



**Aging in Europe: Reforms, international
diversification and behavioral reactions**

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Abstract

The extent of demographic changes in Europe and Asia is much more drastic than in the US. This paper studies the effects of population aging on the interactions between economic growth and living standards in Europe with labor market and pension reform, behavioral adaptations, and international capital flows. Our analysis is based on an overlapping generations model with behavioral reactions to reform which is extended to the multi-country situation typical for Europe. While the negative effects of population aging on growth in Europe can in principle be compensated by reforms and economic adaptation mechanisms, they may be partially offset by behavioral reactions.

Keywords: aging; pension reform; labor market reform; labor supply reactions

JEL classification: J11, J21; D13; E27; H55; F16, F21

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Introduction

While aging is global, there are marked international differences in the speed and the extent of the aging processes, notably also among the US, Europe and Asia. While the US are and will remain relatively youthful, Europe faces a much older population while some Asian countries will go through a very fast aging process. This paper focuses on the three largest Continental European countries: France, Germany and Italy, and juxtaposes them to the US. These three European countries do not only feature a much larger decline in the support ratio (number of workers per population) than the US but also have substantially larger public budgets including their pay-as-you-go financed social security systems. Moreover, these countries have labor markets characterized by low participation rates of young women and individuals aged 55 and over. In spite of these structural problems, France, Germany and Italy have been remarkably resistant to labor market and pension reforms.

This paper extends a line of research based on multi-country overlapping generations models to study the effects of population aging on the interactions between economic growth and living standards with relatively mild labor market, pension and educational reforms, behavioral adaptations, and international capital flows. Key question is which policy mixes are suitable to maintain living standards despite the strong decline in the support ratio.

I. The model

We extend the overlapping generations model of the Auerbach and Kotlikoff (1987) type in several dimensions: we acknowledge the international trade and capital flows of European countries by a multi-country version of the model (Börsch-Supan, Ludwig and Winter, 2007); we model the large frictions in European labor markets by the distinction between exogenous and endogenous labor supply components (Börsch-Supan and Ludwig, 2010); and, in this paper, we add a model of an earnings-related pay-as-you-go public pension scheme typical for France, Germany and Italy which combines aspects of a defined contribution system with

those of defined benefits. A focus on Asia and global capital markets can be found in Börsch-Supan and Ludwig, 2009.

Households have preferences over consumption and leisure. Total labor supply of a household of age j is the product of an exogenous component l_j , and an endogenous component h_j . The exogenous component l_j can be thought of as the maximum life-time number of hours possible for a household, given by restrictions in labor market entry (e.g., due to length of mandatory schooling), restrictions during main working life (e.g., by the availability of day care facilities for families, or the 35-hour week in France), and in older age by restrictions through mandatory retirement. Households have some ability to choose their preferred labor supply by choosing h_j , the endogenous component of labor supply. They can be thought of hours within the maximum life-time number of labor hours l_j . This ability, however, is limited and asymmetrical as h_j may not exceed an upper limit \bar{h} .

More formally, a household of age j at time t in country i derives utility from consumption $c_{t,j,i}$ and leisure $1-l_{t,j,i} \cdot h_{t,j,i}$ where the household's per period utility function is given by

$$(1) \quad u(c_{t,j,i}, 1 - h_{t,j,i} \cdot l_{t,j,i}) = \frac{1}{1-\theta} \left(c_{t,j,i}^\phi (1 - l_{t,j,i} h_{t,j,i})^{1-\phi} \right)^{1-\theta}.$$

The maximization problem of a cohort born in period t at $j=0$ is given by

$$(2) \quad \max \sum_{j=0}^J \beta^j \pi_{t,j,i} u(c_{t+j,j,i}, 1 - l_{t+j,j,i} h_{t+j,j,i}),$$

where β is the pure time discount factor. In addition to pure time discounting, households discount future utility with their unconditional survival probability, $\pi_{t,j,i} = \prod_{k=0}^j s_{t+k,k,i}$. Here, $s_{t+k,k,i}$

denotes the probability to survive from period $t+k$, age k to period $t+k+1$, age $k+1$ in country i with $s_{t,0,i}=1$. Since the time of death is uncertain, we assume that accidental bequests resulting from premature death are taxed by the government at a confiscatory rate and used for otherwise neutral government consumption.

