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Abstract

This paper examines the advantages and disadvantages of non-financial defined contribution (NDC) pension plans relative to financial defined contribution (FDC) pension plans. It also shows how an NDC outcome can be replicated in a FDC framework.

* I am grateful for helpful comments from Edward Palmer and for some useful references provided by Salvador Valdés-Prieto.

Introduction

Given that the Swedish non-financial defined contribution (NDC) pension system has had around a decade to bed down since its launch in 1999, this is an ideal opportunity to examine its advantages and disadvantages relative to financial defined contribution (FDC) pension plans. It also provides an opportunity to investigate whether an NDC outcome can be replicated in a FDC framework.

As we conduct this analysis, we should keep in mind the three main characteristics of the pension benefits in a 'good' pension plan:

- They are related to final salary. In line with the lifecycle model (LCM) of Ando and Modigliani (1957) and Modigliani and Ando (1963), consumers value consumption smoothing over their lifetimes and dislike sharp falls in income and hence consumption between one year and the next.
- They are uprated with inflation once in payment in order to maintain the standard of living in retirement.
- They hedge longevity risk by providing an income for life. A pension is a stream of payments that starts when someone retires and continues in payment until they die. In other words, a pension provides lifetime income security in retirement for however long the retiree lives (Bodie, 1990). Unless a plan provides this protection, it can be considered to be a wealth management plan, but not a pension plan.

We also need to distinguish between the accumulation phase and the decumulation phase of funded pension plans.

NDC: Pros & Cons

Before examining the pros and cons of NDC, it is worth briefly reviewing its design, using the original Swedish model for illustration. During the accumulation phase, each plan member has a 'notional' fund which grows with new contributions at a rate of return which equals the average wage growth rate in the economy plus an adjustment arising from an automatic balancing mechanism (ABM). Defining A/L as the ratio of assets to liabilities in the plan, the adjustment will be negative if A/L < 1.00. It will be positive if, following a negative adjustment, A/L >1.10 and this adjustment will be maintained until the system has returned to the same path of indexation that would have been followed had the negative adjustment not occurred. There is no positive adjustment in other circumstances, however, so, in principle, the system could build up a surplus that is never distributed.

In the NDC decumulation phase, the life annuity at retirement that each plan member receives will equal the individual's accumulated account value divided by an annuity factor that depends on cohort life expectancy at retirement. The initial real growth rate in the annuity was set at 1.6 % p.a., with this adjusted (upwards or downwards) to maintain system financial balance. The annuity can be claimed in part or whole from age 61. The worker does not need to leave the labour force to claim it and, as long as he or she

continues to work, contributions will be paid on earnings. Also, there is no maximum age at which the pension must be drawn. The Swedish plan has a minimum pension guarantee, financed through general tax revenues, allowing an element of redistribution in favour of poorer retirees. Additional redistribution occurs through non-contributory rights, such as child care rights granted during the first four years after a child is born, also paid through external contributions from the general budget.

NDC plans have a number of advantages:

- They are compulsory, so the plan designer can choose and enforce the parameters of the system. For example, the designer can choose an appropriately high contribution rate, one intended to achieve a desirable replacement ratio in retirement: the Swedish system has a 16% mandatory contribution rate in its NDC component and a 2.5% mandatory contribution rate in its FDC component. As another example, the designer can specify the minimum guaranteed pension level.
- They involve risk sharing within each generation, thereby avoiding the intergenerational inequities of other systems – including the previous Swedish system – that pass deficits down to the next generation. Given demographic changes – increasing life expectancy and declining fertility – these deficit transfers were seen as unaffordable going forward.
- They overcome the intragenerational inequities of defined benefit (DB) pensions which leave companies bearing longevity risk and are unfair to early leavers – who experience portability losses when they change jobs – and to low fliers – who do not gain from the backloading of benefits in DB plans.
- In addition, the Swedish FDC plan, which supplements the NDC plan, with a free choice of investment portfolios from a set of registered funds, is characterized by the following: Its cost of operation is low. Economies of scale are maximized since the state (via the tax authorities) collects contributions and there is a central clearing house (via the PPM, the Premium Pension Authority).[1] The long-run target costs (e.g., Palmer, 2008) of around 0.20 % of PPM assets – comprising around 0.04% for PPM overhead costs, 0.15% for fund management fees of FDC assets and 0.01% for contribution collection – are very low compared with typical FDC costs.
- There is good access to information. The clearing house provides information on returns, costs, and risk measures for all funds (in the FDC component).

