Issue Brief 2 Pay-as-You-Go or Fully Funded—Which Costs Less?

A SENSE OF THE RELATIVE COST OF PAY-AS-you-go and fully funded financing of defined benefit systems can be obtained by considering the hypothetical case of a system that aims to provide retired workers with 40 percent of their final year's gross salary. Pensions are assumed to be indexed to wages, rising automatically with the average wage in the economy. This discussion ignores the feedback effects on wage growth of pay-as-you-go compared with full funding. Wages are assumed to be unaffected by the choice of pension financing methods.

The Pay-as-You-Go Contribution Rate

The following equation shows the case of the hypothetical pension under pay-as-you-go financing, when pensions are indexed to wages and financed by a payroll tax:

$$(2.1) \qquad C = BD$$

where B is the target benefit rate, fixed as a percentage of the average wage; D is the system dependency rate (the ratio of beneficiaries to contributing workers); and C is the contribution rate, as a percentage of wages necessary to cover BD.

The Fully Funded Contribution Rate

Relationships are more complex with fully funded plans. Workers must accumulate enough capital during their working years to pay the targeted flow of pensions during their retirement years. Thus a worker contributes CW in the initial year, where W is the starting wage. But in subsequent years wages and contributions grow at the rate of $1 + g$ each year, and the capital accumulated in prior years grows at

the rate of $1 + r$ each year, where g is the growth rate of wages and r is the interest rate. By the year of retirement the capital accumulation for an average worker is:

$$(2.2) \qquad CW[(1 + r)^n + (1 + g)(1 + r)^{n-1} + \dots (1 + g)^{n-1}(1 + r)].$$

If pensions are indexed to wages at a benefit rate of B, the present value of pension payouts over m retirement years, discounted back to the beginning of the year of retirement, is:

$$(2.3) \qquad BW(1 + g)^n[1 + (1 + g)/(1 + r) + \dots (1 + g)^{m-1}/(1 + r)^{m-1}]$$

where n is the number of working years and m/n is the passivity ratio; g, r, n, and m are assumed to be constant over time.

If the interest rate, r, equals the growth rate of wages, g, expressions 2.2 and 2.3 can be simplified to expressions 2.4 and 2.5, respectively:

$$(2.4) \qquad CW(1 + g)^n n$$

and

$$(2.5) \qquad BW(1 + g)^n m.$$

Under fully funded plans, capital accumulation at retirement must equal the present value of the stream of pension payments after retirement. So, expression 2.2 must equal expression 2.3, and if the interest rate equals the rate of wage growth, expression 2.4 must equal expression 2.5. The required contribution rate is then:

$$(2.6) \qquad C = B(m/n).$$

If the interest rate is lower than the rate of wage growth $(r<g)$, the required contribution rate is higher than $B(m/n)$, and vice versa.

Comparing Contribution Rates

When B is fixed at 40 percent and pensions are indexed to wages, the required contribution rate depends on assumptions about the dependency ratio, the passivity ratio, the interest rate, and the rate of wage growth (see table 1). The required contribution rate under pay-as-you-go financing depends only on the old age dependency ratio. The higher the dependency ratio, the more retirees there are relative to workers and the higher the contribution rate required to support them.

Example: A dependency ratio of one retiree for every two workers requires a payroll tax rate of 20 percent. Dropping this ratio to one for three reduces the tax rate to 13.3 percent. As real wages rise, so does the real pension, but the ratio between the two remains constant, so the contribution rate is unchanged (issue brief table 2.1, columns 1 and 2).