Labor productivity changes over the life-cycle according to age-specific productivity parameters ε_j . Hence, the age-specific wage is $w_{t,j,i} = w_{t,i} \cdot \varepsilon_j$.

Denoting total assets by $a_{t,j,i}$, maximization of the household's intertemporal utility is subject to a dynamic budget constraint given by

$$(3) \quad a_{t+1,j+1,i} = a_{t,j}(1+r_t) + \lambda l_{t,j,i} h_{t,j,i} w_{t,j,i} (1-\tau_{t,i}) + (1-\lambda) p_{t,j,i} - c_{t,j,i},$$

where $\lambda=1$ for $j=0,\dots,R$ and $\lambda=0$ for $j>R$ and R is the exogenous retirement age. $\tau_{t,i}$ denotes the contribution rate to the pay-as-you-go financed public pension system and $p_{t,j,i}$ the pension income, see below.

As pointed out above, maximization is subject to the constraint that the endogenous component of labor supply (“hours worked within the limit”) are positive and may not exceed the upper limit \bar{h} . Since the model cannot distinguish between the limit \bar{h} and the exogenous labor supply component, we normalize \bar{h} to one:

$$(4) \quad 0 \leq h_{t,j,i} \leq 1.$$

In those variants of our model in which the labor supply is fully exogenous, we replace the constraint (4) with the constraint that $h_{t,j,i}=1$ for all t,j,i .

The government organizes a prototypical European earnings-related pay-as-you-go financed pension system. Benefits are given by

$$(5) \quad p_{t,i} = \rho_{t,i} w_{t,i} (1-\tau_{t,i}) s_{t,j,i}$$

where $\rho_{t,i}$ denotes the net replacement rate (generosity of the pension system) and $\tau_{t,i}$ the contribution rate of the pension system in country i at time t . The pension stock - which captures the earnings related component of the system and is denoted by $s_{t,i,j}$ - accumulates over the life-cycle according to

$$(6) \quad s_{t+1,j+1,i} = s_{t,j,i} + \frac{\varepsilon_j l_{t,j,i} h_{t,j,i}}{R \cdot \bar{h}_{t,i}}, \text{ where } \bar{h}_{t,i} = \frac{\sum_{j=1}^R \varepsilon_j l_{t,j,i} h_{t,j,i} N_{t,j,i}}{R \cdot \sum_{j=1}^R l_{t,j,i} h_{t,j,i} N_{t,j,i}}$$

Households thus earn one earnings point if they receive average wage income in a given period. Earning points are normalized by the length of the working period R . As we do not model intra-generational heterogeneity here, differences in wage income are induced by age-specific productivity only.

Our model households understand the linkage between contributions to the pension system and pension payments in old age. Therefore, relative to a flat benefit pension system, labor supply distortions are smaller but not zero because the rate of return on the capital market

exceeds the implicit return of the pension system. The main policy parameters of the pension system are either the net replacement rate ρ or the contribution rate τ . The other parameter is determined endogenously since the pension system's budget is assumed to always be balanced. If ρ is large, public pensions substantially crowd out private saving through the households' saving decision given by (1) and (2).

Europe does not live in splendid isolation. There are trade and corresponding international capital flows. Saving and investment decisions are governed by a common global interest rate which, via international capital flows, equalizes the return to capital across countries. Assets held by households in country i therefore do not necessarily equal the capital stock in country i nor does saving necessarily equal investment in a single country.

