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Prudent Pension Planning

HIBERNIAN INVESTMENT MANAGERS

By Shane Whelan

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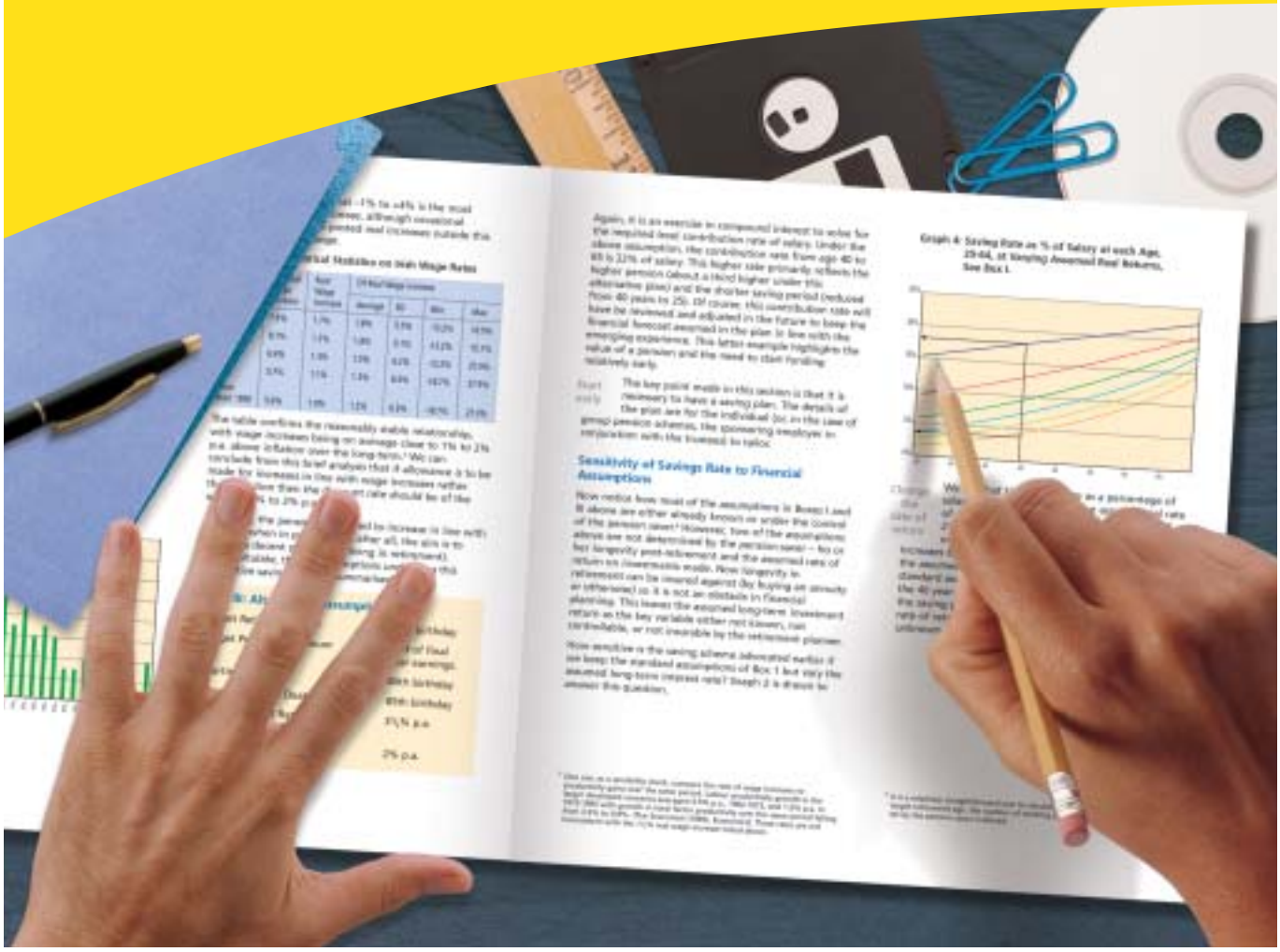

Introduction

As the supplier of asset management services to many large group pension schemes and, through Hibernian Life and Pensions, to many thousands of group and individual members, we in Hibernian Investment Managers are acutely aware of the issues facing the trustees of pension schemes and their advisers currently.

During our many and varied discussions with pension scheme trustees and their advisors, the same topics emerge:

- How do we interpret recent investment returns and volatility, in the light of historical precedence?
- What level of real investment return should we expect in the future?
- What level of contributions should we be making?
- Will equities continue to deliver superior relative returns?
- How should our asset mix alter as our liability profile changes?

This booklet attempts to answer these questions. It highlights the key assumptions and variables underpinning pension scheme structures. It confirms what returns it is reasonable to expect. It examines historical asset performance and puts recent events into their true perspective.

This is a practical guide, aiming to assist advisers, trustees of defined benefit and defined contribution schemes, their members and individual pension investors through the pension planning minefield.

We hope you find it useful.

Tony Joyce,
Managing Director,
Hibernian Investment Managers

December 2002

About the Author

Shane is an actuary with extensive experience of the investment industry where he has worked as an investment analyst, fund manager, and strategist for over a decade. He has presented and published many papers on investment topics to professional and other audiences, the quality of which has been noted by prizes from the Institute of Actuaries (UK) and the Worshipful Company of Actuaries (a guild in the City of London). Shane became a Lecturer in Statistics at University College Dublin in September 2001.

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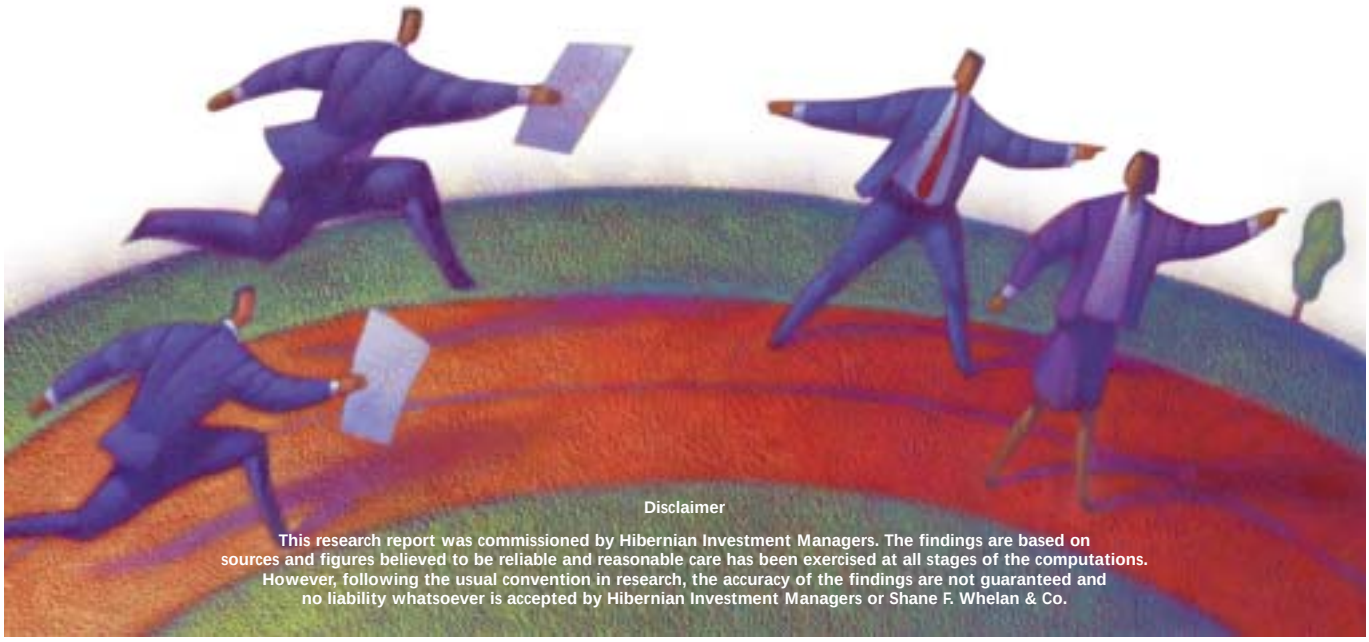
Prudent Pension Planning

December 2002

A research report prepared for Hibernian Investment Managers

By Shane F. Whelan & Co.



Disclaimer

This research report was commissioned by Hibernian Investment Managers. The findings are based on sources and figures believed to be reliable and reasonable care has been exercised at all stages of the computations. However, following the usual convention in research, the accuracy of the findings are not guaranteed and no liability whatsoever is accepted by Hibernian Investment Managers or Shane F. Whelan & Co.

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Overview: Blueprint of a Financial Plan

More than three out of every five workers in Ireland are not covered by occupational pensions and so must either provide for themselves or else adjust their lifestyle in retirement to be able to live on the basic state pension.[1] Even for those with occupational pensions, one-third are members of defined contribution arrangements and are made to shoulder the investment risk of their final pension failing to meet their needs.

60% not covered

Irish workers, outside of a few select sectors such as state or semi-state enterprises and the financial services industry, must be self-reliant when it comes to providing for their old age. They face two related but distinct risks in their advanced years:

- Failure to set aside sufficient funds during their working life
- Failure to invest these funds prudently.

The pension saver cannot remove the risks, and so must become informed on how to control them. Readers of this booklet will discover five millennia of financial history, from investment tips in the Old Testament to how Nobel Prize winners in the 20th century have modelled the problem. Our survey of the full expanse of financial history, with some diverting digressions, takes in several different approaches to provide the pension-motivated saver with the key insights necessary to appreciate the twin risks. The reader who makes it to the final page will, we hope, be left with informed common sense. We show how informed common sense leads to a structured financial plan which can dynamically control the twin risks by giving early warning of future problems and by suggesting avoiding manoeuvres.

This booklet is divided into two sections. The first section attempts to answer the question of "how much to save?". Put another way, this question reduces to "what return can be expected above inflation on suitable investments over the long-term?." We propose that a real return of 3% to 4% per annum over the long term seems a reasonable projection for a well-diversified portfolio. The pension saver is then encouraged to develop a saving plan that, on the basis of a $3^{1}/_{2}$% or so real return per annum, will produce the required nest egg come retirement.

How much to save

While this assumed real return is the best estimate based on our current knowledge, there is an inherent wide margin of error around this estimate.

We can control for this uncertainty by periodically reviewing the actual accumulated fund versus the expected size of the fund under the savings plan. If there is a shortfall then the future savings rate is adjusted upward and vice versa. This review may be once every five years when retirement is a decade or more away, reducing to once every three years and then, with five years to go, every year. Reviewing progress frequently means that the changes to the savings rate tend to be small. This structured common sense approach ensures that the first risk – failure to save enough - is controlled. If the individual still fails to put enough aside, it has not been out of insufficient warnings.[2]

The second section focuses on the risk that the individual fails to invest the accumulated savings prudently. This risk manifests itself in different ways over the long and short term. An investment strategy that is too cautious over the long-term can be expected to reduce the return on assets and thereby increase the savings rate needed to produce the same pension at the end of the day. On the other hand, an investment strategy that is too aggressive in the few years approaching retirement can create a sudden and large deficit in the fund that can only be righted by a dramatic increase in the savings rate over the remaining few years to keep the retirement plan on track. The trick is, as we shall discuss, to pursue an unconstrained investment strategy with more than a decade to go to retirement and then to gradually adopt a more risk averse strategy. What might constitute a suitable investment strategy is discussed in the second section, which contains a few statistical studies on the outcome of suggested investment strategies. These statistical investigations are known as asset-liability modelling. This modelling exercise, despite the sophistication of the techniques employed, still produces recommendations that are frustratingly vague and qualified. Yet, that remains the state of the art-come-science of asset-liability modelling at the moment.

