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THE REFORM OF PENSION SYSTEMS: WINNERS AND LOSERS ACROSS GENERATIONS

David Miles and Andreas Iben

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Centre for Economic Policy Research
90–98 Goswell Rd
London EC1V 7DB
Tel: (44 171) 878 2900
Fax: (44 171) 878 2999
Email: cepr@cepr.org

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ABSTRACT

The Reform of Pension Systems: Winners and Losers Across Generations*

In this paper we perform simulations with a stylized model of Germany and the United Kingdom to show which generations might be direct gainers, and which losers, from a transition to funded state pensions. We estimate what the structure of inter-generational bequests would need to be in a pre-reform equilibrium for different generations to be insulated from the effects of a transition to a fully funded pension system. We calibrate a simple overlapping generations model and estimate the money value of the losses or gains to each generation as the unfunded state system is wound down. If there is altruism toward future generations, bequests of wealth are likely to exist. We show that it is likely that more than one generation will be direct losers as a result of a transition (especially in Germany). If more than one generation are direct losers, then in order for those generations not to be net losers, the chain of bequests (in the initial equilibrium) needs to satisfy a simple condition: this is that the cumulated value of the sum of losses of all the previous generations that are direct losers needs to be less than the pre-reform bequest of each generation to the next generation.

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David Miles and Andreas Iben
Imperial College
Princes Gate
53 Exhibition Road
London SW7 2PG
UK
Tel: (44 171) 594 9112/722 7015
Fax: (44 171) 823 7685
Email: d.miles@ic.ac.uk
a.iben@ic.ac.uk

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NON-TECHNICAL SUMMARY

The reform of state pension systems is close to the top of the policy agenda in many developed countries. In most developed countries, a combination of rising life expectancy and declining fertility will substantially increase the ratio between the population of pension age and those of working age, unless there are dramatic and unforeseen events. Unfunded, state pension systems rely on contributions from current workers to pay pensions to the current retired. Where the contribution rate to the pension system is constant, the effective return earned on contributions made by workers is equal to the growth of the aggregate wage bill between the period when they are contributing and when they receive pensions. Demographic shifts are likely to reduce this growth rate sharply. In the absence of significant increases in contribution rates, or of significant reductions in the generosity of state pensions, demographic shifts may also create large shortfalls of revenues from expenditure in state pension systems. For both these reasons there has recently been substantial research into the economic impact of reform of pension systems.

It is well known that so long as the (net of costs) rate of return on assets exceeds the rate of growth of aggregate wages, then once a transition from an unfunded pension system to a funded system has occurred, welfare for all future generations can be higher. It is also well known that in general on the transition from an unfunded to a funded system some generations will be worse off. Contributions must increase so that a fund can be built up. This could mean that a majority of voters alive at the start of a transition would lose out, and might therefore block a transition. But that conclusion depends on whether current voters focus only on the direct impact to themselves of pension reforms or whether they attach weight to benefits to future generations. Altruism toward future generations might mean that a majority could favour embarking on a transition even though most voters were directly worse off themselves. What matters here is the degree of benevolence toward future generations.

In this paper we perform simulations on a stylized model of Germany and the United Kingdom to show which generations might be direct gainers, and which losers, from a transition to funded state pensions. We show that this is highly sensitive to the rate of return on funds and to how labour productivity varies over the life cycle for a particular cohort as well as to how it changes across cohorts. We estimate what the structure of inter-generational bequests would need to be in a pre-reform equilibrium for different generations to be insulated from the effects of a transition to a fully funded pension system. Germany and

the United Kingdom are interesting cases; the United Kingdom does not face the prospect (on unchanged policies) of substantial pension deficits, but Germany does – in part because of more rapid ageing but also because state pensions are relatively generous.

The transition we analyse is similar to that recently proposed by Feldstein. We calibrate a simple overlapping generations model and estimate the money value of the losses or gains to each generation as the unfunded state system is wound down. If there is altruism toward future generations, bequests of wealth are likely to exist. We calculate how great those bequests need to be to ensure that the 'double paying' cohorts are no worse off as a result of a transition to a funded system which, ultimately, may generate higher welfare for future generations. We show that it is likely that more than one generation will be direct losers as a result of a transition (especially in Germany). If more than one generation are *direct* losers, then in order for those generations not to be net losers, the chain of bequests (in the initial equilibrium) needs to satisfy a simple condition: for each generation it needs to be the case that the sum of the present values of losses of all the previous generations is less than the present value of its pre-reform bequest to the next generation. This condition assumes that negative bequests are not available. In this paper we calculate what the chains of bequests must look like with a model where demographic structure and pension systems are characterized to reflect the situation in Germany and the United Kingdom. Not surprisingly, the critical level of bequests is highly sensitive to the rate of return on assets; the initial generosity of the state pension scheme; and the scale of future demographic shifts.

What the results show is that for a dynasty with workers of ages 50 and 20 at the time of pension reforms, the generation aged 20 would need to pass on a very much lower bequest to the next generation in order to prevent its own consumption, and that of its parents, from falling. The cut in bequest is often large relative to *average* bequests actually passed on in the United Kingdom and Germany. Sometimes it exceeds it by a large margin. Since actual inheritances are skewed, even when the cut in bequest is below the average scale of inheritances actually received there would be a large number of families who would need to cut consumption as a result of a pension reform of the sort analysed here. This, of course, assumes that negative bequests are impossible.

Even if a cohort had to cut its consumption because of pension reform it does not follow that its welfare is reduced. If the welfare of future generations is given sufficient weight then a cohort that is a direct loser, and cannot compensate by cutting its bequest enough, may nonetheless favour reform. The implication of the results is not that any reform of the sort considered here cannot gain popular support, but rather that it is unlikely to do so *unless* people can be persuaded that the benefits to future generations are large and sufficient to compensate them for more immediate losses which they may be unable to avoid.

But even if everyone had the same degree of benevolence to future generations they could still strongly differ on whether the sort of pension reforms considered here should be undertaken. The ages of the members of the dynasty alive at the start of the reform and the times at which their successors in the family line are born matter a great deal. A dynasty whose oldest worker at the time of the reform is 50 would view the benefits very differently from one whose oldest worker is 35, even if they both only considered the impact on the overall net present value of the wealth of the whole dynasty.

The implications of all this are that governments need to think very carefully about the structure of a transition from unfunded state pension systems to funded ones. Gains and losses to different dynasties can be very different even if their members are born quite close to each other. And the way in which gains or losses are distributed across different dynasties depends in a highly sensitive and non-linear way upon real rates of return and upon how labour productivity grows with time and with age.

The Reform of Pension Systems: Winners and Losers Across Generations

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Introduction

The reform of state pension systems is close to the top of the policy agenda in many developed countries. A combination of rising life expectance and declining fertility will, unless there are dramatic and unforeseen events, substantially increase the ratio between the population of pension age and those of working age in most developed countries. Within Europe the number of pensioners relative to workers is likely to double within the next 30 years. (See Bos (1994), Chand and Jaeger (1996), Turner et al (1998) and Bank for International Settlements (1998)). Unfunded, state pension systems rely on contributions from current workers to pay pensions to the current retired. Where the contribution rate to the pension system is constant, the effective return earned on contributions made by workers is equal to the growth of the aggregate wage bill between the period when they are contributing and when they receive pensions. Demographic shifts are likely to reduce this growth rate sharply. In the absence of significant increases in contribution rates, or of significant reductions in the generosity of state pensions, demographic shifts may also create large shortfalls of revenues from expenditure in state pension systems (see Roseveare et al (1996) for details). For both these reasons there has recently been substantial research into the economic impact of reform of pension systems (see, for example, Feldstein (1996a and 1996b); Feldstein and Samwick (1998); Kotlikoff (1995 and 1996); Diamond (1996); Mitchell and Zeldes (1996)).