NDC plans have a number of disadvantages:

- They require the whole country to participate. This, in turn, implies that a high degree of social solidarity is required.
- The assets are very poorly diversified internationally. In effect, the Swedish NDC system invests in a single stock called 'Sweden'. This means that Swedish pensions – in the NDC component at least – are wholly dependent on Swedish economic growth rates and Swedish demographic trends. Countries can become insolvent – what happens then to NDC pension entitlements?

[1] In 2011, the PPM became part of the Swedish Pension Agency which administers the entire public pension system.

- They cannot deal well with international labour mobility.[2]
- The pension assets are not portable in a way that the assets in FDC plans are.
- The state is a monopoly supplier of services and products (e.g., annuities). Can it be trusted to provide these services efficiently and at fair prices? Can it be trusted not to change contract terms in the long run?
- Because the annuity factor depends on cohort life expectancy at retirement, the NDC pension is unfair to people with impaired lives.

In short, NDC pensions are really just pay-as-you-go (PAYG) pensions with a bit more equity, although NDC is arguably more efficacious than other forms of PAYG, since members get what they pay for with their contributions.

FDC plans also have a number of advantages:

- A separate fund accumulates for each individual, giving a sense of 'ownership' and 'security'. The fund also allows greater portability: workers can move between jobs and between countries more easily, taking their pension pot with them.
- They are transparent: the value of the assets held in each pension pot can easily be determined at any time, as can the size of the annuity that can be bought with the assets.[3]
- They allow for the diversification of investments internationally: they can invest in the world's fastest growing companies in the world's fastest growing economies.
- Aaron (1966) showed the condition under which funded pension plans are superior to unfunded plans: it requires the real rate of return on assets in funded plans to exceed the real growth rate in the wage bill which equals the 'rate of return' in a PAYG plan, such as NDC. This condition holds in practice, not least because pension funds are able to generate higher returns by investing in the fastest-growing economies of the world, rather than in the domestic economy. The condition must also hold in theory on account of the 'dynamic efficiency' of the economy (see, e.g., Blake, 2000). 'Dynamic efficiency' requires that the average return on financial assets exceeds the growth rate in the wage bill, which, in turn, equals the growth rate in national income, if the share of wages in national income is constant. Saving via a pension fund helps the process of capital accumulation, which, in turn, improves the productivity of workers. However, it is possible to accumulate so much capital that the rate of return on capital assets falls below the growth rate in national income and the economy becomes 'dynamically inefficient': people could be made better off by saving less and consuming more. Dynamically inefficient economies are unlikely to be sustainable in the long run, since the owners of capital are likely to transfer their capital to economies offering higher returns. This implies that, in long-run equilibrium, funded plans, such as FDC plans, will be superior – in the sense of generating higher overall returns – than unfunded plans, like NDC plans.

[2] A similar weakness holds for DB plans.

[3] This is also true of NDC, unlike other PAYG plans: the exact accounting values in NDC are always either known or can be readily computed for all participants.

FDC plans also have a number of disadvantages:

- The contribution rates might be insufficient to generate an adequate pension in retirement, unless the FDC plan has mandatory minimum contributions.
- The individual funding of pension arrangements might not be feasible for the low paid.
- State-run PAYG systems permit minimum welfare standards to be established via income redistribution in a way in which private-sector funded plans do not.
- Funded pension arrangements can give an illusion of 'security' which disregards the political risks associated with the visible presence of a large pool of financial assets. Cash-strapped finance ministers can change the rules of the game: e.g., UK finance ministers have removed the right of pension funds to recover tax paid on dividends in UK companies (in 1997) and have put a cap on the level of contributions eligible for tax-relief (in 2011).
- Individually-funded pension arrangements are subject to the following types of risks:
    - Contribution risk due to unemployment, ill-health, disability or death-in-service
    - Asset return risk
    - Inflation risk
    - Interest rate risk
    - Longevity risk, the risk related to the provision of pension annuities when lifetimes are uncertain.

  These risks are either expensive or impossible to hedge using private insurance markets:[4] individuals are unable to transfer risks efficiently to the insurance companies operating in these markets.

How one compares the pros and cons of the two types of pension plan is largely a matter of personal preference, but, for me, the Aaron condition and the condition for dynamic efficiency provide a powerful argument favouring FDC over NDC.