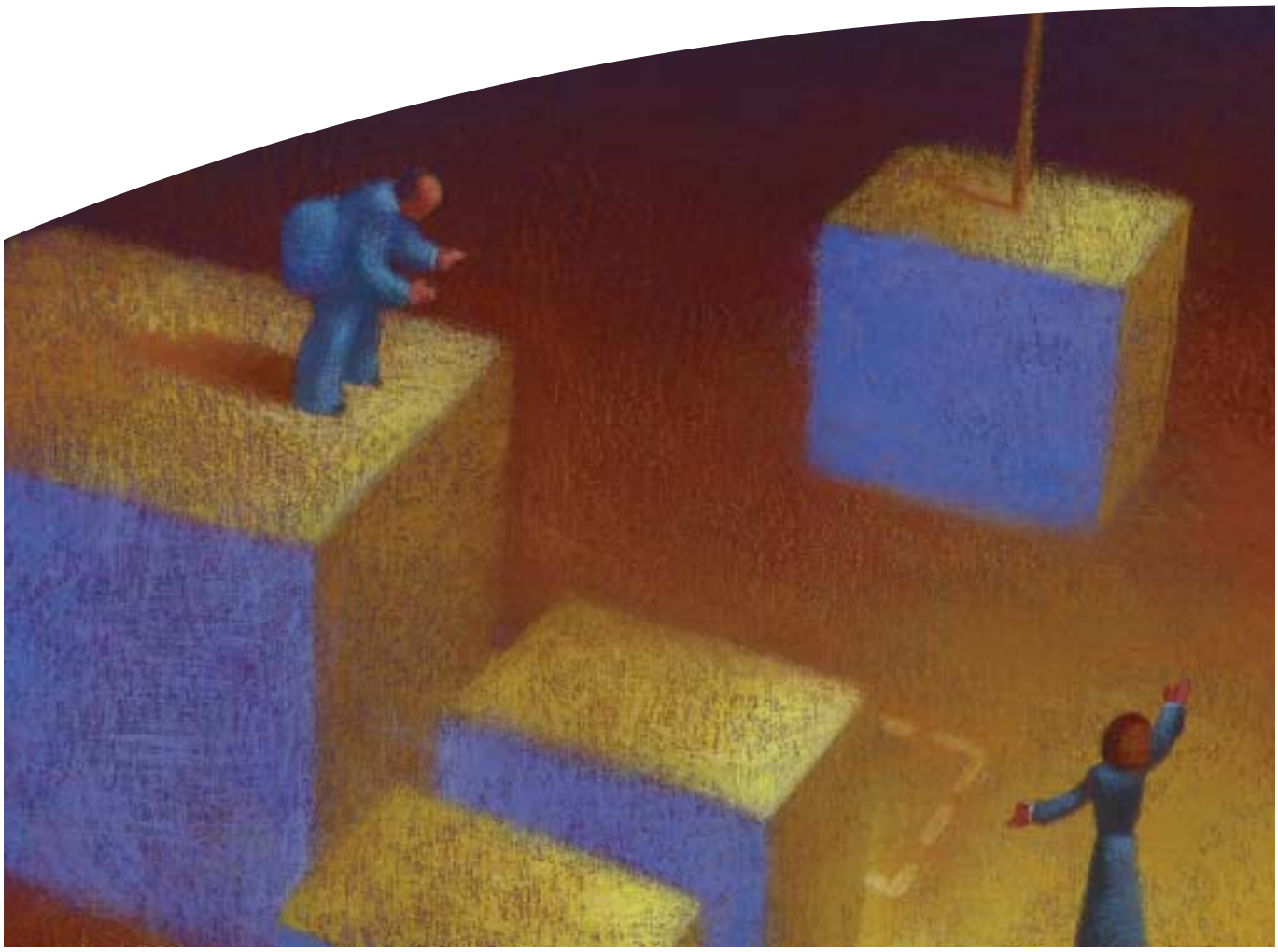
In what to invest

[1] *Annual Report 2001* of The Pensions Board and *Quarterly National Household Survey, 1st Quarter 2002*, of the Central Statistics Office.

[2] Actuaries apply this control cycle with a little more rigour - at each financial review, they also review the key assumptions (in this case the assumed interest rate and the pensioner's longevity post retirement) in the light of the new information collected between reviews. Actuaries collect data with zeal, collecting details of every death of every person with a life insurance policy in the UK and Ireland since the 1920s and maintaining databases of daily price movements of almost every share in the world over the last few decades (and since the 1930s for the larger UK stocks).

Part I: A Funding Strategy

OR HOW MUCH TO SAVE



Getting a Handle on the Problem

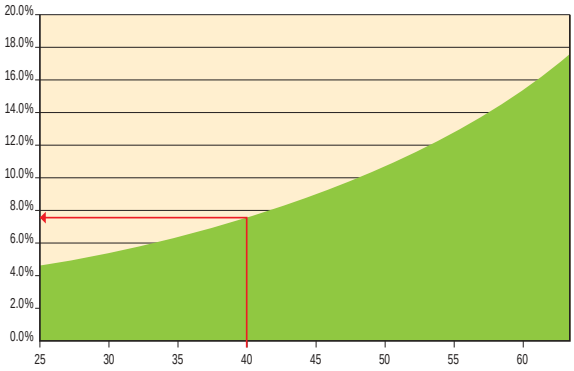
How much should be saved to provide yourself with a decent standard of living in retirement? The answer clearly depends on the standard of living you enjoyed in your working life, how long you will live after retirement, and the return achieved on any savings put by. By way of illustration, so we can get a handle on the magnitude of the sums involves, let us make some assumptions

Assumptions for a Pension Plan

Target Retirement Date	65th birthday
Target Pension per annum	Half of average yearly earnings, the average taken over the full working lifetime (additional to State Pension)
Started Working Life	25th birthday
Expected Age at Death	85th birthday
Long-term Real Rate of Return	$3^1/_2$% p.a.

On the basis of the assumptions above, a reasonable saving or funding plan would be to invest the percentages of salary each working year as shown in Graph 1.

Graph 1: Saving Rate as % of Salary at each Age, 25-64, (on standard assumptions above)



Rising savings rate

So a person aged 40 should save 7.8% of salary in that year. This sum, invested to return $3^1/_2$% above inflation over the next 45 years odd, will generate enough money to pay a pension of 1/80 of the salary earned in that year from retirement until death. This small bit of pension, when added to the other small bits of pension generated following the saving rate indicated on the graph for each of the other 39 working years, will produce a total pension of 40/80 – or half – of the lifetime average earnings indexed in line with inflation.

The saving plan pictured in Graph 1 is a particularly simple and natural plan. It funds for the targetted pension accruing in a particular year out of earnings for that year. This gives a gently rising savings rate (as a percentage of salary) with age, as the earlier contributions grow more as the assumed rate of investment return of $3^1/_2$% per annum applies for longer. This rising savings rate might suit the expenditure pattern of many – being relatively low in those years when buying a house and raising a family, but higher in the later years when the house is paid for and the family raised. Other saving plans are, of course, possible and might be preferable. To illustrate the choice of such plans, we give another example below.

An Alternative Savings Plan

The savings plan above might not suit everyone. In particular, the proposed commencement of saving – from age 25 – might be unrealistic. So let us, as an alternative savings plan, assume that provision for retirement is to commence at age 40. Retirement age is set again at 65 years, and, as before, we assume that the pension will be drawn-down over a period of 20 years. The saver wants to provide half of the salary received in the final working year as a pension, supplementary to the State pension. Further, the saver wants to set aside a level percentage of salary from his 40th year to his retirement. How much should be set aside in each year?

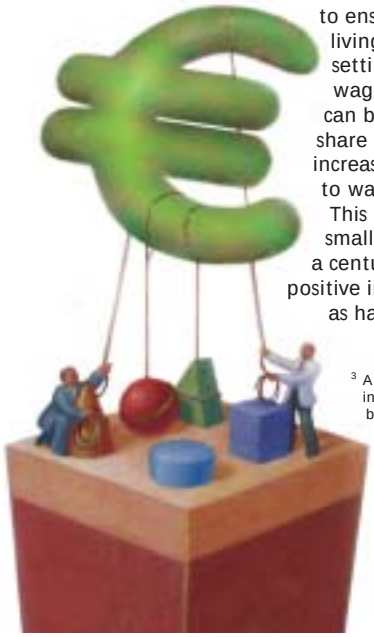
Final salary pension

This plan differs in some important respects from that proposed earlier. The pension is likely to be higher as it is linked to wages in the final year not career average wages indexed with inflation. Now, to estimate the savings rate for this plan, we must determine the relationship between price and wage inflation over the long term. This relationship is also, of course, of interest in itself as it determines the rate at which workers' living standards improve with time. We explore the historic relationship in Box II and the graphs and table below and find that wages have tended to grow somewhat ahead of inflation – perhaps by 1½% per annum over the 20th century in Ireland. This entails the long-term rate of return above wage escalation falls to about 2% (a material change from the earlier 3½% rate assumed as interest is compounding over decades).

Relationship between Price and Wage Inflation in Ireland over 20th Century

Few occupations have remained unchanged over the centuries. Many disappeared with disappearing industries, replaced by new ones with short histories and, perhaps, shorter futures. Even if an occupation has remained in existence in name for a long while, what it involves and the social standing it entails, has often radically changed. Teachers have a long history but their social standing – at least judged by wage relatives – has disimproved; politicians' wages, on the contrary, have shown the greatest increase over the 20th century – they were not paid in 1900 (but a blind-eye turned to their use of the position for personal gain), so they record an infinitely high annualised rate of increase.[3] The choice of occupation to represent the average wage rate over the very long term is not so obvious. A venerable occupation, little changed, whose social standing remains largely unaltered with time, is that of the carpenter. We use the increase in the hourly rate paid to carpenters as an indication of wage inflation over the 20th century.[4]

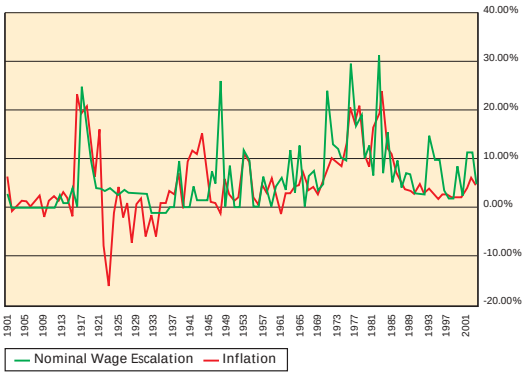
In the graphs and tables below, we relate wage inflation to price inflation in the past to find if there is a relatively stable relationship between them. One anticipates such a stable relationship as workers strive to ensure their standard of living does not fall, thereby setting inflation as a floor on wage negotiations. Workers can be expected to demand a share of real productivity increases, giving a positive bias to wage rates above inflation. This positive bias, however small, should accumulate over a century to have an obvious positive impact on living standards, as has been observed.



[3] A thorough analysis would of course include the value of the perquisites, both at the start and end of the century. However, hard data is unavailable but there is anecdotal evidence suggesting that the value derived from the position remains material.

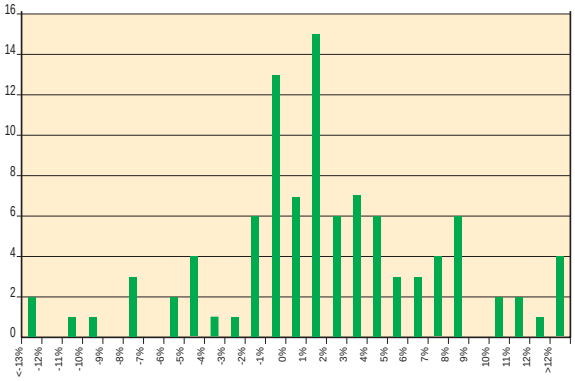
[4] Sources and data as detailed in *Appendix I*.

Graph 2: Irish Price Inflation and Wage Inflation, Each Year, 1900 - 2001



A relatively stable relationship emerges between inflation and wage increases in any one year, as could be expected. There tends to be a short lag between wage increases and inflation, particularly noticeable in the early years after World War II.

Graph 3: Histogram of Real Wage Increases, Each Year, 1900-2001.



The histogram shows that –1% to +4% is the most common real wage increase, although occasional individual years have posted real increases outside this relatively narrow range.

Table 1: Key Historical Statistics on Irish Wage Rates

Years Ending 2000	Nominal Wage Increase	Real Wage Increase	Of Real Wage Increase			
			Average	SD	Min.	Max.
25	8.8%	1.9%	2.1%	6.1%	-13.2%	14.5%
50	8.5%	1.9%	2.0%	5.4%	-13.2%	15.1%
75	6.5%	1.5%	1.6%	6.3%	-13.2%	27.9%
100	5.7%	1.2%	1.4%	6.7%	-18.7%	27.9%
Since Start 1900	5.7%	1.1%	1.3%	6.6%	-18.7%	27.9%

The table confirms a reasonably stable relationship, with wage increases being on average 1% to 2% p.a. above inflation over the long-term.[5] We can conclude from this brief analysis that if allowance is to be made for increases in line with wage increases rather than inflation then the discount rate should be of the order of 1% to 2% p.a. lower.

Now, from this analysis, we are in a position to estimate the savings rate to provide the targetted pension under our alternative pension plan. As before, the pension is assumed to increase in line with inflation when in payment (as, after all, the aim is to provide a decent standard of living in retirement).
To recapitulate, the key assumptions underlying this alternative saving plan are summarised below:

Alternative Assumption Set

Target Retirement Date	65th birthday
Target Pension per annum	Half of final year earnings
Starting Saving	40th birthday
Expected Age at Death	85th birthday
Long-term Real Rate of Return	$3^1/_2$% p.a.
Long-term Rate of Return above Wage Escalation:	2% p.a.