It is well known that so long as the (net of costs) rate of return on assets exceeds the rate of growth of aggregate wages, then once a transition from an unfunded pension system to a funded system has occurred, welfare for all future generations can be higher. It is also well known that in general on the transition from an unfunded to a funded system some generations will be worse off (see Breyer (1989)). The proposal of Feldstein and Samwick for a transition from a (partially) funded to a fully funded pension system in the US involves some generations (current workers) losing. Miles (1998) describes simulations on an overlapping generations, general equilibrium model which shows that a

Feldstein type transition could mean that a majority of voters alive at the start of a transition would lose, and might therefore block a transition. But that conclusion depends on whether current voters focus only on the direct impact to themselves of pension reforms or whether they attach weight to benefits to future generations. Altruism toward future generations might mean that a majority could favour embarking on a transition even though most voters were directly worse off themselves. What matters here is the degree of benevolence toward future generations.

In this paper we perform simulations on a stylised model of the UK and Germany to show which generations might be direct gainers, and which losers, from a transition to funded state pensions. We show that this is highly sensitive to the rate of return on funds and to how labour productivity varies over the life cycle for a particular cohort as well as to how it changes across cohorts. We estimate what the structure of inter-generational bequests would need to be in a pre-reform equilibrium for different generations to be insulated from the effects of a transition to a fully funded pension system. The UK and Germany are interesting cases; the UK does not face the prospect (on unchanged policies) of substantial pension deficits while Germany – in part because of more rapid ageing and also because state pensions are relatively generous – does. The transition we analyse is similar to that proposed by Feldstein (Feldstein and Samwick (1998)). We calibrate a simple overlapping generations model and estimate the money value of the losses or gains to each generation as the unfunded state system is wound down. If there is altruism toward future generations, bequests of wealth are likely to exist. We calculate how great those bequests need to be to ensure that the "double paying" cohorts are no worse off as a result of a transition to a funded system which, ultimately, may generate higher welfare for future generations. We show that it is likely that more than one generation will be direct losers as a result of a transition (especially in Germany). If more than one generation are *direct* losers, then in order for those generations not to be net losers, the chain of bequests (in the initial equilibrium) needs to satisfy a simple condition: for each generation it needs to be the case that the sum of the present values of losses of all the previous generations is less than the present value of its pre-reform bequest to the next generation. This condition assumes that negative bequests are not available. In this paper we calculate what the chains of bequests must look like with a model where demographic structure and pension systems are characterised to reflect the situation in the UK and Germany. Not surprisingly, the critical level of bequests is highly sensitive to the rate of return on assets, the initial generously of the state pension scheme, and to the scale of future demographic shifts.

I. Developing a simulation model

In the stylised model we develop agents live for 61 periods as adults, either working (for 41 periods) or retired (for 20 periods). The average retirement age in Europe is now around 60 (though many retire earlier) and life expectancy for those who reach adulthood is close to 80 (averaged across males and females). These figures suggest we could usefully interpret our model as implying a working life from 20 to 60 (inclusive) with retirement from age 61 to death at 80.

Our starting point is to calculate the pay-as-you-go (PAYG) tax rate for an unfunded scheme in balance; we denote this rate t. Given that pensions, p, are financed by a proportional payroll tax, t, balancing the public pensions budget requires that:

$$t_i\, w_i\, L_i = p_i\, R_i \qquad (1)$$

where w is the average wage of the labour force at time i;

L is the number of economically active (the employed population);

R is the number of retired.

Rearranging, the basic formula for the PAYG tax rate at time i needed to finance pensions is given by:

$$t_i = (p/w)_i\, (R/L)_i \qquad (2)$$

where (p/w) is the replacement ratio in terms of average wages;

(R/L) is the elderly dependency ratio.

We assume that wages for a particular cohort rise over time due to two sources of productivity growth: first, aggregate wages rise each year due to general productivity growth; second, as workers gain experience earnings rise due to age-related productivity. For simplicity, we assume that the rates of growth of age-related productivity and of aggregate labour productivity are equal (to g). Based on post-war growth rates in Europe, a central estimate for g might be around 2%. (In the simulations we also consider productivity growth rates significantly lower and higher than this). A value of g of 0.02 would imply a cross-section ratio of the wages of a typical 40 year old to those of a 20 year old of about 1.5, a plausible figure for the economy as a whole, though clearly not appropriate for some sectors of the labour market. Meghir and Whitehouse (1996) report evidence on the cross-section distribution of wages by age that implies significant age related productivity growth for many workers (most clearly in non-manual professions). They also report no tendency for hourly wage rates to fall with age. Both observations are consistent with our simplifying assumption about g.

The state pension paid to all those retired at any time is assumed to be a fixed proportion of the wage of the worker who then has median earnings i.e. the individual exactly halfway through a 41 year working life (20.5 years more senior than a 20 year old). Thus we define the replacement rate as the ratio of the state pension to the wages of the representative worker who is of average working age; and we assume this ratio is constant[1]. We denote the replacement rate by rep; at every point in time p_i = rep. $\{w(20)_i(1+g)^{20.5}\}$. Using these assumptions we can write equation (1) in a more revealing way. We express the PAYG contribution rate as a function of the number of people of different ages, the cross-section pattern of wages (which is a function of g) and the replacement rate. In order to balance the PAYG scheme, we require:

$$t_i \{ w(20)_i (d(20)_i + d(21)_i(1+g) + d(22)_i(1+g)^2 + \ldots + d(60)_i(1+g)^{40}) \} =$$
$$rep \{ w(20)_i(1+g)^{20.5} [d(61)_i + d(62)_i + \ldots + d(80)_i] \} \qquad (3)$$

where t_i is the PAYG tax rate at time i;

$w(20)_i$ is the wage of an individual aged 20 at time i;

g is the rate at which wages grow with seniority;

rep is the replacement rate;

$d(j)_i$ is the relative size of cohort j at time i (with a constant population $d(j)_i=1$ for all j and i).

Equation (3) shows that for the scheme to be in equilibrium, aggregate contributions by the working population (the LHS) must be equal to the benefits paid out to the retired population (the RHS). Equation (3) implies

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[1] The basic state pension in the UK is currently indexed to prices rather than to average earnings, which is at odds with the assumption of a fixed replacement ratio. But the sustainability of price indexation – which implies ever falling replacement rates if there is any productivity growth – is doubtful. The simulations we describe run far into the 21st century. If a state pension does exist in the UK in 2100 it is most unlikely to have the same real value as that paid today.

$$t_i \quad = \quad \frac{rep(1+g)^{20.5}\ \{\ (\ d(61)_i + d(62)_i + \ldots\ldots + d(80)_i)\ \}}{\{\ d(20)_i + d(21)_i(1+g) + d(22)_i(1+g)^2 + \ldots + d(60)_i(1+g)^{40}\ \}} \qquad (4)$$

In the case of a constant population, given that individuals work from age 20 to 61 and retire from age 61 to the end of their 80th year, the ratio of retirees to workers (or elderly dependency ratio, R/L) would be a constant equal to 20/41. With an unchanging population structure and an unchanging replacement rate, the values of d(j) and the PAYG tax rate, t, will be constant. When the population structure is changing the PAYG contribution rate will obviously change according to equation (4). Notice that how the contribution rate changes with population structure depends on g.

We now calculate the contribution rate to a fully funded scheme that pays the same pensions as a PAYG scheme with a constant replacement rate. We denote this rate c. The equilibrium contribution rate to a funded scheme is such that if all contributions made by a worker were invested, it would produce a flow of pension benefits equal to pensions under the PAYG scheme where the replacement rate is held constant. If contributions and pension benefits in the funded scheme are to be equal in present value then for each agent we require:

$$\sum_{a=20}^{60} c\ w(20)\ \{\ (1+g)^{2(a-20)}.\ (1+r)^{(60-a)}\ \} \quad = \quad \sum_{b=61}^{80} p(61)\ (1+g)^{(b-61)}\ .\ (1+r)^{-(b-61)} \qquad (5)$$

where a is the age of the individual when working;

c is the contribution rate to the funded scheme;

w(20) is the wage earned by the individual when aged 20;

r is the real rate of return earned on the invested assets;

b is the age of an individual in retirement and;

p(61) is the pension of the individual at retirement (at age 61).

The LHS of equation (5) is the value of the accumulated fund at retirement while the RHS is the value of pension payments discounted back to the retirement date. Notice that the wage earned by an individual grows at rate $(1+g)^2$ each year since general productivity rises at rate g and wages are also assumed to increase with seniority at the same rate.

