, as capital markets are not yet completely integrated, countries which want to tackle jointly the redistribution effects of population aging need to discuss social security reforms and deeper capital market integration at the same time.

The research can be continued in different directions. I mention some of the most interesting options. First, welfare analyses can be performed. In this paper, the point of view of governments was taken, which tend to focus on production and public finance outcomes. Although the analyses did not rule out potential efficiency gains from coordination, it did not find any. One could take the point of view of households, looking for potential welfare gains from coordination. Second, an endogenous migration component can be added. In this paper, international migration is taken as given, from demographic projections. In reality, capital-labor ratios and thus wages will be increasing more in fast aging countries. Migration towards fast aging countries should thus increase, reducing the magnitude of cross-country redistribution.

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A Appendix: overview of results for all countries

This appendix provides an overview of the results for all countries for the main scenarios, focusing on the main macroeconomic indicator (average GDP/capita variations over the next 50 years). The legend of the tables follows that of table 1.

	Dependency ratio		GDP/capita change (%) Average 2015-2065		
	2015	2065	CE	MC	Gap MC-CE
Austria	0.28	0.50	-8.1	-8.1	0.0
Belgium	0.29	0.41	-3.6	-4.9	-1.3
Czech Republic	0.27	0.51	-6.0	-7.6	-1.6
Denmark	0.29	0.42	-4.1	-6.1	-1.9
Finland	0.31	0.45	-3.4	-2.6	0.8
France	0.30	0.47	-4.9	-2.8	2.1
Germany	0.35	0.60	-1.2	-4.1	-2.9
Italy	0.34	0.54	-5.9	-4.6	1.3
Netherlands	0.28	0.48	-3.1	-7.9	-4.8
Poland	0.24	0.58	-7.4	-9.0	-1.6
Slovakia	0.22	0.53	-7.8	-8.8	-1.1
Spain	0.29	0.63	-4.2	-5.2	-1.0
Sweden	0.31	0.42	-4.5	-4.3	0.3
United Kingdom	0.28	0.44	-7.1	-5.7	1.4

Table 6: Aging and labor tax reforms, all countries, 2015-2065

	Dependency ratio		GDP/capita change (%) Average 2015-2065		
	2015	2065	CE	MC	Gap MC-CE
Austria	0.28	0.50	-3.9	-2.6	1.3
Belgium	0.29	0.41	-1.2	0.5	1.8
Czech Republic	0.27	0.51	-2.5	-3.1	-0.6
Denmark	0.29	0.42	-0.9	-0.2	0.8
Finland	0.31	0.45	1.0	1.7	0.7
France	0.30	0.47	0.2	2.9	2.7
Germany	0.35	0.60	4.0	1.1	-2.9
Italy	0.34	0.54	-1.6	1.5	3.1
Netherlands	0.28	0.48	1.1	-2.7	-3.8
Poland	0.24	0.58	-2.0	-3.7	-1.6
Slovakia	0.22	0.53	-3.6	-4.6	-1.0
Spain	0.29	0.63	1.5	0.6	-0.9
Sweden	0.31	0.42	0.2	1.5	1.3
United Kingdom	0.28	0.44	-3.1	-2.0	1.1

Table 7: Aging, retirement age and labor tax reforms, all countries, 2015-2065

	Dependency ratio		GDP/capita change (%)		
	2015	2065	Average 2015-2065		
			CE	MC	Gap MC-CE
Austria	0.28	0.50	-7.9	-7.8	0.1
Belgium	0.29	0.41	-4.5	-4.5	0.0
Czech Republic	0.27	0.51	-5.8	-6.8	-1.0
Denmark	0.29	0.42	-3.8	-5.5	-1.7
Finland	0.31	0.45	-3.4	-2.7	0.7
France	0.30	0.47	-4.6	-2.5	2.1
Germany	0.35	0.60	-1.2	-4.1	-2.9
Italy	0.34	0.54	-5.7	-4.4	1.3
Netherlands	0.28	0.48	-2.9	-7.7	-4.8
Poland	0.24	0.58	-7.1	-8.6	-1.5
Slovakia	0.22	0.53	-7.7	-8.8	-1.1
Spain	0.29	0.63	-4.2	-5.3	-1.0
Sweden	0.31	0.42	-4.8	-4.1	0.7
United Kingdom	0.28	0.44	-6.9	-5.6	1.3

