

# Equity investment in pension asset management in India

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October 19, 2000

**Abstract**

# 1 Introduction

Pension funds are a unique situation where individuals invest over multi-decade horizons, in order to obtain consumption in old age. All pension investment works with the “fundamental pension equation” (Ambachtsheer & Ezra 1998):

$$\text{Contributions} + \text{Investment returns} = \text{Benefits paid}$$

What is unique about pension investment is the multi-decade horizons over which investment is done. These long horizons generate a strong sensitivity to small changes in the rates of return; they also imply that pension funds can safely ignore day to day or month to month volatility and focus on the long-run average rate of return.

The existing returns on PF investment in India are fairly poor. Dave (1999) estimates that the average rate of return has been around 1% in real terms. This is in contrast with pension systems elsewhere in the world which are known to deliver real returns in excess of 5%. These small differences in the rate of return are powerfully magnified by the multi-decade horizons in pension investment.

In this paper, we measure the performance of investment strategies on multi-decade horizons, using probability distributions of prices and returns from India’s experience over the last twenty years. We find that the terminal wealth which can be accumulated using equity investment is much larger than that obtained by investing in government bonds. We measure the ‘shortfall risk’, the risk that the all-equity strategy might underperform when compared with the all-bonds strategy, and find that the shortfall probability is fairly small. In addition, we also explore some of the implications of international diversification of equity investments for pension investment.

Equity investment does involve significant investment risk in the sense that different cohorts experience a different 35 years of the equity market index. We explore two strategies through which this inter-cohort variation can be reduced – phasing out equity exposure from age 50 onwards, and international diversification – and find that both these strategies are quite effective.

## 2 Assumptions about contributions

The per-capita GDP in India in 1999-2000 is Rs.20,000 (\$460). The numerical calculations shown in this paper assume a daily pension contribution of Rs.10 per day, or Rs.3,650 per year.

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This table reports the terminal wealth obtained by a pension contribution rate which starts at Rs.10 per day at age 25, growing at 3% per year till age 60. Pension assets are purely invested in government bonds. Two scenarios are shown: one where the real rate of return proves to be 2% and another where it proves to be 4%.

	Real rate of return on GOI bonds	
	2%	4%
Terminal wealth	Rs.152,000	Rs.215,000

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Table 1: Investment strategy A: 100% in government bonds

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All calculations in this paper are in real terms, in 1999 rupees. We assume that contributions grow at 3% per year, which is approximately related to a GDP growth of 5% per year and a population growth rate of 2% per year.

### 3 Investment using government bonds

The long-run historical rate of return on government bonds in India has been around 4% per annum (corresponding to a nominal interest rate of 12% and an inflation rate of 8%).<sup>1</sup> It is likely that in the future, the real rate of return on government bonds will be lower than has been observed in the past. Hence we additionally analyse a scenario where the real rate of return on government bonds proves to be 2% in real terms.<sup>2</sup>

The results are shown in Table 1. As is typical of calculations involving multi-decade horizons, we see that the small difference in two percentage points between the two scenarios generates a large 41% change in the 35-year horizon terminal wealth.

If we assume that an inflation-indexed annuity for a person at age 60 pays around 7% per annum, then this accumulation yields an inflation-indexed annuity of between Rs.887 and Rs.1254 per month.

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<sup>1</sup>At the time of writing, the real interest rate on government bonds is around 8%. However, this is clearly an aberration; looking forward into the coming 35 years, it is unlikely to persist.

<sup>2</sup>For a comparison, the real rate of return on government bonds in OECD countries is between 0.5% to 1%.

## 4 Investment using equity index

Alternatively, we can explore an investment strategy where all pension assets are invested into equities. The basic rationale for equity investment is based on the idea of the “equity premium”, where equity investors earn a higher average rate of return in compensation for the volatility that they experience.

### 4.1 The equity premium

The motivation for long-term investment into equity is based on what financial economists call “the equity premium”, i.e. the higher returns which equities have to pay (on average) in order to justify the volatility of stock prices. The difference between long-run average rates of return on riskless investments and on equities is termed “the equity premium”.

Empirically, it has been established that the equity premium exists in every country of the world, and that the size of the premium itself varies from country to country. Empirical estimates for the size of the equity premium are most robust from countries where the stock market index has been recorded over longer time periods. In the US, where the data quality is strong, the long-run real rate of return on equities has proved to be 6% while government bonds are at 0.5% (Siegel 1994).

