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# Partially funded social security and growth

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**Abstract**

This paper investigates the relationship between economic growth and the degree of fundedness of a social security system in an overlapping generations model with family altruism. It is shown that the relationship between the degree of fundedness and economic growth is inverted U-shaped so that a gradual increase in funding may harm growth if bequests are not operative within the family. Our findings put some caution on the conventional view that a higher degree of funded social security is beneficial for growth.

**KEYWORDS**

family altruism, growth, social security

**JEL CLASSIFICATION**

D9, H3, I2, O4

## 1 | INTRODUCTION

Pensions are financed by both the pay-as-you-go and the funding principle in many countries. In recent years, however, due to rapid population aging and slow economic growth, a shift towards more funding could be observed with a corresponding increase in the share of private pensions in total pension spending (OECD, 2019). For example, the share of public old age spending in GDP among OECD countries increased from 4.9% in 1980 to 7.4% in 2019 whereas the corresponding share of mandatory and voluntary private spending almost tripled from 0.6% in 1980 to 1.7% in 2019.

The transition from an unfunded pension system towards a fully funded one has recently received much attention in the economic literature. However, most of the existing theoretical work is concerned about transitional issues between both pension schemes (e.g., Gyárfás & Marquardt, 2001) or focusses on the comparison of funded versus unfunded social security systems and their performance with growth and other outcomes (e.g., Docquier & Paddison, 2003; Kaganovic & Zilcha, 2012). With respect to economic growth, the general finding of these studies is that a fully funded social security system is superior to an unfunded scheme as it provides better incentives for human capital accumulation. Moreover, the growth effects from either an existing unfunded or an existing funded social security system are well documented, see, for example, Lambrecht et al. (2005) and Maebayashi (2020) for the case of an unfunded system and Zhang (1995) and Kunze (2012) for the case of a fully funded system.[1] However, none of these studies analyze how changes in the degree of fundedness affect economic long-run growth in a model with both a funded and an unfunded component. To close this gap is the aim of the current paper.

The scarce empirical evidence on the relationship between pension reform towards more funding and economic growth, however, turns out to be mixed. Davis and Hu (2008) find a positive effect of pension savings on output for both OECD countries and Emerging Market Economies whereas Zandberg and Spierdijk (2013) and Altiparmakov and Nedelkovic (2018) find no significant effects on economic growth for OECD and non-OECD countries or countries in Latin America and Eastern Europe, respectively. Papers focussing on the effects of pension reforms on aggregate savings find that countries with pay-as-you-go pensions tend to have lower aggregate saving rates than countries with funded pensions, see, for example, Samwick (2000) and Bailliu and Reisen (1998). Finally, Bijlsma et al. (2018) find a significant impact of pension assets on growth for sectors that are more dependent on external financing. These generally mixed findings are somewhat confirmed by some casual inspection of Figure 1 which uses data from the OECD Social Expenditure Database (SOCX)[2] and shows the degree of fundedness, calculated as the share of mandatory and voluntary private old age spending in total old age spending, and annual GDP growth rates for OECD countries from 1980 to 2020. If at all, these data point to a weak non-linear relationship between the degree of funding and economic growth.

To interpret these findings, this paper addresses the question how an increase in the degree of fundedness of an existing pension scheme with both a funded and an unfunded component impacts on economic growth depending on preferences with regard to altruism and technology. Using an overlapping generations model with family altruism and homogenous households, as has been formalized by Lambrecht et al. (2006), where private investment in human capital of children is the engine of growth, we consider a unified social security system in which different social security plans are represented via certain degrees of fundedness and which comprises the cases of an unfunded and a fully funded pension scheme as special cases (as in Park (2018)).

In contrast to the conventional view that a fully funded system is superior to an unfunded one with respect to economic growth, the current paper demonstrates that the relationship

[1] Note that the focus of this paper is on the impact of a higher degree of fundedness on privately-financed human capital formation. Therefore, we do not deal with the issue of public versus private education funding. Kaganovich and Zilcha (1999), for example, analyze the relationship between a pay-as-you-go pension programme and growth when both private and public spending finances education.

[2] See https://www.oecd.org/social/expenditure.htm.

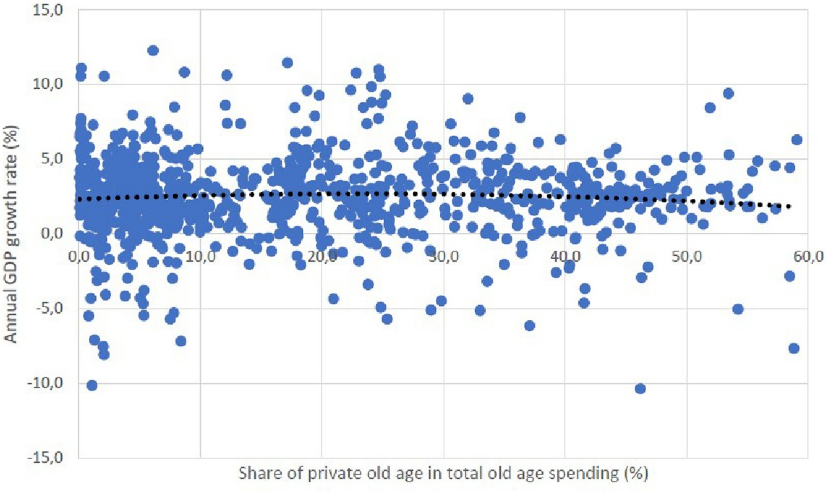


**FIGURE 1** Share of mandatory private and voluntary private old age spending in total old age spending and annual GDP growth rates for OECD countries from 1980 to 2020. *Source*: Own calculations, OECD Social Expenditure Database (SOCX). [Colour figure can be viewed at wileyonlinelibrary.com]