Under full funding the required contribution rate depends on two other factors: the passivity ratio and the difference between the real interest rate and the growth rate of real wages. A lower passivity ratio means that workers spend a smaller proportion of their adult lives in retirement, which reduces the required contribution rate. The contribution rate also drops if the interest rate exceeds the rate of wage

Issue Brief Table 2.1 Contribution Rate Needed to Pay a Pension Equal to 40 Percent of Final Year Salary
(indexed to wages)

| | Pay-as-you-go (dependency rate) | | Fully funded (passivity rate) | | | | | |
	1/2	1/3	1/2			1/3		
Real wage growth	—	—	0	2	5	0	2	5
Real interest rate								
0	20	13	20	35	77	13	23	49
2	20	13	11	20	46	7	13	30
5	20	13	4	8	20	3	5	13
Real pension rate at death[a]	—	—	40	60	106	40	54	83
Relative pension rate at death[b]	40	40	40	40	40	40	40	40

—Not available.

Note: Real wage growth is assumed to apply equally to each cohort, and the average wage for the retiring cohort is the same as the average wage for the economy as a whole. Under pay-as-you-go numbers apply to the average wage worker, whose pension upon retirement is 40 percent of his final wage. Under fully funded each worker gets 40 percent of his own final salary at the start. Plan expenses and disability and survivors' benefits are not included. These would raise the required contribution rate about 3 to 5 percentage points in a well-run mature system. Costs due to unemployment and evasion are also not included. The one-half passivity rate stems from an assumption of forty working years and twenty years of retirement; the one-third passivity rate implies forty-five working years and fifteen years of retirement.

a. Real pension in year of death as proportion of final year's salary. For pay-as-you-go, it depends on wage growth in the economy.

b. Pension relative to average wage in the economy in year of death.

Source: Schwarz (1992a); Vittas (1993b).

growth. But if wages grow faster than interest rates, the required contribution rate rises. Accumulated pension assets are not increasing as fast as earnings, thus forcing workers to save more to meet the 40 percent benefit rate.

Example: If the real interest rate equals the rate of wage growth and the passivity ratio is one to two, the required contribution rate is 20 percent; lowering the passivity ratio to one to three reduces the rate to 13.3 percent (issue brief table 2.1, columns 3 through 8).

Several conclusions follow:

- When the dependency ratio equals the passivity ratio and the interest rate equals the rate of wage growth, pay-as-you-go and fully funded schemes require the same contribution rate.
- When the interest rate exceeds the rate of wage growth, fully funded plans have a cost advantage over pay-as-you-go plans, which do not benefit from the high interest rate. The opposite is true when the rate of wage growth exceeds the interest rate.
- When the dependency ratio is smaller than the passivity ratio, pay-as-you-go plans require a lower contribution rate than fully funded plans (and vice versa) if interest and wage growth rates are equal. In general, if the population covered by the system is growing, there are more people for each "young" age group than for each "old" age group, so the dependency ratio is smaller than the passivity ratio.

Under a set of simplifying assumptions, such as zero transaction costs and zero feedback effects on wage growth, these comparisons may be summed up as follows:

- Full funding costs less than pay-as-you-go (or yields a higher rate of return) if the interest rate is higher than the rate of wage growth plus the rate of population growth. If the interest rate is lower than wage growth plus population growth, the cost advantage lies with pay-as-you-go.

Which Set of Conditions Is More Likely?

If an economy is dynamically efficient, the interest rate should be at least as high as the rate of growth of GDP or total earnings (which include growth in wages per worker and growth in the labor force). Full funding in this case would be at least as cost-effective as pay-as-you-go—and possibly more. Real world data confirm this expectation of the cost advantage of full funding over long periods for several countries.

Earnings growth and the interest rate. Although the relation between earnings growth and the interest rate varies over time and by country, the rate of return to long-term capital, especially equity capital, has been considerably higher than the rate of wage growth over the last three decades—indeed over the last 100 years (Maddison 1987; Siegel 1992). While the variation among countries is wide, the unweighted average growth rate of wages for all countries between 1962 and 1990 was less than 2 percent. In some African and Latin American countries the rate was negative for much of this period. Real wages in most OECD countries rose 3 to 4 percent a year during the 1960s but slowed to about 1 percent during the 1980s. In all these regions the rate of return to investment, proxied by the return to human capital, was much higher (issue brief table 2.2).