Again, it is an exercise in compound interest to solve for the required level contribution rate of salary. Under the above assumptions, the contribution rate from age 40 to 65 is 22% of salary. This higher rate primarily reflects the higher pension (about a third higher under this alternative plan) and the shorter saving period (reduced from 40 years to 25). Of course, this contribution rate will have be reviewed and adjusted in the future to keep the financial forecast assumed in the plan in line with the emerging experience. This latter example highlights the value of a pension and the need to start funding relatively early.

Have a plan

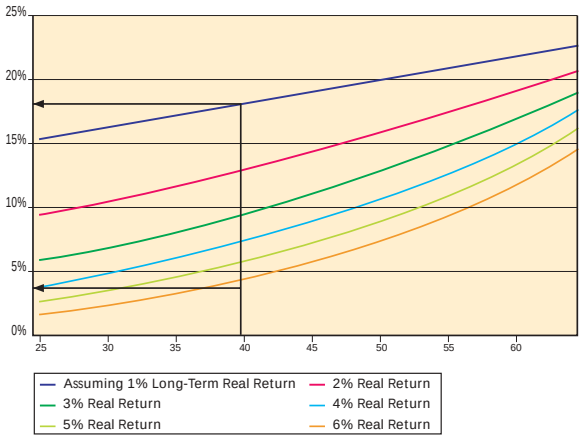
The key point made in this section is that it is necessary to have a savings plan. The details of the plan are for the individual to tailor (or, in the case of group pension schemes, the sponsoring employer in conjunction with the trustees).

Sensitivity of Savings Rate to Financial Assumptions

Now notice how most of the assumptions in Boxes I and III above are either already known or under the control of the pension saver.[6] However, two of the assumptions above are not determined by the pension-saver – his or her longevity post-retirement and the assumed rate of return on investments made. Now longevity in retirement can be insured against (by buying an annuity or otherwise) so it is not an obstacle in financial planning. This leaves the assumed long-term investment return as the key variable either not known, not controllable, or not insurable by the retirement planner.

How sensitive is the saving scheme advocated earlier if we keep the standard assumptions of Box 1 but vary the assumed long-term rate of return? Graph 4 is drawn to answer this question.

Graph 4: Saving Rate as % of Salary at each Age, 25-64, at Varying Assumed Real Returns, (See Box I).



Changing the assumed rate of return

We see that the savings rate as a percentage of salary is very dependent on the assumed real rate of return. If the assumed rate of return is 1% (i.e. $2^1/_2$% per annum below our standard assumption of $3^1/_2$%) then the saving rate for the 40 year old increases from 7.8% to 17.8%. Alternatively, if the assumed real rate of return is 6% ($2^1/_2$% above our standard assumed rate) then the required saving rate for the 40 year old falls to $3^1/_2$% of salary. We conclude that the saving plan is critically dependent on the assumed rate of return. It follows that we need to estimate this unknown parameter as accurately as possible.

[5] One can, as a sensibility check, compare the rate of wage increases to productivity gains over the same period. Labour productivity growth in the larger developed countries averaged 4.5% p.a., 1962-1973, and 1.5% p.a. in 1973-1995 with growth in total factor productivity over the same period falling from 3.3% to 0.8%. (The Economist (1999), *Economics*). These rates are not inconsistent with the $1^1/_2$% real wage increase noted above.

[6] It is a relatively straightforward sum to calculate the saving rate required if the target retirement age, the number of working years, or any other preference set by the pension saver is altered.

Will the Real Rate of Return Please Stand Up?

So what is a reasonable real rate of return to assume? And what is the range of likely outcomes?

The Irish courts are frequently called on to answer a very similar question. The judicial system often must decide on a lump sum needed to compensate the plaintiff for a future loss of earnings and pension entitlements. Typically, the plaintiff and the defendant employ expert witnesses (e.g., actuaries or economists) to testify on what rate of interest a sum prudently invested will generate, so the future loss can be discounted to a lump sum settlement. Over the last two decades, the Irish courts have generally opted for a real rate of interest of 4% but, more recently, a rate of 3% above inflation has been settled upon.[7] Other jurisdictions tend to settle on different real rates of return with, for instance, the real rate prescribed for use in courts in England and Wales now set at the lower rate of $2^1/_2$%.[8] So even the courts disagree, although the extent of the disagreement is modest.

3% - 4% return

Indeed, a convincing case can be made that the real rate of return achievable over the long-term on prudently invested funds will probably be in the range 3-4%.

Argument I: Real Rate of Return of $3^1/_2$%

An initial guide to establishing the appropriate real rate of return is to find a freely traded asset whose proceeds closely reproduce the future income stream required. Over the last few years, many governments have issued just the sort of securities that are ideal for pension savers: index-linked gilts – that is, government guaranteed payments that increase in line with general inflation. Currently such securities in the US, Canada, Australia, Sweden, and France provide investors with a real return of about $3^1/_2$% over the longer term. Index-linked stocks in Ireland and the UK break the general consensus with real rates of about $2^1/_2$%. Now, Irish index-linked stocks can hardly be termed 'freely tradeable' as they are so small and illiquid.[9] Equally, a case can be made that the UK index-linked market is distorted of late.[10] In fact, the monthly real yield on long-term UK index-linked stock since they were issued in 1984 to mid-1994 averaged 3.6%.[11]

But $2^1/_2$ possible

A brief review of the real yield on index-linked stocks around the world at the present time indicates that a real yield of $3^1/_2$% is a reasonable assumption for the long-term saver to make, but the return could be as low as $2^1/_2$%.

[7] In the judgement of Mr Justice Finnegan in the Boyne-v-Bus Atha Cliath & James McGrath, April 2002, No. 2000/12133p.

[8] See Setting the Discount Rate: Lord Chancellor's Reasons, Report dated 27 July 2001. HMSO and currently available at www.lcd.gov.uk/civil/discount.htm.

Argument 2: Likely Range of Real Rate of Return 3-4% (but 2-6% Possible)

Argument 1 is not completely convincing. First, index-linked gilts typically are not long enough to match the pension saver's investing horizon. Consider the 40 year old putting by some savings. She requires an index-linked gilt with a maturity of 45 years so its proceeds lasts until her 85 year. Few economies offer securities of this length. Second, even if suitably long-term index-linked bonds exist, the pension-saver is left with a significant re-investment problem. That is, the income from the asset in the years pre-retirement, which is not then needed, will have to be reinvested at future, unknown, rates. The ultimate return from the investment cannot be known until the terms on which these re-investments are made are known. This reinvestment problem cannot be dismissed as immaterial for, in the context of a saving horizon stretching decades, it is a key assumption.[12]

[9] There are just two such stocks - the government guaranteed Housing Finance Agency bonds of 2008 and 2015 with €108 million nominal of the former in issue and €95 million of the latter. The current market value of both of these bonds is €426 million.

[10] "…expert financial analysts...concurred that the market is distorted at present…[by] minimum funding requirement introduced by the Pensions Act 1995…". *Reasons for Setting the Discount Rate*, ibid.

[11] Wilkie, *The risk premium on ordinary shares*. British Actuarial Journal, Vol. 1, 1995, p. 271.

[12] For instance, the 40 year old investing in an index-linked gilt maturing in 45 years' time and currently yielding 3.5% real would produce an average real return of 3.75% over the term if re-investment of income is made at 4% real. It is of some historical interest to note that the first known bond tables to allow re-investment rate assumed 4% (Robinson, J.W., *Bond and Investment Tables*, privately published in Boston in 1890).

History Lesson: Five Millennia of Interest

Past as a guide to the future

In investment, as in so many other matters, the past is a most valuable guide to the future. The past gives a rough guide to the range of possibilities and an indication of their probability. But, in human affairs, thankfully the past does not repeat itself in an obvious way, so skill is required to forecast. The skills required to forecast in investment are all the greater as considerable rewards go to the best forecasters. We can look at the long-term past to see the real returns posted by the different asset classes.

The historical evolution of interest rates has been exhaustively documented.[13] Interest rates have been traced back five millennia, running through every major economy in modern times and through major civilisations back two thousand years before even coinage was first introduced. Appendix III sets out a brief review of fixed interest markets from 3000 BC to modern Europe.

However, much of the long history of financial markets is irrelevant to the modern investor. The capital markets as we know them today are relatively recent inventions. The City of London only allowed interest-bearing loans since 1545; in 1553 the London firm, Muscovy Company, issued the first equity shares; the first general law allowing limited liability was in 1811 in New York state; the UK (including Ireland at that time) only allowed limited liability to be widely available from the mid-nineteenth century. The early equity markets were somewhat less regulated than they are today, with insolvencies commonplace. In Ireland, for instance, out of the 2,854 limited liability companies established in the 50 years following the Joint Stock Companies Act of 1856, less than half were surviving by 1906.[14] Markets in the form known today are only recent innovations in the time-scale of investors with investment horizons of half-centuries.

[13] Homer (1963), updated in Homer & Sylla (1996), *A history of interest rates.* Rutgers University Press.

[14] Thomas, W.A., *The Stock Exchanges of Ireland*, Chapter 8. Based on a comparison with the experience of the UK, we can infer that about one-half of disappearances can be put down to companies failing and the other half disappearing as a result of mergers and takeovers (Kindleberger, C.P., *A Financial History of Western Europe*, p. 199).

Diverting Digression 1: Interesting Spouses

The Code of Hammurabi, dating from 3,800 years ago, documents the ancient practice in Babylonia in financial and other matters. It contains regulations that could be sensibly employed today.

The legal maximum interest rate of 20% (which bears comparison with the current rate on many credit cards) was to persist from 1900 BC to 539 BC and actual interest rates tended to be in the range 10-20%. The Code ensured that the defaulting debtor was humanely treated and even demanded that the debt be made void on certain misfortunes. Contrast the fate of the debtor then to that in Samuel Johnson's time and those appaling Debtor's Prisons. Yet, nowadays, it is suspected that the Code, by being lenient on defaulting debtors, was good for general economic growth – modern economies with the more tolerant bankruptcy laws tend to experience higher growth rates. The US, the most successful economy in the 20th century, dishes out the lightest punishment to bankrupts. Hence America is the friend of the entrepreneur - being notoriously lavish in its rewards when things go well and, equally, treating them sympathetically when things fail. Indeed, the whole notion of limited liability – the bedrock of our capitalist system – can be seen as an extension of this forbearance to defaulters.

As a curious aside, in ancient times borrowers could use a list of items (which included the door of his house or his wife) as security for the loan. If a wife was seized on default then she must be treated well and returned at the end of three years in a similar good condition! Interestingly, the wife's signature was often required on the loan contract and her own rights to property were safeguarded (the husband could not sell or use it as surety). Finally, to round out the story, the defaulting debtor with no surety could himself be enslaved, again for a maximum of three years.

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Homer, S. & Sylla, R. (1996) A history of interest rates. Rutgers University Press, New Brunswick

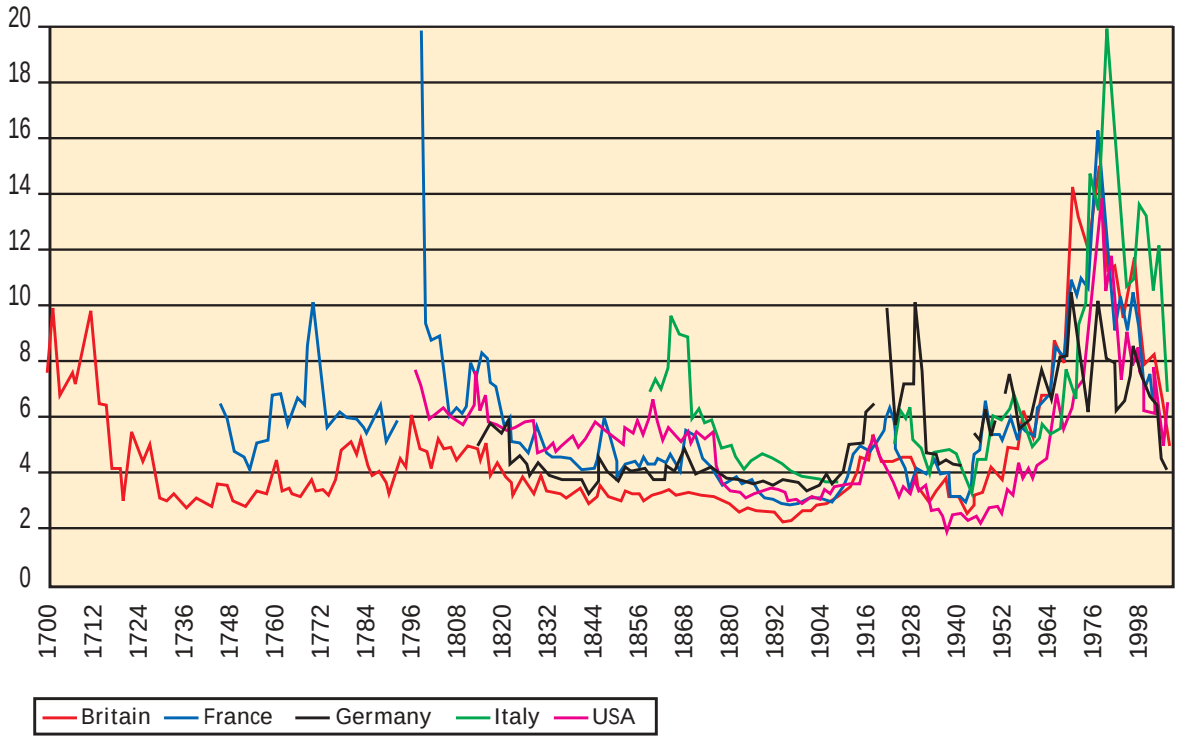
Homer, S. (1997) An informal history of interest rates. Reproduced in The Investor's Anthology, Ellis, Vertin (Editors), Wiley, 1997.