between the degree of fundedness and economic growth may be inverted U-shaped if bequests are not operative within the family. In response to a gradual increase in funding individuals substitute private savings for educational spending as a result of a lower pension benefit from the unfunded part of the social security system. If this direct effect through lower educational spending dominates the positive general equilibrium effect resulting from higher capital accumulation and therefore a higher return to education, a gradual increase in the degree of fundedness reduces growth. When bequests are operative, however, our results are consistent with previous results in the literature as a higher degree of fundedness is beneficial to growth. In this case individuals substitute voluntary savings for consumption spending to provide a larger amount of bequest to their offspring which in turn increases aggregate savings and capital accumulation.

Our results add to the ongoing debate regarding the desirability of a transition from a pay-as-you-go social security regime to a fully funded one by providing an additional argument against a higher degree of funded social security, based on a possible negative effect on economic growth, thereby corroborating the conclusions of the most recent literature on this topic. Westerhout et al. (2022), for example, study the optimal balance between pay-as-you-go and funding in view of recent trends, as for example, low economic growth and increased capital market volatility, and conclude that it may be wise to halt the shift towards more funding. Similarly, Lin et al. (2021) show that reforms of unfunded systems outperform the transition to a funded system in many aspects, for example, a higher GDP in the long run, which in turn provides an explanation of why a shift to a funded system is rarely observed.

The remainder is organized as follows. The next section introduces the model and derives the growth effects of a higher degree of fundedness when bequests are either operative or not.

## 2 | THE MODEL

We consider an overlapping-generations model in which parents have an altruistic concern and care about the disposable income of their children.[3] Population size $N_t$ is assumed to grow at a constant rate $n$, so that a new cohort of identical individuals is born in each period, that is, $N_t = (1 + n)N_{t-1}$.[4] Each individual lives for three periods: During childhood individuals are educated by their parents and do not make any economic decision. In the second period of life, each individual gives birth to $1 + n$ children and inelastically supplies $h_t$ efficiency units of labor, her endowment of human capital depending on her parents' spending on education. She receives the market wage $w_t$ and a non-negative bequest $b_t$ from her parents. Income is spend on consumption $c_t$, private education $(1 + n)e_t$ and savings $s_t$:

$$I_t \equiv (1 - \tau)w_t h_t + b_t = c_t + (1 + n)e_t + s_t \tag{1}$$

where $\tau$ is the contribution rate to the pension scheme. During old-age, each individual allocates the return to her voluntary savings $R_{t+1}s_t$ plus the benefit from the pension scheme $\theta_{t+1}$, to second period consumption $d_{t+1}$ and to give a non-negative bequest $b_{t+1}$ to her $(1 + n)$ offsprings:

$$d_{t+1} = R_{t+1}s_t + \theta_{t+1} - (1 + n)b_{t+1} \tag{2}$$

where $R_{t+1}$ is the interest factor at $t + 1$.

The government runs a unified social security system which is parametized by the intensity $\phi \in [0, 1]$ of fundedness. Hence, the portion $\phi\tau$ of individual contributions is invested as mandatory savings whereas the remaining share $(1 + n)(1 - \phi)\tau$ is used to pay retirement benefits to the currently old individuals. Consequently, the case $\phi = 0$ corresponds to an unfunded social security system while $\phi = 1$ implies a fully funded one. The main focus of this paper is to study how a shift in the degree of fundedness towards a more funded pension scheme (a higher $\phi$) affects long run growth depending on assumptions with regard to preferences and technology.[5]

[3]The model is a generalization of Lambrecht et al. (2005) and Kunze (2012), who study the growth effects of a pay-as-you-go and a fully funded pension scheme, respectively. The main idea of the family altruism model is that parents care about the economic success of their children, which is measured by the children's lifetime income. See the aforementioned papers and references therein for further details and empirical evidence.

[4]Note that we follow the most closely related literature (see Kunze, 2012; Lambrecht et al., 2005; Park, 2014) and assume that fertility choice is exogenous. An analysis of the case with endogenous fertility is left for future research. In this case, however, the model would no longer be analytically tractable.