Can NDC be replicated in a FDC framework?[5]

The answer is 'yes' if the government introduces two new types of bonds, one designed for the accumulation phase and the other for the decumulation phase.[6]

Since benefits in a NDC plan grow with earnings, a perfect matching asset for the accumulation phase would be either (zero-coupon) wage-indexed bonds or – since the

[4] For example, attempts to provide guaranteed minimum returns within FDC plans tend to reduce total returns.

[5] Valdés-Prieto (2000, 2004) provides the formal conditions under which a FDC plan can replicate a mature NDC plan: (a) the FDC plan is taxed to equalise returns, (b) the NDC plan is heavily guaranteed by the State, and (c) the FDC plan is fully invested in long term public debt. The two plans will, however, differ during a transition arising from changes in the population growth rate.

[6] It is possible for these bonds to be issued by private sector organisations , although with greater credit risk attached.

long-run shares of factors of production in national income are relatively stable over time, as Figure 1 demonstrates for the UK – GDP-indexed bonds. If pension contributions were invested in these bonds, they would accrue returns precisely as they would in a NDC plan. Note, coupons are not needed prior to retirement, hence the bonds should be zero-coupon. The government is a natural issuer of these bonds, since it has a natural hedge in its balance sheet – if wages or GDP increase, the payments on the bond increase, but so do the tax revenues to pay for these extra payments. The risk premium that the government would need to charge on these bonds would therefore be negligible.

Since pensions in payment need to provide an income for life and also need to protect against post-retirement inflation, the best way for members of DC pension plans to hedge their (idiosyncratic) longevity risk and inflation risk after retirement is to purchase an index-linked lifetime annuity at retirement. The best way for annuity providers to hedge the (aggregate or systematic) longevity risk that they face is to buy index-linked longevity bonds issued by the government.[7, 8]

A longevity bond with the following characteristics can help annuity providers hedge aggregate longevity risk:

- The bond pays coupons that decline over time in line with the actual mortality experience of a cohort of the population, say 65-year-old males from the national population: so the coupons payable at age 75 will depend on the proportion of 65-year-old males who survive to age 75.[9]
- Coupon payments are not made for ages for which longevity risk is low: so, for example, the first coupon might not be paid until the cohort reaches age 75 (such a bond would be denoted as a deferred longevity bond).
- The coupon payments continue until the maturity date of the bond which might, for example, be 35 years after the issue date when the cohort of males reaches age 100.
- The final coupon incorporates a terminal payment equal to the discounted value of the sum of the post-100 survivor rates to account for those who survive beyond age 100. The terminal payment is calculated on the maturity date of the bond and will depend on the numbers of the cohort still alive at that time and projections of their remaining survivorship. It is intended to avoid the payment of trivial sums at very high ages.
- The bond pays coupons only and has no principal repayment. In financial engineering terms, it is equivalent to an annuity bond plus a longevity swap.

[7] Annuity providers do not face idiosyncratic longevity risk if the annuity pool is sufficiently large. They do face basis risk, which arises from the difference between the realised mortality experience of the national population upon which the bond's coupon payments are based and the realised mortality experience of their annuity pool. However, basis risk can be hedged effectively (see Coughlan et al,, 2011).

[8] Interestingly, Palmer (2011 and in his contribution to this volume) shows that a longevity bond – which he calls a NDC bond – is needed to close a NDC pension system and establish a unique value for the NDC assets. In other words, a NDC pension system is an incomplete system without a longevity bond.

[9] The coupons will, however, increase in line with an inflation index.

Figure 2 shows the likely range of coupon payments on a deferred longevity bond, purchased by an annuity provider with the proceeds from selling an index-linked annuity to a 65-year old retiree. There is little aggregate longevity risk in the first 10 years after retirement, so there is no need for the annuity provider to seek aggregate longevity risk protection for annuitants aged between 65 and 75. After age 75, longevity risk increases and reaches a peak around age 90. After 90, longevity risk begins to tail off, but there is still a long tail of annuitants – even if small in number – who survive to ages above 110. The best estimate of the coupons on the longevity bond is shown by the central bar in the middle of the 90% confidence band for coupon payments in Figure 2. If population survivorship is higher at each age than was expected, the bond pays out higher coupons. This is what the annuity providers need to help match the higher than expected annuity payments they need to make. If, on the other hand, survivorship is lower at each age than was expected, the bond pays out lower coupons. But annuity providers are not likely to mind this, since their annuity payments are also likely to be lower.