A survey of interest rate history shows that the past was quite different to the present so that the current investor must interpret the last five thousand years of interest rate statistics wisely. Holland from the seventeenth century and England from the eighteenth century provide the only compelling parallels with modern market conditions. The Dutch developed the notion of a national debt, funded from the taxation revenues of a stable and reliable system of government. The Dutch mercantile system functioned because its citizens were enriched from unfettered trading and confidently lent to its government of like-minded merchants at 3-4% because they shared a common interest. The Dutch system would persist and reproduce under the compelling advantage of ready long-run financing at low interest rates, fending off the medieval prince-states with their irregular and more expensive forms of finance. The Dutch system of finance migrated to England with King William of Orange, and from England was spread to Ireland, America, and elsewhere.

[15] This is more than just a metaphor: the Dutch defeated the King of Spain in a war that lasted eighty years (1568-1648). The Spanish King borrowed (illegally) at 40% interest and, like most medieval rulers, regularly defaulted on his debts. The ability to raise loans at low interest rates to fund the engagement gave the Dutch a decisive advantage.

The history of long-term interest rates in modern times is summarised in the graph below.

Graph 5: Average Annual Long Bond Yields, 1700-2002



Sources of Data: *A History of Interest Rates*, Homer, S. & R. Sylla, Rutgers University Press, 1996; Sylla, R. website; Global Financial Data website; *British Historical Statistics*, Mitchell, B.R., Cambridge University Press, 1988.

The graph captures as much of interest rate history as can be usefully employed to shed light on the problem facing the modern pension investor. It traces long-term interest rates each year up to 2001 - from 1700 in the UK, in France from 1746, in the US from 1798, in (what was to become) Germany since 1815, and in Italy since 1861. This is the financial history of almost the entire western world since 1700, with particular emphasis on those currencies to which that of Ireland is or has been pegged. We see that, up until inflation became endemic in the world economy after World War II, the long term interest rate had almost always been in the range 2-6%. In the UK, the most likely values lay in the range 3-4%. In fact, the real return on such long-term government stocks over the period, from 1700 to1995, averaged 3.1% per annum in the UK.[16]

This review of interest rate history again supports the view that the real rate of return might be expected to be in the 3-4% range. It also gives a feel for the possible range of fluctuation. It chronicles times when interest rates fell to 2% and reached, with the help of inflation, unpredictably high levels.

The 20th Century

The financial markets broadened over the course of the nineteenth and twentieth centuries from fixed interest markets (peppered with the occasional company with limited liability granted by an Act of Parliament) to be now roughly split equally between equity and bond markets.[17] However, as remarked earlier, it was only in the 20th century that equity markets became the deep, regulated, markets we know today.

But the 20th century also brought with it considerable instability in political and economic management in Europe. In the first part of the century the German mark, the forerunner of our current euro, was debased, beggaring long-term savers. In the second half of the century inflation became endemic, frustrating financial planning. Yet, ignoring the wild swings and turmoil that occasionally gripped the markets, a clear picture emerged by the century's close: the 20th century was the century of the equity investor.

The table below summarises the annualised real returns to local investors, delivered by the different markets over the last 101 years from 1900, with particular attention to those markets on which Irish investors tend to focus.

Table 2: Annualised Real Returns on Major Markets, 101 Years Ending 31st December 2000

Country	Equity % p.a.	Bonds % p.a.	Cash % p.a.	Inflation % p.a.
Ireland	4.7	1.0	0.7	4.5
UK	5.8	1.3	1.0	4.1
US	6.7	1.6	0.9	3.2
Japan	4.5	-1.6	-2.0	7.6
Netherlands	5.8	1.1	0.7	3.0
Germany	3.6	-2.2	-0.6	5.1
France	3.8	-1.0	-3.3	7.9
Italy	2.7	-2.2	-4.1	9.1
Spain	3.6	1.2	0.4	6.1

Sources: As detailed in Appendix I for Ireland, otherwise figures taken from Tables 4-1 and 5-1 in Dimson *et al.* (2002). Figures for Germany exclude the two-year hyperinflationary period of 1922-23. If this episode was included then German inflation would go up to an annualised rate of about 34%, cash returns fall to –19% real p.a, bond returns to –8.5%, and equities to 4.5% real p.a. (Dimson *et al.* (2000)).

[16] Source: *Global Financial Data.*

[17] The 111 or so equity markets around the world at the start of 2000 had a market capitalisation somewhat in excess of US$36 trillion compared with a world bond market capitalisation of about US$31 trillion (Dimson *et al.*, *Triumph of the Optimists*, Princeton University Press, 2002).

Equities the best

Notice how the financial experience of Ireland mirrored that in other economies. Inflation was roughly in line with international averages; equities considerably outperformed the two other asset classes and by roughly the same margin; bonds and cash struggled to keep ahead of inflation and posted similar modest real returns. In fact, we can and will use Irish financial history as a good proxy for world financial history.

The returns for the second half of the century bare out the pattern above: equities outperform bonds and cash. However, the margin of outperformance of equities was somewhat wider in the second half of the century.

The table above shows that the bond and cash investor did not fare well over the 20th century. Only an investor with 40% or so in equities would have achieved the target real return of $3^1/_2$% per annum. Our target rate was achievable over the 20th century, but in a manner that was quite different from earlier times.

Part II of this report takes a closer look at how to structure an investment strategy to achieve the reasonable rate of return set in the planning process.

Diverting Digression 2: A Wholly Good Investment Tip

Ecclesiastes (VIII:13) advises 'Lend not to him who is mightier than thou'. As an investment tip this is good advice that even the 20th century investor was paid to heed.

We are all equal in the eyes of the law but some – those who have the power to make and change the law or the economic environment – are more equal than others. The financial advantage of having such power offers manifest advantages over the long run.

Government usually borrows at fixed nominal rates and the government can control the real repayments to be made by controlling the level of inflation in the economy. Few can be surprised that the level of inflation tends to be high when the level of government debt is high. The tale of the second half of the 20th century was of persistent and sometimes high inflation, often explicitly engineered by the government (in pursuit of higher growth and employment). This ensured that bonds fared poorly in real terms, lagging the real return delivered by other asset classes considerably. The great economist Keynes, seeing the operation of this force in history, declared in 1923 that 'this progressive deterioration in the value of money through history is not an accident, and has had behind it two great driving forces – the impecuniosity's of governments and the superior political influence of the debtor class'.[18]

Ecclesiastes had earlier seen the conflict of interest that a powerful borrower had and how it was likely to be resolved. Indeed, the investment dictum was followed through most of history by refusing to lend, or charging penal high rates of interest, to princes. The bond investor in the second half of the twentieth century got an expensive history lesson.

[18] Keynes, J.M. (1923), *A Tract on Monetary Reform*. Vol. IV in The Collected Writing of John Maynard Keynes. Royal Economic Society. Quote is from page 8.

The Review

Difficult to forecast

A reasonable savings plan, and the dedication to stick to it, is not enough to ensure the targetted pension come retirement. The future will inevitably differ from the assumptions underlying the plan. For instance, it may be that you opt for a different retirement age or failing health may indicate that 20 years is too optimistic a draw-down period. But one assumption is bound to be wrong – the assumed rate of return on investments. It simply is not possible to forecast this key assumption with anything like the certainty demanded by the pension saver.

Review regularly

It is possible to allow for the uncertainty of the future. The trick is to build a control into the savings plan at the outset so that, when the actual experience differs from that assumed, the savings plan can be tweaked back in the right direction. Our saving plan, outlined earlier, was particularly sensitive to the assumed rate of investment return. The actual return achieved on the fund must be compared with the $3^1/_2$% rate assumed, to determine what adjustments are needed to the future contribution rate. These calculations are 'straightforward' exercises in compound interest.

The prudent investor must have regular reviews. These reviews allow the plan to be altered to take into account new information to ensure the target pension is still met. This review may be once every five years when retirement is more than a decade away, reducing to once every three years and then, with five years to go, every year. At this frequency of review, the changes to the savings plan tend to be small as whatever shortfall or excess is revealed can be made up with a slight alteration to the future saving rate.

Saving for a pension is like steering a large ship towards a distant port. If it goes off course after a few miles then only a small change in its course is necessary to home in on its distant target again. As the port is approached, the bearing is checked more frequently to ensure no large swerve is needed.

Part II: Investment Strategy

OR WHAT TO BUY

Evaluating the Different Asset Types

So having established a sensible funding plan and decided the frequency of regular reviews, now what should the accumulated assets be invested in?

What will deliver the returns

The funding plan has an implicit real rate of return that is believed achievable over the long term. The investment strategy should be consistent with delivering a return of at least this magnitude, with an acceptably low probability of falling short of it. The question is: do assets exist that deliver the required proceeds, in both timing and amount?

No, is the straightforward answer. Very long-term index-linked gilts are the most closely approximating asset, as discussed in Part I, but are not generally available. There does exist a small, relatively new market in such securities but it is neither deep nor broad. At most, index linked securities can form only part of the investment portfolio. One must look further afield.

Inflation risks

Prior to the Second World War, the fixed interest markets were the natural haven for the risk averse investor. Over centuries, the stability of interest rates and inflation led to a reassuring predictability of real financial outcomes from this asset category. For most of the period, the financial industry's infamous '3-6-3' Rule worked extraordinary well: borrow from depositors at 3%, lend at 6%, and be on the golf course by 3 o'clock! So, if we were advising the pension saver prior to World War II, the stability witnessed in interest rates and inflation would have led us to entrust the greater part of funds to this asset category. However, the stability observed was to break down in the second half of the 20th century. From the 1950s, the higher and more variable level of inflation has reduced predictability of real returns. Finance professionals have had to work harder from that time (although, it must be admitted, some of them maintain remarkably low golf handicaps!).

Financial history over the last 50 years has taught us, if nothing else, to be more circumspect in our predictions. Despite widespread modelling of the markets from academics, fund managers, and other professionals, the markets continue to defy the predictions of the best models available. To some extent, of course, this is logical. The markets adjust prices to reflect all new information, which includes the predictions of models, thus invalidating those predictions. This is known as the 'efficient market hypothesis'. It assumes that everyone tries to beat the market (so prices adjust properly to news) and then shows that this implies that nobody can. Despite this, we still try – even the very clever.

Pension Plan book unplanned 4/12/02 1:06 PM Page 21

Diverting Digression 3: Do what I say, not what I do...

Robert C. Merton is one of the leading authorities in the study of the financial markets. He is the man who came up with a revolutionary new way to price options. His work was awarded the Nobel Prize in 1997 (together with Myron Scholes). In theory, Merton understood the limitations of our models of the markets. Addressing The Royal Society at the end of 1993, he said:

"Any virtue can become a vice if taken to an extreme, and just so with mathematical models applied to finance. I therefore close with an added word of warning about their use. At times the mathematics of the models become too interesting and we lose sight of the models' ultimate purpose. The mathematics of the models are precise, but the models are not, being only approximations to the complex, real world. Their accuracy as a useful approximation to that world varies across time and place. The practitioner should therefore apply the models only tentatively, assessing their limitations carefully in each application."[1]

However, in practice, Merton enjoyed playing the markets like the rest of us. As early as 10 or 11 he bought his first share (General Motors) and, when studying mathematics at Cal Tech, he routinely began his day at 6:30 a.m. trading stocks and shares at a local brokerage house for a couple of hours.[2]

However, Merton dramatically reinforced his cautionary remarks on applying mathematical models without suitable caution. In 1993 Merton, Scholes and other academics got together with high-profile traders lead by John Meriwether to found a hedge fund, Long Term Capital Management (LTCM). After a promising start, the fund hit a bad patch in August and September 1998. On August 17th Russia signalled it would default on debt repayments, which created significant volatility in bond markets around the world. LTCM had about $4 billion in capital (over 40% belonging to Merton and the 15 other partners), but borrowed heavily (having $125 billion on-balance sheet and $1.25 trillion off-balance sheet). The market jitters hit them heavily. On 21st August the Fund lost $550 million, suffered another $550 million loss on 21st September, and with the intervening days also poor, the hedge fund ended up with just $400 million capital left of the $4 billion by 28th September. The Federal Reserve felt compelled to intervene as the complete meltdown of LTCM, as its chairman Alan Greenspan made clear, 'could have potentially impaired the economies of many nations, including our own'.[3] This incident reinforces the truth of Merton's earlier observation far more dramatically than he might have wished.

