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By Nicholas Barr and Peter Diamond*

Introduction

The public pension world has seen two innovations in recent years. One is the emergence of notional defined contribution (NDC) plans. The other is the introduction of automatic adjustment mechanisms to help keep pension systems solvent when the economy weakens. This *brief* looks at the Swedish system to demonstrate how NDCs work and evaluates the workings of the automatic adjustment mechanism in the wake of the 2008 financial crisis.

Sweden passed reform legislation in 1994 that introduced a partially-funded NDC plan.[1] The arrangement is conceptually similar to a defined contribution plan in that contributions are accumulated in individual accounts, but different in that the accounts are not fully funded and may be financed entirely on a pay-as-you-go basis. In this setting, the rate of return credited on the account assets is based on a rule rather than on actual returns. The Swedish system uses a notional interest rate equal to the rate of growth of average earnings. However, if a calculation suggests a potential deficit, the notional interest rate is automatically reduced through a "brake" mechanism. The recent financial crisis has highlighted ways in which the brake mechanism could be improved.

This *brief* proceeds as follows. The first section describes Sweden's NDC plan. The second describes the Swedish brake mechanism. The third describes two problems with the current adjustment procedure: 1) it creates the likelihood of large shocks for retirees; and 2) while disadvantaging retirees, it tends to advantage workers. The fourth section presents possible fixes for the current problems. The final section concludes that the Swedish NDC plan could function more effectively with modest changes to the brake mechanism.

The Swedish NDC Pension

The Swedish NDC system operates as follows:

- Workers contribute 16 percent of earnings, which is credited to a notional individual account.
- Each year the government credits each worker's account with a notional interest rate, which is equal to the growth rate of average earnings.

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- At retirement, the value of a person's notional accumulation is converted into an annuity in a way that mimics actuarial principles. The calculation is described in terms of an annuity divisor; each birth cohort and each age has a specific divisor.

- The account balance is for record keeping only, because the system does not own matching funds invested in the financial market. This treatment explains the term "notional."

- Benefits in payment grow at the notional interest rate minus 1.6 percent, where 1.6 percent is intended to represent the long-run growth of real wages. With the notional interest rate equal to average wage growth, if real wages do grow at 1.6 percent, benefits keep pace with inflation.

The Swedish Brake Mechanism

The Swedish NDC system has a brake mechanism that is triggered by a change in the "balance ratio." The intention is to maintain sustainability while avoiding increases in payroll taxes that would, in turn, lead to an eventual increase in benefits.

The balance ratio adds the current market value of the buffer funds to a "contribution asset" (reflecting the present value of projected contributions), and divides this total by a measure of pension liabilities, all calculated on the basis of recent data.[2]

$$\text{Balance ratio} = \frac{\text{Contribution assets + Buffer funds}}{\text{Pension liabilities}}$$

When the balance ratio is less than one, the brake automatically reduces the accrual rate of workers' accumulations and the indexation of pensions in payment.[3] These lower rates of accrual and indexation continue until financial balance is restored.

If the balance ratio recovers and moves above one, a period of catch-up occurs with higher rates of accrual and indexation.[4]

Problems with the Brake Mechanism

The Swedish brake responds to a low balance ratio by mimicking the response to low asset returns of fully-funded defined contibution accounts followed by variable annuities; specifically, the brake reduces the notional interest rate credited to notional account balances and reduces the indexation of benefits in payment. It then allows for catch-up when the balance is good, paralleling the funded model if the period of low returns was followed by a period of higher-than-normal asset returns. As currently constructed, the brake has some undesirable results. It creates the likelihood of large shocks; and it can advantage workers while disadvantaging retirees.