What is more remarkable about the international evidence, is that because it spans such long periods, it often also covers several disruptive episodes. Siegel (1994) shows evidence for Germany and Japan, economies that had been devastated by the world wars. Even for these countries, the long-run real return on the equity index proves to be around 6%, and strongly in excess of investment in government bonds.

### 4.2 Active versus passive management

Equity exposure could be obtained using either active management or using passive management. Active management adds value when fund managers are able to exploit market inefficiencies adequately, and pay for transactions costs and management fees (Shah 1997). Active management subtracts value in the absence of such abilities. In addition, active management introduces *risk* in terms of the variability of performance of a manager or of a AMC subject to manpower turnover. Active management introduces substantially greater regulatory complexities, since regulators have to deal with a much greater range of trading strategies adopted by active managers. In a country like India, where regulation and enforcement is weak, this generates significant risks.

In contrast, passive management (index funds) reliably harness the equity premium. Index funds are not vulnerable to the volatility of performance of active managers. Index funds are easier to regulate.

Pension funds, the world over, have steadily raised the fraction of resources allocated to index funds over the years. Index funds are quite feasible in India today (Nayak 1997, Waghmare 1997, Thomas 1998), and their implementation will be further enabled by the onset of index futures trading (Thomas 1997).

The problems connected with hiring an active manager and appropriately motivating an active manager can be bypassed by favouring indexation (Shah 1997, Shah & Fernandes 1999). Hence, all the calculations about equity investment strategies in this paper are based on the assumption that equity investment will be done using a NSE-50 index fund.

### **4.3 Empirical evidence about equity investments in India**

The long-run average rate of return on the stock market index in India, inclusive of dividends, is 23.5% per annum.<sup>3</sup> This is based on evidence over the twenty year period from 1979 to 1999. If we assume that the riskless rate of return is around 12% (four percent in real terms), this gives us an equity premium of 12 percent per year.

### **4.4 Numerical simulations**

As of late 1999, the evidence available (for twenty years) suggests that the equity premium in India was around 12 percentage points. This is a large value for the equity premium by world standards.

In the future, the equity premium could prove to be lower for a variety of reasons: enhanced wealth in India leading to an enhanced supply of risk capital, the onset of capital account convertibility, the fact that an episode like the reforms of the early 1990s is unlikely to be repeated, etc. Hence, we show two scenarios: using an equity premium of 10 or 12 percentage points. In all cases, the volatility of the NSE-50 index is set to its long-run historical average, i.e. 1.8 percent per day.

We see that under all these scenarios (Table 2), the median value of the terminal wealth proves to be enormously larger than the values seen in Table

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<sup>3</sup>Our evidence is based on pasting together the time-series for the NSE-50 index (Shah & Thomas 1998) from 3 July 1990 onwards, and the BSE 'Sensitive' Index from April 1979 till July 1990.

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This table reports the terminal wealth obtained by a pension contribution rate of Rs.10 per day from age 25 till age 60, where pension assets are purely invested in equities. The rates of return assumptions are varied in two dimensions. The riskless rate of return is varied between two and four percentage points. The equity premium is varied between 10 and 12 percentage points.

Equity investment implies that the terminal wealth cannot be exactly forecasted. The table reports the median value across 2,000 simulations.

Equity premium	Real rate of return on GOI bonds	
	2%	4%
10%	507,254	737,654
12%	775,761	1,165,611

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Table 2: Investment strategy B: 100% in an NSE-50 index fund

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1. Assuming that an inflation-indexed annuity pays around 7% per annum, this accumulation yields an inflation-indexed annuity of between Rs.2,959 and Rs.6,799 per month. The gains range from 3 to 7 times when compared with Table 1. The comparison between Table 2 and Table 1 makes a powerful case for pension investment in equities.

## 5 Investment risk borne by participants

Equity investment involves investment risk. The results of Table 2 focus on the median outcome; however these results mask the variation that follows from the volatility of the stock market index. In a world where individuals follow Strategy B for 35 years, they suffer from the possibility that the 35 years for which they are in the stock market could prove to be unusually good or bad.

The first question we ask is: What is the possibility that the terminal wealth under Strategy B could be less than that obtained under Strategy A? This is termed the *shortfall probability*.

Shortfall probabilities associated with Table 2 are shown in Table 3. Lower values of the equity premium, higher values of the volatility of the market and higher values for the riskless rate of return generate higher shortfall probabilities.

The variability of terminal wealth is also a useful way of measuring the investment risk of being in equities. Investing in equities exposes the individ-

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This table reports the probability that the terminal wealth under Strategy B (100% equities) could prove to be less than that obtained under Strategy A (100% government bonds). For example, if the rate of return on government bonds proves to be 4%, and if the equity premium proves to be 14%, then the probability that Strategy B underperforms Strategy A is 4%.