[1] Merton, R. C. (1993), *Influence of mathematical models in finance on practice: past, present and future.* In Mathematical Models in Finance, Howison, Kelly, Wilmott (Editors), Chapman & Hall for The Royal Society (1995).

[2] Merton, R.C. (1997), *Robert C. Merton – Autobiography.* On the Nobel Prize website: www.nobel.se/economics/laueates/1997/merton-autobio.html.

[3] Jorion, P. (2000), *Risk Management Lessons from Long-Term Capital Management.* European Financial Management, Vol. 6, 277-300.

The modern parable of how the markets parted Merton from his Nobel Prize money (awarded for pricing market risk) should bring little amusement to the pension saver. It is to these capricious markets that they must entrust their standard of living in retirement.

Build a portfolio

The problem thickens. No single asset class is designed to deliver the proceeds sought by the pension saver, hence the saver must build a portfolio of assets that comes close to achieving their objective. To arrive at such a portfolio, it is necessary to know, at the very least, the future terms at which re-investment can be made and the impact of unanticipated inflation. However, this inevitably involves some sort of market modelling, as we must make some predictions. Yet market modelling is still too crude and approximate an exercise to provide the pensioner with the comfort demanded.[19]

Use past returns as a guide

There is a straightforward way out of our dilemma. Every proposed model of the markets, to be worthy of consideration, must be consistent with the past returns generated by the market. So we can model the markets in a naive way by simply using the past returns of the market as a guide. On the basis that the long-term future will resemble the long-term past, we can piece together the sort of returns that can be expected in the future (and the risks associated with these returns). What is proposed here is to break-down the 101 year aggregated returns from the markets summarised in Table 1 earlier so we can better understand the manner in which, year-by-year, the returns are delivered.

[19] A concise review of the major ideas in modelling the markets, their development, and how the models fit reality is given in Whelan, S.F. et al. (2002), *A Primer in Financial Economics*. British Actuarial Journal, Vol. 8, Part 1. This justifies to some extent the generalisation of the Merton parable to this stronger statement.

Irish returns are representative

We can use Irish financial history as our guide as it has broadly reflected global financial history. In fact, prior to the First World War, global markets were more integrated than they have been subsequently[20] and Ireland, as part of the dominant empire of the time, was more integrated than most. So, by taking a closer look at our own financial history, we are capturing the lessons the world economy has to offer.

The investor has a choice of several different asset types – cash, bonds (or fixed interest), equities, or property – and will typically maintain a portfolio with each of these asset types represented to some extent. We want to explore the likely outcome from all the possible portfolios and then select the one that looks the most suitable. Clearly, there are too many possible portfolios to be iterated one-by-one so we need a way to summarise the results. One way to do this is set up a three-step procedure to:

(i) map out the risk and rewards from each class of security, then

(ii) understand how the different security classes interact together, so that

(iii) we can understand the overall risk and return characteristics of any constructed portfolio.

Appendix I sets out the salient features of Irish financial history since 1900 for all asset classes bar property.[21] The return on property has only been traced back three decades, which provides rather too little data to form a reliable picture on how this asset class behaves.[22] However, as the digression below highlights, the Irish saver probably has more than enough exposure to property assets already.

[20] O'Rourke, K.H. & Williamson, J.G. (1999), *Globalization and History*, Chapter 11. Of course, the world had essentially one currency back then – the gold standard.

[21] Whelan (1999) traces Irish financial history back to 1783 with more data series than reproduced here. The wage rates of Irish carpenters and others in the building trade have been traced back to 1667 (D'Arcy, F.A. (1988, 1989)). Appendix I updates Whelan (1999), taking account of recent research by Dimson, Marsh, & Staunton (2002), especially in recasting Irish equity returns in the period 1900-1933, and now includes a wage index.

[22] Property has been, perhaps surprisingly, a poor investment over the very long term. This is because property is leased to generate income and the lease terms in the nineteenth century and earlier tended to be very long (e.g., 999 years) with no rent reviews allowed. This lease structure, reasonable when inflation was counterbalanced by deflation, proved disastrous to the investor in the inflationary 20th century.

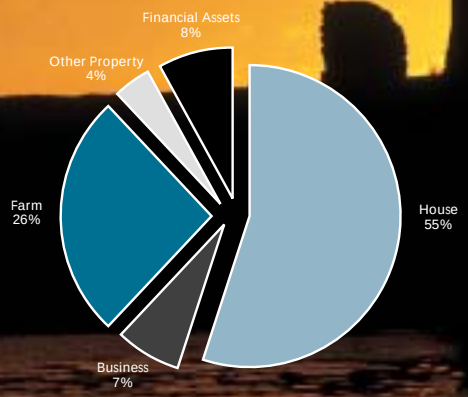
Diverting Digression 4: The Irish: Outstanding in their own Field

Investment decisions should properly be made in the context of the total balance sheet of wealth of the individual. For instance, a dairy farmer is best to avoid investing any part of their pension fund in Irish agricultural co-operatives; similarly, a local grocer is best avoiding any further investment in retail outlets so as to help mitigate overexposure to one sector. The total balance sheet of wealth would include such tangibles as house, farm, life assurance policies, as well as pension and other savings but would also include intangibles such as human capital (e.g. good reputation or professional qualification) and even possible contingent future payoffs (e.g. the expected settlement from a rich ill relation).

Housing is often the single biggest component of an individual's total tangible wealth portfolio. Housing represents one-quarter of the tangible wealth of the average US household (more than four times that invested in equities) and in western Europe the proportion is estimated to be higher – maybe as much as 40%.[1] The Irish, though, always appear top or next to the top in international comparisons with over 80% of Irish households owning their own home. The percentage is higher than Britain and the US (both less than 70%), considerably higher than Japan, France and the Netherlands (between 50% and 60%) and double that of Germany. Any investment advice to an Irish householder should, at a minimum, reflect this considerable proportion of their invested wealth.

A detailed survey of the financial wealth of Irish households excluding pension entitlements was conducted by the ESRI in 1987.[2] The graph below summarises the distribution of total tangible wealth when the equity in the house (house value less outstanding mortgage), wealth in farm land and other assets are taken into account. We find that the Irish are particularly keen on property – with 85% of their net wealth invested in their house, farm, or other property investments.

Graph 6: Average Distribution of Irish Tangible Household Wealth, excluding Pension Entitlements



Irish people invest primarily in bricks-and-mortar, land, or other property to an unusual extent – they are outstanding in this (probably in their own) field. It would seem sensible not to invest any of their pension assets in property – or, at least, not in Irish property. Also, it is perfectly reasonable to take account of the capital tied up in your house in your retirement savings plan now that products exist to convert part of this capital into income.

[1] Economist, The, 30th March 2002, *Special Report on House Prices*, 65-67.

[2] Honohan, P. & Nolan, B. (1993), *The Financial Assets of Households in Ireland*. ESRI, General Research Series No. 162. The graph above is based on Table 7.1.

The Suitability of the Different Asset Classes

Re-investment risk

Before we begin the purely statistical analysis, a few general remarks are in order. While neither category of asset match the requirements of the pension investor, some come closer than others. Two key risks have already been identified. The first is re-investment risk. That is, some of the future proceeds from investments currently made will have to be invested again as such proceeds are not wanted until retirement. The terms on which this re-investment can be made depend on future investment conditions, which are unknown. Hence the ultimate pension depends on future unknown investment conditions. Cash, for instance, is an asset that leaves the investor most exposed to re-investment risk. At the end of the short investment period of cash instruments, all the proceeds must be invested again at an unknown rate. Next, in order of exposure to re-investment risk, are bonds because of their higher running yield and generally shorter maturity, then property and finally equities.

Inflation risk

Another significant risk to the pension saver is unanticipated inflation. We ideally seek an investment that can generate a positive real return, irrespective of the actual inflation level. Long-term bonds are clearly most exposed as they give a nominal level of income, irrespective of how inflation changes in the future. The current yield on bonds reflects the markets' best estimate of future inflation, including an inflation risk premium. However, the yield is prone to change quickly and dramatically when current expectations on inflation change – an all too often occurrence to which the fixed interest investor is fully exposed. Next, in order of exposure to the risk of unanticipated inflation, are equities. The very short-term nature of cash investments means that the interest rate on cash can respond quickly and with little capital loss to a changing inflationary environment.

Equities not an inflation hedge

It may surprise the reader that equities, long regarded as a hedge to inflation, may not perform well in inflationary times. The theory that there is a positive relationship between inflation and the nominal return on stocks (so that they both move up and down together) is generally known as the Fisher Hypothesis, after the famous mathematical economist, Irving Fisher.[23] While there is evidence that the Fisher hypothesis holds for Irish and UK equities, it has been shown not to hold in equity markets generally. In particular, equities have not demonstrated themselves an inflation hedge in the US and in the major euro equity markets.[24] In short, no consistent positive relationship is evident between equity returns and inflation in most economies. Accordingly, the Irish pension saver would be unwise to rely on equities hedging inflation in the future.

Step 1: Modelling the Risk & Return Payoff of Irish Cash, Bonds, and Equities

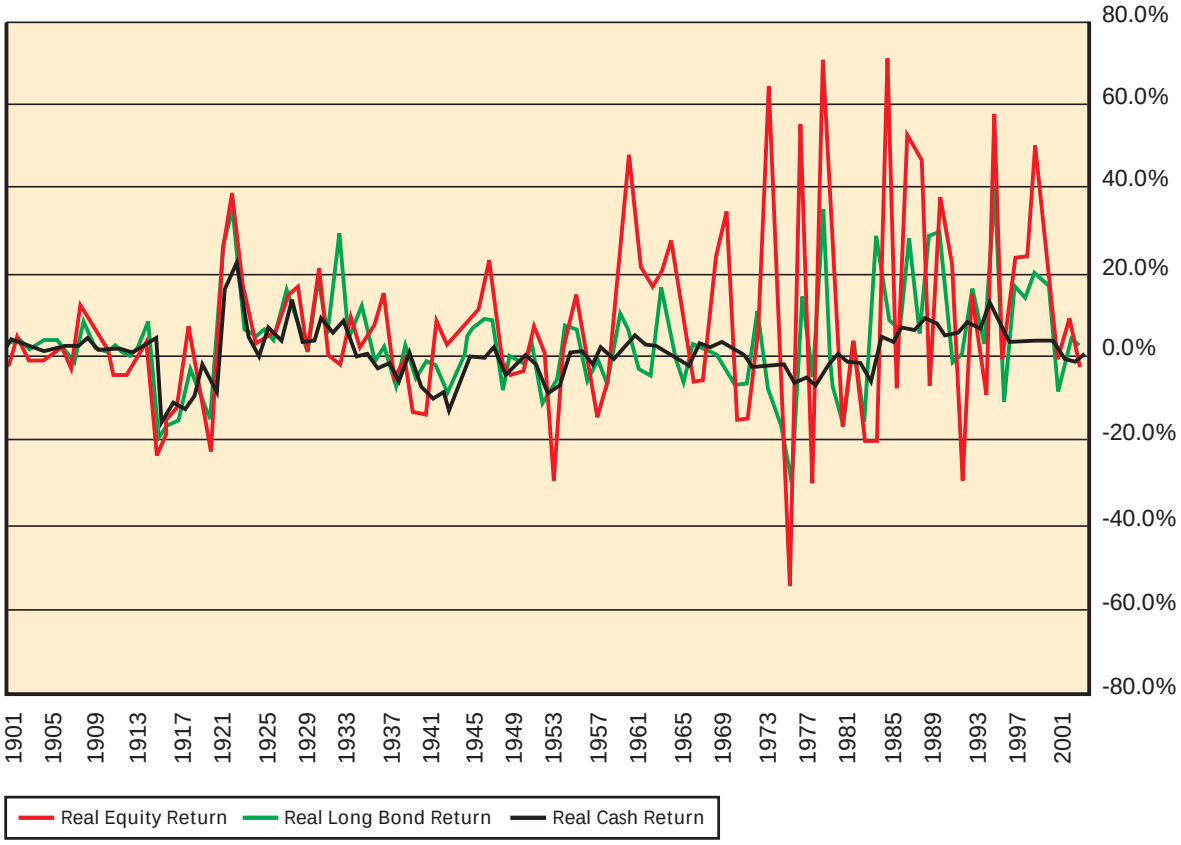
We use the complete data set of 102 annual returns for each asset class since 1900 to picture how each might be expected to perform in the future. Our analysis will focus on the real return that they can deliver rather than nominal returns.