In OECD countries the real interest rate on government bonds was slightly below the growth rate of wages during 1971–90 (the exact relationship varies by country). But a portfolio with half stocks and half bonds would have yielded a rate of return ranging

Issue Brief Table 2.2 Real Earnings Growth versus Returns to Human Capital

	Real earnings growth[a]	Social returns to education investment		Private returns to education investment		Rate of return per year of education
		Secondary	Higher	Secondary	Higher	
Sub-Saharan Africa	-1.4	18.2	11.2	26.6	27.8	13.4
Asia	2.4	13.3	11.7	18.9	19.9	9.6
Eastern Europe, North Africa, and the Middle East	2.6	11.2	10.6	15.9	21.7	8.2
Latin America and the Caribbean	-1.1	12.8	12.3	16.8	19.7	12.4
OECD	2.5	10.2	8.7	12.4	12.3	6.8
World	1.5	13.1	10.9	18.1	20.3	10.1

a. Compound real growth in wages for countries with data for at least ten years.

Source: Earnings growth rates calculated using UNIDO data base; data for Latin America and Sub-Saharan Africa come from Mazumdar (1994). Returns to investment in education from Psacharopoulos and others (1993); average of real earnings growth for OECD includes all the countries except Belgium, France, Germany, Greece, Iceland, the Netherlands, and Switzerland. For Asia it includes Bangladesh, Fiji, the Republic of Korea, Malaysia, Nepal, Pakistan, the Philippines, Singapore, Sri Lanka, and Thailand. For Eastern Europe, North Africa, and the Middle East it includes Afghanistan, Algeria, Cyprus, the Czech Republic, Egypt, Hungary, Iran, Iraq, Israel, Jordan, Kuwait, Lybia, Malta, Morocco, Tunisia, and the Federal Republic of Yugoslavia. Latin America includes Argentina, Chile, Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Panama, and Peru. Sub-Saharan Africa includes Botswana, Burundi, Egypt, The Gambia, Ghana, Kenya, Malawi, Mauritius, Sierra Leone, Swaziland, and Zimbabwe.

from 3 to 6 percent, about 3 percentage points higher than wage growth (issue brief table 2.3). From the very long-term (100-year) perspective most relevant to pension plans, labor productivity in the United Kingdom and the United States appears to have grown about 2 to 3 percent a year. Again, this was about the same as the real interest rate on bonds but much less than a portfolio equally divided between stocks and bonds (Maddison 1987; Siegel 1992). Data for selected developing countries (those with emerging stock markets during the 1970s and 1980s) show that rates of return to equities and education—which ranged from 6 to 42 percent— were much higher than the growth rate in earnings, which ranged from -4 to 8 percent (issue brief table 2.4). The high returns to capital reflect its scarcity and risk and the selectivity of the sample; it is likely that stock markets will emerge in countries with favorable investment prospects. (For further data on wage growth over time see appendix table A.3.)

The fact that capital has become far more mobile than labor (except where there are government restrictions) further boosts the expected returns to capital and the potential cost advantage of fully funded pension plans. Full funding permits international diversification of investments, which allows pensioners in slow-growth countries to benefit from the higher yields in high-growth countries. This comparison suggests that full funding has a strong cost advantage over pay-as-you-go.

The dependency ratio and the passivity ratio. In previous decades, the potential cost advantage of full funding was offset by the fact that the world's population was growing so rapidly that the dependency

Issue Brief Table 2.3 Real Wage Growth Contrasted with Real Returns on Capital, Selected OECD Countries, 1971–90
(percent)

Country	Real wage growth	Real average annual return on equities	Real average annual return on government bonds	Real average annual return on balanced portfolio[a]	Returns on 50–50 portfolio minus real wage growth
Canada	1.1	5.0	1.1	3.1	2.0
Denmark	2.5	9.4	4.5	7.0	4.5
France	4.0	9.6	1.3	5.5	1.5
Germany	3.6	9.3	2.6	6.0	2.4
Japan	3.0	11.2	0.0	5.6	2.6
Netherlands	1.4	8.6	1.8	5.2	3.8
Switzerland	1.8	4.7	-1.7	1.5	-0.3
United Kingdom	2.4	10.8	1.6	6.2	3.8
United States	0.1	5.9	1.2	3.6	3.5

Note: The numbers shown are simple annual averages.
a. Balanced portfolio consists of 50 percent government bonds and 50 percent equities.
Source: Real earnings growth in France from IMF *International Financial Statistics* (various years), other data from Davis (1993).