In equation (5) we set pensions to rise at the same rate as aggregate wages increase, g. This ensures that the ratio between the pension and the wages of the representative worker is constant over time. The pension of an individual aged 61 relative to that same individual's income in their first year of work is given by:

$$p(61)_t \,/\, w(20)_{t-41} = (1+g)^{41}.(p(61)_t/w(20)_t) = \text{rep}.\ (1+g)^{61.5} \qquad (6)$$

where $p(61)_t/w(20)_{t-41}$ is the ratio of the pension of an individual aged 61 to the wages of the same individual aged 20, (41 years earlier). Since all wages rise with time at rate g the ratio of $w(20)_t$ to $w(20)_{t-41}$ is $(1+g)^{41}$; hence the intermediate equality in equation (6). Note also that pensions are, by assumption, always equal to the replacement rate times the median wage. Median wages are those earned by someone half way through their working life who is aged 40.5. The median wages are $(1+g)^{20.5}$ times the wages of a 20 year old at each date. This result is used in the final equality in (6). (6) ensures that the pension paid from the funded scheme is equal to the pension paid from the PAYG system.

Using (6) and (5) the contribution rate to the funded scheme is given by:

$$c = \frac{(1+g)^{61.5}.\text{rep}.(1/(1-(1+g)/(1+r))).(1-((1+g)/(1+r))^{20})}{(1+r)^{40}.(1/(1-((1+g)^2/1+r))).(1-((1+g)^2/(1+r))^{41})} \qquad (7)$$

From (7) it is clear that the contribution rate to a fully funded scheme does not depend on demographic structure. But both t (the rate needed to balance a PAYG system) and c (the contribution rate to a funded scheme) depend upon the shape of earnings over the working life. This is why we need to make assumptions about both time-related and age-related labour productivity growth to derive c and t. The timing of labour income over the working life and its relation to contribution rates are particularly important when the contribution rates are moving either because of demographic changes or of policy reform. In calculating the gains or losses accruing to different cohorts from pension reforms that change contribution rates the pattern of labour income over the life cycle matter, not just its present value.

II Modelling the transition from PAYG to funded pensions

We assume that any transition from an unfunded to a funded system is implemented gradually. We use a phase-in period of 41 years (one complete working life cycle) and the transition is assumed to start in 2000. In that and subsequent years all workers pay the contribution rate needed in equilibrium for a fully funded scheme *plus* whatever extra rate is needed to finance that part of total current pension payments that are not financed out of past contributions to a fund by the current retired. Throughout the transition and beyond, pension payments remain the same as they would have been under the old PAYG system with a fixed replacement rate.

In 2001, the first generation of retirees will enter retirement under the new partly funded scheme. Having made one year's worth of contributions to their personal funds in 2000, the first generation will, effectively, receive a very large proportion of their pension benefits from the existing PAYG scheme and a correspondingly small proportion of benefits from the funded scheme. By 2041, the fortieth generation of retirees after the start of the reform will be the first to receive 100% of their pension benefits from the funded scheme. This cohort of retirees will have made 41 years of contributions to the funded scheme. But at that point all the cohorts aged 62 to 80 receive less than 100% from the funded scheme. The overall contribution rate will only fall to c at the end of 2060 since it is only at this stage that all cohorts of age 61 to 80 will be receiving 100% of their pension benefits from the funded scheme.

As we move further into the future, two changes take place: each new generation entering retirement will have a larger fund accumulated so that a smaller proportion of its pension benefits will be paid out from the PAYG scheme; as a result, the residual PAYG tax rate, t, needed to finance the unfunded share of aggregate pensions will, other things equal, fall. But the ratio of the retired to the working population also changes over time and the rate needed to balance an unfunded scheme rises. Whether or not the residual PAYG rate falls or not depends on how fast the dependency ratio rises and also upon r and g (which determine the speed with which the transition to funding is made).

The combined contribution rate levied on workers each year is the contribution rate to the funded scheme, c, plus the residual PAYG tax rate, t. If population structure were unchanging, the residual

PAYG contribution falls monotonically as new cohorts entering retirement receive a smaller proportion of their pensions from the unfunded scheme. But with changing demographics this need no longer be the case and the combined contribution rate may rise for several years after the start of pension reform.

III. Parameter values and simulation results for the UK and Germany

a. Simulation results for the transition in the UK

We use 20% as an approximation to the replacement rate for the PAYG social security scheme in the UK at the start of a transition assumed to take place in 2000. The basic state pension for a couple in the UK in 1998 was slightly over £5000. Average full time earnings were then around £17000, but a couple might expect over their joint working lives to earn more than that for substantial periods when both were working. With a 20% replacement rate we are assuming a median joint income for a couple of working age of £25,000. The single person pension in the UK in 1998 was close to £3400, around 20% of average annual earnings.

We use United Nations projections of the UK's demographic structure and show how a transition to a fully funded state pension system evolves for various combinations of earnings growth (g) and real rate of return (r). We consider four values for r: 3%, 5%, 7% and 9%. We assume that the rate of return is unaffected by pension reform[2]. Productivity growth is set at a low value (1%), a high value (4%) or at a rate close to the post-war average rate of growth of GDP (2.4%). We consider combinations of r and g where the rate of return exceeds productivity growth. (If g exceeds r a move to a funded pension scheme generates long run losses and would not be sensible).
The transition path for contribution rates from 2000 to 2060 are shown in figures 1-11; summary statistics are shown in tables 1a to 1c.

In the figures we show three lines. The horizontal line in each case is the equilibrium contribution rate to a fully funded scheme. Since this is unaffected by demographics, and we assume r, g and the replacement rate are constant, this contribution rate does not vary over time. In each figure the line which starts out (in 2001) highest and converges to the fully funded rate by the end of 2060 is the

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[2] The validity of making the small, open-economy assumption for Germany and the UK is obviously open to question. If rates of return were to fall as pension funds are accumulated the pattern of intergenerational gains and losses would be affected in several distinct ways. Existing holders of assets might make gains (depending on when they bought assets and whether at that time future movements in r were anticipated). Those accumulating funds are worse off if r falls unless they have other debts.

overall contribution rate on the transition path. The other line is the contribution rate that would need to be levied to preserve a PAYG (fully unfunded) system in continual balance. At the start of the transition the overall contribution rate is the sum of the PAYG rate and the fully funded rate. In the early years on the transition the overall contribution rate is obviously above the PAYG rate (the rate of contributions if there were no pension reforms). As time passes the transitional contribution rate (eventually) falls and, as a result of an ageing population, the PAYG rate rises. At some point there is a crossover. After that time all workers pay lower contributions than they would had there been no reform. Pensions paid are, by assumption, unaffected by reform.

Table 1: **Transition for the UK (replacement rate set at 20%)**

Table 1a: **Crossover year**

(year when combined contribution rate equals PAYG rate under unfunded system)

Wage Growth (g)	0.01	0.024	0.04	Interest rate (r)
	2037	2054	No crossover	**0.03**
	2029	2032	2044	**0.05**
	2024	2026	2029	**0.07**
	2021	2022	2024	**0.09**

Table 1b: **Maximum combined tax rate (T)**

Wage growth (g)	0.01	0.024	0.04	Interest rate (r)
	0.132 (2018)	0.184 (2037)		**0.03**
	0.104 (2017)	0.118 (2015)	0.142 (2021)	**0.05**
	0.093 (2019)	0.097 (2015)	0.107 (2001)	**0.07**
	0.089 (2022)	0.087 (2017)	0.090 (2001)	**0.09**

Table 1c: **Final contribution rate to unfunded scheme (c)**

Wage growth (g)	0.01	0.024	0.04	Interest rate (r)
	0.053	0.079		**0.03**
	0.029	0.045	0.067	**0.05**
	0.015	0.025	0.040	**0.07**
	0.008	0.014	0.024	**0.09**

In the UK the most favourable case is when the difference between the real rate of return and aggregate wage growth is greatest (g=0.01 and r=0.09). In this case the crossover in contribution rates (when the overall contribution rate on the transition path first falls below the pure PAYG rate) takes place 21 years from the start of the transition. In the long run contributions to a funded scheme would be only around 1% against a rate of about 10% for an unfunded scheme paying equivalent pensions. But with lower rates of return the final (funded) contribution rate is much higher and the level at which the overall contribution rate peaks on the transition is far greater. Table1b shows the date at which the overall contribution rate peaks and its maximum value. The table shows that it is usually between 15 and 20 years after the start of the transition that the contribution rate is at its highest. But with very rapid productivity growth and a very high rate of return ($g=0.04$; $r \geq 0.07$) the highest overall contribution rate is at the start of the transition.