Likelihood of Large Shocks to Retirees

The balance ratio fell below one for the first time in 2008, calling for adjustment in 2010, reflecting lags in calculation and implementation. However, the required adjustment was so large that the government responded by altering the mechanism to reduce the initial impact on benefits in payment. Of course, slower adjustment now means more adjustment later.[5]

Potential Gains for Workers

The easiest way to understand how workers gain under the current mechanism is through an example. The worker is assumed to have 1,000 kronor in his account when the brake is applied, to which he adds 100 each year.[6] In years one and two, the brake interest rate of 4 percent is applied, and in years three and four, the catch-up rate of 6 percent. As Table 1 on the next page shows, 100 kronor are deposited in the account during year one, with 4 percent interest added at the end of the year to the initial balance plus the new deposit, for a total of 1,144 kronor. In year two, another 100 are deposited and the brake interest rate of 4 percent applied to the total. In years three and four, the process is identical, except that the catch-up rate of 6 percent is applied. At the end of the period of brake and catch-up, the account balance is 1,672 kronor. In contrast, in the absence of the brake, a

Table 1. Example of Effect of Brake and Catch-up on Accumulation, Swedish Kronor

Year	Brake and catch-up			Steady indexation		
	Interest rate	New deposit	Account balance	Interest rate	New deposit	Account balance
Initial balance			1,000			1,000
1	4%	100	1,144.0	5%	100	1,155.0
2	4	100	1,293.8	5	100	1,317.8
3	6	100	1,477.4	5	100	1,488.6
4	6	100	1,672.0	5	100	1,668.1

Source: Authors' calculations.

return of 5 percent throughout would have produced a total notional balance of 1,668. Thus, someone working throughout the period of brake and catch-up comes out ahead. The reason is that the catch-up rate is applied not only to the initial balance of 1,000 but also to the deposits made while the brake and catch-up were in effect.

The gain is larger:
- the higher are annual deposits during the period of brake and catch-up;
- the longer the period of brake and catch-up, since the higher catch-up rate is applied to a greater volume of deposits during the brake and catch-up phases; and
- the larger the difference between brake and catch-up rates relative to the steady growth accrual rate.

Potential Losses for Retirees

Even without the brake, benefits in payment were scheduled to fall by 1.3 percent in 2010 because of slow wage growth. This large response was a result of the unfortunate use of wage growth minus 1.6 percent as the index for pensions in payment, a design which faces pensioners with the whole year-to-year variation in rates of wage change. The automatic brake rule would have reduced benefits in payment further, to 4.6 percent (Sundén, 2009, Table 2). Since pensioners on average are more risk averse than workers, who have more ability to adjust, it would be better for them to bear less of the wage risk.

Even if real wage growth were 1.6 percent, retirees would be harmed by the current brake procedure. Again, an example is useful. The retiree is assumed to have a benefit of 100 prior to the operation of the brake. With steady growth, the pension would have been indexed by 3.4 percent (nominal wage growth of 5 percent minus real wage growth of 1.6 percent). In the example, the application of the brake reduces indexation to 2.4 percent; the catch-up rate is 4.4 percent. As shown in Table 2, catch-up is complete in year four, and the pension, 114.3, is the same as it would have been with steady indexation. However, as the last column shows, in each of the first three years the pension is lower under brake and catch-up than with steady indexation. So total pension benefits received over the four-year period are lower. Thus, in contrast with a worker, a retiree never makes up for earlier losses, much less comes out ahead.

Table 2. Example of Effect of Brake and Catch-up on Benefits in Payment, Swedish Kronor

Year	Brake and catch-up		Steady indexation		Annual difference
	Index	Pension	Index	Pension	
1	2.4%	102.4	3.4%	103.4	-1.0%
2	2.4	104.9	3.4	106.9	-2.0
3	4.4	109.5	3.4	110.5	-1.0
4	4.4	114.3	3.4	114.3	0.0

Source: Authors' calculations.

The loss is greater:
- the longer the period of brake and catch-up; and
- the larger the difference between brake and catch-up rates relative to the steady growth accrual rate.

Someone who retires during the period of brake and catch-up faces a combination of the effects illustrated by Tables 1 and 2. Though the details of who gains and who loses depend on a range of factors, the major driver is timing. The later that retirement occurs during the period of brake and catch-up, the more the situation resembles that of the worker, so that the person may be a net gainer. Conversely, the earlier retirement occurs, the more the situation resembles that of the retiree, so that the person may be a net loser.

