Chapter 5

Conceptualization of Non-Financial Defined Contribution Systems

*Assar Lindbeck**

WHEN COMPARING ALTERNATIVE PENSION SYSTEMS, it is useful to rely on a three-dimensional classification: funded versus unfunded systems, actuarial versus nonactuarial systems, and DB (defined benefit) versus DC (defined contribution) systems (see Lindbeck and Persson 2003).

The basic distinction between funded and unfunded (PAYG) pensions is that pension benefits in funded pension systems are financed by the return in financial markets on earlier accumulated pension funds, but in unfunded (PAYG) systems they are financed by the current flow of contributions (taxes) from the active population. In the context of the box (trapezoid) in figure 5.1, where funding is depicted on the vertical axis and actuarial fairness on the horizontal axis, variations in the degree of funding are illustrated as vertical movements. It is also useful to distinguish between "broad funding," when the build-up of pension funds is associated with increased national saving, and "narrow funding," when this is not the case.

The second dimension of pension systems, actuarial versus non-actuarial arrangements, refers to the link between the individual's own contributions and his or her future pension benefits. The strength of this link may be characterized as an expression of the degree of actuarial fairness. A pension system is completely non-actuarial if there is no link at all. By contrast, a link is "actuarially fair" if the capital value of the individual's expected pension benefits is equal to the capital value of his or her own contribution—also on the margin (that is, when the individual varies his or her hours of work during his lifetime). This is the only type of pension system in which there is no labor market distortion. Variations in the degree of actuarial fairness, and hence in the labor market distortion, are schematically depicted as horizontal movements in the figure. Thus not only the funding dimension but also the actuarial dimension is a continuous variable.

In principle, all pension systems covered by the two dimensions depicted in figure 5.1 could be either DC or DB. This aspect of pension systems is then a third (orthogonal) dimension (not depicted in the figure). I define a DC system as one where the contribution rate is fixed, which means that the pension benefits must be (endogenously) adjusted from time to time to ensure that the pension system remains financially viable. In a DB system,

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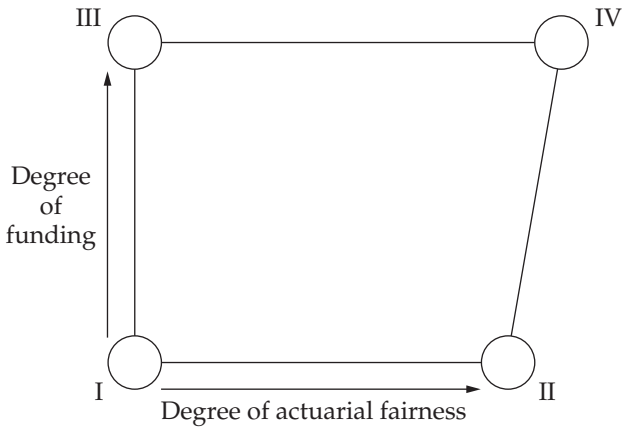
Figure 5.1. A Taxonomy of Social Security Systems



Source: Lindbeck and Persson 2003.

by contrast, the individual is promised either a lump-sum pension benefit or a specific relation between earnings and subsequent pension benefits (often expressed as a promised replacement rate). The contribution rate then must be (endogenously) adjusted from time to time to ensure financial balance.

The taxonomy may be illustrated by considering the extreme points I–IV in the figure. A tax-financed lump-sum pension benefit, equal for all pensioners, is the prototype of a non-actuarial unfunded system (position I in the figure). In the context of a simple overlapping generations model, where the individual's lifetime is divided into two periods—work and retirement—the average return on previously paid contributions is then equal to the growth rate of the tax base, G, while the marginal return is zero.

Position III in the figure instead depicts a non-actuarial, fully funded system, where the average return is the return in financial markets, R, and the marginal return is zero. In position II, with the maximum degree of actuarial fairness for a PAYG system, both the average and the marginal return is G. Finally, position IV depicts an actuarially fair fully funded system where both the average and the marginal return is R. Since the average and marginal returns in position II differ from the corresponding returns in position IV (the former are usually lower), I call a system in the former position "quasi-actuarial" rather than actuarially fair.

In the context of this classification of pension systems, a "notional defined contribution" (NDC) system is simply a quasi-actuarial system (position II in the figure) of DC type: that is, a system with an exogenous contribution rate. The individual's pension wealth may then be registered in an abstract ("notional") account —rather than in a factual financial account as in fully funded, actuarially fair systems.[1]

Although the entire contribution rate, τ, constitutes a marginal tax wedge in a completely non-actuarial system (positions I and III in figure 5.1, as well as in between them), the wedge falls when the system becomes more actuarial (that is, by a move to the right in the figure). For instance, a horizontal move from position III to position IV reduces the marginal tax wedge from τ to zero. The consequences for the marginal tax wedge of a move from I to II are slightly more complex. While the marginal tax wedge in the case of a

lump-sum pension (position I) is τ, in a quasi-actuarial system (position II), it may be written as follows in a two-period overlapping generations model (Lindbeck and Persson 2003):

$$\tau(R-G)/(1+R) \equiv \tau\left[1-(1+G)/(1+R)\right] \tag{5.1}$$

The equation says that the individual's income loss from having to pay the contribution rate τ in a quasi-actuarial system is equal to (the discounted value) of the difference between the market return, R, and the return in the PAYG system, G, multiplied by the contribution rate, τ. (The individual is forced to save the fraction τ of his earnings at the return G rather than at the market rate R.)[2] Thus a shift from a completely non-actuarial PAYG system to a quasi-actuarial system implies a reduction in the marginal tax wedge from τ to the expression in equation 5.1. For instance, if the contribution rate is 20 percent, such a shift may cut the marginal tax wedge by approximately half—with realistic assumptions about the number of years in work and retirement, respectively, and with reasonable assumptions about G and R.[3] This would amount to a nontrivial reduction in the tax distortion of work. Since there is no income effect in this case (the *average* return is G both before and after the reform), the individual is encouraged to choose more hours of work, a longer working life, more investment in human capital, more effort to be promoted, more geographical mobility, and so on—provided he understands that the marginal tax wedge has been reduced considerably.

This schematic calculation has assumed that the original pension system was completely non-actuarial. If, instead, the original PAYG system has some actuarial elements—if it is located somewhere between positions I and II in figure 5.1—the reduction in the marginal tax wedge would, of course, be smaller. Indeed, simply basing the pension benefits in a DB system on more years of earnings than the current scheme may reduce the marginal tax wedge. In the limiting case, when the pension benefit is based on an individual's lifetime earnings, the implicit marginal tax wedge could, in fact, be the same as in the expression in equation 5.1, provided yearly earnings are indexed by the same factor as the return factor in the NDC system. Thus an earnings-based DB system may mimic the work incentives in an NDC system. The reason for claiming that the DB system then mimics an NDC system, rather than the other way around, is that the latter type of system is by its very nature quasi-actuarial, while the degree of actuarial fairness varies in DB systems. Indeed, in many countries, the degree of actuarial fairness in DB systems is quite modest, since such systems are designed to ensure income protection (hence to guarantee an accustomed income level) and to redistribute income across income classes.