Table 1c shows the equilibrium contribution rate to a fully funded scheme at various values of r and g. The rate is highly sensitive to r but also depends significantly on g (which affects how much pensions rise in retirement and also the profile of wages over each agent's working life). At $r = 0.05$ the contribution rate can vary from 0.029 with low productivity ($g= .01$) to .067 ($g = .04$). The worst-case scenario occurs when productivity growth is only slightly below the rate of return: at $g=0.024$ and $r=0.03$ the funded contribution rate is 0.079.

b. Simulation results for the transition in Germany

German state pensions are substantially higher than the basic state pension in the UK. We use 55% as an approximation to the current replacement rate for the PAYG social security scheme in Germany (see Chand and Jaeger (1996) and Roseveare et al (1996)). The main features of the transition are shown in Tables 2a-2c and figures 12-21. Because of the much more rapid pace of ageing, and the more generous pensions, the transition in Germany involves much higher contribution rates. Crossover dates are later (table 2a) and the maximum contribution rates dramatically higher (table 2b). We focus on combinations of g and r where the crossover comes before 2050.

The combined contribution rate on the transition usually peaks at about 30 years after the start of the reform. In all cases the residual PAYG rate initially rises because population ageing in Germany is rapid relative to the speed of the phase in of funded pensions. In the least favourable cases the overall contribution rate moves up to around 0.50 by around 2035. The drop in the overall contribution rates as the transition reaches an end is dramatic. For example, with $g=0.024$ and $r =0.07$ the contribution rate falls from just over 30% of wages in 2027 to about 10% in 2050. If productivity growth is only 1% and the rate of return as high as 7% the long run contribution rate is only just over 4%. At that combination of g and r the PAYG rate would be around 40% by 2040.

Table 2: **Transition for Germany (replacement rate set at 55%).**

Table 2a: **Crossover year (year when combined tax rate equals PAYG tax rate)**

Wage growth (g)	0.01	0.024	0.04	Interest rate (r)
	2046			0.03
	2033	2039		0.05
	2027	2029	2034	0.07
	2023	2024	2027	0.09

Table 2b: **Maximum combined tax rate (T)**

Wage growth (g)	0.01	0.024	0.04	Interest rate (r)
	0.513 (2038)			0.03
	0.363 (2030)	0.407 (2030)		0.05
	0.318 (2030)	0.313 (2027)	0.334 (2026)	0.07
	0.305 (2030)	0.282 (2028)	0.270 (2015)	0.09

Table 2c: **Final contribution rate to unfunded scheme (c)**

Wage growth (g)	0.01	0.024	0.04	Interest rate (r)
	0.147			0.03
	0.079	0.125		0.05
	0.042	0.070	0.111	0.07
	0.021	0.038	0.065	0.09

IV. Net benefit/loss in wealth for cohorts and dynasties for the transition in the UK and in Germany

The direct net benefit or loss of a transition to funded pensions to a given cohort is the present value of the changes in contributions over that cohort's working life. Table 3 shows the money value of the net gain or loss in wealth for various cohorts in the UK taking £12,150 to be the average wage of a 20 year old at the start of the transition in 2000. The figure for a 20 year old wage is based on an assumed value of about £20,000 for the median wage of workers in 2000; since we assume that the median wage is earned by the worker half way through their working life, £20,000 is discounted (at a rate of just over 2% a year) over 20.5 years to reach £12,150. (Using different values for the 20 year old wage simply scales all the figures in the table up or down.) For the German case (table 4) we take DM 30,380 to be the average wage of a 20-year-old.

In tables 3 and 4 we represent the net direct gain or loss to different cohorts as the lump sum equivalent of the change in future contributions. For people working at the initiation of the transition this is the equivalent change in wealth at the start of the reform (2000). For people not yet working we calculate the present value of their gains or losses discounted to when they start work (at age 20).

Table 3: **Net benefit/loss in £ of transition in the UK to various cohorts**

	(g/r)						(g/r)				
	0.01/0.03	0.01/0.05	0.01/0.07	0.01/0.09	0.024/0.03	0.024/.05	0.024/0.07	0.024/0.09	0.04/0.05	0.04/0.07	0.04/0.09
Age at transition											
50	-9092	-4363	-2068	-970	-23539	-12004	-5952	-2914	-33996	-17829	-9185
40	-14313	-5962	-2522	-1071	-38929	-16387	-6988	-3010	-50895	-21048	-9142
30	-16151	-5652	-2076	-775	-49907	-15219	-5257	-1854	-55285	-15644	-5043
20	-14517	-3962	-1124	-305	-56847	-10097	-2182	-300	-45706	-6227	-4
10	-6751	1484	2292	1746	-62103	596	5569	4709	-34245	10897	12639
0	5205	10320	8563	6072	-45942	19310	20012	15124	365	44710	39119
-10	18760	21299	17487	13202	-17693	43944	40874	32001	56082	96987	83242
-20	30767	31936	27245	22093	20009	70886	65568	53871	129862	167971	146341
-30	38770	39583	34631	29204	60536	97330	90623	76462	217434	261142	229948
-40	43662	44539	39191	33340	85884	124793	116430	98775	326759	389125	343389

Table 3 shows that in the UK all workers alive at the start of the transition (cohorts aged 20 to 50 in the table) experience net losses in wealth. For most wage growth rate and interest rate combinations the cohort aged somewhere between 40 and 30 at the start of the transition to a funded state pension faces the highest net loss in wealth. This cohort pays higher contributions for most of its working life and generally gains no benefit since the crossover data for the overall contribution is usually just beyond retirement. In the best-case scenario (g=0.01 and r=0.09) the cohort aged 40 in 2000 has a net loss in wealth of only £1,071 while in the worst-case scenario (g=0.04 and r=0.05) the cohort's net loss in wealth is over £ 50,000. The cohort just starting work at the beginning of a transition (that aged 20 in 2000) faces a maximum net loss in wealth of £ 56,847 (g=0.024 and r=0.03) and a minimum net loss in wealth which is trivial (only £4 when g=0.04 and r=0.09). It is obvious from the table how sensitive the losses are to the values of r and g. It is also clear that the combinations of g and r that are best or worst are different for different cohorts.

In most cases the cohorts which have not yet entered the labour market at the initiation of the transition (in the table those cohorts aged +10 to -40 in 2000) enjoy net increases in wealth. Once again the sensitivity to r and g is great. The cohort born 20 years after the transition begins (age at reform = -20) may gain the equivalent of a lump sum of just over £146,000 at age 20 (at g=0.04, r=0.09) or only around £20,000 (at g =0.024, r=0.03). The cohort aged 10 in 2000 gains at some combinations of g and r and loses at others. If the real rate of return is only 3% the losses are very substantial.

In Germany the absolute values of gains and losses for different cohorts are higher than for the UK (table 4). In the best-case scenario (g=0.01 and r=0.09) the cohort aged 40 at the start of the transition faces a net loss in wealth of DM 8,122 (compared to £1,071 for the UK) while with faster labour productivity growth and lower rates of return (g=0.03 and r=0.05) the cohort's net loss in wealth is dramatically higher at DM 187,894. The cohort aged 20 at the start of the transition could face a net loss of DM197, 771 (g=0.03 and r=0.05) or of only DM 2,899 (g=0.01 and r=0.09).

In most cases cohorts that have not yet entered the labour market (cohorts aged +10 to -40) face net increases in wealth. These increases can be very substantial. For example, the cohort born in 2020 faces a net increase in wealth of DM 944,540 if productivity growth is strong (g=0.03) and the rate of return is 5%. The cohort aged 10 in 2000 faces substantial net increases in wealth at some combinations of g and r and large losses at others.