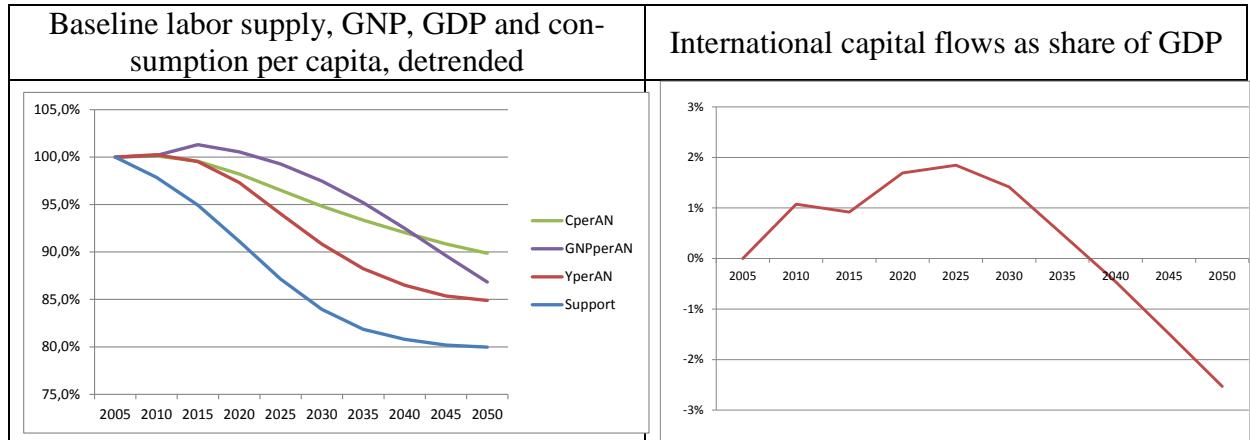
The remainder of the model is conventional. Exogenous demography, determined by mainstream fertility, mortality and migration assumptions (Eurostat 2013), determines cohort sizes and provides the main exogenous driver of the model: population aging. Production and wage setting in each country is neoclassical. Equilibrium is achieved if supply equals demand in the national labor markets and in the global capital market. Further details including the numerical solution and calibration procedures are relegated to the technical annex.

II. Results

A. Baseline results

Our baseline is defined as status quo in terms of labor market and pension system. We assume constant age and gender-specific labor force participation rates and a constant replacement rate $\rho_{t,i}$, see equation (5). Initially, we also assume equal productivity for all ages. All results refer to EU-3, the aggregate of France, Germany and Italy. As their populations age, the support ratio declines by 20 percent from 2005 until 2050. As a consequence, GDP per capita would decline by 15 percent and consumption per capita by about 10 percent relative to a non-aging economy with the same total factor productivity if policies and behavior were to remain at the current status quo, see the left panel of Figure 1.

FIGURE 1: Baseline results



Note: Authors' computations. Variables in the left panel are normalized to 100% in 2005 and net of TFP trend. Capital flows are saving minus domestic investment in Europe, relative to GDP and normalized to a balance of zero in 2005.

B. International capital flows

The decline in GDP per capita is smaller than the decline of the support ratio because scarce labor due to population aging is partially substituted by additional capital. This adaptation occurs in response to rising wages and falling interest rates. Since the US is aging much less than Europe, the return to capital would fall less (and wages increase less) than in Europe if these two regions were economically isolated. In an open economy setting, however, European households will invest in foreign capital deriving higher returns until a common interest rate is achieved in equilibrium. From a life-cycle point of view, such behavior differs according to age: eventually, households will repatriate their foreign savings and, according to the life-cycle mechanism underlying equations (1) and (2), enjoy their retirement consumption. The aggregate effect depends on demography. The large cohort sizes born in the 60s and 70s lead to first rising, then falling net capital outflows, until they turn negative after about the year 2035, see the right panel of Figure 1. These international capital flows reach almost 2% of GDP and are substantial in the sense that consumption per capita falls by about 5 percentage points less than GDP per capita in 2050. It also implies that de-trended GNP is substantially larger than de-trended GDP until about 2055 (left panel of Figure 1). These capital flows become even larger if the “rest of the world”, seen from Europe, includes Asia, see Börsch-Supan and Ludwig, 2009, although the long-term effect is smaller than maybe expected since the higher speed of the population aging process in Asia generates convergence of population structures between Asia and Europe.

