The combined effect of aging and PAYGO pensions on capital accumulation and welfare.

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Introduction

Objective: assess the effect of aging on capital accumulation and welfare when a PAYGO social security prevails.
Three relevant distinctions are made.

- Two ways of aging: increased longevity or declining fertility.
- Three types of pensions systems: DB, DA and DC.
- Two retirement regimes: endogenous or induced early age of retirement.

Two standpoints: the steady state and the transition.
The approach is theoretical: analytical and numerical.

Outline

Why are those distinctions important ?

They are important for our topic, the effects of aging on growth.
They are often neglected.
Longevity increase raises fewer problems than fertility decline: smoother and can be coped with by rising the retirement age.
Recently, the increase in the dependency ratio (65+/20-64) is to be attributed to longevity increase.
For ex., in Belgium: over 2020-2060 the dependency will go from .31 to .44, with 60% due to longevity increase.
DB and DC are often discussed in a setting of uncertainty and risk sharing. Here the changes can be foreseen.

EU Countries

	Effective age of retirement	PAYG pensions as % of GDP	Life expectancy At 65	Fertility	DB/DC
UK	63.5	7.7	20.0	1.98	DB
Ireland	64.9	7.5	19.4	2.07	DB
France	60.1	14.6	21.7	2.03	DB
Italy	61.3	15.3	20.7	1.41	Notional Acc
Sweden	64.2	9.6	20.0	1.98	Notional Acc

Basic model

Log utility and Cobb Douglas production functions.
Quadratic disutility of postponing activity.

$$U = \ln(c_t) + \beta\ell \ln(d_{t+1}/\ell) \tag{1}$$

$$\begin{aligned} U &= \ln(w_t - s_t - \tau) \\ &+ \beta\ell \ln((R_{t+1}s_t + w_{t+1}z_{t+1} - z_{t+1}^2/2\gamma\ell + \tau(1+n))/\ell) \end{aligned} \tag{2}$$

$$y_t = Af(k_t) \tag{3}$$

$$(1+n+z_{t+1})k_{t+1} = s_t \tag{4}$$

$$G = (1+n+z_{t+1})k_{t+1} - \frac{\beta\ell}{1+\beta\ell}A(1-\alpha)k_t^{\alpha} \tag{5}$$
$$+\tau\left(\frac{\beta\ell}{1+\beta\ell} + \frac{(1+n)k_{t+1}^{1-\alpha}}{A\alpha(1+\beta\ell)}\right)$$
$$+\frac{z_{t+1}k_{t+1}^{1-\alpha}}{A\alpha(1+\beta\ell)}(A(1-\alpha)k_{t+1}^{\alpha} - z_{t+1}/2\gamma\ell)$$

With z=0 and no social security, one has

$$dk/dn < 0 \tag{6}$$

$$dU/dn < 0 \tag{7}$$

and

$$dk/d\ell > 0 \tag{8}$$

$$dU/d\ell > 0 \tag{9}$$

Basic model

What appears from introducing z and a PAYG pension is that the effect of aging on either utility or capital accumulation varies according to the source of aging and the type of social security that prevails.

To get a better grasp at the joint incidence of aging and social security on welfare, we proceed with a numerical example in two stages.

Basic model

First we consider the steady state levels of k and U as n or ℓ vary for the 6 types of social security and then we analyze the dynamics for the two types of aging calibrated in such a way that they imply the same increase in the rate of dependency measured by $\ell/(1+n)$. Throughout the exercise we make sure that $r < n$ and that $\bar{z} < z^*$.

Steady-states values of U and k as n or l evolve.