[5]Such a unified framework has been considered by Park (2014, 2018) in the context of a neoclassical growth model. Moreover, the case $\phi = 0$ corresponds to the model in Lambrecht et al. (2005) whereas the resulting model with $\phi = 1$ has been analyzed by Kunze (2012). These two papers focus on the growth effects resulting from changes in the contribution rate $\tau$. With operative bequests, Lambrecht et al. (2005) find that a higher contribution rate reduces long run growth whereas there is a growth maximizing size of $\tau$ in Kunze (2012). By contrast, with inoperative bequests an increase in $\tau$ is neutral to growth in Kunze (2012) while there is a growth maximizing size of $\tau$ in Lambrecht et al. (2005). Consequently, for a given degree of fundedness, that is, $\phi \in (0, 1)$, there should be a growth maximizing size of $\tau$ when bequests are inoperative (where the positive growth effect becomes less likely the higher $\phi$), whereas there will either be a negative growth effect or a growth maximizing size of $\tau$ when bequests are operative (the magnitude of these effects again depending on the level of $\phi$).

A balanced social security budget thus requires

$$\theta_{t+1} = (1-\phi)(1+n)\tau w_{t+1}h_{t+1} + \phi R_{t+1}\tau w_t h_t. \tag{3}$$

The human capital of an individual in period $t+1$ is a function of the private investment in education, $e_t$, and the parent's human capital, $h_t$:

$$h_{t+1} = De_t^{\delta}h_t^{1-\delta} = D\overline{e}_t^{\delta}h_t \tag{4}$$

where $D$ is a scale parameter, $0 < \delta < 1$ is the elasticity of the education technology with respect to private educational spending and $\overline{e}_t \equiv e_t/h_t$ private educational spending per unit of human capital. Individual preferences are assumed to be logarithmic and depend on first and second period consumption and on the disposable income of the adult children:

$$U_t = (1-\beta)\ln c_t + \beta \ln d_{t+1} + \gamma \ln I_{t+1} \tag{5}$$

where $0 < \beta < 1$, $\gamma$ denotes the degree of altruism towards own children and

$$I_{t+1} = (1-\tau)w_{t+1}h_{t+1} + b_{t+1}. \tag{6}$$

Each individual maximizes utility (5) subject to the constraints (1), (2), (6) and the non-negativity of bequests $b_{t+1} \geq 0$ by choosing $c_t$, $e_t$, $s_t$, $d_{t+1}$ and $b_{t+1}$. The first order conditions determining optimal savings, private educational spending and bequest are[6]:

$$\frac{\partial U_t}{\partial s_t} = -\frac{1-\beta}{c_t} + \frac{\beta R_{t+1}}{d_{t+1}} = 0 \tag{7}$$

$$\frac{\partial U_t}{\partial e_t} = -\frac{(1+n)(1-\beta)}{c_t} + \frac{\gamma(1-\tau)w_{t+1}D\delta e_t^{\delta-1}h_t^{1-\delta}}{I_{t+1}} = 0 \tag{8}$$

$$\frac{\partial U_t}{\partial b_{t+1}} = -\frac{(1+n)\beta}{d_{t+1}} + \frac{\gamma}{I_{t+1}} \leq 0 \quad (=0 \text{ if } \quad b_{t+1} > 0) \tag{9}$$

Inserting Equations (7) and (8) into (9) gives

$$(1-\tau)w_{t+1}D\delta e_t^{\delta-1}h_t^{1-\delta} \geq R_{t+1} \tag{10}$$

When bequests are operative, Equation (10) holds with equality and the rate of return to private education equals the interest rate. With inoperative bequests, however, the rate of return to private education exceeds the interest rate.

[6]Note that the focus of this paper is on the case in which the funded share of public pensions does not fully crowd out private savings. An analysis of the case in which voluntary savings are zero is left for future research.

In every period $t$, firms produce a single output good according to a Cobb–Douglas production function combining physical capital $K_t$ and human capital $H_t$:

$$Y_t = AK_t^{\alpha} H_t^{1-\alpha} \tag{11}$$

where $0 < \alpha < 1$ denotes the capital share. Profit maximization gives the usual marginal productivity conditions:

$$w_t = (1-\alpha)AK_t^{\alpha} H_t^{-\alpha} = (1-\alpha)Ak_t^{\alpha}, \quad R_t = \alpha AK_t^{\alpha-1} H_t^{1-\alpha} = \alpha Ak_t^{\alpha-1} \tag{12}$$

where $k_t = K_t/H_t$ is the physical to human capital ratio.

In equilibrium, the market clearing conditions for the capital, the labor and the good market are:

$$K_t = N_{t-2}s_{t-1} + \phi\tau w_{t-1}h_{t-1}N_{t-2} \tag{13}$$

$$H_t = N_{t-1}h_t \tag{14}$$

$$Y_t = N_{t-1}(c_t + s_t + (1+n)e_t + \phi\tau w_t h_t) + d_t N_{t-2} \tag{15}$$