C. Labor market reform

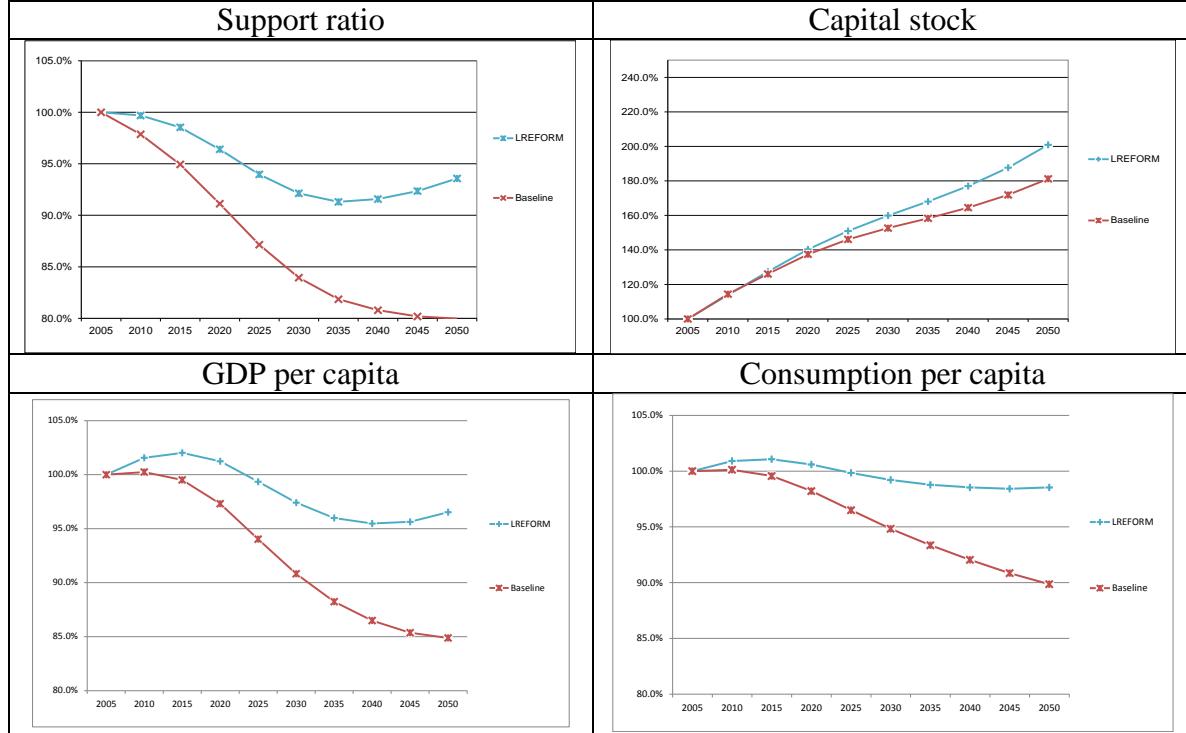
Labor market reform is supposed to relieve some of the current restrictions on European labor markets in order to increase labor supply and to offset the decline of the support ratio in the course of population aging. In the language of our model, the exogenous component l_j will be increased. As a realistic example, our labor market reform scenario includes four policy changes:

- increase in the retirement age by 2 years;
- decrease in the job entry age by 2 years;
- convergence of female labor force participation to 90 percent of the rate for men;
- reduction of unemployment to the NAIRU rate (Ball and Mankiw, 2002).

These reform steps are motivated by actual policy proposals. The Monti-government in Italy has raised its retirement age; in Germany, the statutory retirement age is gradually raising from 65 to 67 years until the year 2029; and in France, the minimum pensionable age of 60 has been raised to 62. The change in the European high school and university system (the so called Bologna process) is expected to decrease duration in schooling by about 2 years. These reform steps will be phased in linearly between 2010 and 2030.