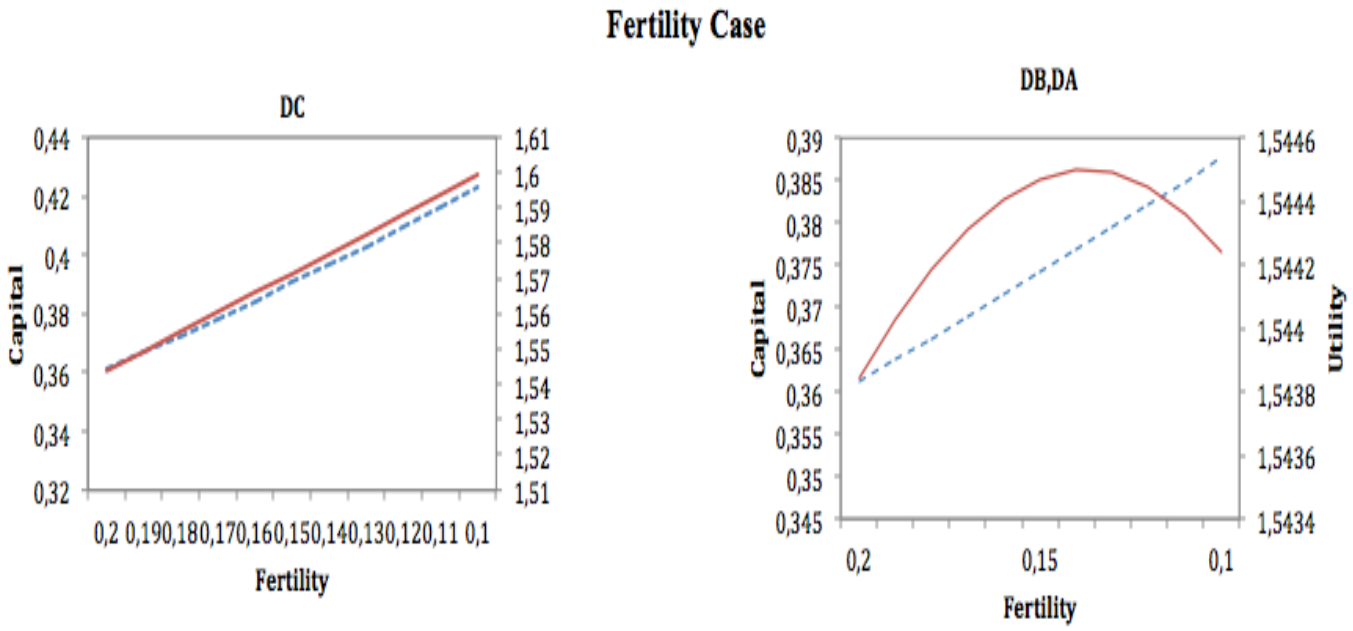
Parameters values

- $A = 10$
- $\alpha = 0.33$
- $\gamma = 0.05$
- $\beta = 0.25$
- $n = 0.2$
- $\ell = 0.6$
- $\bar{z} = 0.05$
- $\tau = 0.85/1$