Earnings-based DB systems may also mimic other typical features of NDC systems. One example is automatic reductions in pension benefits in proportion to increased average life expectancy for each cohort. Such adjustments are also an inherent ("natural") feature of NDC systems, which are designed to include strong actuarial elements. Although the same mechanism can be introduced in earnings-based DB systems, this would be less self-evident since actuarial features are not emphasized in such systems.

Another difference between DB and NDC systems concerns the *international transferability* of pension benefits. Such transferability is also an obvious element in NDC systems, since an individual's pension wealth consists of personal accounts based on contributions paid earlier by the individual. Thus the wealth in a notional account is in a natural way regarded as the individual's property. Such transferability is a less obvious feature of DB systems, where pension benefits have traditionally been tied to citizenship or residence in a specific country. Moreover, international complications are bound to arise if interna-

tional transferability is allowed in today's DB pension systems. The reason is that such systems are often tied to earnings over a limited number of years. Without intergovernment coordination of pensions systems, some individuals may lose their pension benefits when they move to another country (because of too few years of work to be eligible for pension benefits). In other cases, the sum of pension benefits from different countries may add up to a larger amount than an individual would have accumulated if he or she had lived in one and the same country during his or her entire working life. (Only if all years of earnings would count, as is automatically the case in NDC systems, could this problem be avoided in an earnings-based DB system.)

DB and NDC systems may also differ with respect to their *financial viability*. A crucial issue in this context is whether it is politically easier, or more difficult, to adjust the pension benefits in NDC systems than to adjust the contribution rates in DB systems. Historically, it has certainly turned out to be politically feasible to raise the contribution rates gradually over the years in DB systems—from a few percent of earnings to 15 to 25 percent in most developed countries. The situation may be different today in the sense that voters and politicians may regard contribution rates as so high that further increases are not politically feasible. Indeed, ambitions to avoid further increases in contribution rates are an important background for recent attempts to freeze the contribution rates in DB systems. Again, this would mean that a typical feature of NDC systems is introduced into a DB system.

How financially stable then are NDC systems compared with DB systems? This depends, of course, on exactly how the systems are designed. In principle, in order to be financially stable, pension benefits in an NDC system should ideally be gradually adjusted throughout an individual's retirement period in response to variations in the growth rate of the tax base of contemporary workers and expected remaining longevity of retired individuals. This would obviously require a *variable* rather than a fixed annuity. (The need for such adjustments of annuities could be reduced, however, if the systems had buffer funds that smooth the benefit payments over time, although this would make the pension system less actuarial.)[4]

The distributional effects also tend to differ between DB and NDC systems. In principle, an NDC system reflects no particular distributional ambitions, either within or across generations, since the system is supposed to be quasi-actuarial. DB systems have no such distributional limitations, and they have traditionally been regarded as legitimate and useful tools for both inter- and intragenerational redistribution. Like other PAYG systems, earnings-based *DB* systems redistribute income in favor of the first generation of pension beneficiaries, which also implies subsidization of the labor supply (another example of a labor market distortion). Intragenerational redistributions are more ambiguous. For instance, although floors and ceilings on benefits (without corresponding arrangements in the case of contribution rates) tend to redistribute income in favor of low-income groups, rules according to which pension benefits are based on earnings during the best x or last y years usually favor relatively affluent individuals. The net effect on the redistribution of lifetime income among income classes within generations usually seems to be rather modest in real world systems.

Although "pure" NDC systems are void of redistributional ambitions, real world NDC systems are often *combined* with policy measures designed to bring about intragenerational redistribution. Obvious examples are specific tax-financed pension benefits for military service, childcare, sickness, and unemployment. In other words, redistributional elements are often *added* to pure NDC systems, so that the distributional consequences become more like DB systems. In this special sense, NDC systems may mimic the distrib-

utional features of DB systems. If politicians are anxious to maintain the "purity" of an NDC system itself, such tax financing may be kept outside the NDC system. Nevertheless, such complementary arrangements have to be considered when analyzing the consequences of shifting from DB to NDC systems.

DB and NDC systems also have different implications for intergenerational *risk sharing*. Mature DB and NDC systems distribute income risk differently in response to disturbances of various types. In principle, in DB systems, the "burden" of unexpected changes in the growth rate of aggregate earnings (and hence the tax base) is borne by active generations, in the form of variations in contribution rates. In NDC systems, by contrast, this risk is shared between generations, since pension benefits will change for both pensioners and workers (in the future). Current employees, of course, also experience a change in earnings.

The distribution of income risk also differs in response to changes in life expectancy. If pension annuities in NDC systems are adjusted gradually (for instance, every year) during the retirement period (a variable annuity), pensioners bear the entire income risk. In NDC systems in the real world, however, the adjustment often takes place only at the time of retirement. If no further adjustment occurs during an individual's retirement period in response to changes in remaining longevity (a fixed annuity), such disturbances may impair the financial viability of an NDC pension system. Subsequent generations then have to bear this risk in one way or another. In the real world, politicians often try to create financial viability by combining reduced benefits and increased contributions, presumably to force active generations and pensioners to share the risk.

To summarize: Even if DB systems may mimic typical features of NDC systems (and in some cases, vice versa), the systems differ in their *general philosophy*. Some features "fit" better in NDC systems than in DB systems—and vice versa. The systems also have different distributional consequences, within as well as across generations, and they tend to distribute income risk differently. Moreover, they differ with respect to the ease of allowing pension benefits to be transferable across countries. It is also likely that the "property rights" of pension benefits are more robust politically in NDC systems.

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Lindbeck, A., and M. Persson. 2003. "The Gains from Pension Reform." *Journal of Economic Literature* 41 (1): 74–112.

Notes

1. "Notional defined contribution" and "non-financial defined contribution" should be understood to have the same definition.

2. However, the implicit tax wedge will be higher in early than in late working life, since in the former case the contributions are locked in (at a low yield) over a longer period than in the latter case; see Lindbeck and Persson (2003, p. 85).

3. The calculation is based on the assumption that the value of the contributions accumulates, on average, for 32 years, which means that equation 5.1 may be rewritten $\tau[1 - (1 + G_1)^{32}/(1 + R_1)^{32}]$. I also assume that $G = .02$ and $R = .04$.

4. The Swedish system is unnecessarily unstable because the return is tied to average real wages rather than to the wage sum, and changes in life expectancy do not result in changes in pensions during the course of the retirement period. This is the background for the introduction of a special "balancing mechanism" in the Swedish system.