Inserting the old's budget constraint (2) into the good market equilibrium condition, Equation (15) becomes

$$d_t + (1+n)I_t = (1+n)(1-\phi\tau(1-\alpha))Ak_t^{\alpha} h_t \tag{16}$$

## 2.1 | Inoperative bequests

In a first step, we study the growth effects of an increase in the degree of fundedness (an increase in $\phi$) when bequests are inoperative in period $t+1$. Then, Equations (9) and (16) give

$$I_{t+1} = (1-\tau)w_{t+1}h_{t+1} = (1-\tau)(1-\alpha)Ak_{t+1}^{\alpha} h_{t+1} \tag{17}$$

$$d_{t+1} = (1+n)(\alpha + (1-\phi)\tau(1-\alpha))Ak_{t+1}^{\alpha} h_{t+1} \tag{18}$$

Combining Equations (7), (8) and (12) we obtain

$$\bar{e}_t^{1-\delta} = \frac{\gamma\delta D}{\beta\alpha}(\alpha + (1-\phi)\tau(1-\alpha))k_{t+1} \tag{19}$$

For a given stock of capital $k_{t+1}$, a higher degree of fundedness reduces educational spending. At the same time a lower effective contribution rate from the unfunded social security system, that is, $(1-\phi)\tau$, may have a positive impact on $k_{t+1}$ through voluntary savings. This raises the question whether a higher degree of fundedness is beneficial to or harms growth when bequests are inoperative.

From the non-negative bequest condition (10) and (19) we can derive an upper bound on the social security contribution rate so that bequests are inoperative if the following inequality holds

$$\tau \leq \frac{\beta - \alpha(\beta + \gamma)}{(1-\alpha)(\beta + \gamma(1-\phi))} \equiv \chi \tag{20}$$

Consequently, the case with inoperative bequests occurs if the contribution rate is not too large, that is, $0 < \tau \leq \chi$, which further implies that, by assumption, individuals are not too altruistic as $\chi > 0 \Leftrightarrow \gamma < (1-\alpha)\beta/\alpha$. Using Equations (4) and (19) gives

$$k_{t+1}h_{t+1} = \frac{\alpha\beta}{\delta\gamma} \frac{1}{\alpha + (1-\phi)\tau(1-\alpha)} \bar{e}_t h_t \tag{21}$$

which in turn allows us to determine individual savings $s_t$ and consumption $c_t$ (from Equations (13), (7) and (18), (21)):

$$s_t = \frac{\alpha\beta}{\delta\gamma} \frac{(1+n)}{\alpha + (1-\phi)\tau(1-\alpha)} \bar{e}_t h_t - \phi\tau(1-\alpha)Ak_t^{\alpha}h_t \tag{22}$$

$$c_t = \frac{(1+n)(1-\beta)}{\beta} \frac{\alpha + (1-\phi)\tau(1-\alpha)}{\alpha} k_{t+1}h_{t+1} = \frac{(1+n)(1-\beta)}{\delta\gamma} \bar{e}_t h_t \tag{23}$$

Plugging Equations (22) and (23) into (1) and solving for $\bar{e}_t$ gives

$$\bar{e}_t = \frac{(1-(1-\phi)\tau)(1-\alpha)}{B(\tau,\phi)} Ak_t^{\alpha} \tag{24}$$

where

$$B(\tau,\phi) = (1+n)\left(1 + \frac{1-\beta}{\gamma\delta} + \frac{\alpha\beta}{\gamma\delta} \frac{1}{\alpha + (1-\phi)\tau(1-\alpha)}\right). \tag{25}$$

The dynamics of the physical to human capital ratio $k_t$ with inoperative bequests result from combining Equations (19) and (24)

$$\left[\frac{\delta\gamma D}{\alpha\beta}(\alpha + (1-\phi)\tau(1-\alpha))k_{t+1}\right]^{\frac{1}{1-\delta}} = \bar{e}_t = \frac{(1-(1-\phi)\tau)(1-\alpha)}{B(\tau,\phi)} Ak_t^{\alpha} \tag{26}$$

which converge monotonically towards a steady state $(k, \bar{e})$.[7] To assess the growth effect of increasing the degree of fundedness of the social security system when bequests are inoperative, we first derive the long-run physical to human capital ratio $k$. It is obtained by rearranging Equation (26) in steady state:

[7] Note that Equation (26) can be rearranged so that $k_{t+1} = Ck_t^{\alpha(1-\delta)}$ with $\alpha(1-\delta) < 1$, which in turn ensures convergence towards a unique steady state.

$$k = \left( \frac{\alpha\beta}{\gamma\delta D(\alpha + (1-\phi)\tau(1-\alpha))} \left[ \frac{(1-(1-\phi)\tau)(1-\alpha)A}{B(\tau,\phi)} \right]^{1-\delta} \right)^{\frac{1}{1-\alpha(1-\delta)}} \tag{27}$$

Using Equations (24) and (27), the growth factor of the economy, which equals $g = h_{t+1}/h_t = D\bar{e}^{\delta}$, can then be derived as

$$g = D\left( \frac{(1-(1-\phi)\tau)(1-\alpha)A}{B(\tau,\phi)} \left[ \frac{\alpha\beta}{\gamma\delta D(\alpha + (1-\phi)\tau(1-\alpha))} \right]^{\alpha} \right)^{\frac{\delta}{1-\alpha(1-\delta)}} \tag{28}$$

Further inspection of Equations (20) and (28) reveals:

**Proposition 1.** *If parents are not sufficiently altruistic towards their child, that is, $\gamma < (1-\alpha)\beta/\alpha$, then bequests are inoperative and a higher degree of funded social security is beneficial for growth if*

$$\beta < \tilde{\beta} \equiv \frac{(1+\gamma\delta)\alpha(2-\alpha)}{(1-\alpha)} \tag{29}$$

*If $\beta > \tilde{\beta}$, however, there exists a growth maximizing degree of funded social security $\widehat{\phi}$ so that a higher degree of fundedness lowers growth if the initial degree is already sufficiently large $(\phi > \widehat{\phi})$. Furthermore, if*

$$\beta > \bar{\beta} \equiv \frac{(1+\gamma\delta)(\tau + (1-\tau)\alpha)(\tau + (1-\tau)(2\alpha-\alpha^2))}{(1-\alpha)(\tau^2(1-\alpha(1-\alpha)) + \alpha(1-\alpha\tau) + \alpha\tau(1-\tau))} > \tilde{\beta} \tag{30}$$

*then $\widehat{\phi}$ is at a corner and increasing the degree of funded social security always reduces growth.*

*Proof.* The logarithmic derivative of $\partial\bar{e}^{1-\alpha(1-\delta)}/\partial\phi$ has the same sign as the function

$$\begin{aligned}\Psi(\kappa) = {} & x\big((1-\alpha)^3\kappa^3 + \alpha\kappa(1-\alpha)(3-2\alpha) + \alpha^2(2-\alpha)\big) \\ & -\beta(1-\alpha)\big((1-\alpha)^2\kappa^2 + \alpha\kappa(1-\alpha) + \alpha\big)\end{aligned}$$

with $x = 1 + \gamma\delta$ and $\kappa = (1-\phi)\tau$. This function increases from

$$\Psi(0) = -\alpha(\alpha x(\alpha-2) + \beta(1-\alpha))$$

to

$$\begin{aligned}\Psi(\tau) = {} & x(\tau + (1-\tau)\alpha)\big(\tau + (1-\tau)\big(2\alpha - \alpha^2\big)\big) \\ & -\beta(1-\alpha)\big(\tau^2(1-\alpha(1-\alpha)) + \alpha(1-\alpha\tau) + \alpha\tau(1-\tau)\big)\end{aligned}$$

as $\phi$ varies between [0, 1]. Note that

$$\frac{\partial\Psi(\kappa)}{\partial\kappa} = (1-\alpha)\left(x\alpha + 2x\alpha(1-\alpha) + 2\kappa(1-\alpha)^2(x-\beta) - \alpha\beta(1-\alpha)\right) > 0$$

Depending on the signs of $\Psi(0)$ and $\Psi(\tau)$, the growth effect will therefore either be positive (if $\Psi(0) > 0$), ambiguous (if $\Psi(0) < 0 < \Psi(\tau)$) or negative (if $\Psi(\tau) < 0$). It is straight forward to show that $\Psi(0) \gtrless 0 \Leftrightarrow \beta \lessgtr \tilde{\beta}$ and $\Psi(\tau) < 0 \Leftrightarrow \beta > \overline{\beta}$. Moreover, straight forward calculations show that $\tilde{\beta} < \overline{\beta}$.[8]

When bequests are inoperative, the relationship between the degree of fundedness of the social security system and economic growth is inverted U-shaped so that a higher degree of fundedness may harm growth. There are several effects working in opposite directions: First, the implied increase in forced savings is completely offset by an appropriate decrease in private savings in order to maintain the optimal consumption pattern over the life-cycle. This is the standard effect in overlapping generations models with fully funded pension schemes, see, for example, Zhang (1995) and Kunze (2012). Second, due to the lower pension benefit from the unfunded part of the social security, individuals substitute private savings for spending on consumption and education.[9] Consequently, aggregate savings increase, which in turn speeds up capital accumulation. This effect is also present in the neoclassical growth model studied by Park (2014). Intuitively, young individuals need to save more as their expected pension benefit during old age will be lower. At the same time, however, the decrease in educational spending harms growth. Finally, there is a general equilibrium effect as higher levels of physical capital result in higher wages per unit of human capital, therefore increasing the return on education. If the direct effect through lower educational spending dominates, a higher degree of fundedness reduces growth.