If hours' supply h_j is exogenous, the economy increases its capacity accordingly and the decline in the support ratio is offset to about 94%, see the upper left panel in Figure 2. In addition, saving and investment behavior reacts leading to a small increase in the domestic capital stock relative to the baseline scenario of section B (upper right panel), thereby increasing GDP per capita slightly above the trend of the support ratio (lower left panel). Furthermore, added saving flows abroad and eventually increases consumption per capita stronger than per capita GDP (lower right panel). As a result, economic living standards, here measured as per capita consumption, can essentially be stabilized in spite of population aging in Europe.

FIGURE 2: Labor market reform with exogenous hours



Note: Authors' computations. All series normalized to 100% in 2005. GDP and consumption per capita are net of TFP growth.

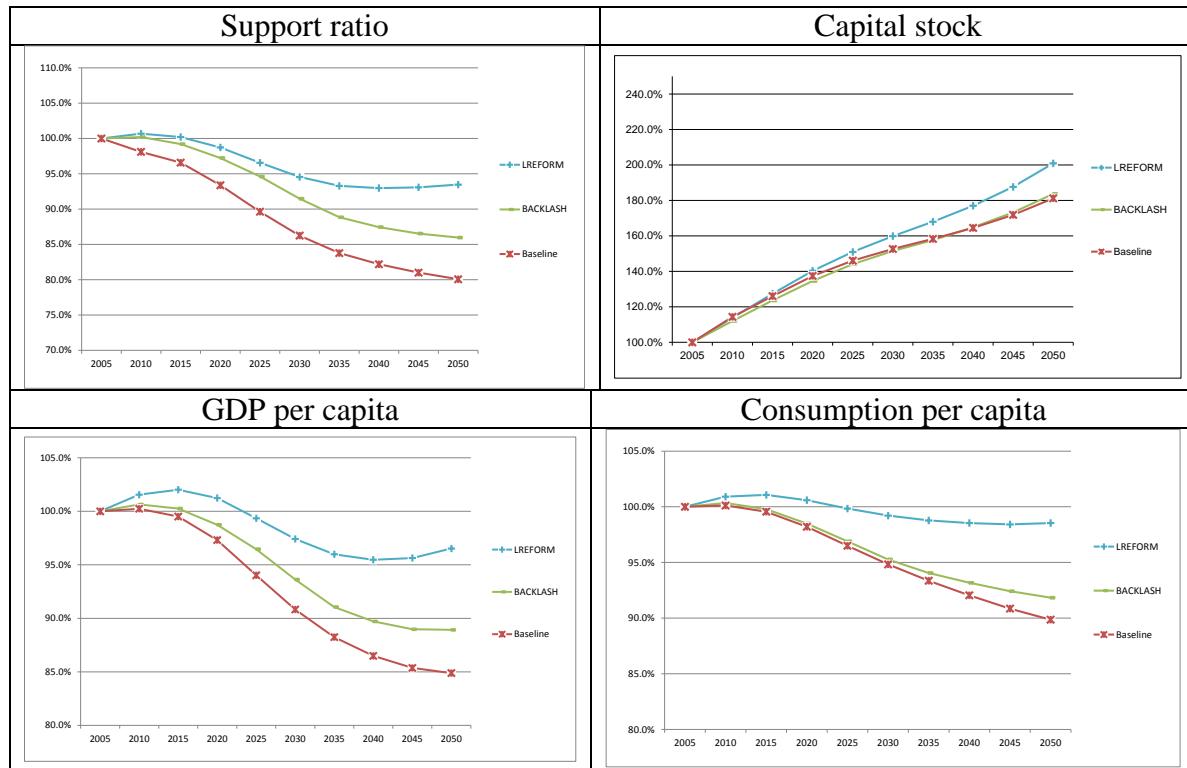
D. Backlashes to labor market reform

Overall, these reform steps do not appear to be overly radical; in fact, their combination would lead in 2040 to labor force participation rates fairly similar to those in Denmark, Sweden or Switzerland today. Nevertheless, attempts to actually execute reforms with those goals have faced stiff opposition in France and Italy, and most recently during the new grand coalition government's formation also in Germany.