Conceptualization of Non-Financial Defined Contribution Systems

*Peter Diamond**

In their paper in the *Journal of Economic Literature*, Assar Lindbeck and Mats Persson (2003) provide a three-dimensional classification of pension systems. One dimension is seen in the contrast between defined contribution (DC) and defined benefit (DB) systems based on adjustment methods to financial realizations. Defined contribution systems adjust benefits, while defined benefit systems adjust revenues. This distinction is really a continuum in that one can adjust a combination of the two. This could be done as part of automatic adjustment, as has been proposed for the United States by Peter Diamond and Peter Orszag (2004), who proposed that roughly half the automatic adjustment for the impact of life expectancy increases on social security finances be done by benefit reductions and roughly half by payroll tax rate increases. Or a combined approach can be done in the course of legislation, as in the 1983 reform of U.S. social security (see Light 1985). When it is done by legislation, then the picture can become even more complicated, in that benefits for some can be increased while the general level of benefits is decreased. In addition to arguing that this dimension be considered a continuum, I wonder if it might not be better to use the phrase "adjustments to stochastic realizations," recognizing that pure DC and pure DB systems are just two points in this continuum.

Lindbeck and Persson's second dimension is the degree of funding, which is a continuous variable as well. This dimension is also more complex in that there is the important distinction made by the source of the funding. Analysts are very aware of the difference between assets that are politically committed to paying for benefits and assets that also have been accumulated in a way that contributes to national savings. Thus there is further complexity in this dimension, as well.

They refer to their third dimension as actuarial—the extent to which there is a tight link between paying taxes and getting benefits. This is clearly tied to labor market incentives and is also more complex than they describe. One can think of a system that is a combination of a flat benefit and a benefit proportional to the accumulation of taxes paid. Then the relative sizes of the two portions indicate how distortive the labor incentives are (distortive in the sense that this would interfere with the fundamental welfare theorem if there were no other violations of the conditions needed for the theorem to hold). This example makes it clear that, as with the other two dimensions, there is no sense that "more actuarial" is necessarily better (since income distribution matters as well as efficiency), just as there is no sense in which "more funded" is necessarily better or further along on the defined benefit defined contribution dimension (in one direction or the other).

But there are other ways in which the determination of benefits can differ from a defined contribution system (which may not be distortive in the sense I used the term

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above). There is the issue of the weights on different years of earnings in determining benefits— the difference between accumulating at a market interest rate in a DC system and an internal rate of return in an NDC system. Actually this comparison needs to be adjusted if it is to be orthogonal to the other dimensions. That is, the comparison ought to be done holding constant the present value budget constraint for a given cohort. In this case, the NDC approach is expected to weight earlier years less than the market interest rate does and weight later years more than the market interest rate does. Use of the market interest rate involves no distortion if the cohort breaks even on taxes and benefits, there is no redistribution within the cohort, and there are no other labor market distortions. But these conditions do not hold generally. Indeed, the use of progressive annual income taxes would make the NDC approach less distortive since it would tend to balance the rise in marginal income taxes that comes with the usual age-earnings profile. That is, with an upward sloping age-earnings profile and progressive annual income taxes, the sum of explicit income tax and implicit social security tax can well be smoother with NDC than with DC.

It is common to observe that the redistribution to earlier cohorts distorts the labor supply of later ones. In a two-period overlapping generations (OLG) model where the first generation gets a surprise benefit after retirement and all later cohorts pay for it, this is the full story. In practice, early generations are treated more generously over an extended period, thereby affecting labor supply of both recipients and payers of intergenerational redistribution. That is, early cohorts get their labor supplies subsidized, while later ones get them taxed. Given a presumption of a preference for relatively stable tax rates, this is suggestive of a distortion, but a more complex one than in the simple two-period model.

The same issue arises in systems that use a shorter averaging period—the last n years rather than all years, for example. Then, with a break-even comparison, there is taxation of earnings in earlier years that do not count for benefits, and subsidization in later years, which produce so much in benefits as to more than offset the taxes paid. The story becomes even more complex in a setting of individual uncertainty and the use of some measure of highest earnings rather than last earnings. That is, different benefit rules, combined with different stochastic structures on earnings possibilities, will yield different degrees of uncertainty about retirement benefits. I am not convinced that *actuarial* is a good term for this dimension since it is an intervention in the labor market that affects efficiency, individual insurance, and redistribution. Such a term is not used in considering the degree of progressivity of the income tax and it is not clear it is helpful to do so here. This is not to suggest a disagreement with Lindbeck and Persson's identification of labor market incentives as a very important third dimension when classifying systems—just that this dimension, like the other ones, is itself multidimensional, not a single point in a one-dimensional scale. Perhaps "labor market incentives" is a better phrase than "degree actuarial."

Thus I would rename their three dimensions, with new names of "adjustments for stochastic realizations," "degree of funding," and "labor market incentives." Renaming is essentially agreeing with the value in this tripartite way of approaching the effects of social security designs.

In this setting, a pure NDC does all its adjustments on the side of benefits and none on the side of taxes, has limited funding through its buffer stock of assets, and has good labor market incentives. Where each of these three choices is, relative to optimality for some particular country's initial position, is a hard question to answer. There is no basis for claiming a general optimality for any of the positions of a pure NDC system in any of the three dimensions.

To put an NDC system into context, let us briefly review how other systems work. If there is no system, an individual who is doing lifecycle optimization saves, with different savings rates at different times; invests in some combination of assets; and at some time purchases an annuity of some form, with at least some of the accumulation. (Rolling purchase of annuities would be better insurance if available at equivalent pricing.) Such a person adjusts the level of savings over time in response to both the realizations of returns on assets and the realized earnings levels.

A mandatory DC plan preserves the individual character of budget balance and the reliance on market pricing of assets and annuities and the bearing of the risk in both asset returns and earnings trajectories. A mandatory DC system does not typically attempt to adjust the savings rate to realizations. The uniform savings loses out on both the liquidity needs behind an ex ante plan of varying savings rates and the ability to adapt savings to experience. But there is room for varying savings if the mandatory rate is not too high—below a savings level adequate for financing all of appropriate retirement income. Redistribution can be combined with this, either through a separate arrangement (such as minimum incomes) or within the system by transferring between accounts.

A corporate DB plan typically relates benefits to a history of earnings and uses projected needs to determine assets to be accumulated. If there is government regulation of financing, it does not apply to an individual but to the plan as a whole. Contribution rates would be continuously adjusted if there was a serious attempt to preserve full funding. In practice, corporations adjust both benefit formulae and contribution rates in response to realizations of both corporate earnings and pension system experience. Moreover, the wage levels themselves are among the candidates for responding to the risks in both pension experience and corporate earnings, subject of course to labor market responses.