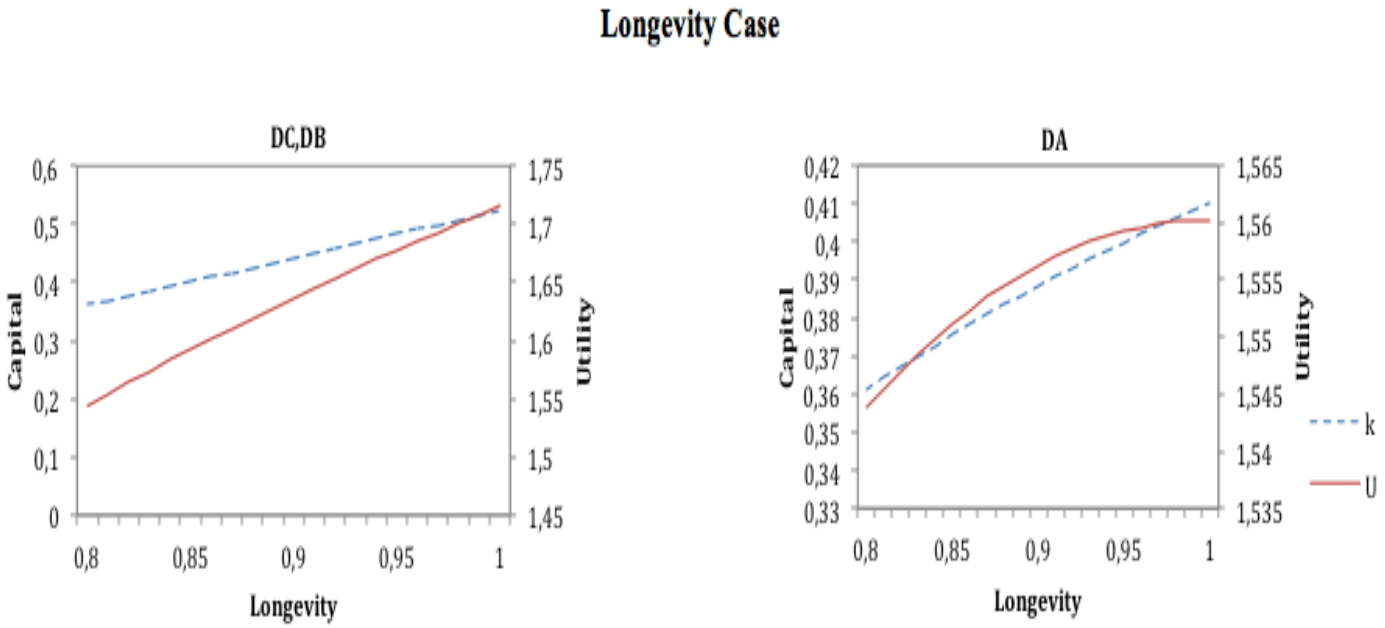
Findings from the numerical examples

	dk/dn	dU/dn	dk/dl	dU/dl
No pension, z=0	-	-	+	+
DC; z <z*	-	-	+	+
DB; z <z*	-	+/-	+	+
DA; z <z*	-	+/-	+	+
DC; z=z*	-	-	+	+
DB; z=z*	-	+	+	+
DA; z=z*	-	+	+	+/-

SS utility and capital: Early Retirement



SS utility and capital: Early Retirement



Our numerical illustration indicates that in most cases the incidence of aging has the same sign as without pension or activity in the second period.
There are exceptions. An increase in fertility may has a positive effect on utility for low rates of fertility in case of defined benefits or defined annuities. This means that the decline in capital accumulation is more than offset by the fact that the pension burden is alleviated by an increase in fertility. As to longevity increase, we see that in the case of DA it can have a depressive effect on welfare when longevity is high enough. The reason is to be found in the fact that the age of retirement increases as well.