Figure 2 provides a graphical representation of the different cases derived in Proposition 1. Specifically, it shows how the pattern of the degree of fundedness and growth depends on the two key parameters $\beta$ and $\gamma$, characterizing individuals' degree of patience and the strength of the altruistic concern. To illustrate this pattern, we choose $\alpha = 0.25$, $\delta = 0.1$ and $\tau = 0.1$. Then, for varying degrees of $\beta$, we plot $\gamma = (1-\alpha)\beta/\alpha$, which determines if bequests are either operative or inoperative.[10] As can be inferred from Figure 2, the upper left area corresponds to combinations of $\beta$ and $\gamma$, for which bequests are positive, that is, $b > 0$. For this case, the growth effects resulting from changes in $\phi$ will be analyzed in the next subsection. The lower right area of Figure 2, however, corresponds to situations in which bequests are inoperative. We also plot the expressions (29) and (30) assuming that they hold with equality. For $\beta$ sufficiently small (Case A), a higher degree of fundedness is beneficial for growth, whereas there is a non-linear relationship for intermediate values of $\beta$ and $\gamma$ (Case B). Finally, an increase in $\phi$ harms growth if $\beta$ is sufficiently large (Case C). If we additionally set $\gamma = 0.01$ and $\beta = 0.65$ for illustrative purposes, then the resulting threshold values in Proposition 1, $\tilde{\beta}$ and $\overline{\beta}$, are given by $\tilde{\beta} = 0.58$ and $\overline{\beta} = 0.78$ and the growth maximizing degree of funded social security $\widehat{\phi}$ equals $\widehat{\phi} = 0.67$.

[8] It can be shown that $\overline{\beta} < 1$ if both $\tau$ and $\alpha$ are sufficiently small. See also the graphical representation of the different cases in Figure 2 and the numerical example related to it.

[9] Note that the total pension benefit may either increase or decrease as a result of a higher degree of fundedness, depending on the relative return of the unfunded and the funded part of the pension system. This can be seen by rearranging Equation (3) in steady state as follows: $\theta/(\tau w h) = (1-\phi)(1+n)g + \phi R$.

[10] We also checked that $\tau$ is sufficiently small so that $\tau < \chi$ holds (according to Equation (20)).

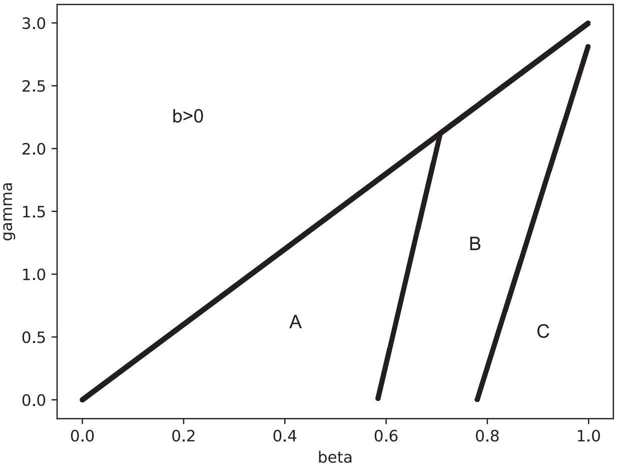


**FIGURE 2** Graphical representation of different growth effects according to Proposition 1. Parameters: $\alpha = 0.25$, $\delta = 0.1$, $\tau = 0.1$.

## 2.2 | Operative bequests

Now we turn to the case when bequests are operative. Then, Equation (9) holds with equality and combining Equations (9) and (16) gives

$$I_{t+1} = \frac{1 - \phi\tau(1-\alpha)}{1 + \beta/\gamma} A k_{t+1}^{\alpha} h_{t+1} \tag{31}$$

$$d_{t+1} = \frac{(1+n)(1 - \phi\tau(1-\alpha))}{1 + \gamma/\beta} A k_{t+1}^{\alpha} h_{t+1} \tag{32}$$

From the assumption of non-negative bequests, $b_{t+1} = I_{t+1} - (1-\tau) w_{t+1} h_{t+1} \geq 0$, it follows:

$$\tau \geq \frac{\beta - \alpha(\beta + \gamma)}{(1-\alpha)(\beta + \gamma(1-\phi))} \equiv \chi \tag{33}$$

where $\chi$ defines a lower bound on the contribution rate. If parents are sufficiently altruistic, that is, $\gamma \geq (1-\alpha)\beta/\alpha$, it is $\chi \leq 0$ and bequests are always operative. Combining Equations (10) and (12) determines private educational spending per unit of human capital, $\overline{e_t}$, as a function of the physical to human capital ratio:

$$\bar{e}_t^{1-\delta} = \frac{(1-\tau)(1-\alpha)\delta D}{\alpha} k_{t+1} \tag{34}$$

which further implies (using Equation (4)):

$$k_{t+1} h_{t+1} = \frac{\alpha}{(1-\tau)\delta(1-\alpha)} \bar{e}_t h_t \tag{35}$$

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Equation (34) shows that, for a given stock of capital $k_{t+1}$, a higher degree of fundedness has no effect on educational spending. This finding stands in contrast to the results found by Lambrecht et al. (2005) and Kunze (2012) where changes in the size of the pension programme, that is, changes in $\tau$, distort parents' educational choices by reducing the return to education when bequests are operative. In our model, however, we focus on the composition of pension benefits, that is, changes in $\phi$, which in turn does not affect parents' educational choices for a given stock of capital.