Table 1 earlier summarised the average real return delivered by each asset class over the last 101 years. This section is primarily concerned with the manner in which those returns were delivered. Graph 7 contrasts the percentage real return of each asset class with each other over each year of the 20th century. We see that all the markets got progressively riskier as the century progressed, with the amplitude of real return swings increasing. From the early 1960s, equities get appreciatively riskier than either bonds or cash.

[23] Irving Fisher (1867-1947) had the dubious distinction of playing the role that Merton now plays in showing that even clever people lose a lot of money playing the markets. Fisher was a professor at Yale who was the leading authority of the day on the theory of interest and capital. He is popularly remembered for saying that "stock prices have reached what looks like a permanently high plateau" just days before the 1929 Crash. Fisher lost his self-earned fortune of $10m in the subsequent crash and became so indigent that Yale has to buy his house and rent it to him to save him from eviction.

[24] For Ireland, see the working paper by Ryan, G. (2002) *Irish Stock Returns and Inflation: A Long Horizon Perspective*. For international evidence across 26 equity markets capturing more than 60% of the capitalisation of all equities in the world over the period 1947-1979, see Gultekin, N.B. (1983) *Stock Market Returns and Inflation: Evidence from Other Countries*. Journal of Finance, 38,1,49-65.

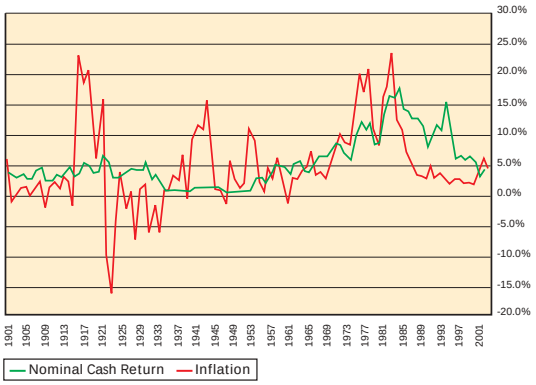
Graph 7: How the Different Asset Classes Delivered Real Return, 1900-2001



Irish Cash (Now Euro Cash)

The rate of inflation in Ireland each calendar year is graphed below alongside the nominal return on cash in that calendar year. We see that the two series tend to move in line with one another, although the inflation series appears more volatile. In particular, we notice that the nominal return on cash tends to be higher than inflation in many years and this is especially noticeable when the inflation rate is stable.

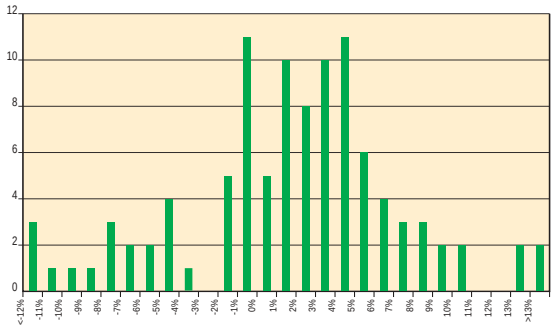
Graph 8: Irish Inflation and Nominal Return on Cash, Each Year, 1900-2001



The interest rate earned on cash tends to have a reasonably stable relationship with inflation, as could be expected.

Another way of presenting the above data is by a histogram. Here we count the number of years the real return was, say 2%, and plot its frequency. This allows us to get a rough-and-ready feel for the likelihood that the return will fall below (or rise above) a certain value, simply by counting the proportion of times in the past the event has been observed. The graph below does this for the full range of returns delivered each year in the twentieth century.

Graph 9: Histogram of Real Returns from Irish Cash, Each Year over 20th Century



Cash returns 1% to 6 %

The graph captures how regularly the real return has been delivered. We see that real returns from cash are most likely to be in the range –1% to +6%, although values lower than –14% and higher than +11% have been posted in some years. This graph, by outlining the full range of outcomes in the past, captures the riskiness of investing in cash.

Average 0.7% p.a.

Finally, the above figures can be summarised in tabular form. We note that the real return from cash averaged 0.7% p.a. over the twentieth century, but the rate has been higher in more recent times. The standard deviation (SD) column gives a rough measure of the risk associated with using cash to match inflation.

Table 3: Key Historical Statistics on Irish Cash Returns

Years Ending 31 Dec 2001	Nominal Return	Real Return	Of Real Return			
			Average[25]	SD	Min.	Max.
25	10.0%	3.6%	3.7%	4.3%	-5.7%	12.6%
50	8.0%	1.6%	1.7%	4.3%	-7.2%	12.6%
75	5.8%	0.7%	0.8%	5.1%	-12.3%	12.6%
100	5.2%	0.7%	0.8%	6.0%	-15.7%	22.7%
Since Start 1900	5.2%	0.7%	0.8%	6.0%	-15.7%	22.7%

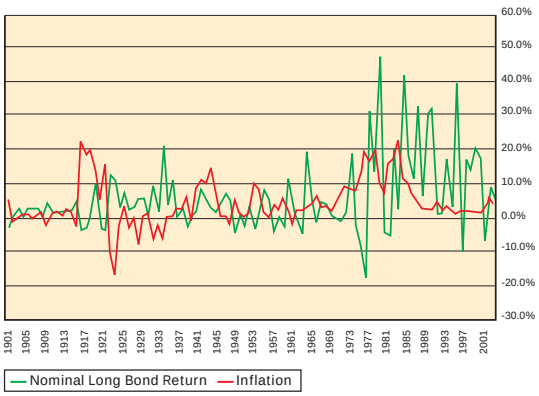
We apply the same way of presenting past returns on the gilt and equity markets.

[25] That is, arithmetic average of real returns in each year as opposed to the geometric averages shown in the earlier column.

Irish Bonds

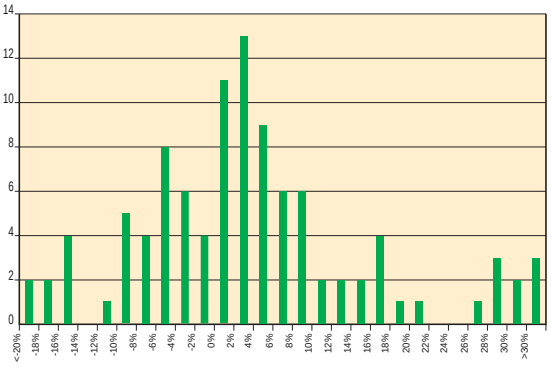
The nominal return on gilts in Ireland each calendar year is graphed below alongside the rate of inflation in that calendar year. We notice that, from 1900 to the late 1960s, the two lines tend to be close together, indicating a stable and therefore reasonably predictable real return from bonds in any year.

Graph 10: Irish Inflation and Nominal Return on Long Gilt, Each Year over the 20th Century



The relationship between gilt returns and inflation has clearly been more volatile since the early 1970s, with big gains or losses relative to inflation being posted from that time. The last decade or so has been unusually good for gilts, as the inflation expectations built into their yields by the start of the 1980s proved too pessimistic. The Irish trend above faithfully reflects international trends.

Graph 11: Histogram of Real Returns from Irish Long Gilt, Each Year, 1900-2001



Gilts return 2% to 4%

The histogram shows the wide spread of the real returns delivered by gilts. While the mode was a real return of between 2% and 4%, real returns lower than –20% and greater than +30% have been observed.

Average 1% p.a.

Finally the table captures the cumulative effect of such gains or losses up to the end of the year 2001. The real return over the last 25 years has been unusually high, just over 1% p.a. being the annual average for the twentieth century as a whole. Notice that the standard deviation of the real return – our proxy for short-term risk- is roughly three times that of cash.

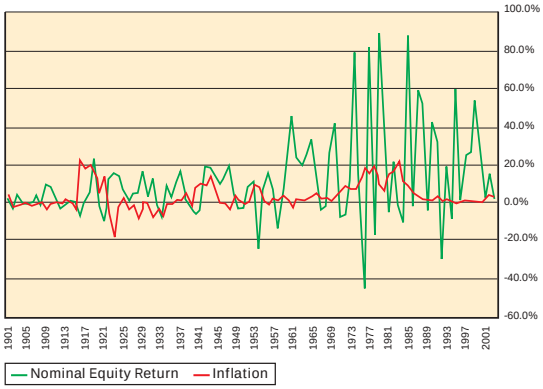
Table 4: Key Historical Statistics on Long Gilt Returns

Years Ending 31 Dec 2001	Nominal Return	Real Return	Of Real Return			
			Average	SD	Min.	Max.
25	13.7%	7.0%	8.2%	15.9%	-18.0%	37.9%
50	8.2%	1.8%	2.7%	14.2%	-31.1%	37.9%
75	6.7%	1.5%	2.3%	12.7%	-31.1%	37.9%
100	5.6%	1.1%	1.8%	12.5%	-31.1%	37.9%
Since Start 1900	5.5%	1.0%	1.7%	12.4%	-31.1%	37.9%

Irish Equities

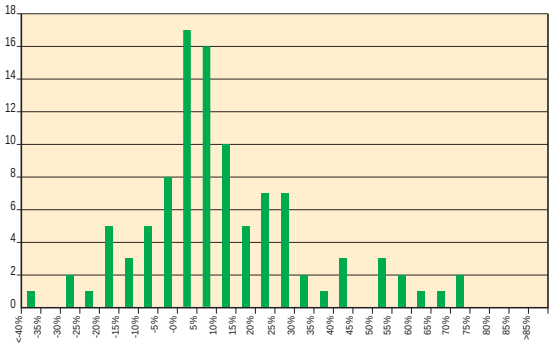
Finally, we turn to the Irish equity market. The graph of inflation and the total return (capital and income) from equities in any one calendar year is shown below. A similar pattern to that presented in the gilt graph is evident: in the early years of the century the relationship between inflation and the equity return was more regular than from the inflationary 1970s onwards. The muted feature of equity volatility over the first half century is an unusual feature of the Irish equity market compared to other equity markets.[26]

Graph 12: Irish Inflation and Nominal Return on Equities, Each Year over the 20th Century



Drawing a histogram to picture the extent and frequency of the fluctuations in the real return delivered by equities produces the following result:

Graph 13: Histogram of Real Returns from Irish Equities Each Year, 1900-2001



Difficult to predict equity returns

This pattern is more irregular than the earlier ones, showing how difficult it is to predict the real return from equities and, therefore, how risky it would be to rely upon an all-equity investment to produce a regular real income. The table summarises the return and risk statistics.

Table 5: Key Historical Statistics on Irish Equity Returns

Years Ending 31 Dec 2001	Nominal Return	Real Return	Of Real Return			
			Average	SD	Min.	Max.
25	20.2%	13.2%	16.8%	29.5%	-31.1%	69.9%
50	14.6%	7.8%	11.6%	28.8%	-54.3%	69.9%
75	11.8%	6.4%	9.1%	24.3%	-54.3%	69.9%
100	9.6%	4.8%	7.1%	22.3%	-54.3%	69.9%
Since Start 1900	9.4%	4.7%	6.9%	22.1%	-54.3%	69.9%

Higher real returns

Two main points emerge. The real yield on equities has been significantly higher than that of either bonds or cash over the past. The short-term risk, measured by the standard deviation of real returns, has been roughly twice that of gilts and six times that of cash.

[26] See Lucey, B. & Whelan, S.F. (2001) *A Promising Timing Strategy in Equity Markets.* Journal of The Statistical and Social Inquiry Society of Ireland, forthcoming.

Step 2: How the Different Asset Classes Interact

The analysis above explored how each individual asset class is likely to meet the funding objective. We also got a handle on how uncertain the outcome is by taking the dispersion of real returns as a measure of risk. Typically, of course, a pension portfolio will consist of a mix of such assets so in order to understand how the portfolio will behave it is necessary to know, in addition to the risk and reward profiles of the individual asset classes, how the asset classes will interact.

Correlation

Ideally, we would like all assets to do well all the time. However, this is not to be. Our second preference is to observe a tendency for one asset to do well when another does poorly so the two, when combined, produce a more predictable outcome. We would prefer not to see the different asset classes always produce their good and bad returns at the same times.