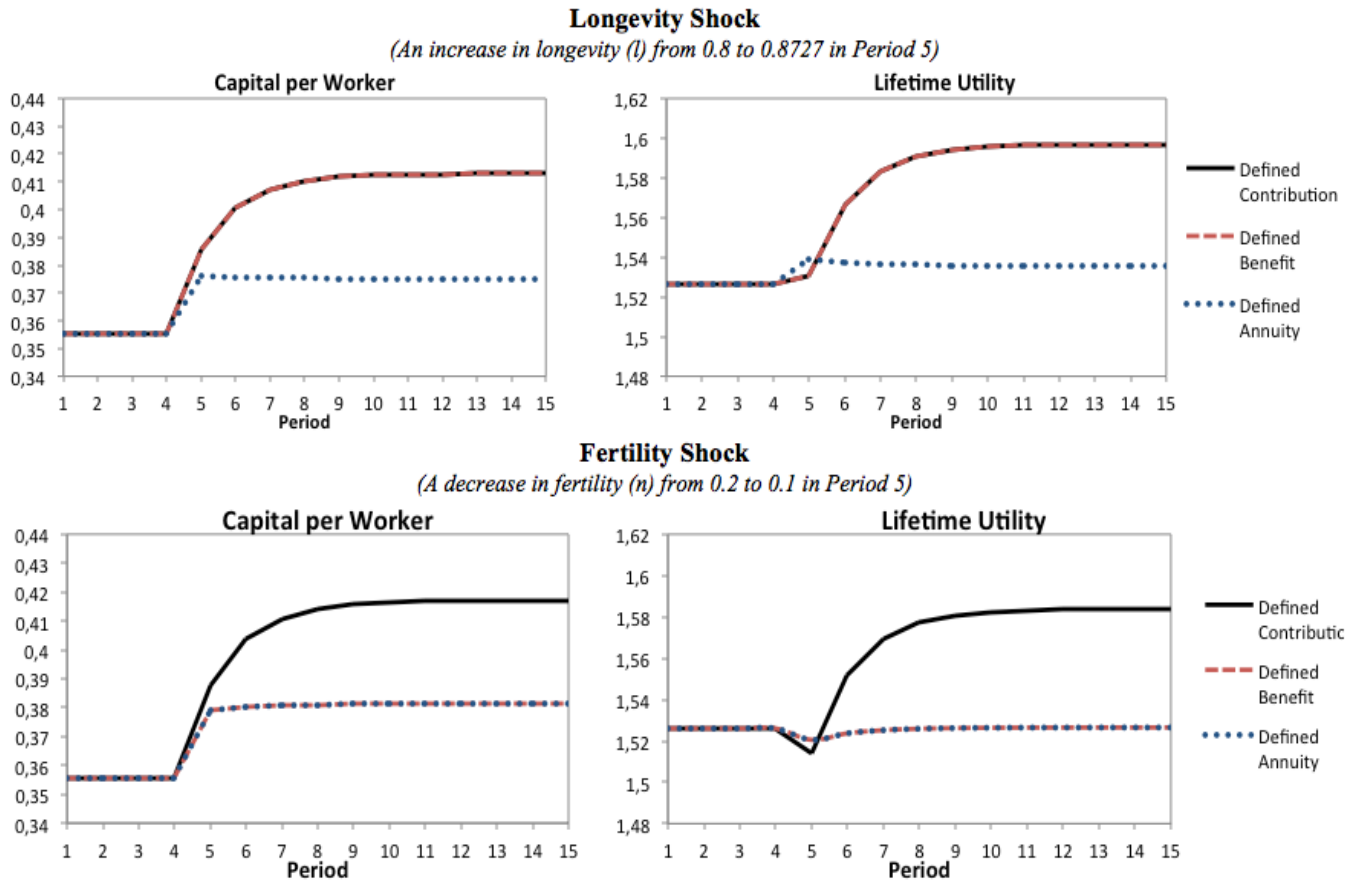
Dynamics

We are particularly interested by the gains (if any) in capital accumulation and in utility resulting from aging and by the cases where the transition can be welfare worsening for some generations. These results are given in the Table below and are illustrated by the most striking figures.

Comparative Statics for Capital per Worker and Lifetime Utility under Different Social Security Systems and Shock Scenarios
(Percentage Change in the Steady State Values after the shock)

	Longevity Shock		**Fertility Shock**	
	Capital per Worker	Lifetime Utility	Capital per Worker	Lifetime Utility
Early Retirement				
Defined Contribution	16.22	4.64	17.37	3.79
Defined Benefit	16.22	4.64	7.31	0.03
Defined Annuity	5.59	0.63	7.31	0.03
Optimal Retirement				
Defined Contribution	11.75	4.17	13.87	3.37
Defined Benefit	11.75	4.17	4.73	-0.76
Defined Annuity	3.72	0.40	5.88	-0.27