We can now determine individual savings $s_t$ (from Equation (13)) and consumption $c_t$ (from Equations (7) and (32)):

$$s_t = \frac{(1+n)\alpha}{(1-\tau)\delta(1-\alpha)}\bar{e}_t h_t - \phi\tau(1-\alpha)Ak_t^{\alpha}h_t \tag{36}$$

$$c_t = \frac{(1+n)(1-\beta)(1-\phi\tau(1-\alpha))}{\alpha(\beta+\gamma)}k_{t+1}h_{t+1} = \frac{(1+n)(1-\beta)(1-\phi\tau(1-\alpha))}{(1-\tau)\delta(\beta+\gamma)(1-\alpha)}\bar{e}_t h_t \tag{37}$$

Inserting Equations (36) and (37) into (1) and solving for $\bar{e}_t$ gives

$$\bar{e}_t = \frac{\gamma+\beta\phi\tau(1-\alpha)}{(\beta+\gamma)\tilde{B}(\tau,\phi)}Ak_t^{\alpha} \tag{38}$$

where

$$\tilde{B}(\tau,\phi) = (1+n)\left(1+\frac{\alpha}{(1-\tau)\delta(1-\alpha)}+\frac{(1-\beta)(1-\phi\tau(1-\alpha))}{(1-\tau)\delta(1-\alpha)(\beta+\gamma)}\right) \tag{39}$$

Finally, by combining Equations (34) and (38), we obtain the dynamics of the physical to human capital ratio $k_t$,

$$\left[\frac{(1-\tau)\delta D(1-\alpha)}{\alpha}k_{t+1}\right]^{\frac{1}{1-\delta}} = \bar{e}_t = \frac{\gamma+\beta\phi\tau(1-\alpha)}{(\beta+\gamma)\tilde{B}(\tau,\phi)}Ak_t^{\alpha} \tag{40}$$

which converge monotonically towards a steady state $\left(k,\bar{e}\right)$ (as in the case with inoperative bequests). Rearranging Equation (40) in steady state determines the long-run physical to human capital ratio:

$$k = \left(\frac{\alpha}{(1-\tau)\delta D(1-\alpha)}\left[\frac{(\gamma+\beta\phi\tau(1-\alpha))A}{(\beta+\gamma)\tilde{B}(\tau,\phi)}\right]^{1-\delta}\right)^{\frac{1}{1-\alpha(1-\delta)}} \tag{41}$$

which in turn allows us to derive the growth factor of the economy with operative bequests using Equation (38)

$$g = D\left(\frac{(\gamma+\beta\phi\tau(1-\alpha))A}{(\beta+\gamma)\tilde{B}(\tau,\phi)}\left[\frac{\alpha}{(1-\tau)\delta D(1-\alpha)}\right]^{\alpha}\right)^{\frac{\delta}{1-\alpha(1-\delta)}} \tag{42}$$

Further analysis of Equations (33) and (42) gives rise to the following proposition:

**Proposition 2.** *If parents are sufficiently altruistic towards their child, that is,* $\gamma \geq (1-\alpha)\beta/\alpha$, *then bequests are operative and an increase in the degree if fundedness is always beneficial for growth.*

*Proof.* The logarithmic derivative of $\partial\bar{e}^{1-\alpha(1-\delta)}/\partial\phi$ has the same sign as the expression

$$\tilde{\Psi} = 1-\beta(1-\alpha)(1-\delta(1-\tau)) > 0$$

When bequests are operative, a higher degree of fundedness does not distort parents' educational choices by decreasing the return to education (recall Equation (34)). Consequently, a lower benefit from the unfunded part of the pension scheme is neutral to growth as individuals can see through the budget constraint and counter any public transfer (as in Lambrecht et al., 2005, with lump sum contributions).[11] As a result, the positive growth effect stems from a general equilibrium effect: Individuals substitute voluntary savings for consumption spending to provide a larger amount of bequest to their offsprings which in turn increases aggregate savings. As a result, capital accumulation speeds up which is beneficial for growth.

## 3 | CONCLUSION

This paper shows that the relationship between the degree of fundedness of a social security system and economic growth is inverted U-shaped when bequests are inoperative. It thereby puts some caution on the conventional view that a funded social security system dominates an unfunded one in terms of economic growth. In view of the ongoing debate regarding reforms of existing unfunded systems in many OECD countries, these findings are highly relevant from a policy perspective. Specifically, they imply that starting from a relatively low degree of fundedness, the net effect of a gradual increase in the degree of fundedness is to raise the growth rate whereas the net effect turns out to be negative in countries in which the funding component is already sufficiently large. In the present model, the overall growth effect is determined by the balance of two opposing effects: A direct negative effect as individuals substitute private savings for educational spending as a result of a lower pension benefit from the unfunded part of the social security system and a positive general equilibrium effect increasing the wages of workers and thus the return to education.

The model could be extended to study how increasing the degree of fundedness affects individuals' welfare or how it is determined within a politico-economic equilibrium. Moreover, it might be interesting to study the case in which households are heterogenous, so that some households leave bequests while others do not, as only a minority of households reports to

[11] The corresponding technical explanation is that the expression $(1-\phi)\tau$ does not show up in Equation (42).

receive an intergenerational wealth transfer in many developed countries (see Nolan et al., 2022, and references therein).[12] In this case, we expect the existence of a critical mass of household types for which either the positive or the inverted U-shaped growth pattern dominates (see also the discussion in Lambrecht et al., 2005).