Unlike wage- or GDP-indexed bonds, the government is not a natural issuer of longevity bonds. It has an existing large net exposure to longevity risk via the social security pension system and the pension plans of public-sector workers. The government would therefore need to charge a longevity risk premium to issue longevity bonds. However, annuity providers would be willing to pay a fair longevity risk premium to hedge a risk that cannot be hedged with existing instruments. So a potentially important advantage of traded longevity bonds would be to help to establish a market price for longevity risk.[10] As well as earning the longevity risk premium, the government can also hedge the longevity risk that it would be assuming from issuing longevity bonds by indexing the state pension age to increases in life expectancy: this would provide an alternative to the ABM adjustment.

[10] Palmer (2011 and in his contribution to this volume) argues that the NDC longevity bond required to complete the NDC pension system does not need to be sold on the financial markets and can be issued without a longevity risk premium accruing to the government. '[I]t is clear that there would be no marginal gain in marketing the NDC bond. Selling the NDC bond on the market would lead to marginal costs in the form of transaction costs and a risk premium to compensate the holder for holding the bond. This would however create no welfare gain for the participants – this only shifts individuals' money from one pocket to the other; the taxpayers are in principle the same individuals as the workers and pensioners' (Palmer (2011, pp 23-24)...'[T]here is no reason for the government to attach a risk premium to this debt component and by not doing this the cost to the taxpayers is exactly on par with the value of the commitment behind the bond'. The same arguments could be made for standard longevity bonds as originally proposed by Blake and Burrows (2001) if everyone in the economy were covered by a FDC or DB pension plan. Absent that, there would be redistributional effects – associated with all tax payers providing the longevity insurance, but only some tax payers benefitting from it – which can be (at least partially) overcome by the government earning a longevity risk premium from selling longevity bonds on the open market. Further, the trading in market-issued bonds establishes a market price for longevity risk. The absence of such a market price is presently a key weakness in the life market – the newly emerging global market that trades longevity-linked assets and liabilities. The NDC bond proposed by Palmer will not provide a price of longevity risk.

Conclusion

An NDC pension plan is a PAYG pension plan with greater inter- and intragenerational equity than a standard PAYG plan. The rate of return to plan members is linked to the wage growth of the economy in which the plan resides over the accumulation phase and to the realised post-retirement life times of each cohort of members. NDC plans cannot be considered as offering a well-diversified investment. Further, given the long-run dynamic efficiency of economies, NDC plans fail the Aaron test and so will generate lower average pensions than available from FDC plans.

NDC outcomes could be replicated using an FDC framework if the government:

- Issued wage-indexed or GPD-indexed bonds for the accumulation phase.
- Issued indexed-linked longevity bonds for the decumulation phase.

However, while these bonds would help to deal with the poor international portability of NDC plans, they would not address the issue of poor international diversification of investment risks nor the failure of NDC plans to pass the Aaron test.