Improving the Brake

When considering ways to improve the brake, three central issues arise: 1) removing the gains for workers; 2) reducing the losses for retirees; and 3) lowering the speed of adjustment for an imbalance.

A 'Fix' for Workers

A straightforward solution is to have two accounts for workers during a period of brake and catch-up, one with the brake and catch-up applied, the other not. At the time of retirement or, if sooner, at the end of catch-up, each worker's account is set to the lower of the two calculations so that the maximum value of the worker's account is what would have happened without brake and catch-up. Thus, where catch-up is complete, the worker's account equals what would have happened with steady indexation; if catch-up is less than complete at retirement, the worker's account may be below what it would have been with steady indexation. For someone who retires during this period, the two separate accounts could be used for two separate benefit calculations, again with the lower of the two used to determine benefits. The two-account approach avoids unintended gains, with twin advantages: the result is desirable in itself for reasons of fairness; and it reduces the liabilities of the system, allowing the balance ratio to be higher, thus limiting the losses of retirees.[7]

Possible 'Fixes' for Retirees

We regard the use of wage growth rate minus 1.6 percent as a poor design for indexing benefits in payment because it puts too much risk on retirees. Specifically, retirees face the full year-to-year variation in wage growth. One way to reduce the risk they face is to use a weighted average of price change and wage change.[8] If the increase in benefits in payment is based 80 percent on price change and 20 percent on wage change (as in Finland), retirees would bear some risk but less than that faced by current workers. With the brake applied only to the wage portion of the calculation, the annual impact would be smaller, although the brake might last longer. Smaller shocks to retirees seem preferable, even if they last longer. A longer period also spreads the losses across more cohorts.

Alternatively, if the present method of indexing benefits in payment were retained, the brake could be applied to part of wage growth, rather than all of it. For example, during stable times, benefits in payment could be increased by the rate of wage growth minus 1.6 percent, but when the brake was in effect the adjustment would be applied to 20 percent of wage growth.[9]

Table 3 on the next page illustrates how modified indexation could help. The first four rows illustrate the workings of the brake with modest inflation of 2.0 percent and real wage growth that matches the norm of 1.6 percent. Benefits in payment are indexed by the rate of wage growth minus 1.6 percent. Thus, with a balance ratio of 1.0 and wage growth of 3.6 percent, benefits rise by 1.97 percent in nominal terms and hence remain broadly constant in real terms. Lower balance ratios result in lower indexation rates on a roughly one-for-one basis. Therefore, when the balance ratio is 0.99, nominal benefits rise by 0.95 percent; hence, real benefits fall by about 1 percent. With a lower balance ratio, the indexation of benefits in payment turns negative in nominal terms and, of course, more so in real terms. Modified indexation moderates the declines and reduces the risk that retirees face. Thus, with a balance ratio of 0.97 percent, real benefits fall by 0.63 percent under the modified rule, compared with about 3 percent under the current rule. The next four lines of Table 3 illustrate the effect of modified indexing with lower wage growth (0.6 percent rather than 1.6 percent real); again, annual retiree losses are reduced.

The last line of Table 3 shows the situation in Sweden in 2010, based on the balance ratio in 2008, and illustrates what happens if low wage growth and a low balance ratio occur together. It is a misreading to think of these events as a "perfect storm" – many of the factors that reduce the balance ratio also reduce wage growth, so that the combined effect is no accident. The design of the brake should recognize that the two sets of events are correlated. With low wage

Table 3. Effect of Modified Brake on Pensions in Payment[10]