Equity premium	Real rate of return on GOI bonds	
	2%	4%
10%	13.3	14.6
12%	7.5	7.5

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Table 3: Shortfall probability with equity investment

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ual to the returns on the stock market over the 35 years that he is invested in equities. Each cohort which embarks on equity investment at age 25 faces a different 35 years of returns on the equity market.

In Table 4, we focus on the 25th and 75th percentile of the distribution of the terminal wealth. We see a fairly large variability associated with Strategy B.

## 6 Reducing the investment risk associated with equity investment

Table 2, when compared with Table 1, makes a strong case for equity investment. Table 3 shows that there is a fairly small risk that the all-equity strategy could *underperform* the all-bonds strategy. However, Table 4 reveals a wide spread in the range of outcomes that could derive from the all-equity strategy. What can be done in containing this investment risk, and in obtaining a more predictable outcome?

### 6.1 Phasing out of equity exposure

Alier & Vitas (1999) discuss a variation of the all-equity strategy, where equity exposure is phased out as the retirement date approaches. In Section 4.3, we saw that there has not been a period of longer than eight years in which equity investment underperformed bonds. Hence, we follow Alier & Vitas (1999) in implementing a strategy where from age 50 onwards, equity

This table shows the 25th and 75th percentiles, and the interquartile range (IQR), associated with Strategy B (100% investment in the NSE-50 index fund). All values are in million rupees.

For example, if the equity premium proves to be 12% and if the riskless rate of return proves to be 4%, then the variability of the terminal wealth is as follows. The 25th percentile is Rs.0.523 million (i.e. there is a 25% chance of reaching age 60 below Rs.0.523 million) and the 75th percentile is Rs.2.835 million (i.e. there is a 25% chance of reaching age 60 above Rs.2.835 million). The difference between these two cutoffs – the interquartile range – is Rs.2.312 million.

Equity premium	Real rate of return on GOI bonds					
	2%			4%		
	25	75	IQR	25	75	IQR
10%	0.235	1.169	0.934	0.320	1.775	1.455
12%	0.323	1.725	1.402	0.523	2.835	2.312

Table 4: Investment risk with equity investment

exposure is linearly phased out till it reaches zero at age 60.

The results from this strategy are summarised in Table 5. A comparison with Table 4 reveals that this strategy routinely obtains a much lower inter-quartile range; however a comparison with Table 2 reveals significantly lower accumulation.

As emphasised by Alier & Vittas (1999), this strategy – of phasing out equity exposure – has the appeal of being easily implemented using unsophisticated financial markets. It is very likely that when futures and options on the NSE-50 index become available, it would become possible to apply financial engineering to obtain lower investment risk, possibly at a lower price in reduced accumulation when compared with the results of Table 5.

## 6.2 International diversification

One of the most effective tools for reducing the risk of equity investment is to diversify internationally. This dramatically brings down volatility. Index funds give an excellent Sharpe's ratio (reward to risk ratio) among funds which invest in one country. When investment barriers are dropped to allow for funds to be invested the world over, the Sharpe's ratio can further increase (which is equivalent to either higher returns or lower risk, both of which imply lower shortfall probabilities). The diversification across countries allow for a

This table shows the results obtained by linearly phasing out equity exposure from age 50 onwards. For example, if the riskless rate of return proves to be 4%, and the equity premium proves to be 12%, then the outcomes are as follows. The median value of the terminal wealth is Rs.0.785 million. The 25th percentile of the terminal wealth is Rs.0.408 million (i.e. there is a 25% probability of reaching age 60 with less than Rs.0.408 million). The 75th percentile is Rs.1.715 million (i.e. there is a 25% probability of reaching age 60 with over Rs.1.715 million). The inter-quartile range is Rs.1.307 million. The probability of obtaining lower returns than Strategy A (all bonds) is 7.8%.

GOI Bond	Equity Premium	Median	25%	75%	IQR	Shortfall probability
2	10	0.381	0.221	0.702	0.481	12.5
4	10	0.573	0.313	1.166	0.853	12.3
2	12	0.520	0.290	1.058	0.768	6.5
4	12	0.785	0.408	1.715	1.307	7.8

Table 5: Phasing out equity exposure from age 50 onwards

much lower risk, while the expected rate of return taken as an average across different countries only drops slightly.