Such backlash appears in our model in the substitution between the endogenous component h_j and the exogenous component l_j . In the absence of constraints, the two components of labor supply are perfect substitutes such that the exogenous variation of l_j leaves the labor supply of the household unaffected: as the age-specific employment l_j is exogenously increased, the household endogenously decreases hours worked, h_j . The exogenous variation of l_j affects total effective labor supply, however, for those households for whom the time endowment constraint \bar{h} is binding. As a consequence, the exogenous employment variation of l_j has a positive effect on labor supply but the overall effect is substantially smaller than in the previous section where labor supply was fully exogenous. The interplay between l_j and \bar{h} is most obvious in the household context where female and male working hours are jointly determined.

In our model, the resulting substitution is extreme for households in the middle ages of their life-cycle who are unconstrained. In the real world we would probably expect a less than one for one reduction of male hours when female hours increase.

FIGURE 3: Baseline results



Note: Authors' computations. All series normalized to 100% in 2005. GDP and consumption per capita are net of TFP growth.

E. Pension reform

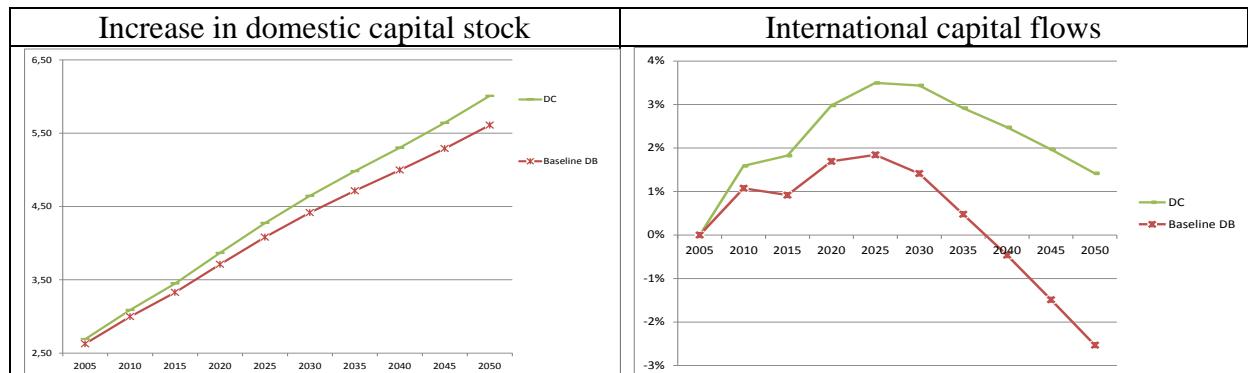
The public pension systems in France, Germany and Italy are pay-as-you-go financed. They used to be defined benefit (DB) systems in which the contribution rates were raised to maintain a politically determined relatively high replacement rate. Recently, reforms have initiated a process which introduces elements of notional defined contribution (NDC) systems in these DB systems. This transition is strongest in Italy, where a formal NDC system of the Swedish type has been introduced for new entrants, and has recently been accelerated by the Monti government. France and Germany have earnings-related pension systems in which the labor market risk to pension benefits is borne by workers, an important element of a defined contribution (DC) system. In addition, Germany introduced a “sustainability factor” which adjusts pension benefits not only to productivity increases, but also to the ratio of pensioners to workers, effectively transiting to a mixed system with DB and DC features.

Our model captures the earnings-related nature of the pension systems in France, Germany and Italy. In addition, we simulate two policies to set the replacement and the contribution rate which bracket the current mixture of DB and DC:

- the replacement rates are constant and roughly correspond to the 2010 levels (OECD, 2013). This corresponds to a DB system; the contribution rate adjusts accordingly to maintain a balanced budget;
- the contribution rates are frozen at their 2010 levels corresponding to a DC system; the replacement rate adjusts accordingly to maintain a balanced budget.