Now, the 'correlation coefficient' is a simple measure of the tendency of one asset class to produce good and bad returns in tandem with another asset class.[27] It is recorded on a scale of –1 to +1, where –1 means that they move exactly opposite to each other and +1 means they always move exactly in tandem. A zero score implies that there is no simple relationship between the two. Given the risk and reward information about each individual asset classes above and their mutual correlation coefficients, we can determine the risk and return profile of any portfolio constructed from those asset classes.

Below we set out in tabular form the correlation coefficient of the different asset classes estimated from annual real returns over the last 102 years (see appendix II).

Table 6: Correlation Coefficients Between Asset Classes, Based on Annual Real Return Data, 1900-2001

	Equity	Bond	Cash
Equity	1.00		
Bond	0.57	1.00	
Cash	0.36	0.66	1.00

Bad news

The above correlation matrix is not good news. All the coefficients are positive, which tells us that all the asset classes tend to register good and bad returns at similar times. The correlation coefficients are, however, less than one so there are some diversification benefits in a mixed portfolio, and further, these benefits are strongest between cash and equities. We also investigated the relationship over shorter periods ending 2001 and can report that there appeared little change in the equity-bond correlation coefficient but the cash-equity and cash-bond relationship seemed less stable but always the same sign. The table below shows how they varied together over the last twenty-five years.

Table 7: Correlation Coefficients Between Asset Classes, Based on Annual Real Return Data, 25 Years to End 2001

	Equity	Bond	Cash	Property
Equity	1.00			
Bond	0.51	1.00		
Cash	0.08	0.38	1.00	
Property	0.12	-0.17	-0.33	1.00

[27] In fact, the square of correlation coefficient between two asset classes (known as the 'coefficient of determination') gives the proportion of the movements of one asset class that can accounted for by movements of the other.

Property offers diversification

Property is included in the above table and is shown to have very worthwhile diversification benefits, with its low or negative correlation with the other asset classes. Taking both tables together, it seems reasonable to take the correlation between equities and bonds as about 0.5, between equities and cash as about 0.2, and between bonds and cash as about 0.5.

The tables of cross-correlations shown between Irish asset classes are also typical of international asset classes. For instance, the correlation between real returns of equities and bonds in the UK from 1919 to 1996 was 0.56, that for equities and cash 0.25 and that between bonds and cash 0.61 (*BZW Equity-Gilt Study 1997*).

[28] Equally, the correlations tend to vary according to the time period over which they are measured with the real bond-equity return correlation 0.57, the equity-cash 0.16, and bond-cash 0.18 in the period 1983 to 1996 (*BZW Equity-Gilt Study 1997*).

Step 3: Portfolio Construction

Steps 1 and 2 above consist of a structured investigation into how the different asset classes delivered their real returns in the past. From this analysis, we can make an informed judgement as to what the real rates of return might average over the long term future, together with the associated risks and the interaction between all the asset classes. Now 'informed judgement' leads us to an estimate that will doubtless prove to be wrong but it is the best we can do in the face of such uncertainty. Of course, we have built in the automatic stabilisers of frequent reviews to ensure we do not go far wrong.

Key table

A reasonable interpretation of the past statistics as a basis to project the future, might be to suggest the following table of risks and rewards from each asset class:

Table 8: Possible Assumptions to Model Real Returns for Portfolios

Assets Class	Expected Annual Real Return	SD of Real Returns (Risk)	Correlation Coefficient with		
			Equity	Bond	Cash
Equity	5%	25%	1.0	0.5	0.2
Bond	$3^1/_2$%	13%	0.5	1.0	0.5
Cash	2%	6%	0.2	0.5	1.0

The real returns on equities are adjusted downwards to reflect the belief that it is not prudent or realistic to forecast such a superlative performance in the future, especially now as there are so many long term investors bidding up the price (and down the return of such securities). Bonds are adjusted upwards as bond-holders have clearly learned an expensive lesson from the bouts of inflation in the last three decades – we take $3^1/_2$% p.a. so that the expected real yield on conventional bonds match that of index-linked stocks around the world. Finally, we take the real return from cash as below that of bonds, as it is inherently a safer asset class.
The measure of risk for each asset class is roughly that experienced over the last century and the assumed correlations are as outlined in Step 2.

Aim for $3^1/_2$%

On the basis of the assumptions outlined in Table 8 above, we can solve for the portfolio mixes that are expected to deliver the assumed $3^1/_2$% real return. There are many such portfolios – for example, 100% bonds, or 50% equities and 50% cash, or one-third of each of equities, bonds, and cash. The question is which of these portfolios is best in the sense that the risk is minimised for the real return target of $3^1/_2$%? A further bit of investigation (involving calculating the risk for every portfolio with an expected real return of $3^1/_2$%) reveals that the portfolio with minimum risk comprises 23% equities, 54% bonds, and 23% cash.

Best mix

The portfolio with the least risk (known as the 'efficient portfolio') for any target return can be obtained from the data in Table 8. However, the calculations are very sensitive to the figures assumed in the Table, especially the return figures. This means that the output of our simple asset-liability model is heavily dependent on the inputs, in particular to those inputs in which we have least confidence. We are faced with an acute case of a GIGO model – a garbage in, garbage out model. The obvious way forward is to treat the outputs of the model as only a very broad guide, supplementing the model's predictions with common sense.

GIGO model

The high liquidity and bond weightings (some three-quarters of the minimum risk portfolio) leave us heavily exposed to reinvestment risk. It also appears to be a very staid investment policy, with only a modest exposure to the roller-coaster equities. How might we tinker with the model to get answers we are more comfortable with?

Immature Scheme or Young Pension Saver

One possible way to use the model is to recognise the implicit risk tolerance of the investor. The young pension saver (more than a decade to go to retirement) or immature scheme (a suitably high ratio of future service liabilities to past service liabilities) might argue that, as no asset is a good match anyway for such a long investment horizon, we should invest with the hope of achieving a realistic, but high, return. So, even if the actual return falls short of the target it might still produce a perfectly acceptable return and one that is in line with the long-term funding strategy. In essence we are playing for a win, even though a draw is acceptable. This strategy, termed an aggressive strategy, recognises that the key long-term risk to the funding strategy is underperformance of the investments, and seeks to minimise this risk.

Aim for $4^1/_2$%

On the basis of the assumptions in Table 8, the highest real return we can target is 5% (with a 100% equity portfolio) and the associated risk is very high at 25%. What portfolio would our simple model advise if our target return was, say, $4^1/_4$%? (This rate is chosen as it is halfway between the assumed maximum long-term return of 5% from Equities and our funding level target of $3^1/_2$%). It turns out in this example that the risk is best diversified by a portfolio split equally between equities and bonds with no cash. This portfolio, under the assumptions, produces an average real return of $4^1/_4$% but with a risk of 17%. That is, we are managing to achieve a return considerably higher than bonds without increasing the risk very much.

Mature Scheme or Older Pension Saver

Reduce risk

Now, as retirement approaches, the investor becomes more concerned with insuring that the stock markets do not frustrate the pension plan. Time is now running out and the focus naturally changes to the short-term risk inherent in the investment strategy. The investor is now keener to trade off rewards to mitigate risks, recognising that the key risk is now a capital loss on investments not the opportunity cost.
So, let us say, that we would reduce our target rate to $2^{3}/_{4}$% (that is, half way between the assumed expected return of 2% from Cash, the safest asset, and our targeted funding rate of 5%) if the risks were considerably lower. Well, our model now dictates that a portfolio comprising 13% equities, 24% bonds and 63% cash will produce the required return with the risk minimised at 7.8%.

Aim for 2%

These examples show how we can use the historic market return statistics, suitably interpreted, to build a simple model to guide us in constructing portfolios that optimise our investment strategy, given a targetted return. Other models can be built with different investment objectives, such as targeting a nominal annuity from retirement or maximising return subject to a risk constraint. The models though, are only guides and must be used with common sense – recall Merton's wise words. The output of such models give us a starting point from which to build our investment strategy.
In particular, of course, current market conditions must also be incorporated into the investment policy. Flawed as they are and wrong as they are sure to be, our models try to distil the essence of our financial history to inform our future. What else can we do?

Diverting Digression 5: Bigger is not Better: Lessons from Macro-Econometric Modelling

Macro-economics concerns itself with describing the relationship between aggregated economic variables – inflation, interest rates, economic growth, employment etc. Macro-econometrics attempts to predict the precise change in these variables (that is, say, estimate the percentage change in the unemployment rate when short-term interest rates are raised by $^{1}/_{2}$%). Macro-econometricians provide a crucially important service to economic policy-makers as their models purport to predict the short and long term impact of policy decisions on the whole economy. It follows that when macro-econometricians get it wrong, the costs are inestimably large.

The 1960s was an unusually optimistic decade and, even by the standards of that time, macro-econometricians were unusually optimistic. They believed that they had cracked how the economy worked. They believed that by pulling this lever (say, lowering interest rates) that they could increase employment and economic growth. True, there were some details still to be worked out in their models, but nothing a few million pounds in research grants could not solve.

Policymakers in the US, UK, and even Germany fell under the guile of the econometricians.[1] The euphoria was particularly acute in the UK, whose economic problems were more pronounced than elsewhere. By the early 1970s macro-econometricians had built four large-scale models of the UK economy – namely, the Bank of England Model, the Treasury Model, the Model of the National Institute of Economic and Social Research, and the London Business School Model. These models were elaborate – a labyrinth of 500-1,000 equations – with the output of one being the input of another so that the knock-on effect of changing one policy instrument could be traced throughout the entire system. At last, we could control our economic destiny...

Well, not quite. The models proved less than useless – they were grossly misleading. Each model produced different outputs from the same inputs, and being so complicated, it proved impossible to say exactly why.

Worse, though, was that the predictions of all proved very wide of the mark.

And, again, it was difficult to say what was going wrong and thereby improve the models. The planned for miracle growth decade did not materialise: the 1970s was the UK's worse decade after the 1930s with stagflation (rising inflation against stagnant growth – a combination thought impossible in the earliest versions of the models), worsening unemployment, civil unrest, and even the ignobly of an IMF bail-out. By the early 1980s, macro-economic forecasters had lost credibility.

This is yet another tale of youthful overconfidence colliding with hard reality. But the lessons for those who attempt to forecast their financial future go deeper. It demands that we develop simple models: models must be seen to be flexible friends.[2] It advises that we have limited expectations of their accuracy – they are better than nothing, and the models we replace them with will be better still – but they may not be reliable.[3] It points out that big is not better in this instance. And, as always, it reinforces the motto of the stock exchange - caveat emptor – never naively trust the person selling you something, not even a dusty old academic.

[1] Deutsche Bundesbank (1988), *Forty Years of the Deutsche Mark*. Monthly Report, May 1988, 13-23.

[2] Whitley, J. (1997), *Economic Models and Policy-Making*. Bank of England Quarterly Bulletin, May 1997, 163-173.

[3] Blinder, A.S. (1998), *Central Banking in Theory and Practice*. MIT Press.

Conclusion

The past is a good guide

This overview of the elements of pension planning has, we hope, conveyed the flavour of the process. Historic return figures inform our expectations of what is a reasonable real return target, and these figures (adjusted somewhat) can be used as a guide to help construct suitable investment strategies over the long term future. The process is quite empirical or, for the pension saver, uncomfortably close to trial-and-error. Hence the funding plan and the investment strategy must be reviewed regularly and adjusted so that the targetted decent standard of living does not fall foul to the capriciousness of the capital markets.

Market failing pension saver

Why is it so difficult to provide for a specific pension? The market is failing to issue security types, such as very long-term inflation-linked bonds, which most suit the pension investor. This failing is likely to be only transitory – the market eventually responding with more appropriate investment instruments as such instruments will command a higher price, thus lowering the cost of capital to firms. But until such securities are issued, the current pension saver must forge out of the large second-hand market of securities, issued for different investors with different aims, an investment strategy that provides a reasonable pension with some peace-of-mind.

Risk of doing nothing

Finally, we save for last the biggest risk facing the future pensioner. It is what may be termed the 'ostrich risk' – the risk of doing nothing. While this booklet highlights the problems in trying to achieve a pre-set target pension, it should not obscure the plain obvious: any savings are better than none, and the more you save the better the standard of living you will have in retirement.