Shah (1998) shows a case study of funds in India, with a comparison across a purely domestic actively managed fund in an optimistic scenario, a purely domestic index fund (the NSE-50 index) and a fund which invests passively in the domestic index fund and an international index fund (the NSE-50 and the S & P 500 index). The passively managed fund investing in both domestic and international indexes show better gains than even the highly successful actively managed fund. By introducing the international index, the Sharpe's ratio goes up to 1.46, compared to the purely domestic index fund with a Sharpe's ratio of 0.91 and the domestic highly successful actively managed fund at 1.0.

While international diversification sharply reduces risk, it also reduces the rates of return accessible for unleveraged investments, since the equity premium internationally is lower than that found in India (where risk capital is scarce). In addition, an environment with capital account convertibility is also likely to go along with a reduced interest rate on government bonds. Hence, the scenario that we assume is (a) a riskless rate of return of 2%, (b) an equity premium of 8%, and (c) a daily standard deviation of the world market index of 0.8% (in contrast with the value of 1.8 for the NSE-50 index).

This gives the following results. The median value of the terminal wealth

This table summarises the results of this article. Four strategies are shown: all bonds (assuming a 4% riskless real rate of return), all equities (assuming a 4% riskless real rate of return, and an equity premium on the NSE-50 index of 12%), a strategy of phasing out equity exposure from 100% at age 50 to 0% at age 60 (using the same assumptions as the all-equity strategy), and an internationally diversified 100% equity portfolio (assuming a 2% riskless real rate of return and an equity premium of 8%).

For example, in the last case (internationally diversified equities), we see that the median outcome is a terminal wealth of Rs.0.6 million, with a 0.2% probability of underperforming when compared with Strategy A (all bonds). The interquartile range with this strategy is Rs.0.884 million.

(Rs. million)			
Strategy	Median Terminal Wealth	Shortfall Probability	Inter- quartile Range
A: All bonds (4%)	0.215	0	0
B: All equity (4%,12%)	1.166	7.5	2.312
C: Phaseout after age 50 (4%,12%)	0.785	7.8	1.307
D: Intl. diversified equities (2%,8%)	0.617	0.2	0.884

Table 6: Summarising the empirical results

proves to be Rs.0.617 million. The inter-quartile range is Rs.0.455 million (going from Rs.0.428 million to Rs.0.884 million). The probability of underperforming an all-bonds strategy drops to 0.2%.

This is a highly attractive set of outcomes, the main driver for which is the lower volatility of the world stock market index when compared with the much less diversified NSE-50 index. The median accumulation is lower (owing to the lower rates of return that are prevalent internationally). Individuals who desired higher rates of return in such a world could do so by leveraging using index futures.

## 7 Conclusion

A compact summary of all the empirical results of this article is presented in Table 6. While both Strategy C and Strategy D yield a lower inter-quartile range as compared with Strategy B, Strategy D is clearly superior in generating a near-zero shortfall probability and a lower inter-quartile range.

The empirical results make a strong case for equity investment as being a central feature of pension investment. Equity investment is often criti-

cised on the grounds that it imposes investment risk upon individuals. This is indeed the case in the sense that a cohort which embarks on equity investment at age 25 in 1955 would have obtained a different terminal wealth at age 60 when compared with a cohort that started in 1956. However, if investing in government bonds is viewed as an alternative, then the equity index strategy dominates: government bonds yield similar outcomes across different cohorts, but these outcomes underperform what might have been obtained using equity investment with a high probability.

One set of traditional concerns about equity investment are connected with the risks, fees, and governance problems associated with active management. The prospect of hiring an active manager and asking him to speculate on stocks is a daunting one. These concerns are fully addressed by indexation. Equity investment of pension assets should rely on index funds, especially in a country like India with weak law enforcement and limited skills in solving principal-agent problems. The vision of pension assets invested in the NSE-50 index is much more reassuring when compared with envisioning pension assets being applied into stock picking,

The case for international diversification is similarly compelling. The East Asian Crisis has been a vivid reminder of the dangers of investing in one country; any portfolio formed of purely Malaysian, purely Indonesian, purely Korean or purely Thai assets would have fared badly in 1997. International diversification is now a major part of the pension reforms agenda in these countries.

The implications of this research for the pension reform process in India are as follows:

- Pension savings should not be a source for financing government deficits,
- A large fraction of pension savings should be invested in equities,
- Equity exposure should be obtained using index funds,
- International diversification should be harnessed to reduce the investment risk to the extent possible, and
- The wealth accumulation through equity-oriented investment strategies is quite remarkable, even at fairly low contribution rates like Rs.10 per day.

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