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## DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

## REFERENCES

Altiparmakov, N., & Nedelkovic, M. (2018). Does pension privatization increase economic growth? Evidence from Latin America and Eastern Europe. *Journal of Pension Economics and Finance*, *17*(1), 46–84. https://doi.org/10.1017/s1474747216000160

Bailliu, J. N., & Reisen, H. (1998). Do funded pensions contribute to higher aggregate savings? A crosscountry analysis. *Weltwirtschaftliches Archiv*, *134*(4), 692–711. https://doi.org/10.1007/bf02773293

Bijlsma, M., Bonekamp, J., van Ewijk, C., & Haaijen, F. (2018). Funded pensions and economic growth. *De Economist*, *166*(3), 337–362. https://doi.org/10.1007/s10645-018-9325-z

Davis, E. P., & Hu, Y.-W. (2008). Does funding of pensions stimulate economic growth? *Journal of Pension Economics and Finance*, *7*(2), 221–249. https://doi.org/10.1017/s1474747208003545

Docquier, F., & Paddison, O. (2003). Social security benefit rules, growth and inequality. *Journal of Macroeconomics*, *25*(1), 47–71. https://doi.org/10.1016/s0164-0704(03)00006-5

Gyárfás, G., & Marquardt, M. (2001). Pareto improving transition from a pay-as-you-go to a fully funded pension system in a model of endogenous growth. *Journal of Population Economics*, *14*(3), 445–454. https://doi.org/10.1007/s001480000030

Kaganovic, M., & Zilcha, I. (2012). Pay-as-you-go or funded social security? A general equilibrium comparison. *Journal of Economic Dynamics and Control*, *36*(4), 455–467. https://doi.org/10.1016/j.jedc.2011.03.015

Kaganovich, M., & Zilcha, I. (1999). Education, social security, and growth. *Journal of Public Economics*, *71*(2), 289–309. https://doi.org/10.1016/s0047-2727(98)00073-5

Kunze, L. (2012). Funded social security and economic growth. *Economics Letters*, *115*(2), 180–183. https://doi.org/10.1016/j.econlet.2011.11.032

Lambrecht, S., Michel, P., & Thibault, E. (2006). Capital accumulation and fiscal policy in an OLG model with family altruism. *Journal of Public Economic Theory*, *8*(3), 465–486. https://doi.org/10.1111/j.1467-9779.2006.00273.x

Lambrecht, S., Michel, P., & Vidal, J.-P. (2005). Public pensions and growth. *European Economic Review*, *49*(5), 1261–1281. https://doi.org/10.1016/j.euroecorev.2003.09.009

Lin, H.-C., Tanaka, A., & Wu, P.-S. (2021). Shifting from pay-as-you-go to individual retirement accounts: A path to a sustainable pension system. *Journal of Macroeconomics*, *69*, 301–329. https://doi.org/10.1016/j.jmacro.2021.103329

Maebayashi, N. (2020). Is an unfunded social security system good or bad for growth? A theoretical analysis of social security systems financed by VAT. *Journal of Public Economic Theory*, *22*(4), 1069–1104. https://doi.org/10.1111/jpet.12403

[12]For example, according to their estimates, the share of households having received an intergenerational wealth transfer, that is, an inheritance, a gift or both, is largest in France and Great Britain with 36.1% and 34.7%, respectively, and smallest in the US with 19.1%, whereas estimates for countries like Germany, Ireland, Italy and Spain have intermediate values.

Nolan, B., Palomino, J. C., Kerm, P. V., & Morelli, S. (2022). Intergenerational wealth transfers in Great Britain from the Wealth and Asset Survey in comparative perspective. *Fiscal Studies*, *43*, 179–199.

OECD. (2019). *Pensions at a glance 2019: OECD and G20 indicators*. OECD Publishing. https://doi.org/10.1787/b6d3,dcfc-en

Park, H. (2014). Partially funded social security and inter-generational distribution. *Theoretical Economics Letters*, *4*(09), 839–850. https://doi.org/10.4236/tel.2014.49107

Park, H. (2018). Loss aversion and social security: A general equilibrium approach. *International Review of Economics*, *65*(1), 51–75. https://doi.org/10.1007/s12232-017-0284-5

Samwick, A. A. (2000). Is pension reform conducive to higher saving? *The Review of Economics and Statistics*, *82*(2), 264–272. https://doi.org/10.1162/003465300558777

Westerhout, E., Meijdam, L., Ponds, E., & Bonenkamp, J. (2022). Should we revive PAYG? On the optimal pension system in view of current economic trends. *European Economic Review*, *148*, 104–227. https://doi.org/10.1016/j.euroecorev.2022.104227

Zandberg, E., & Spierdijk, L. (2013). Funding of pensions and economic growth: Are they really related? *Journal of Pension Economics and Finance*, *12*(2), 151–167. https://doi.org/10.1017/s1474747212000224

Zhang, J. (1995). Social security and endogenous growth. *Journal of Public Economics*, *58*(2), 185–213. https://doi.org/10.1016/0047-2727(94)01473-2

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