A mandatory national DB often differs from corporate DBs in the formula chosen for relating benefits to the history of earnings, although it need not (some corporate plans use the entire history of earnings in determining benefits). It also can differ from a regulated corporate plan in the target level of funding. Put differently, the risk implications of the level of funding are different for corporate and national plans since conditions leading to corporate bankruptcy are different from conditions resulting in countries repudiating benefits.

An NDC is a hybrid with two creative innovations. One is that benefits depend on taxes paid, not earnings. The second is that the NDC plan is discussed in terms of a DC vocabulary, not a DB vocabulary. In the context of an unchanging tax rate, the first innovation is of little significance. The second innovation must have been helpful in achieving political consensus for reform in Sweden, but Axel Börsch-Supan, (2005) has argued that it would not have been helpful in Germany.

If followed closely, a pure NDC has one less degree of freedom than does a similarly constructed DB. An NDC is supposed to provide benefits for different cohorts that have a present discounted value (PDV) that equals the value of the account, using the internal rate of return (IRR) for a discount rate. A DB system could adjust benefits for successive cohorts that followed a similar rule for relating relative benefits to relative life expectancies. But it has a degree of flexibility in setting the relationship between benefits and earnings. In practice, the Swedish NDC used a degree of flexibility in choosing to use period mortality tables rather than cohort ones, either projected or adjusted based on experience, as does a (CREF) annuity pioneered by TIAA-CREF in providing annuities for university employees. Instead, the Swedish system does its adjustment in two ways. One is the level of assets to provide the system at the start. The other is the automatic adjustment mechanism.

In contrasting a well-designed DB or NDC system with a DC system, we see the potential in the DB to improve social welfare by redistributing income and providing insurance for earnings through a progressive benefit formula. (Differently designed redistribution is potentially present in both DC and NDC, but is more in keeping with the approach of a DB.) We see the potential in both the DB and the NDC to provide more within-cohort risk sharing by relying less on rates of return, (rates of return also being earned on individually held assets). We see differences among the three in the weighting of earnings in different years in the determination of benefits. There is no sense in which an NDC is better than a well-designed DB. Instead I think of it as a way to get a DB system that is better designed than many current or former DB systems.

There is wide agreement on several properties of a good system. A country should have one system—not separate systems for separate groups, with political power affecting the relative treatment of different workers. Benefits should be based on at least a large fraction of a career. A system should preserve projected balance, either through fully automatic adjustments or some combination of some automatic adjustments and periodic legislation.[1] A system also needs to have a reliable process for projecting the future workings of the system—both its financial position and its fulfillment of its social insurance goals. And not too much of the cost of reaching balance should be shifted onto generations in the distant future. Does an NDC help countries not meeting these conditions meet them? It may, but it need not.

It has been claimed that it is a virtue of the Swedish system that there is no reliance on forecasts. I think this is not necessarily a virtue. In a fully privatized system, the market engages in projections when deciding how to price annuities and when committing to rates of return on long-lived investment options that have given rates of return. I see nothing inherently problematic in using projections in determining a balance between benefits of different cohorts. I also note that with a private market system with sensible workers, workers would be adjusting their savings rates to realizations of their experience in financing retirement incomes. Moreover, the adjustment rules that do not use an explicit forecast can be seen as merely relying on a naïve forecast.

It should be noted that the value of one kronor in an NDC account is not equal to the value of one kronor in a funded DC account. Since the NDC kronor is earning a lower rate of return than the DC kronor, it is worth less. Thus the claim that workers know the value of their accounts is wrong. It is good for workers to be informed about anticipated monthly benefits. Since there is speculation that workers overvalue lump sums relative to the flows they can finance, more information is definitely useful. Moreover, the dependence of the value of the accumulation in an NDC account on future legislated returns means that accounts with the same accumulation would have different values in countries with different anticipated growth rates. Thus wider use of NDC does not provide ready transfers between countries without detailed actuarial calculations of assets that would need to be transferred to accompany a transfer of liabilities.

An NDC system faces a choice between how it allocates risk to different participants at different times and how likely it is to have a need for an adjustment. For example, recognizing the higher risk aversion of retirees than of workers, it makes sense to have benefits in force not fully subject to the fluctuations in taxable earnings.

In sum, an NDC system is likely to be pretty good—serving its social insurance goals well. It leaves open several choices about design, choices that should be based on the consequences of choice, not some notion of an ideal NDC in light of NDC philosophy. The choices in the design of benefits may be particularly important—single or joint-life annuities, choice of indices for adjusting benefits, and the time shape of benefits more generally.

These choices should reflect both the impact on retirees and the labor market incentives. On a break-even basis, steeper benefits that start lower may be particularly useful for discouraging retirements if they are thought to be occurring too early. Related is the choice of whether to have a retirement test for a few years after initial eligibility for retirement benefits. Such a test affects the time shape of consumption beyond the early entitlement age as well as retirement decisions. Although an NDC is likely to be a pretty good system, it does not make sense to oversell it, claiming excessive virtues relative to alternatives.

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Note

1. For discussion of different ways of achieving balance—of allocating the risk associated with realizations of economic equilibria—see Diamond (2004).

Conceptualization of Non-Financial Defined Contribution Systems

*Salvador Valdés-Prieto**

SEVERAL PARTICIPANTS IN THIS CONFERENCE MENTIONED that NDC-like plans were devised independently by policy makers in places as different as Sweden (1992), Uruguay (1992), Kyrgyz Republic (1992), and Italy (1993). These episodes and others[1] suggest that the NDC design has substantial following in a variety of contexts. Policy makers would benefit from a detailed understanding of the notional defined contribution (NDC) design.[2]

The first section of these comments shows where NDC plans stand regarding funding method and benefit formulae. The second section shows that most NDC plans allocate the outcomes of risk in a way that is fundamentally different from fully funded DC plans (which are mutual funds), and in this sense most NDC plans are not really defined contribution. The third section argues that the NDC design should not be allowed to have a role in first-pillar and in third-pillar policies. The final section argues that NA plans can and should provide some liquidity for their members, illustrating that the room for improvements of NDC plans is significant.

Mapping the NDC Family

The three main dimensions of pension plan design are the degree of financial funding of the plan, the type of benefit formula offered to members, and the method used by the plan to allocate the outcomes of aggregate plan risk.[3] It is generally agreed that NDC combines a benefit formula that uses "actuarial" formulae, with a low degree of financial funding: that is, it approaches pure pay-as-you-go finance.

Adoption of the NDC design seems driven by the wish to attenuate initially very high labor distortions, and by the inability of the adopting country to overcome the transition cost toward partially or fully funded alternatives. These issues relate to the first two of the main design dimensions, not to the third.