Table 4: Net benefit/loss in DM of transition in Germany to various generations

	(g/r)				
	0.01/0.03	0.01/0.05	0.01/0.07	0.01/0.09	0.024/.05
Age at transition					
50	-63024	-30838	-14689	-6895	-84290
40	-103915	-45359	-19189	-8122	-125236
30	-132344	-48009	-17336	-6423	-136925
20	-146624	-38236	-10544	-2899	-114002
10	-122741	-493	14588	12409	-48455
0	-32765	74100	67115	48203	114479
-10	101135	181908	150477	112820	370760
-20	270920	304413	252612	201564	702025
-30	427668	397814	333118	275357	1035208
-40	502886	451462	379196	316010	1341814

	(g/r)				
	0.024/0.07	0.024/0.09	0.03/0.05	0.04/0.07	0.04/0.09
Age at transition					
50	-42489	-20832	-125498	-126921	-66186
40	-54420	-23314	-187894	-167681	-72989
30	-46559	-16257	-214430	-150794	-47843
20	-24291	-4364	-197771	-85818	-8387
10	34024	34026	-142694	40928	91593
0	159526	122384	69391	350807	324688
-10	360239	277442	430250	885357	740858
-20	620229	494073	944540	1668929	1368371
-30	884752	719631	1528007	2683818	2193464
-40	1141791	933002	2110738	4016490	3283344

In both the UK and Germany for all wage growth rate and interest rate combinations the workers alive at the start of the transition (in the tables cohorts aged 20 to 50) face net losses in wealth while future generations (cohorts aged 10 in 2000 and every unborn cohort) usually face net increases in wealth. By adding the (present values of) the gains/losses to successive generations of the same dynasty we can determine whether, as a group, a set of generations of the same family are net beneficiaries. This depends on the number of generations we take, the age of those generations alive at the start of the transition, the dates of birth of those not yet alive and, of course, upon g and r. We assume that a given cohort has children at the age of 30 and we calculate the net benefit/loss in wealth for a dynasty over four generations. We express the net gain or loss as the present value at the start of the transition (2000) of the sum of the gains or losses to all four generations. We assume dynasty A consists of the cohorts aged 50, 20, -10 and -40 at the time the transition starts; dynasty B consists of the cohorts aged 40, 10, -20 and -50 while dynasty C consists of the cohorts aged 30, 0, -30 and -60. (Note we can ignore any members of each dynasty beyond retirement at the start of the transition since the impact upon their wealth is zero).

Table 5: Net benefit/loss in £ of transition in the UK for dynasties A, B and C over four generations

	(g/r)					
	0.01/0.03	0.01/0.05	0.01/0.07	0.01/0.09	0.024/0.03	0.024/.05
Dynasty						
A (cohorts 50, 20, -10 and -40)	-8469	-1013	-230	-91	-73098	-5252
B (cohorts 40, 10, -20 and -50)	-3813	1102	835	458	-65255	-753
C (cohorts 30, 0, -30 and -60)	582	2786	1523	742	-48565	4593

	(g/r)				
	0.024/0.07	0.024/0.09	0.04/0.05	0.04/0.07	0.04/0.09
Dynasty					
A (cohorts 50, 20, -10 and -40)	-756	-241	-49233	-4600	-964
B (cohorts 40, 10, -20 and -50)	1517	994	-37576	761	2076
C (cohorts 30, 0, -30 and -60)	3825	2034	-21740	8577	5792

As before, we only consider cases where the transition ultimately reduces contribution rates, and for Germany we consider only cases where the crossover in contribution rates occurs before 2050. Table 5 shows that in the UK Dynasty C experiences a net increase in wealth at each of the rates of return we consider so long as the rate of growth of labour productivity is only 1%. If labour productivity is at rate 2.4% the return on assets must exceed just under 5% to generate overall net gains. With labour productivity at 4% - a much higher level than has been achieved in the UK for any sustained period – the rate of return needs to exceed just under 7% to generate gains. Dynasty B always gains less, or loses more, than dynasty C since it has a worker who is age 40, close to the least favourable age, at the initiation of the transition. Dynasty A is worse off again since there are now two generations of the family line working at the start of the reform (aged 50 and 20) who each face major losses – at no rate of return/productivity combination is there a net gain across the four generations for dynasty A; losses are often very substantial (in excess of £50,000) but highly sensitive to g and r.

Table 6 : **Net benefit/loss in DM of transition in Germany for dynasties A, B and C over four generations**

	(g/r)				
	0.01/0.03	0.01/0.05	0.01/0.07	0.01/0.09	0.024/.05
Dynasty					
A (cohorts 50, 20, -10 and -40)	-82626	-2816	1079	504	-40671
B (cohorts 40, 10, -20 and -50)	-42036	13968	8772	4375	641
C (cohorts 30, 0, -30 and -60)	4735	25725	13380	6272	40001

	(g/r)				
	0.024/0.07	0.024/0.09	0.03/0.05	0.04/0.07	0.04/0.09
Dynasty					
A (cohorts 50, 20, -10 and -40)	248	1015	-110720	-27118	-82
B (cohorts 40, 10, -20 and -50)	16993	9627	-48097	16734	20930
C (cohorts 30, 0, -30 and -60)	32883	16778	21890	70218	46882

In the German case (table 6) the net changes in wealth for the three dynasties are generally larger (and sometimes of opposite sign) than for the UK. Unlike in the UK case Dynasty A – who still do consistently worse from the pension reform than the other dynasties – do enjoy (small) net gains at some rate of return/productivity growth combinations. Dynasty C is a consistent gainer; at a return of 5% and productivity of 1% the net present value of gains across the four generations is DM 25,725.

Notice that there is not a monotonic relation between overall dynasty gains and the rate of growth of productivity. For example, if the rate of return on assets is 5% then the gain for dynasty C in Germany is higher when productivity grows at 2.4% than when it grows at either 1% or 3%. The reason is fairly straightforward: faster productivity growth has two effects; on the one hand the growth in wages over time increases the effective rate of return on an unfunded scheme and so reduces the gains of switching to a funded scheme. But so long as there is still a long run benefit of switching, then the higher are wages in the distant future the greater is the value of the gains once the crossover point in contribution rates has been met. Of course the crossover point is itself a complex function of g and r and so the overall dynasty gains are a highly non-linear (and in fact non-monotonic) function of g and r. Note also that the ranking of combinations of g and r is different across dynasties. In Germany Dynasty A is best off at g=0.01 and r = 0.07; dynasty B prefers g=0.04 and r = 0.09; dynasty C is best off at g = 0.04 and r = 0.07.

V. Intergenerational gains and losses and bequests:

If, in the absence of pension reform, people plan to leave bequests then they are likely to change their target if reforms generate substantial inter-generational transfers. It is interesting to calculate what change in bequests to the next generation would be required to keep the consumption of each cohort in the dynasty unchanged. For this to arise each generation must alter its bequest by the cumulated sum of the gains and losses of all earlier cohorts plus the net effect of changing contribution rates on itself. We focus on a dynasty where at the start of the transition there is a 50-year-old and a 20-year-old alive (the 80 year old who is about to die is irrelevant). We express all the required changes in bequest at their present value equivalents in 2000.

Table 7 shows that in the UK case if g=0.01 and r=0.03, the cohort aged 50 faces a net loss in wealth of £9,092. If the cohort aged 50 passes on this net loss to the cohort aged 20 it will bequeath £9092 less. The cohort aged 20 in 2000 itself faces a net direct loss of £14,517 so that this cohort's total net loss in wealth is £23,609 (expressed as a present value in 2000). The direct effect of pension reform on the next generation of this dynasty (aged –10 in 2000) is an increase in wealth of £7,729. It receives £23,609 less in bequest so to keep its consumption at the pre-reform level its bequest to the next generation is only £15,880 lower.

In most cases the bequests to the next generation would have to fall by increasing amounts for at least two generations, but then the decline is reversed. In the UK the scale of the cut in bequests and the length of time until bequests move back towards their pre-reform levels vary greatly. But in many cases bequests would have had to exceed £20,000 in the pre-reform equilibrium – often dramatically so

- to prevent consumption from falling. The cohort aged 20 (in 2000) consistently has to cut its bequest by most to preserve consumption. The cut can be as high as £80,386 (g=0.024 and r=0.03) or as little as £ 1,275 (g=0.01 and r=0.09).