Early Retirement



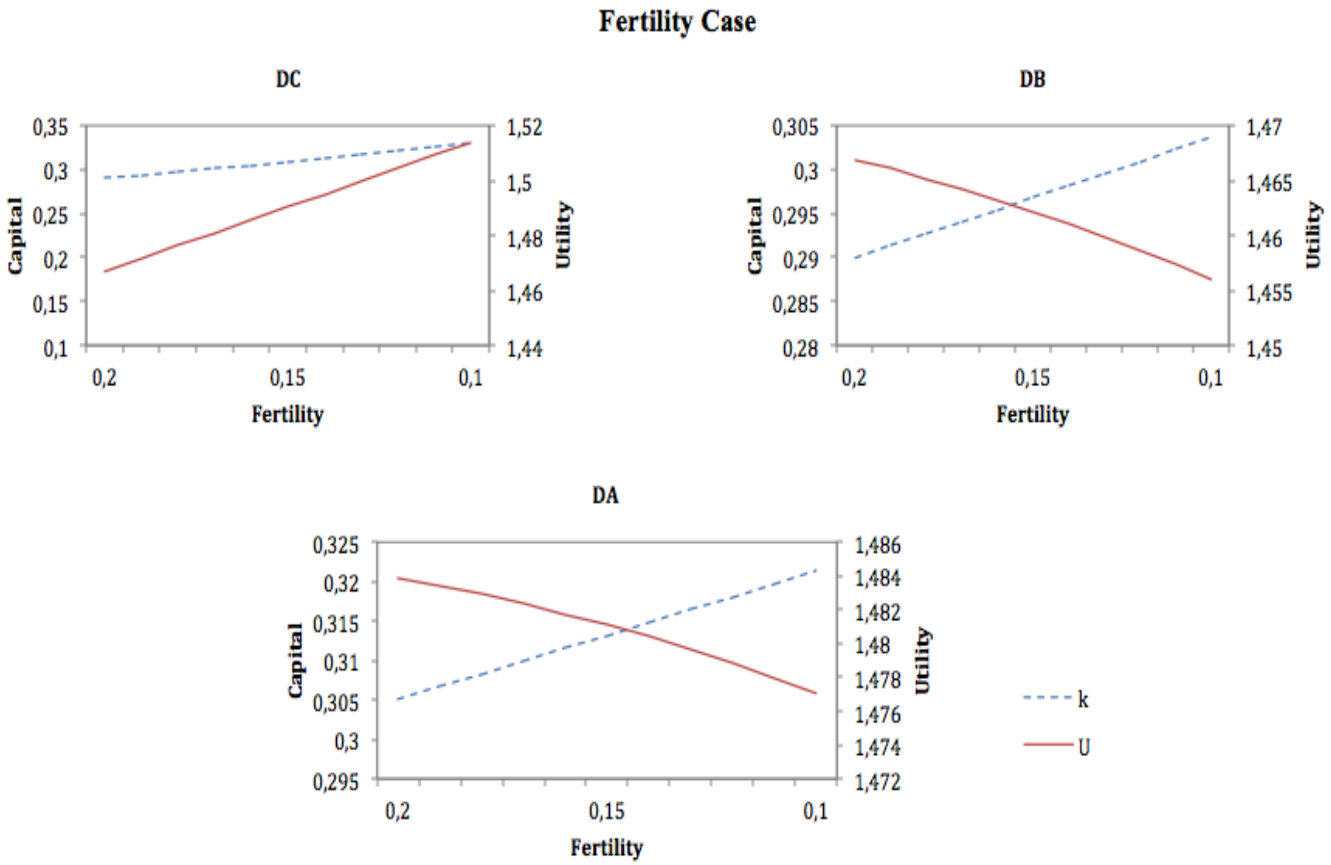
Striking result : loss in utility following a fertility shock.
Particularly with DC.
Loss in second period consumption.
Same transitory loss with optimal retirement.