Degree of Funding

Consider the degree of "financial" funding of the plan, which is the same as the "narrow funding" mentioned by Assar Lindbeck in this roundtable. This degree of funding is obtained by dividing the market value of the pension fund by the expected discounted value of accrued liabilities at the same date. What economic assets are part of the pension

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fund? Possible assets include not only financial securities, but also land, real estate, and even precious metals owned by the plan. On the other hand, the present expected value of government subsidies and other donations to the plan do not belong in the pension fund because those policies can be modified and those donations can stop. It follows that a pension fund is the set of payment promises in favor of the plan that are protected by property rights, defined in turn by protections spelled out in the constitution (Valdés-Prieto 2002, pp. 391–3).

There is another aspect of funding, referring to economy-wide savings. The degree of "ultimate" or "broad" funding is the degree to which individual wealth is backed by physical assets and net foreign assets. The degree of broad funding is a function of the size of the public debt and of publicly financed infrastructure, and not only of the funding status of the national pension plan. In fact, intergenerational transfers in health subsidies, in education, and in the stock of knowledge can back substantial amounts of individual wealth,[4] influencing the degree of broad funding.

Which of these two is most relevant? It is not appropriate to characterize a pension plan by the features of the economy in which it operates. Therefore, the degree of broad funding of the economy cannot be one of the defining characteristics of a pension plan.[5] Consider an economy where credit card securitization is introduced, allowing an expansion of the stock of consumer credit outstanding and a transitory increase in the flow of consumer expenditures. As the economy's stock of national saving has fallen, the degree of broad funding of the economy has fallen. However, if a fully funded pension plan buys these securitized bonds, any observer will ascertain that the plan itself remains fully funded. As shown by Bernheim and Shoven (1988), there is no link between aggregate savings and changes in the funding status of a pension plan. In conclusion, what matters for labeling the funding status of a pension plan is its degree of "financial" funding.

A pension plan's impact on aggregate national saving may be positive, but it depends heavily on how much other components of savings adjust when the pension plan changes its degree of narrow funding. Raising the degree of "financial" funding of a plan does have two desirable consequences, even if national saving is unaffected. First, the plan gets the additional protection of property rights over the future cash flows produced by the assets. Second, a higher share of plan assets can be traded in financial markets, and this allows the plan to gain from trade, benefiting members. In contrast, raising the size of national savings may or may not be desirable after the transition cost is taken into account.

Benefit Formulae

Benefit formulae are functions that link the amount of benefits received by an individual member during the passive phase of life with that same member's circumstances during the active phase of life. There are two main classes of benefit formulae. The "actuarial" class is based on the amount contributed when active, uses individual account balances, interest is credited to the accounts and uses annuity conversion factors to transform the balance in an annuity. This class includes deferred annuities purchased by installments and variable annuities. The other main class of benefit formulae is built around "years of service" and "revalued career average salary." There are other benefit formulae outside these two classes, such as the Brazilian "*fator previdenciario*" introduced in 1999. Under some parameter configurations, a years-of-service benefit formula can be almost equal to an actuarial benefit formula, but they always differ in one aspect: the response of benefits to increases in contribution *rates* is positive for actuarial formulae and is zero for years of service formulae.

It was suggested in the conference that NDC plans introduce no tax wedge on labor decisions because they use an actuarial benefit formula. I disagree, because a benefit for-

mula may be actuarial but can use nonmarket parameters. Examples of parameters are the interest rate credited to individual accounts and the annuity conversion factors that set the amount of the pension. The link between individual contributions and the expected present value of additional benefits may be far from the analogous link offered by financial market prices, despite the mathematical shape common to all actuarial formulae.

Consider NDC plans. The fact that they use PAYG finance fixes the direction of the deviation between the link provided by the financial market and the link provided by the benefit formula, at least for steady states. Consider a situation where GDP and the covered wage bill grow at a constant rate g, where the internal rate of return (IRR) offered by the NDC plan's benefit formula is g, and where the real rate of return on a balanced portfolio of investments and insurance contracts available in the financial market is r, after adjusting for risk differences. Asset market equilibrium requires that $r > g$ in the long run. If not, it would be possible for any infinitely lived agent whose income grows in proportion to the economy to borrow at rate r and roll over its debt indefinitely without ever paying interest, and the total debt would still fall over time relative to assets (Tirole 1985). In addition, the empirical evidence supports the hypothesis that $r > g$ in most actual economies most of the time (Abel et al. 1989). It follows that $r >$ IRR. Therefore, the wedge introduced by an actuarial benefit formula with rate g is a tax, not a subsidy, in the long run. Two important labor decisions that are distorted by this hidden tax in NDC plans are:

- Retirement at earlier ages—the fact that IRR $< r$ creates an economic incentive to start a NDC pension as early as allowed, and
- Joining covered employment at older ages—the fact that IRR $< r$ gives an incentive to the young to prolong their studies and ramblings and to engage in uncovered work for a longer period. This may prevent some of them from getting crucial on-the-job training at the most appropriate age.

There are two other good reasons to avoid attaching efficiency, equity, and insurance implications to pension plans that use "actuarial" benefits formulae, as some authors did in the conference. One is that the plan's incentives may be irrelevant in the wider economic context in which the individual operates. The other is that the plan's incentives might be highly correlated with the incentives provided by other government policies that affect the individual.

To see this, consider the efficiency of the labor market decisions made by active workers, such as hours, effort, and participation. These decisions depend on net taxes on earnings. These net taxes, in turn, depend on both the marginal and the average link between contributions and the risk-adjusted expected present value of benefits in this particular pension plan. However, labor incentives also depend on other pension plans in which the individual may participate (say an occupational plan), on the income tax schedule, and on the marginal and average link between contributions and the expected value of benefits offered by mandatory health insurance and unemployment insurance. If a pension reform raises the marginal link between benefits and contributions in the pension plan, the impact on labor choice may be small or zero, if the other programs maintain or increase their tax wedges.

Now consider a case where the current pension plan is fully funded, but it replaced an older PAYG financed plan that was solvent, that is, financially balanced. Assume that the contribution rate to the new funded plan was cut to take advantage of the higher return ($r > g$). Assume also that the transition cost was financed by issuing new public debt and by introducing a new explicit and permanent tax on earnings to finance interest payments on that new public debt, equal to $(r - g) \times$ (New Debt). This new tax collects revenue that is just enough to prevent the ratio of new debt to GDP from exploding in the long run (Auer-

bach and Kotlikoff, 1987, p. 150–1). Then changes in the tax wedge of the mandatory plan—currently zero—are fully *negatively* correlated with the total explicit tax rate on earnings. In fact, the overall tax rate on covered earnings is the same as it was under the old PAYG-financed plan.