Issue Brief Table 2.4 Rates of Return to Labor, Human, and Nonhuman Capital

Economy	Real return to equities [a]	Rates of return per year of education	Real wage growth[b]
Argentina	20.5 (1975–92)	10.3	1.9 (1963–88)
Chile	26.4 (1975–92)	12.0	6.6 (1963–88)
Colombia	41.5 (1984–92)	14.0	1.0 (1963–88)
India	11.5 (1975–92)	4.9	3.0 (1980–89)
Korea, Rep. of	11.2 (1975–92)	10.6	7.8 (1966–88)
Malaysia	6.7 (1984–92)	9.4	2.5 (1968–88)
Mexico	14.5 (1975–92)	14.1	-3.9 (1980–89)
Pakistan	16.4 (1984–92)	9.7	3.8 (1963–86)
Philippines	40.6 (1984–92)	8.0	0.4 (1963–88)
Taiwan (China)	17.9 (1984–92)	6.0	—
Thailand	14.1 (1975–92)	10.4	3.4 (1970–86)
Venezuela	18.5 (1984–92)	8.4	-0.8 (1963–88)
Unweighted average	20.0	9.8	2.3

— Not available.
a. Total returns are given in real U.S. dollars. Years are given in parentheses.
b. Geometric mean.
Source: Stock market data from IFC files, based on returns for years since 1975. Rates of return per year of education, or Mincerian rates of return, from Psacharopolous (1993). Real wage growth from UNIDO data base and World Bank (1992d).

ratio was likely to be smaller than the passivity ratio in many countries. Dubbed the "biological rate of interest," population growth was used in the 1950s to justify the expansion of pay-as-you-go systems in industrial countries. An implicit assumption was that rapid population growth and pay-as-you-go would not depress earnings. Yet, as noted above, wage growth slowed precipitously in OECD countries throughout the 1970s and 1980s, as the baby boom generation entered the labor force. In Africa, where population was growing most rapidly, wage growth turned negative.

In recent years demographic conditions have become less favorable to pay-as-you-go. Today OECD countries barely attain the population replacement rate, and East Asia, Eastern Europe, and parts of Latin America are moving rapidly in the same direction. The demographic dependency ratio is fast approaching the passivity ratio. In addition, because pay-as-you-go plans break the link between benefits and contributions, they may induce evasion, early retirement, or other types of strategic manipulation—problems that push the system dependency ratio above the demographic dependency ratio in many countries (see chapter 4). It is quite likely, therefore, that in middle- and high-income countries the system dependency ratio will be at least as great as the passivity ratio in coming decades. Thus, the influence of the higher return to capital, reflecting its productivity, should dominate.

And the Winner Is...

It is possible, of course, that falling birthrates could mean scarcer labor and higher wages. It is also possible that if many countries adopted funded pension plans, savings would increase and interest rates would fall. Both developments would be favorable to pay-as-you-go financing. But in a world of international flows of capital and goods, this outcome is unlikely to occur before most countries have stable populations and funded pension plans—and even then these price changes are far from certain.

In sum, any cost advantage that pay-as-you-go plans might have had in the past was the result of demographic factors that no longer hold in many countries. In the future, if interest rates and earnings growth maintain their relative positions, and especially if pension funds are able to benefit from equity investments, capital mobility, and international diversification, a fully funded system will require lower contribution rates than a pay-as-you-go system to achieve the same pension benefits.