Figure 4 shows the resulting increase in the European capital stock, expressed in relation to GDP and for the case of exogenous labor supply. The base case is a DB system in which the replacement rate is fixed. In a DC system, the declining replacement rate induces workers to save more for their retirement, resulting in a larger domestic capital stock. Moreover, also international capital flows increase substantially to about 3.5 percent of GDP, more than offsetting the reversal after 2035 in the baseline scenario since the new young cohorts keep building up assets to finance their retirement consumption.

FIGURE 4: Pension reform

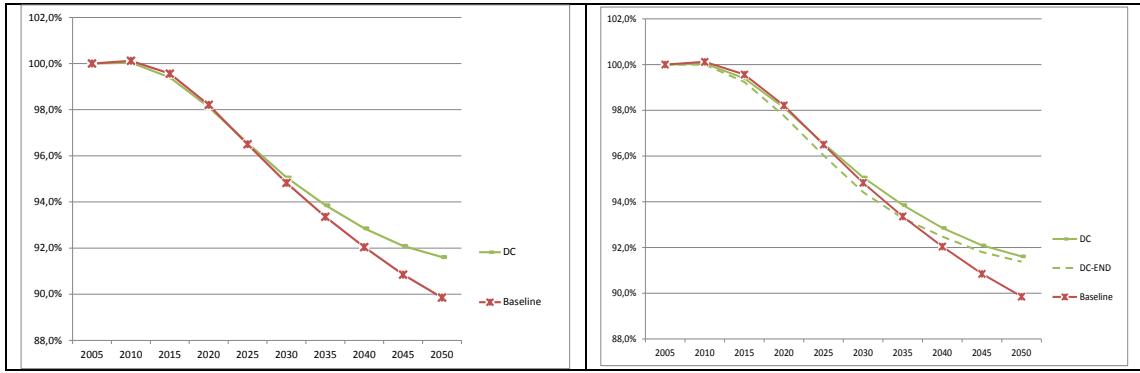


Note: Authors' computations. Capital stock as multiple of GDP. Capital flows are saving minus domestic investment in Europe, normalized to a balance of zero in 2005.

The higher capital stock plus the larger foreign assets lead to higher consumption per capita, see the left panel of Figure 5.

FIGURE 5: Consumption per capita after pension reform

Exogenous hours	Endogenous hours
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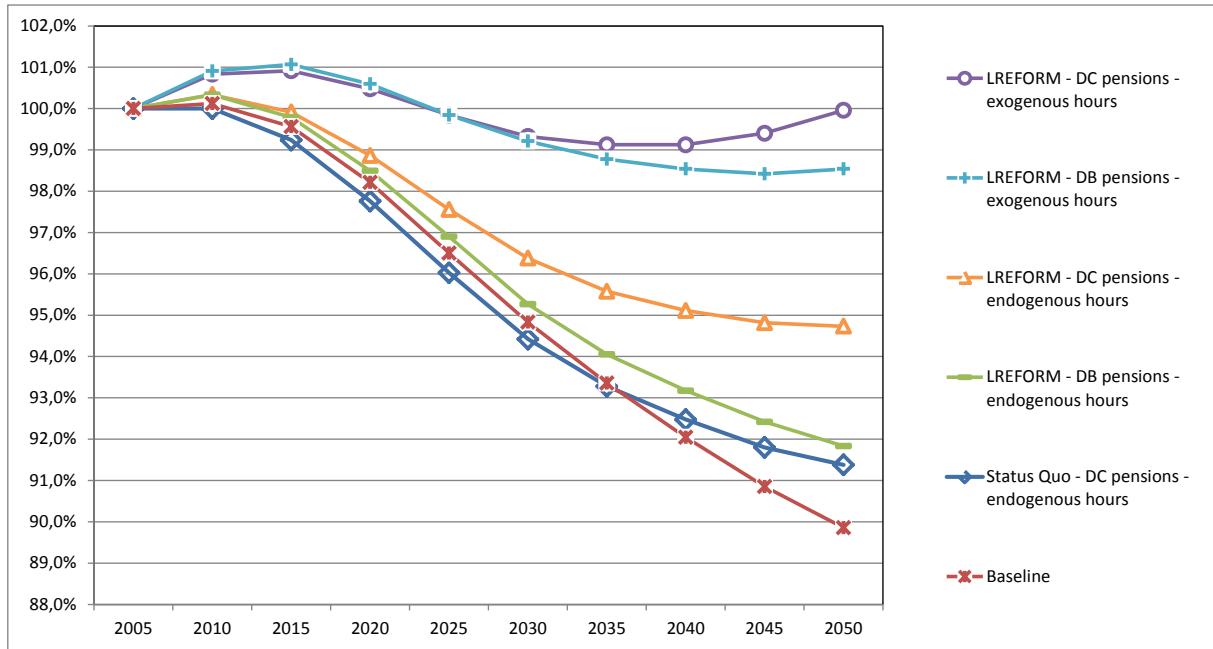
Note: Authors' computations. All series normalized to 100% in 2005 and net of TFP growth.