Table 7: **Change in £ bequest to leave consumption unchanged for the transition in the UK (in present value at time of change in policy)**

	(g/r)					
Dynasty A	**0.01/0.03**	**0.01/0.05**	**0.01/0.07**	**0.01/0.09**	**0.024/0.03**	**0.024/.05**
Age at transition						
50	-9092	-4363	-2068	-970	-23539	-12004
20	-23609	-8325	-3192	-1275	-80386	-22101
-10	-15880	-3397	-895	-280	-87675	-11933
-40	-8469	-1013	-230	-91	-73098	-5252
-70	-4354	-269	-112	-72	-60864	-2103
-100	-2069	-37	-91	-70	-50597	-619
-130	-800	35	-87	-70	-41981	81
-160	-95	58	-86	-70	-34750	411
-190	296	65	-86	-70	-28681	566
-220	513	67	-86	-70	-23588	639
-250	634	68	-86	-70	-19314	674
-280	701	68	-86	-70	-15727	690

Dynasty A	**0.024/0.07**	**0.024/0.09**	**0.04/0.05**	**0.04/0.07**	**0.04/0.09**
Age at transition					
50	-5952	-2914	-33996	-17829	-9185
20	-8134	-3214	-79702	-24056	-9189
-10	-2765	-802	-66726	-11315	-2915
-40	-756	-241	-49233	-4600	-964
-70	-218	-155	-36105	-1739	-487
-100	-74	-142	-26253	-520	-370
-130	-35	-140	-18860	-1	-342
-160	-25	-140	-13312	220	-335
-190	-22	-140	-9148	314	-333
-220	-21	-140	-6023	354	-333
-250	-21	-140	-3678	371	-333
-280	-21	-140	-1918	378	-333

In Germany the changes in bequests to keep consumption constant would have to be much greater (table 8). The cohort aged 20 generally needs to cut its bequest by most; the reduction in bequest would have to be dramatic if the rate of return is only slightly above productivity growth. At r=3% and with 1% productivity growth the bequest would have to fall by over DM 200,000; but if the rate of return were 9% the bequest would need to fall by under DM 10,000. When the rate of growth of productivity is high, and the rate of return only slightly higher, the decline in bequest to the cohort born in 2010 would have to be very large. At $g = 0.03$ and $r = 0.05$ the cohort that is 20 in 2000, and which dies in 2060, needs to cut its bequest by over DM 300,000.

Table 8: **Change in DM bequest to leave consumption unchanged for the transition in Germany (in present value at time of change in policy)**

	(g/r)				
Dynasty A	**0.01/0.03**	**0.01/0.05**	**0.01/0.07**	**0.01/0.09**	**0.024/.05**
Age at transition					
50	-63024	-30838	-14689	-6895	-84290
20	-209648	-69074	-25233	-9794	-198292
-10	-167982	-26985	-5465	-1291	-112506
-40	-82626	-2816	1079	504	-40671
-70	-35228	4721	2238	686	-6814
-100	-8908	7072	2443	705	9144
-130	5707	7805	2479	707	16665
-160	13823	8034	2485	707	20210
-190	18330	8105	2486	707	21881
-220	20833	8127	2486	707	22669
-250	22223	8134	2486	707	23040
-280	22995	8136	2486	707	23215

Dynasty A	**0.024/0.07**	**0.024/0.09**	**0.03/0.05**	**0.04/0.07**	**0.04/0.09**
Age at transition					
50	-42489	-20832	-125498	-126921	-66186
20	-66780	-25196	-323269	-212739	-74573
-10	-19456	-4285	-223719	-96432	-18734
-40	248	1015	-110720	-27118	-82
-70	5521	1829	-47258	2415	4478
-100	6932	1954	-11617	14998	5593
-130	7310	1973	8400	20359	5865
-160	7411	1976	19642	22643	5932
-190	7438	1976	25955	23616	5948
-220	7445	1976	29501	24031	5952
-250	7447	1976	31492	24208	5953
-280	7448	1976	32610	24283	5953

Conclusion:

It is important to be clear about the implications of the numbers in Tables 7 and 8. What the tables show is that for a dynasty with workers of ages 50 and 20 at the time of pension reforms, the generation aged 20 would need to pass on a very much lower bequest to the next generation in order to prevent its own consumption, and that of its parents, from falling. The cut in bequest is often large relative to *average* bequests actually passed on in the UK and Germany – sometimes it exceeds it by a large margin. Since actual inheritances are skewed, even when the cut in bequest is below the average scale of inheritances actually received there would be a large number of families who would need to cut consumption as a result of a pension reform of the sort analysed here. This of course assumes that negative bequests are impossible.

Even if a cohort had to cut its consumption because of pension reform it does not follow that its welfare is reduced. If the welfare of future generations is given sufficient weight then a cohort that is a direct loser, and cannot compensate by cutting its bequest enough, may nonetheless favour reform. The implication of the results is not that any reform of the sort considered here cannot gain popular support, but rather that it is unlikely to do so *unless* people can be persuaded that the benefits to future generations are large and sufficient to compensate then for more immediate losses which they may be unable to avoid.

But even if everyone had the same degree of benevolence to future generations they could still strongly differ on whether the sort of pension reforms considered here should be undertaken. The ages of the members of the dynasty alive at the start of the reform and the times at which their successors in the family line are born matter a great deal. A dynasty whose oldest worker at the time of the reform is 50 would view the benefits very differently from one whose oldest worker is 35, even if they both only considered the impact on the overall net present value of the wealth of the whole dynasty.

The implications of all this are that governments need to think very carefully about the structure of a transition from unfunded state pension systems to funded ones. Gains and losses to different dynasties can be very different even if their members are born quite close to each other. And the way in which gains or losses are distributed across different dynasties depends in a highly sensitive and non-linear way upon real rates of return and upon how labour productivity grows with time and with age.

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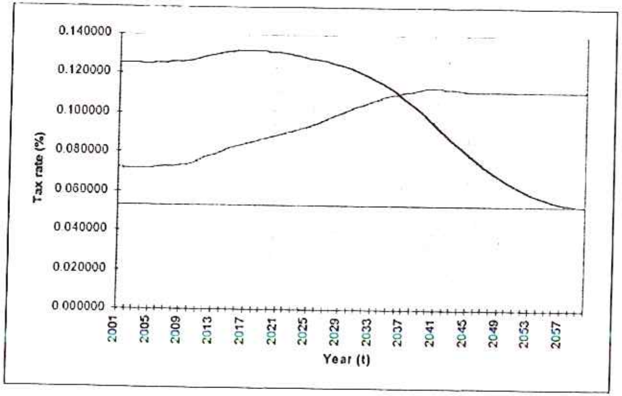
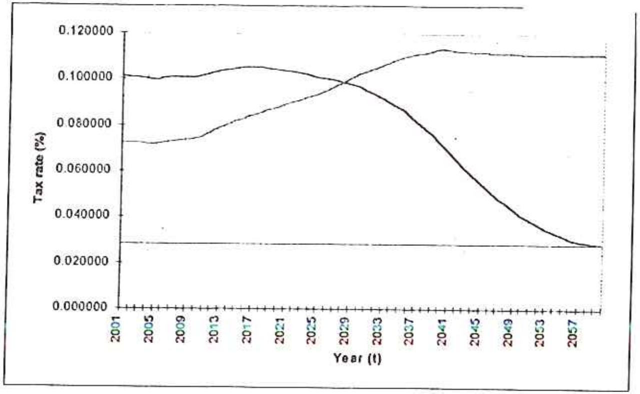
Transition for the UK (replacement rate = 20%)