The impact of the wider economic context should also moderate statements about the impact of pension reforms on insurance and income redistribution. Consider a comparison between a DB (defined benefit) plan that offers implicit insurance for an unexpectedly short working life through a less-than-actuarial reduction to early pensions, such as the U.S. social security program, and a simple NDC plan. It is standard practice to attach insurance advantages to the DB plan over the NDC plan, without checking if the personal tax system in the second country includes implicit insurance for a short working life. This insurance will be offered if the income tax schedule on pension income is progressive, because those who start their pension younger—say, due to an unexpectedly short working life—will receive a smaller pension and therefore will pay lower tax rates, achieving a less-than-actuarial cut on after-tax early pensions. Moreover, if the country with the DB plan exempts pensions from personal income taxes, and the second country does not, total insurance for a short working life may be larger in the second country, despite a plan that does not offer that type of insurance.

From the two features of NDC—an actuarial benefit formula and a low degree of funding—it follows that NDC is a label that covers a wide set of pension designs. For instance, if the notional interest rate credited in individual accounts during the active phase of life is the growth rate of average wages minus 1.6 percent per year, as in Sweden, the financial behavior of the plan and its implications for members are bound to be quite different from those of another NDC plan where the notional interest rate is 6 percent real per year, as was proposed in Brazil during the debate leading to the "*fator previdenciario*" reform of 1999.[6] The use of actuarial benefit formulae still allows for substantial differences in parameters, which may create large differences in the labor market incentives, insurance, and redistributional impacts.

NDC and Redistribution

It is useful to distinguish between three types of redistributive policies. The first supports the poor, including the elderly poor, with resources from the rest of society. The second redistributes income among the employed middle classes, say from professionals with higher earnings toward menial workers with lower earnings. The third type taxes the owners of capital to support the working classes.

Consider the following policy of the second type: concentrating the redistribution among the middle classes in the tax system versus dispersing such redistribution among a variety of pension, health, housing, education, and unemployment insurance programs, in addition to the tax system. If concentration is chosen, then this type of redistribution can be designed in more encompassing ways than if these redistributive policies are dispersed and embedded in several sectoral policies. When the trade-off between redistribution and efficiency is presented globally to public opinion, transparency increases, because the debate is freed from the complicated aspects of sectoral policies that raise the cost of communication.

Some may believe that policies should be made *less* transparent to enable experts to escape the manipulations introduced by politicians seeking reelection through pork rather than through the production of desirable public policies. This can be the case in some countries and episodes. However, experts also have an interest in gaining access to the broad picture when they design policies that redistribute income within the middle classes.

Concentration implies that redistribution within the middle classes ceases to be one of the purposes of pension policy because that goal is served by overall tax policy. Of course, redistribution continues to be important, but it is pursued more comprehensively. A major advantage of adopting NDC is that it facilitates concentration, allowing an increase in the transparency of the overall redistribution policy.

The overall degree of redistribution also implies a degree of partial of insurance of disposable income, because taxes fall when income falls. If pension amounts reflect lifetime income better than annual income, then let fiscal policy impose a different set of income tax rates on pension income than on other sources of annual income. The same logic is used in most countries to set special tax rates on the capital gains that occur when a family sells their house.

Another advantage of concentration is that tax rates on pension income can be designed to take into account income from third-pillar pension contracts and from capital. The tax rates on lump-sum withdrawals should be set by overall tax policy as well.

Method Used to Allocate the Outcome of Aggregate Plan Risks

Casual observers tend to believe that the method used by a plan to allocate the outcomes of aggregate risks is set by the benefit formula. For example, it is thought that actuarial benefit formulae come together with the defined contribution (DC) method used by mutual funds. It is also believed that years-of-service benefit formulae always allocate aggregate risks with the defined benefit (DB) model. Two examples show that this association is invalid. Consider first an annuity contract. As the life insurance company guarantees a certain benefit amount regardless of shocks to investment returns and to the life tables, this contract is appropriately described as a defined benefit. However, its benefit formula is actuarial. In the opposite extreme, consider a plan that uses a years-of-service benefit formula to set the initial pension for each member, but indexes subsequent pension payments to the actual observed growth rate of contribution revenue, in a PAYG context. This plan uses a method to allocate aggregate risks that transfers them in full to older members, so it is not DB.[7]

Although the method for allocating aggregate plan risks is influenced by the benefit formula, it is heavily influenced by other aspects of the plan, too. These other aspects can be rules for adjusting plan parameters (if such rules exist), the rules for the use of credit lines from sponsors (such as the treasury), and the rules for trading the uninsurable component of aggregate risk in the financial markets. Risk can be allocated by discretion as well. Discretion is what happens when the allocation of aggregate financial losses and gains is decided ex post by a designated set of people—say, members of parliament, members of a board of elders, or a minister of finance. Such authorities may also limit the pension plan's access to credit. In practice, successive layers of rules for adjusting parameters blend gracefully into discretion. These other aspects turn the risk allocation method into a design dimension that is effectively independent from the benefit formula, as emphasized by Lindbeck and Persson (2003).[8]

Risk may be created, destroyed, or transferred. Badly designed rules and discretion can create risk. Consider a hypothetical NDC plan whose factor for converting account balances to annuities is a fixed function of the returns earned by a relatively small buffer fund that is partly invested in equities. That rule is a bet that *creates* risk, making the plan operate as a casino, which would be Pareto-dominated by other rules unless some members are risk lovers. Now consider risk creation by a plan whose parameters are set by parliament according to the electoral needs of a changing majority. This plan may turn into a *political*

casino. A partial-equilibrium model of optimal life-cycle consumption calibrated with data for Germany and the United States finds that political risk creates a welfare loss equivalent to between 1.7 percent and 3.6 percent of the pension amount (Holst, 2005).

These examples show that the set of possible risk allocation methods that may be used by a pension plan is wider than the conventional distinction between defined benefit and defined contribution. This fact raises two challenges: the first is to classify the options in a useful way, and the second is to develop welfare criteria to identify the optimal option in a given environment.

Classifying the Options

One of the most useful classifications of risk allocation methods was presented above: rule-based versus discretionary. Another common distinction is between defined contribution (DC) and defined benefit (DB). These distinctions are independent, so we have a two-way classification of risk allocation methods. In one axis is the degree to which aggregate risk is allocated by rules versus discretion. The other axis contains pure DB, pure DC and combinations such as portfolios that change risk in response to the member's age.

Consider the precise meaning of pure DC. The origin of the expression *defined contribution* is legal: the obligations of the sponsor are limited to the obligation of paying the agreed contribution, and are *defined* by this limit. When considering the economic meaning of DC, it cannot be that the contribution rate is fixed over time because when that rate has been changed in fully funded DC plans, those plans have not lost their DC character.[9] DC cannot mean that the contribution rate is not adjusted in response to realizations, because the mutual fund, which is the original DC design, does not change its DC nature when a member adjusts her contribution rate in response to realizations.[10] I offer the following economic definitions (Valdés-Prieto 2002, p. 717):[11]

> DC: *When the risk allocation method transmits all the plan's aggregate financial risk to current members only, and it does so in proportion to the capital value of the accrued rights to pension benefits owned by each member.*

This definition of DC is a summary description of the standard mutual fund. This is the natural benchmark because of its widespread use in financial markets. A mutual fund allocates risk by defining the price of each share as the market value of assets divided by the number of shares (the value of liabilities is this price times the number of shares). The number of shares varies with inflows and outflows valued at yesterday's share price.[12] The proposed definition of DC allows some leeway because the method for calculating capital value in not specified. It is quite different to discount future expected benefits at market interest rates than to discount them at the internal rate of return of the plan, which may be quite lower,[13] because the pro-rata shares for allocating the aggregate outcomes of risk are distributed among plan members in a different way.