Conclusions

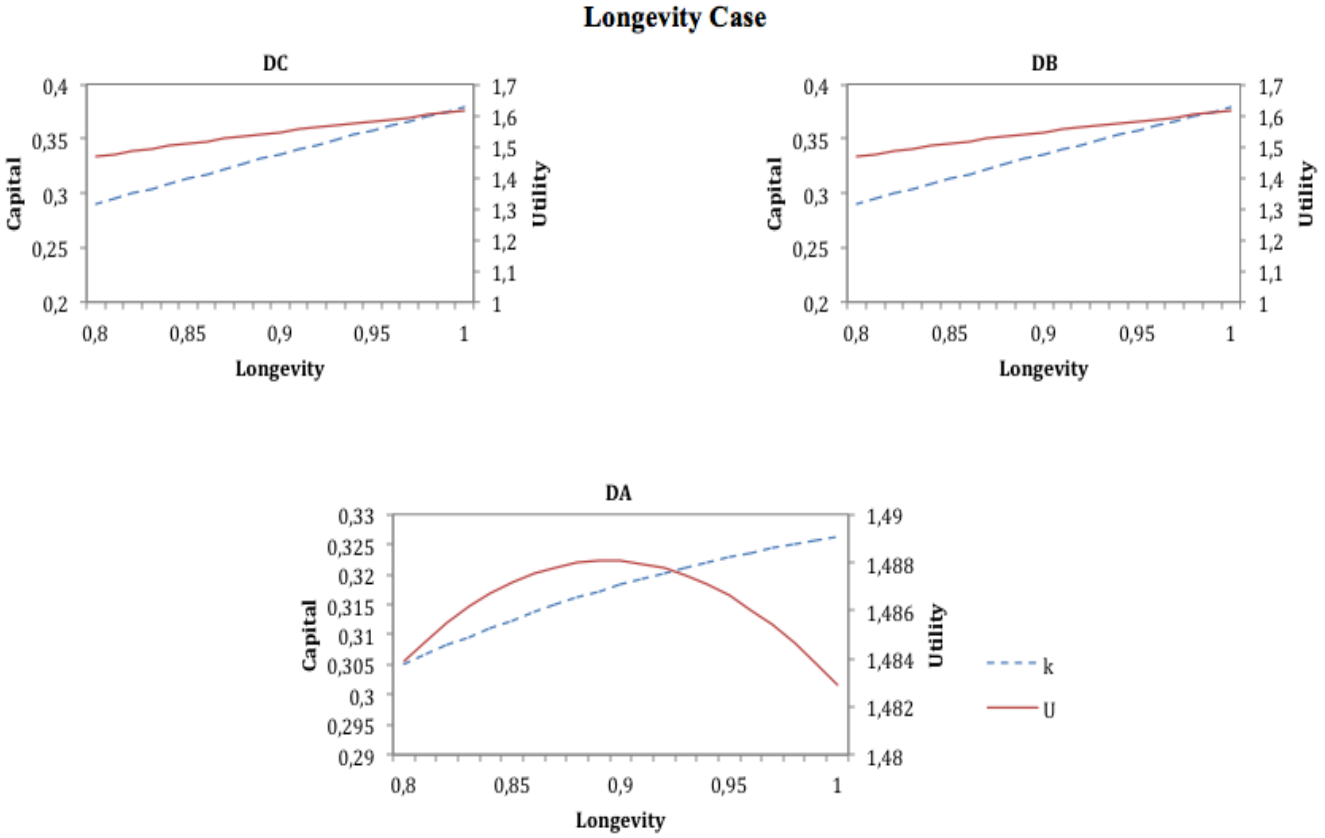
One clearly sees that the effect of aging on both capital accumulation and utility varies a lot depending on the sources of aging and on the type of social security that prevails. Caveat: there are cases where the transition generation suffers a utility loss. Further research :

- The joint effect of aging and changes in the social security regimes: from DA/DB to DC and from early retirement to flexible retirement.
- Opening the economy with the possibility of tax competition.
- Better calibrations.

Optimal Retirement



Optimal Retirement



Optimal Retirement