Such pension reform steps will not only generate reaction in saving behavior but also influence labor supply. However, compared to the reactions to labor market reform, the negative behavioral responses are relatively modest as can be seen in the right panel of Figure 5.

III. Discussion

Our paper shows that direct quantity and indirect behavioral effects of population aging on the economy are large. Direct quantity effects come from releasing restrictions on European labor markets. This increases labor supply, induces more retirement saving and also a higher domestic capital stock. Moreover, additional saving is invested abroad and generates international capital flows. They go first from the old to the young countries until the savings are repatriated to increase retirement consumption. Indirect behavioral effects strengthen saving further but substantially weaken labor supply. Both effects significantly affect economic growth and living standards. Due to the interaction effects between pension system and labor markets, a smart combination of pension and labor market policies can do more than each of such policies in isolation. These interaction effects are shown in Figure 6. A combination of a relatively moderate labor market reform with a pension policy to keep the contribution rate at the current level will reduce the baseline decline of consumption per capita (red crosses in Figure 6) to about a half (orange triangles in the figure). While switching from a DB to a DC pension system increases de-trended consumption per capita by 1.5 percentage points, and creating more labor supply by 1.9 percentage points, the combined effect of labor market and pension reform is 4.8 percentage points, including their interactions which are about 25% of the total effect.

FIGURE 6: Consumption per capita when policies are combined



Note: Authors' computations. All series are normalized to 100 percent in 2005 and net of TFP growth.

The biggest obstacle to further reductions are behavioral effects generated by the high preference for leisure and other incentives not explicitly modeled here but implicitly captured by the interplay between the hours' limit \bar{h} and the exogenous labor volume l_j (difference between orange triangles and purple circles in Figure 6).

The main message of the paper is therefore twofold. First, it is misleading that Europe could resolve all aging related problems by mobilizing the employment pool. Such policy proposals target at the extensive margin of labor supply and ignore behavioral reactions at the intensive margin. In the same vein, budgetary projections based on employment scenarios are severely biased because they implicitly assume that hours worked per person are kept constant. Hence, responses to demographic change do not only require structural reforms of labor markets and pension systems but also changes in the attitudes towards reform.

Second, our analysis suggests that such reform proposals can only be effective when households are constrained in their hours choice by institutions. Yet, we do neither explicitly model these institutions nor the complex household joint labor supply decisions. We leave an extension of our model along these dimensions for future research. The strong substitution between the endogenous hours h_j and the exogenous labor volume l_j in our model may generate too pessimistic an estimate of the reform backlash and its effects on economic growth and living standards. The fact, however, that all three new governments in France, Germany and Italy

are currently reverting pension and labor market reforms enacted by their predecessors shows how real the effects are of these governments' fear of resistance to reform.

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