> DB: *When the risk allocation method does* ***not*** *transmit any portion of the plan's aggregate financial risk to pensioned members.*

Shielding pensioners from aggregate risk implies that risk must be allocated to other plan members, or to a bond issuer (who pays a fixed amount in most states of nature), or to a sponsor (as in annuities, where the life insurance company takes the risk), or to taxpayers (as in discretionary DB, where parliament can pass the risk to taxpayers and recipients of public expenditures).

Optimal policy can be analyzed after the options have been outlined. Automatic financial stability in the short run is a valuable property for a pension plan, because it prevents insolvency. International experience shows that discretion has failed to provide automatic financial stability in the pension policy area, in contrast to the case of central banks and monetary policy. This evidence suggests that rules are better than discretion in pension policy.

Which is the optimal rule? Economic theory shows that to maximize welfare, a plan should trade risk with the rest of the economy at market prices, and the uninsurable risk that remains should be shared among members in proportion to individual risk tolerance.[14] Empirically, the predicted risk tolerance of a member is a function of the volatility of labor earnings, the presence of other wealth, access to insurance and credit lines, and age. Pure DB (as defined above) cannot be socially optimal, because it is unlikely that all pensioners have zero risk tolerance.[15] Even among aged members, risk tolerance is likely to be higher than zero for a subset of members. In the same way, as the capital value of accrued pension rights is not the only factor that predicts risk tolerance, a DC plan with a single portfolio is not optimal either. In contrast, a DC plan where members are allowed to choose among a set of balanced portfolios with different risk levels appears closer to optimality, because adaptation to individual risk tolerance is allowed. Moreover, a portfolio designed to serve those who plan to start a pension in a given set of years can provide a valuable service to its members: change the level of risk slowly as they age, moving toward portfolios more heavily invested in bonds. Bond portfolios are DB as well, because the issuers of the bonds absorb 100 percent of the underlying economic risks.

Implications for NDC Plans

An NDC plan that indexes pensions to price inflation is DB regarding its pensioners, because pensioners are exempt from sharing in the plan's aggregate financial risk. In contrast, when an NDC plan indexes pensions to GDP growth (as in Italy) or to the growth rate of average covered wages (as in Sweden), the plan does not guarantee a fixed standard of living to pensioners, and therefore is neither DC nor DB. Those designs allow pensioners to share in the economy's growth or in the growth of average wages. However, they do so *regardless* of whether the plan is experiencing an aggregate actuarial surplus or deficit in the present. For example, if unemployment rises due to a drop in labor demand for menial jobs, the Swedish rule registers that average wages rise while slower employment growth may push plan assets below liabilities. The ensuing increase to pensions (triggered by the increase in average wages) raises liabilities, exacerbating the financial imbalance. This NDC rule may be foisting risks on members when aggregate risk is zero, a situation that may be described as risk creation or wagering.

In contrast, if the origin of the faster growth in average covered wages is an across-the-board increase in labor productivity, then this rule can be defended on the grounds of intergenerational risk sharing. Policy makers should check how rules respond to a wide variety of shocks, to avoid risk creation.

Now consider rules for active members. Most NDC plans are less financially stable than fully funded DC plans because all deviations from steady state growth create actuarial surpluses and deficits (see Settergren and Mikula 2005, and a proof in Valdés-Prieto 2000). Moreover, reliance on credit lines from the treasury means that these plans create risk for the treasury, or require taxation of past generations to endow the plan with a buffer fund. If parliament makes the final decision but organized members respond with political activism, the plan may come to be seen by some as a political casino.

The *creation* of risk for active members is a trick that a truly DC rule, as the one used by mutual funds, is unable to pull. A truly DC rule transmits all aggregate risk to current plan members, without creating risk. Thus, this rule is not DC, in the sense defined above. For this reason, I subsequently refer to the Italian, Polish, and Swedish plans as "notional accounts" (NA), rather than NDC.

The Swedish plan's original rules were to credit notional capital of active workers at the growth rate of contribution revenue, and to adjust pensions in payment by the growth rate in average wages minus 1.6 percent per year. However, since May 2001, a different rule applies: When the plan's liabilities exceed assets, the notional interest rate credited to active members and the rate of adjustment of pensions in payment are both cut, to equal the growth rate of average wages minus the growth rate in liabilities plus the growth rate in assets (Settergren 2001). This mechanism might endow the Swedish NDC plan with automatic financial balance in the short run and might prevent the creation of risk for the treasury. However, a further twist was introduced in the 2001 reform. Even if subsequent liabilities are surpassed by assets, the lower notional interest rate and the lower rate of indexation of pensions remain in force, until the original ratio of average pensions to average wages is restored. No symmetric rule for the case when assets exceed liabilities is in place. This asymmetry may produce permanent cash surpluses, which would strengthen the treasury at the expense of plan members.

This discussion suggests that sponsors of NA plans have much work to do improving risk allocation methods. This task requires the development of a more comprehensive framework to define optimality.

The Role of NA in Pillars One and Three

Let us discuss first the role of the NA design in third-pillar policy. I define *third-pillar policies* as those that introduce fiscal or regulatory incentives, but not mandates, to induce improvident people in the middle classes to save more for old age on a voluntary basis.[16]

PAYG finance allows workers to invest in an implicit security whose return is given by the human capital returns (earnings) of future generations of covered workers.[17] Assume that this security should have pride of place in most people's long-term portfolios.[18] It follows that any financial services company should consider offering an NA plan to clients who save for old age induced by fiscal incentives. For example, banks and mutual funds that offer IRAs and 401(k) plans may want to offer an NA plan (a third-pillar plan).

However, third-pillar plans that are NA are likely to enjoy an undeserved marketing bonanza in their introductory phase. This is because PAYG finance offers net subsidies to the initial generation. But when PAYG finance matures, it must create a tax on members to remain financially independent. It will be difficult to find new members in the long run, in the absence of a mandate to future workers to join the plan. An example is the pyramid pension plan that appeared in Paraguay in 1985, which grew for at least 10 years thanks to the subsidies offered to the initial members.[19] Therefore, investor protection criteria suggest that financial firms should be banned from offering voluntary NA plans.