Figure 1



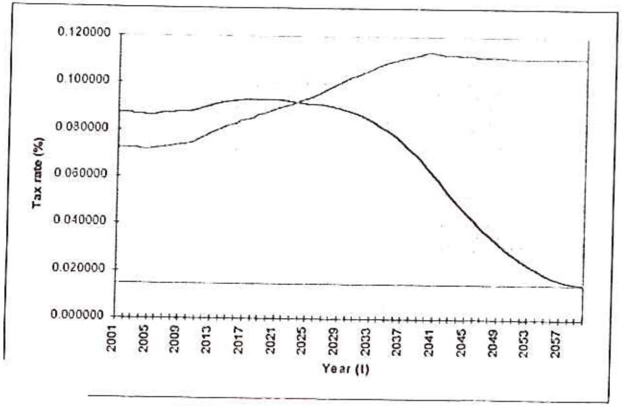
g = 0.01, r = 0.03

Figure 2



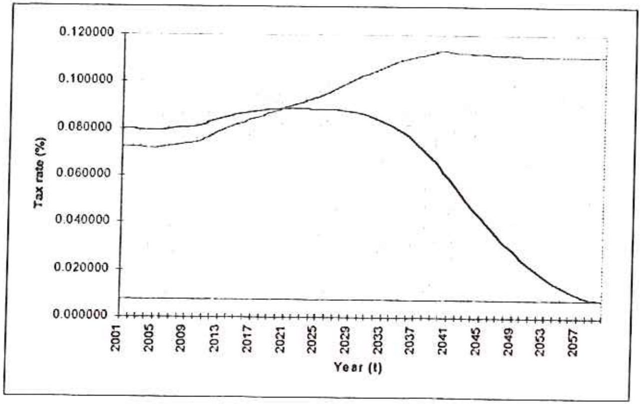
g = 0.01, r = 0.05

Fugure 3



g = 0.01, r = 0.07

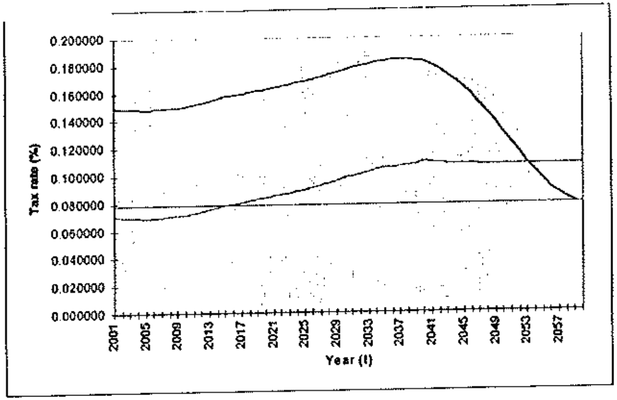
Figure 4



g = 0.01, r = 0.09

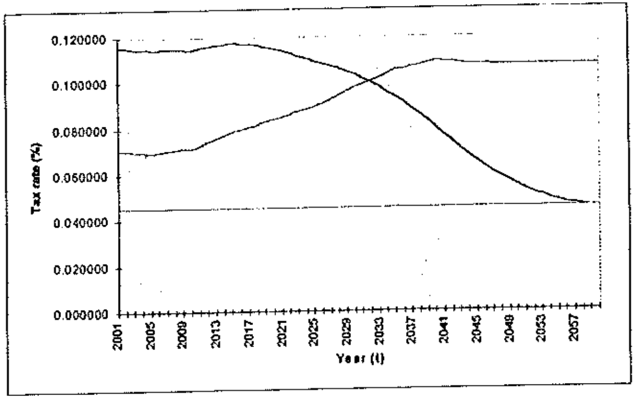
Transition for the UK (replacement rate = 20%)

Figure 5

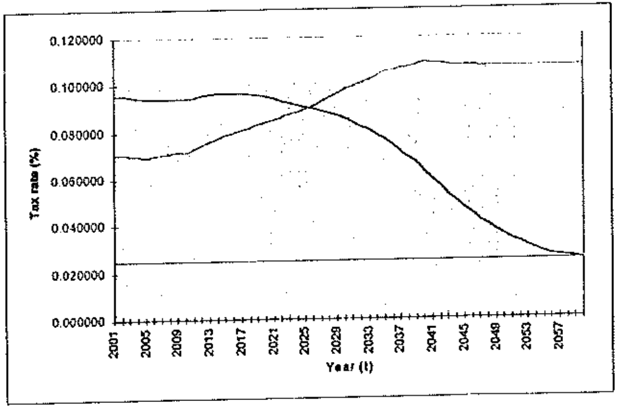


g = 0.024, r = 0.03

Figure 6

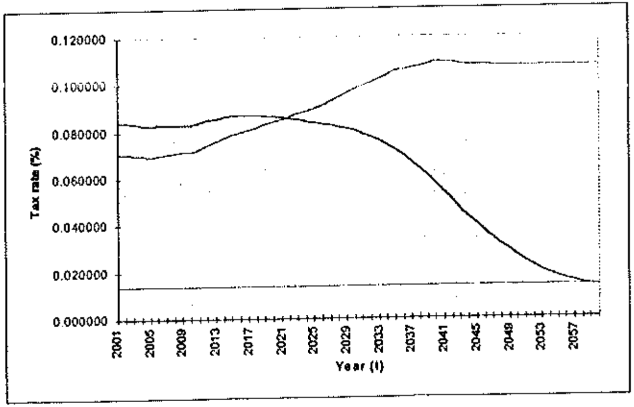


g = 0.024, r = 0.05



g = 0.024, r = 0.07

Figure 7

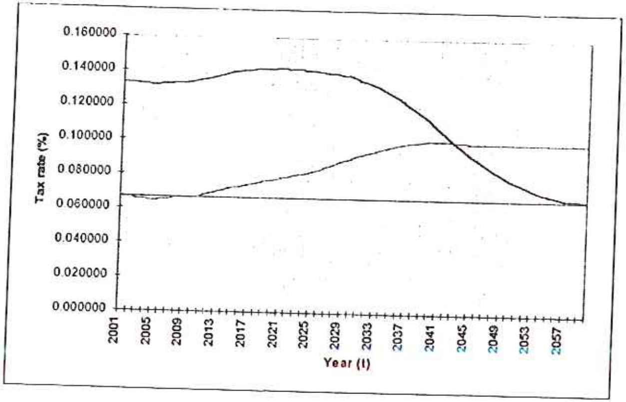


g = 0.024, r = 0.09

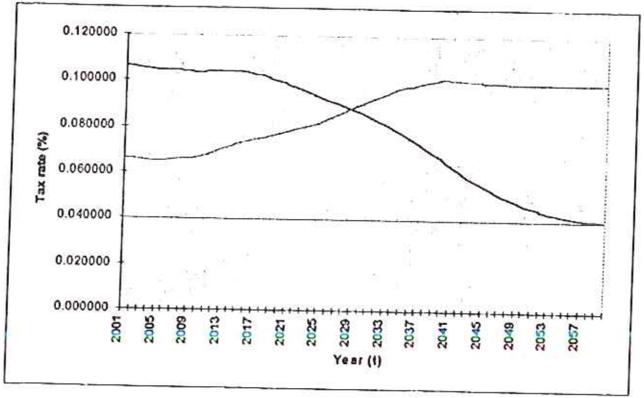
Figure 8

Figure 9

Transition for the UK (replacement rate = 20%)

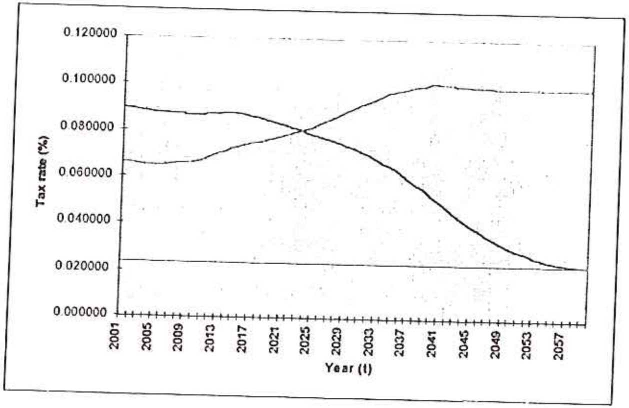


g =0.04, r = 0.05



g = 0.04, r = 0.07

Figure 10

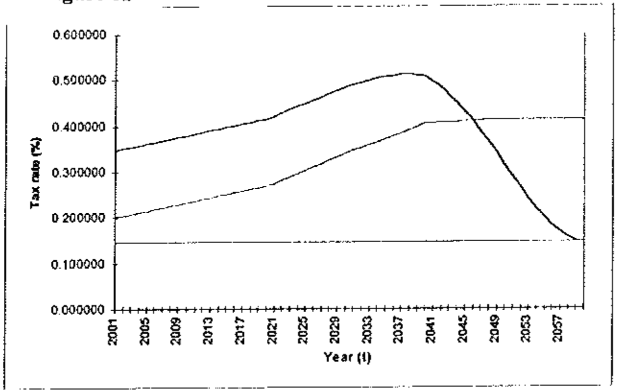


g = 0.04, r = 0.09

Figure 11

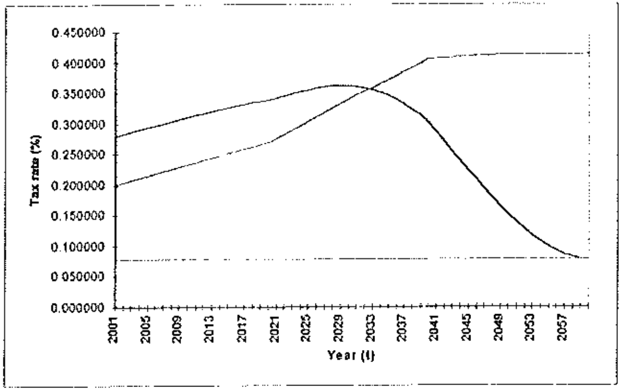
Transition for Germany (replacement rate = 55%)