Balance ratio	Inflation rate	Nominal wage growth	Benefit growth			
			Current indexation		Modified indexation	
			Nominal	Real	Nominal	Real
			Base case			
1.00	2.00%	3.60%	1.97%	-0.03%	1.97 %	-0.03%
0.99	2.00	3.60	0.95	-1.03	1.76	-0.23
0.98	2.00	3.60	-0.07	-2.03	1.56	-0.43
0.97	2.00	3.60	-1.09	-3.03	1.36	-0.63
			Lower wage case			
1.00	2.00	2.60	0.98	-1.00	0.98	-1.00
0.99	2.00	2.60	-0.03	-1.99	0.78	-1.19
0.98	2.00	2.60	-1.04	-2.98	0.58	-1.39
0.97	2.00	2.60	-2.05	-3.97	0.38	-1.59
			Recent experience			
0.97	0.30	0.30	-4.52	-4.80	-1.93	-2.22

Source: Authors' calculations.

growth (0.3 percent), application of the balance ratio of 0.97 would have reduced benefits in payment by 4.52 percent in nominal terms and by 4.80 percent in real terms. In this scenario, modified indexation still faces pensioners with a loss, but significantly softens the decline.

By itself, with a smaller reduction in benefit growth, modified indexation would take longer to restore the balance ratio. However, the extended duration of adjustment would be partly offset if modified indexation were combined with the two-account approach, which speeds up the restoration of the balance ratio by avoiding unintended gains.

Reducing the Likelihood of Sharp Shocks

It is useful to have some automatic adjustment of the notional interest rate in the face of prospective problems of long-run sustainability. However, as recent experience in Sweden has shown, the way the balance ratio is used can have a sharp impact on retirees. To spread out the impact of a decline in the balance ratio, the brake could follow the suggestion of Auerbach and Lee and phase in the impact of the balance ratio on the notional interest rate.[11] Specifically, they suggest a formula that reduces the accrual rate of benefits and the indexation of benefits in payment not by the full decline in the balance ratio, but only by a fraction of the decline. The effect is to attenuate the shock by lengthening the period of adjustment.

The adjustment that is appropriate should depend on whether the problem is one of long-run sustainability only, or whether there is also an immediate need to improve net cash flows. The latter could occur when the funding ratio becomes low enough to call for significant immediate adjustment. Without the need to maintain full funding, as with a corporate system, a cash-flow problem is possible, but is less likely in a national system with considerable automatic adjustments and an adequate buffer stock of financial assets.

In sum, the operation of the brake could be improved – separately or in combination – in three ways:

1. By applying the two-account mechanism to accounts during buildup to avoid an unintended increase in accumulations.

2. By applying the balance ratio only to part of the wage growth rate for the purposes of indexing pensions in payment, thus giving retirees – who are more risk averse – relatively greater protection than workers.

3. By slowing down the operation of the brake along the lines suggested by Auerbach and Lee, thus reducing sharp impacts on retirees.

Conclusion

Adherence to the defined contribution analogy in designing the brake for Sweden's NDC plan places retirees more at risk than workers. Reform should focus on the consequences rather than looking for an unduly close parallel to funded defined contribution systems. Modest changes could make the system function more equitably. And slowing down the operation of the brake could lessen sharp impacts on retirees.

Endnotes

1 For further discussion, see Barr and Diamond (2010); Holzmann and Palmer (2006); Könberg, Palmer, and Sundén (2006); and Swedish Pensions Agency (2009).

2 "The pension liability (*PL*) can be thought to consist of two parts, liability to those who have not yet started to draw their pension (*PLw*) and those who have (*PLr*) ... [with] the pension liability to 'workers' as the sum of the balance of each individual's notional account ... [and] the pension liability to retired as the sum of the pension amount paid to each age group times the life expectancy of that age group" (Settergren, 2001).

It should be noted that the actual calculation is not an extended projection of the future, but is meant to capture a "cross-section internal rate of return on contributions ... [where] the phrase *cross-section* IRR is used to indicate a measure distinct from the more familiar *longitudinal* IRR measure, which informs the rate of return that equates the value of the time-specific contributions with the benefits to an individual or a group of individuals. The cross-section IRR is the return on the pension system's liabilities that keeps the net present value of the pension system unaltered during a period of arbitrary length"(Settergren and Mikula, 2006).