For a related reason, the state should beware of mandating an NA plan on a class of firms or on a sector of economic activity. Although a new NA plan can pay subsidies to the initial generation, which will help attract workers into this sector, in the long run the tax hidden in mature PAYG finance is likely to scare them away. In that case the plan will default on promised pension amounts. At that point, the losing members are likely to remember the sectoral mandate and demand compensation from the government.

Now consider the role of NA in first-pillar policy, which is defined as the set of government programs that provide support to the old poor. The aim of such programs is to provide *more* subsidies to those people who are poorer—and who are precisely those who contribute less. Given the fact that NA plans use actuarial benefit formulae, which pay *less* benefits to those who contribute less, it is obvious that NA plans contradict the aim of first-pillar policy.

Poor old pensioners are likely to be relatively more risk-averse, because of their closeness to perceived subsistence consumption levels. The fact that NA plans are not DB means that they are allocated an excessive share of the plan's aggregate financial risk. Moreover, an NA first-pillar program may subject poor old pensioners to the bets embedded in the risk allocation method. It follows that NA should not be used in first-pillar programs.

NA Plans and Partial Liquidity for Mandatory Saving

Mandatory plans where member wealth is illiquid create efficiency costs when the member values liquidity. Only those members who own substantial voluntary liquid assets are exceptions. Even provident members respond to illiquidity by modifying their labor choices in order to minimize this perceived cost. Mandatory plans that freeze accrued pension rights into an illiquid claim are also likely to be inequitable. The reason is that workers who own negligible amounts of precautionary savings are likely to be the poorest. The illiquidity of pension claims may force these poorer workers to sacrifice too much consumption in order to build up a stock of precautionary savings, or to depend too much on the emergency loans provided by close kin or loan sharks. These problems besiege all mandatory plans, including fully funded, NA, and traditional designs.

An interesting claim made in this conference is that in an NA plan, benefits are as illiquid as in fully and partially funded plans. Pension plan liquidity refers to giving members the option of getting immediate access to a limited portion of their claims on old age benefits in response to an emergency, ideally defined by members themselves. Partial liquidity holds the promise of mitigating the efficiency costs and the inequities caused by imposing a mandate to save at a flat rate, disregarding individual liquidity needs.

Partial liquidity is a real possibility in fully and partially funded plans, which can sell some assets to give credit to members. As international experience shows, recovery of liquidity loans can be ensured by possessing a number of pension payments starting at the date of pension issue, delaying effective pension age.[20] The amount of such loans should be capped with methods that create incentives to repay.[21]

Now consider an NA plan, financed with the PAYG method. Can it offer the option of providing partial liquidity to its members? If members are allowed to make partial withdrawals, the plan has to finance the aggregate net flow by issuing debt in the financial market. To break even, the plan must charge members a market interest rate (plus administrative costs).[22] However, this option is not available to all NA plans: the plan must enjoy enough financial stability to be creditworthy.

Thus, NA plans that wish to offer partial liquidity to their members face one more requirement than those faced by fully funded plans. They must be creditworthy, despite being financed with the PAYG method and being subject to some political discretion.[23] I conclude that current NA plans must be improved in order to become able to provide benefits that are as *liquid* as the benefits that can be provided by mandatory fully funded plans.

Summing up, the NA design is very attractive for initial conditions characterized by highly inefficient benefit formulae and fiscal constraints that prevent a transition to full funding. However, much remains to be done to improve this promising design.

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Notes

1. I have reported elsewhere that analogous "point systems" were adopted by France (1945) and proposed in the by Buchanan in the United States (1968) (Valdés-Prieto 2000).

2. "Notional defined contribution" and "non-financial defined contribution" should be understood to have the same definition.

3. This three-way classification, used by many, including Lindbeck and Persson (2003), is more useful than the older two-way classification that merged together the benefit formula and the method for allocating the outcome of aggregate risks.

4. See Lee (1994),

5. In this we differ from Lindbeck and Persson's taxonomy (2003, p. 75).

6. That proposal was rejected because 6 percent real was far *below* market interest rates in Brazil at the time.

7. There is no suggestion that any of these risk allocation rules is optimal.

8. One may also consider defining DC as a combination of a certain benefit formula (actuarial) and some risk allocation property. That approach would fail to build upon the orthogonality between benefit formulae and the risk allocation method, and would fail to manage the different ways in which a plan may deal with risk.

9. On this point, I disagree with Assar Lindbeck, in this roundtable.

10. On this I disagree with Peter Diamond, in this roundtable.

11. This definition of DC fulfills the principle enunciated by Settergren (2001, p. 4, footnote 9): "In a DC plan uninsurable risks must be assumed by the pension level, rather than by the contribution rate."

12. The use of daily prices to value the accrued rights of members transmits any short-term volatility contained in market prices to the value of accrued rights. To prevent the transitory component of that volatility from creating unwarranted worries among members with limited financial experience, it may be wise to report accrued values using averages over reasonable periods.

13. For example, Sweden discounts liabilities and assets at the growth rate of average covered wages, which is below market interest rates in the long run.

14. See the summary of "Syndicate Theory" provided by Kreps in his textbook, *A Course in Microeconomic Theory* (1990, pp. 169–74).

15. Merton (1983) stated this point more than 20 years ago.

16. Provided that the fiscal incentives are more generous than those given to savings not oriented to cover old-age needs. The fiscal incentive may be flat rate, progressive (as in the Czech Republic's 1995 program), or regressive (as in deductions from income tax in the United States).

17. The word *security* implies that the owner is protected by property rights. This is usually not the case for claims on a share of the future earnings of workers.

18. For example, see Merton (1983) and Dutta, Kapur, and Orszag (2000).

19. See "Voluntary participation in a pay as you go plan," in Valdés-Prieto (2002, box 10.2, p. 516–7).

20. This repossession method is used successfully in the Philippines by the Employees Provident Fund (EPF). The critical requirement for economic efficiency is that the cost of nonpayment remains with the individual, as if the loan were deducted from the individual account balance, not from a collectively owned fund. One requirement for political sustainability of liquidity loans is that repossession does not reduce the pension amount, and this justifies a preference for raising the effective pension age. See a summary of international experience in Valdés-Prieto (2002, chapter 4, section 4.4).

21. A recent proposal is to cap the loans outstanding at, say, 70 percent of the sum of contributions made during the last 36 months. This works like airline frequent-flyer miles. It ensures that 100 percent of the contribution is saved for old age after 3 years and 30 per-

cent is saved immediately. As the option of drawing a liquidity loan is valuable, many are unlikely to remain fully indebted most of the time. See Beyer and Valdés-Prieto (2004) for a recent proposal for Chile.

22. In PAYG-financed plans in steady state, this interest rate will be above the IRR offered by the plan to its members.

23. An NA plan can become creditworthy thanks to a credit line from the treasury, but in this case the scheme should be described as engaging the treasury in consumer finance. The interesting case is where partial liquidity is provided without guarantees from the treasury.