Table 8: Aging, pension benefits and labor tax reforms, all countries, 2015-2065

B Appendix: transition path aging and tax scenario

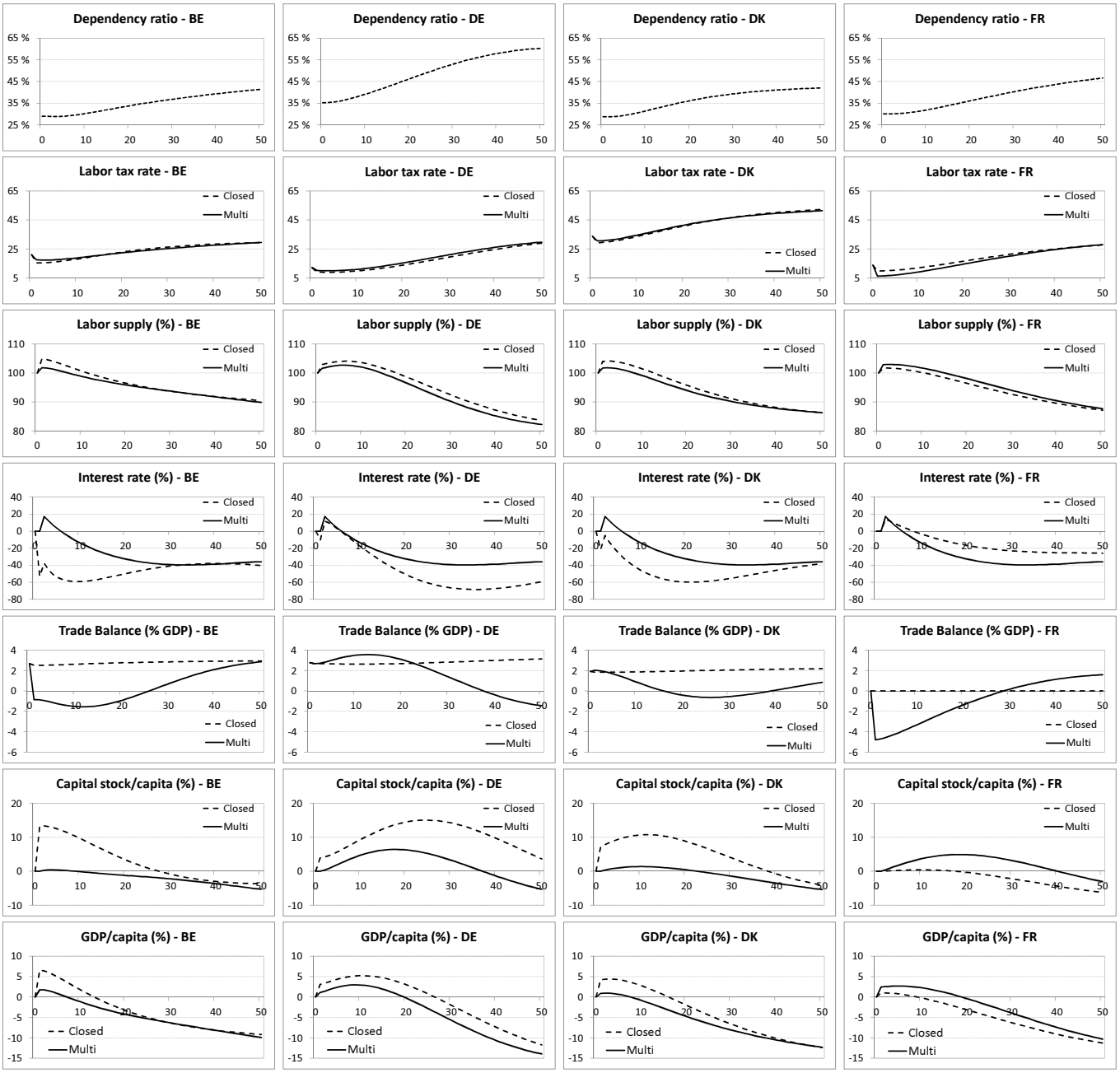

Figure 5: Aging and labor tax reforms, key economic variations, 2015-2065