3 Specifically, both accruals and the indexation of pension benefits are based not on the growth rate of average earnings, *w*, but on the rate (1+*w*)BR-1. For a summary, see Sundén (2009). For more detailed discussion, see Könberg, Palmer, and Sundén (2006); Palmer (2002); and Settergren (2001). On automatic balancing mechanisms more broadly, see Vidal-Melia, Boado-Penas, and Settergren (2009).

4 In contrast, the discount rate used to calculate a person's annuity at retirement does not change. Annuities are calculated using an annuity divisor determined by life expectancy and an interest rate of 1.6 percent, as an estimate of long-run real wage growth.

5 For fuller discussion, see Sundén (2009).

6 The examples assume an economy in which steady wage growth of 5 percent is used as the notional interest rate. In two years, when the brake is applied, the notional interest rate is 4 percent and during two years of catch-up the rate is 6 percent.

7 A further issue is the relative impacts on the benefits of different members of a cohort of a sustained brake without catch-up. The impacts vary, depending on the age-earnings profiles of workers. A standard defined benefit pension plan might respond to a projected shortfall of funds by cutting all benefits by the same percentage. A deviation from equal percentage cuts might take the progressive form of a lower percentage cut for people who have lower benefits.

The current brake leads to a larger percentage reduction in benefits for workers who have more of their earnings early in their careers, since the cumulative impact of a lower notional interest rate applied earlier in a worker's career is greater. Since age-earnings profiles tend to be steeper for higher earners, the brake on average leads to larger benefit cuts for lower earners. A uniform decrease might be more appropriate, since it is a response to current projections of future problems in a national system. One way to bring this about is to apply the brake not to a worker's accumulation but to the calculation of his or her initial benefit. Specifically, at the time that the initial benefits of a cohort are determined, one could calculate the percentage fall in aggregate balances for the cohort as a result of the current brake mechanism compared with balances without application of the brake. That percentage could be applied uniformly to the balances of each member of the cohort, calculated without regard to the brake, and limited to being an actual decline.

This procedure is equivalent to adjusting the initial benefit constant for each cohort. That is, if the annuity divisor assuming steady growth (i.e., no brake and catch-up) is D, and that applying the adjustment in the previous paragraph D´, the adjustment can be considered as the calculation assuming steady growth multiplied by the ratio of the two divisors. The complication with this approach is not conceptual or operational, but mainly that of communicating with workers and pensioners why and how the quasi-actuarial determination of a worker's initial benefit incorporates an adjustment for imbalances in the past.

8 Since a weighted average changes the expected growth of benefits, an adjustment of initial benefits would be necessary if the change is to be cost-neutral. For more discussion of a weighted average design, see Barr and Diamond (2008).

9 That is, for the indexation of pension benefits, instead of using the rate (1+*w*)BR-1 (minus 1.6 percent), the rate would be 0.8[*w*]+0.2[(1+*w*)BR-1] (minus 1.6 percent).

10 Indexation of benefits in payment under the current brake is [(1+*w*)BR-1] minus 1.6 percent and under the modified brake 0.8[*w*]+0.2[(1+*w*)BR-1] minus 1.6 percent. In both cases, the accrual rate of workers' account balances is [(1+*w*)BR-1].

11 As described by Auerbach and Lee (2009), "when the brake is in effect, the adjusted net rate of return, r_t^a, is given

$$(4)\quad r_t^a = (1+r_t)b_t - 1.$$

At low values of *b*, this mechanism implies a near confiscation of pension wealth, a not very desirable outcome if one is trying to spread fiscal burdens among generations. We, therefore, consider a generalized version of the balance mechanism in which equation (4) is replaced by:

$$(5)\quad r_t^a = (1+r_t)[1 + A(b_t - 1)] - 1,$$

where *r* and *b* are defined as before and $A \in [0,1]$ is a scaling factor. Setting *A*=1 results in a brake like that in equation (4); when *A* < 1, full confiscation will result only when *b* reaches 1-1/*A* <0. Setting *A*=0 eliminates the brake mechanism, and a positive value of *A* that is too small will still fail to provide adequate financial stability."

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