Figure 12

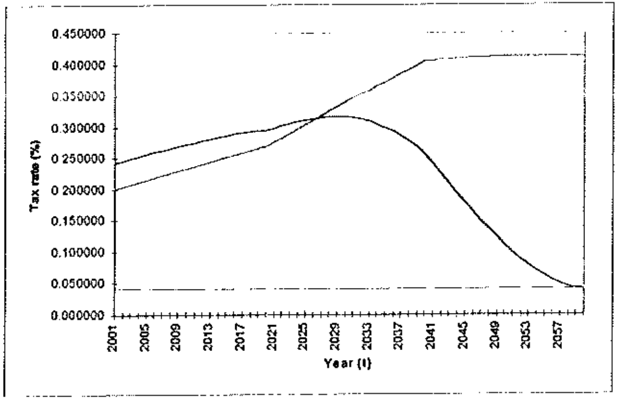


g = 0.01, r = 0.03

Figure 13

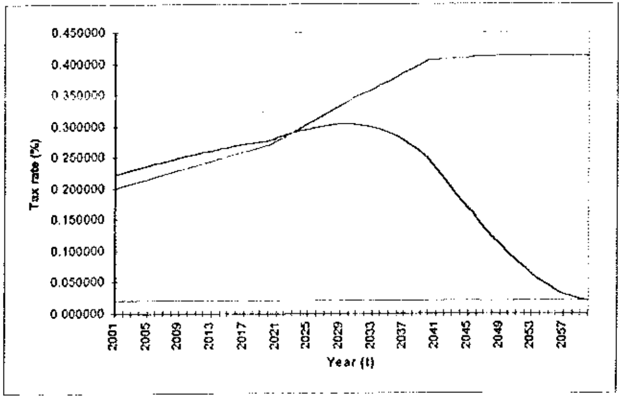


g = 0.01, r = 0.05



g = 0.01, r = 0.07

Figure 14



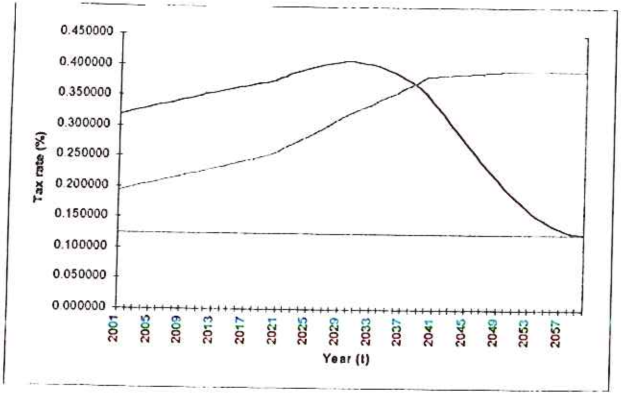
g = 0.01, r = 0.09

Figure 15

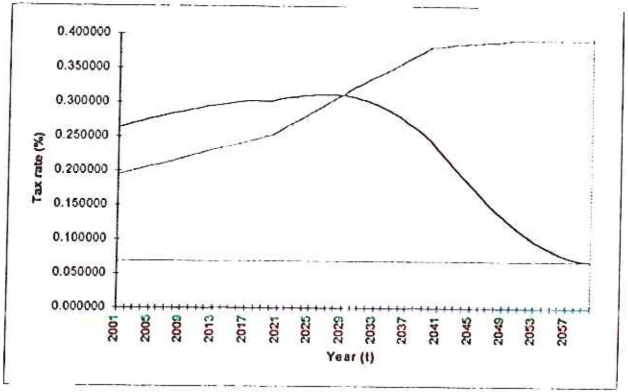
Figure 16

Transition for Germany (replacement rate = 55%)

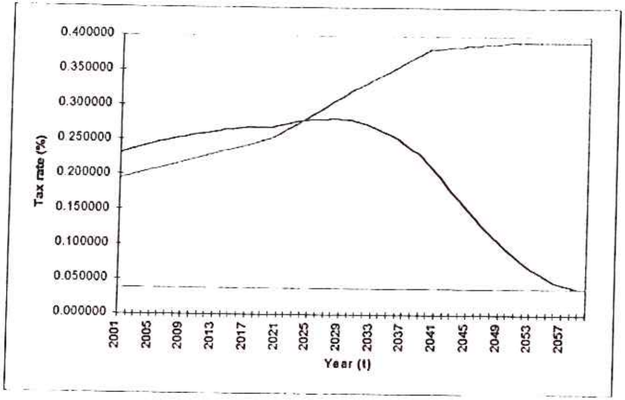
Figure 17



g = 0.024, r = 0.05



g = 0.024, r = 0.07



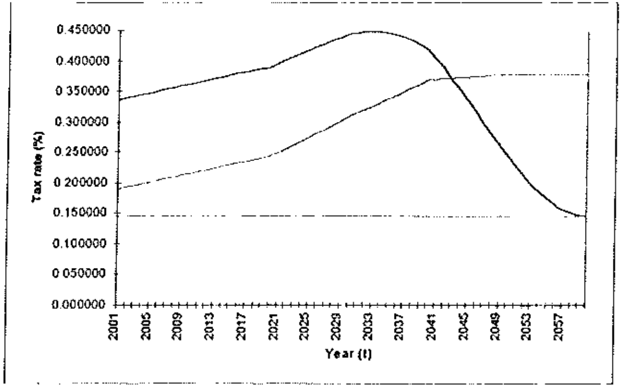
g = 0.024, r = 0.09

Figure 18

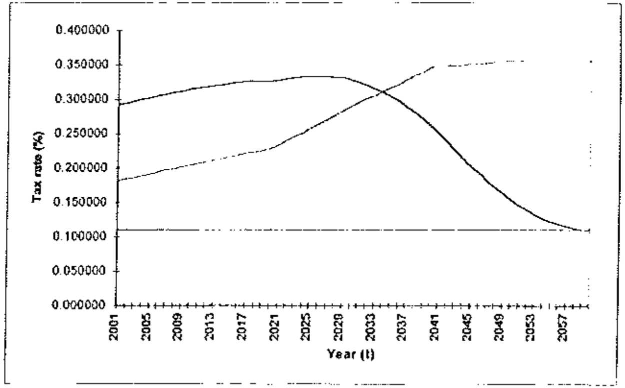
Figure 19

Transition for Germany (replacement rate = 55%)

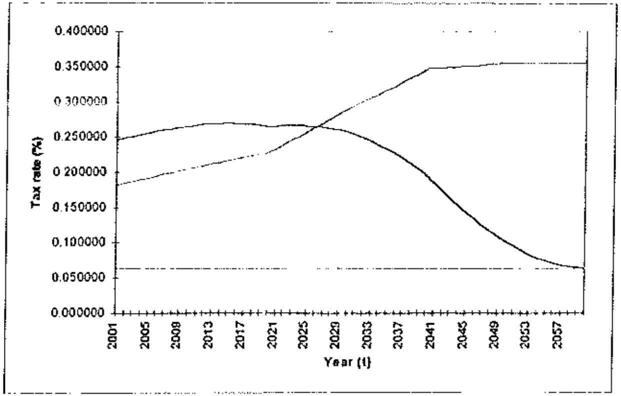
Figure 20



g = 0.03, r = 0.05



g = 0.04, r = 0.07



g = 0.04, r = 0.09

Figure 21

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