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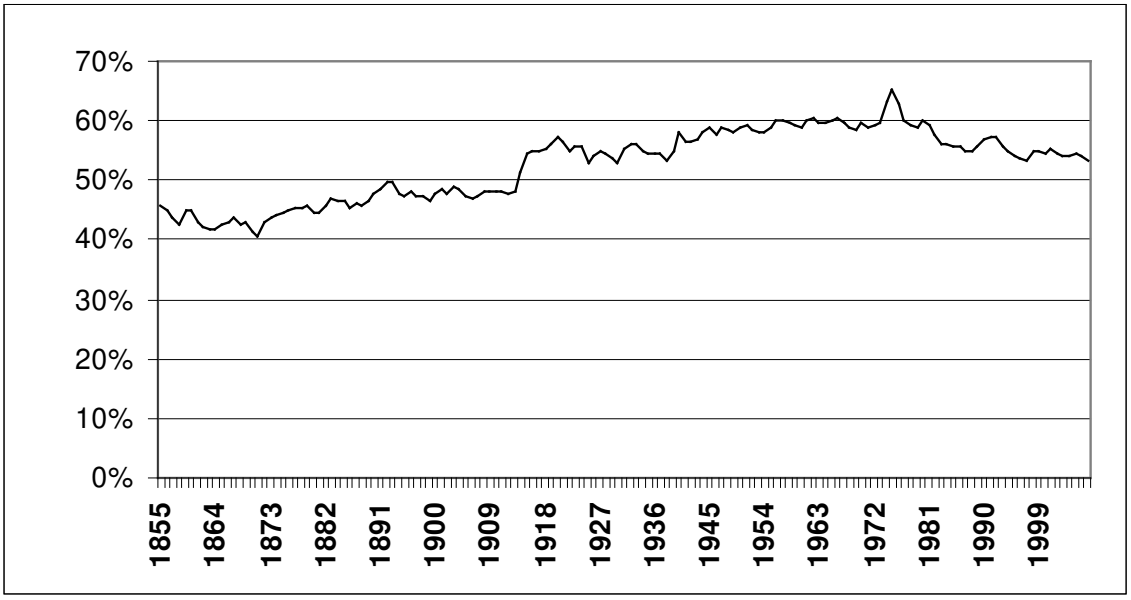
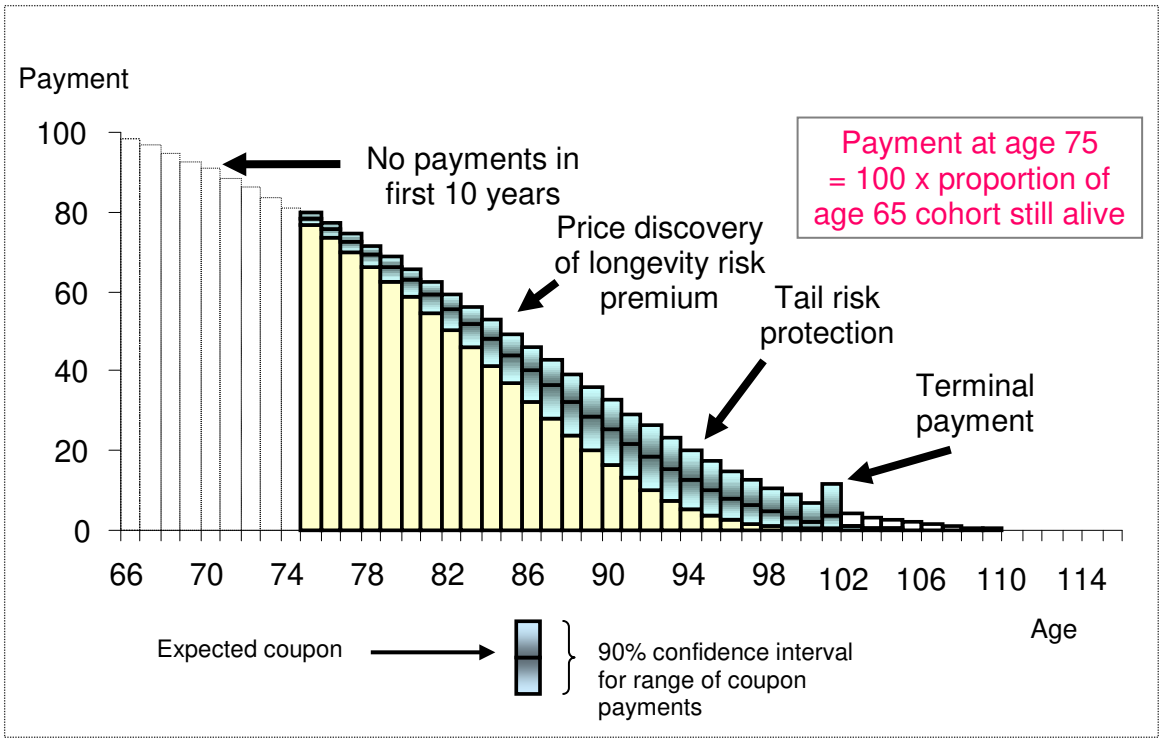
Figure 1 - Share of labour in UK national income (GDP) 1855-2010



Source: Feinstein (1972), *Annual Abstract of Statistics.*

Figure 2 - Longevity bond for a cohort aged 65, payable from age 75 with terminal payment at 100 to cover post-100 longevity risk



Source: Blake et al (2010). The 90% confidence interval for cash flows was produced using the Cairns-Blake-Dowd stochastic mortality model (Cairns et al, 2006) using mortality data from the national population of England and Wales for the period 1961-2003