Appendix I: 20th Century Irish Financial History in Figures

Year Ending December	Equity Return	Long Bond Return	Cash Return	Property Return	Price Inflation	Wage Escalation	Equity Index	Bond Index	Cash Index	Property Index	Inflation Index	Wage Index
2001	1.6%	4.9%	4.5%	8.3%	4.2%	16.0%	1015.62	1049.49	1044.50	1083.00	1042.00	1265.02
2000	**15.7%**	**9.3%**	**4.3%**	**27.9%**	**5.9%**	**21.3%**	**1000.00**	**1000.00**	**1000.00**	**1000.00**	**1000.00**	**1090.54**
1999	2.2%	-7.0%	2.9%	31.1%	3.4%	11.2%	864.08	914.60	959.23	781.86	944.29	899.04
1998	25.5%	17.4%	5.5%	38.2%	1.7%	2.3%	845.62	983.69	931.84	596.39	913.24	808.84
1997	52.7%	20.7%	6.2%	25.3%	1.9%	8.5%	673.72	837.88	882.84	431.54	897.97	791.05
1996	26.1%	13.8%	5.5%	19.1%	1.9%	2.0%	441.19	694.21	831.31	344.45	881.26	729.23
1995	25.0%	18.0%	6.4%	13.2%	2.4%	2.0%	350.00	609.94	788.02	289.33	865.05	714.93
1994	1.1%	-9.8%	6.0%	15.6%	2.4%	3.4%	279.91	516.98	740.84	255.69	844.88	700.92
1993	59.0%	40.0%	9.4%	7.0%	1.5%	9.6%	276.79	573.20	698.74	221.26	825.46	678.10
1992	-7.8%	3.5%	15.2%	-2.0%	2.3%	9.7%	174.07	409.55	638.50	206.84	813.51	618.82
1991	18.9%	17.7%	10.6%	-0.3%	3.6%	14.7%	188.82	395.87	554.24	210.96	794.83	563.95
1990	**-29.2%**	**1.8%**	**11.5%**	**11.5%**	**2.7%**	**2.8%**	**158.78**	**336.42**	**501.06**	**211.65**	**767.19**	**491.48**
1989	30.9%	1.6%	10.1%	35.3%	4.7%	2.8%	224.39	330.62	449.53	189.88	747.02	478.29
1988	42.2%	32.3%	8.1%	17.9%	2.7%	2.8%	171.44	325.43	408.15	140.35	713.67	465.37
1987	-4.0%	30.8%	11.2%	9.8%	3.1%	6.7%	120.53	245.91	377.59	119.07	695.14	452.69
1986	51.3%	6.4%	12.5%	6.1%	3.2%	7.1%	125.55	188.04	339.42	108.47	674.48	424.39
1985	59.3%	32.8%	12.4%	-0.2%	4.9%	4.0%	82.99	176.80	301.67	102.20	653.84	396.26
1984	-1.8%	11.6%	13.9%	-0.9%	6.7%	9.2%	52.09	133.17	268.32	102.39	623.13	381.01
1983	86.7%	18.2%	14.1%	4.3%	10.3%	5.0%	53.04	119.28	235.48	103.37	583.96	348.79
1982	-10.6%	41.9%	17.6%	10.1%	12.3%	15.5%	28.41	100.89	206.38	99.13	529.42	332.19
1981	-2.0%	2.6%	16.3%	21.8%	23.3%	7.0%	31.77	71.10	175.51	90.00	471.41	287.61
1980	**21.4%**	**20.5%**	**16.2%**	**30.8%**	**18.2%**	**31.1%**	**32.41**	**69.32**	**150.91**	**73.87**	**382.28**	**268.80**
1979	-4.9%	-5.0%	13.7%	33.7%	15.9%	6.2%	26.69	57.55	129.83	56.46	323.30	204.97
1978	46.8%	-4.2%	8.9%	37.2%	7.9%	12.8%	28.05	60.58	114.14	42.24	278.83	192.99
1977	88.3%	47.6%	8.5%	25.0%	10.8%	10.0%	19.11	63.22	104.77	30.78	258.33	171.16
1976	-16.4%	13.6%	11.9%	11.5%	20.6%	18.4%	10.15	42.84	96.59	24.62	233.19	155.56
1975	80.8%	31.6%	10.8%	-3.7%	16.8%	16.6%	12.15	37.72	86.28	22.08	193.36	131.43
1974	-45.1%	-17.3%	12.2%	8.0%	20.0%	29.3%	6.72	28.67	77.84	22.92	165.49	112.74
1973	-12.7%	-7.6%	10.0%	35.1%	12.6%	9.3%	12.24	34.69	69.40	21.23	137.88	87.23
1972	77.0%	-2.8%	5.6%	19.4%	8.2%	10.2%	14.03	37.56	63.08	15.71	122.40	79.78

Year Ending December	Equity Return	Long Bond Return	Cash Return	Property Return	Price Inflation	Wage Escalation	Equity Index	Bond Index	Cash Index	Property Index	Inflation Index	Wage Index
1971	13.3%	19.0%	6.2%	19.2%	8.6%	11.9%	7.93	38.66	59.71	13.16	113.08	72.42
1970	**-6.2%**	**1.3%**	**7.8%**	**13.0%**	**10.0%**	**12.8%**	**7.00**	**32.48**	**56.24**	**11.04**	**104.11**	**64.74**
1969	-8.2%	-0.9%	8.5%		7.6%	23.8%	7.46	32.07	52.15	9.76	94.62	57.39
1968	41.1%	-0.1%	7.4%		5.4%	4.7%	8.13	32.37	48.07		87.94	46.35
1967	27.1%	1.1%	6.1%		2.6%	3.4%	5.76	32.41	44.75		83.40	44.26
1966	-1.7%	4.0%	6.4%		3.9%	7.3%	4.53	32.05	42.19		81.28	42.79
1965	-3.6%	5.0%	6.3%		3.2%	6.3%	4.61	30.81	39.64		78.26	39.88
1964	15.3%	-1.1%	4.8%		6.9%	0.0%	4.78	29.34	37.29		75.82	37.53
1963	33.0%	4.2%	3.8%		4.5%	12.5%	4.15	29.66	35.58		70.91	37.53
1962	24.4%	19.8%	4.4%		3.7%	3.0%	3.12	28.45	34.27		67.88	33.35
1961	19.2%	-4.2%	5.3%		2.5%	11.9%	2.51	23.74	32.82		65.45	32.38
1960	**23.0%**	**-1.9%**	**5.1%**		**2.8%**	**3.5%**	**2.10**	**24.79**	**31.16**		**63.82**	**28.94**
1959	45.1%	2.4%	3.5%		-1.7%	6.0%	1.71	25.27	29.67		62.10	27.96
1958	23.1%	11.7%	4.7%		2.7%	4.4%	1.18	24.69	28.66		63.17	26.38
1957	0.5%	-2.5%	5.0%		5.9%	0.0%	0.957	22.11	27.37		61.51	25.26
1956	-13.3%	0.6%	5.0%		2.4%	2.9%	0.952	22.68	26.07		58.10	25.26
1955	5.7%	-3.8%	3.0%		4.5%	6.4%	1.098	22.53	24.82		56.75	24.53
1954	15.7%	5.2%	1.8%		0.4%	0.0%	1.039	23.41	24.09		54.31	23.06
1953	6.7%	8.3%	2.8%		1.8%	0.0%	0.899	22.25	23.66		54.09	23.06
1952	-23.6%	1.3%	2.7%		8.9%	9.4%	0.842	20.55	23.02		53.13	23.06
1951	10.8%	-3.2%	0.9%		10.8%	11.6%	1.102	20.28	22.41		48.79	21.08
1950	**8.9%**	**3.5%**	**0.7%**		**1.9%**	**0.0%**	**0.995**	**20.94**	**22.21**		**44.05**	**18.89**
1949	-2.7%	-2.5%	0.6%		0.9%	0.0%	0.914	20.24	22.06		43.24	18.89
1948	-3.2%	1.6%	0.6%		2.3%	8.4%	0.939	20.74	21.92		42.83	18.89
1947	3.2%	-4.5%	0.5%		5.5%	0.0%	0.970	20.42	21.80		41.88	17.42
1946	20.0%	5.6%	0.5%		-1.7%	25.7%	0.939	21.38	21.68		39.71	17.42
1945	12.5%	7.4%	0.9%		0.7%	4.6%	0.783	20.24	21.57		40.39	13.86
1944	9.5%	4.5%	1.0%		0.7%	7.6%	0.696	18.85	21.37		40.12	13.24
1943	13.6%	1.6%	1.0%		7.7%	1.5%	0.635	18.03	21.15		39.85	12.31
1942	18.4%	3.0%	1.0%		15.2%	1.5%	0.559	17.75	20.93		37.00	12.13

Year Ending December	Equity Return	Long Bond Return	Cash Return	Property Return	Price Inflation	Wage Escalation	Equity Index	Bond Index	Cash Index	Property Index	Inflation Index	Wage Index
1941	19.5%	6.0%	1.0%		10.7%	1.5%	0.472	17.23	20.72		32.12	11.95
1940	**-3.9%**	**9.3%**	**1.0%**		**11.5%**	**4.3%**	**0.395**	**16.25**	**20.51**		**29.00**	**11.77**
1939	-6.3%	2.1%	1.2%		9.1%	0.0%	0.411	14.86	20.30		26.02	11.29
1938	-1.9%	0.5%	0.6%		-0.6%	0.0%	0.439	14.56	20.05		23.85	11.29
1937	1.7%	-2.6%	0.6%		6.6%	9.6%	0.447	14.48	19.93		23.99	11.29
1936	17.0%	2.9%	0.6%		2.5%	0.0%	0.439	14.87	19.81		22.50	10.30
1935	10.6%	0.0%	0.6%		3.2%	0.0%	0.376	14.45	19.69		21.96	10.30
1934	1.9%	11.8%	0.8%		0.6%	-1.2%	0.340	14.46	19.58		21.28	10.30
1933	9.6%	3.3%	0.7%		0.6%	-1.2%	0.333	12.94	19.42		21.14	10.42
1932	-7.9%	21.2%	1.9%		-6.1%	-1.2%	0.304	12.52	19.28		21.01	10.55
1931	-2.2%	1.8%	3.6%		-1.8%	-1.1%	0.330	10.33	18.93		22.36	10.67
1930	**13.1%**	**9.8%**	**2.6%**		**-6.1%**	**2.7%**	**0.337**	**10.15**	**18.27**		**22.77**	**10.79**
1929	2.3%	0.7%	5.3%		1.7%	2.8%	0.298	9.24	17.81		24.26	10.51
1928	16.9%	5.8%	4.2%		0.6%	2.8%	0.292	9.18	16.92		23.85	10.23
1927	5.4%	5.9%	4.3%		-7.4%	2.9%	0.250	8.68	16.25		23.72	9.95
1926	5.5%	3.3%	4.5%		0.5%	3.0%	0.237	8.19	15.59		25.62	9.66
1925	1.0%	1.8%	4.1%		-2.6%	3.5%	0.225	7.94	14.92		25.48	9.38
1924	6.0%	7.0%	3.5%		3.8%	2.7%	0.222	7.79	14.33		26.16	9.06
1923	13.5%	3.2%	2.7%		-1.6%	3.3%	0.210	7.28	13.85		25.21	8.83
1922	15.4%	11.2%	2.6%		-16.4%	3.7%	0.185	7.06	13.48		25.62	8.55
1921	12.2%	13.0%	5.2%		-9.2%	3.2%	0.160	6.34	13.13		30.63	8.24
1920	**-10.6%**	**-3.5%**	**6.4%**		**15.8%**	**3.7%**	**0.143**	**5.61**	**12.49**		**33.75**	**7.98**
1919	-2.1%	-3.2%	3.9%		5.9%	3.8%	0.160	5.81	11.74		29.14	7.70
1918	22.8%	9.9%	3.6%		15.3%	8.6%	0.163	6.01	11.29		27.51	7.42
1917	6.7%	0.4%	4.8%		20.5%	19.6%	0.133	5.46	10.91		23.85	6.83
1916	0.7%	-2.7%	5.2%		18.7%	24.4%	0.124	5.44	10.41		19.79	5.71
1915	-6.8%	-3.4%	3.7%		23.0%	0.0%	0.124	5.59	9.89		16.67	4.59
1914	0.9%	4.8%	2.9%		-2.0%	4.0%	0.133	5.79	9.54		13.55	4.59
1913	0.5%	1.9%	4.4%		2.0%	0.7%	0.131	5.52	9.28		13.82	4.41
1912	-1.6%	1.8%	3.6%		3.1%	0.7%	0.131	5.42	8.89		13.55	4.38
1911	-3.8%	1.7%	2.9%		1.0%	2.5%	0.133	5.32	8.58		13.15	4.36

Year Ending December	Equity Return	Long Bond Return	Cash Return	Property Return	Price Inflation	Wage Escalation	Equity Index	Bond Index	Cash Index	Property Index	Inflation Index	Wage Index
1910	**3.7%**	**1.6%**	**3.2%**		**2.1%**	**0.0%**	**0.138**	**5.23**	**8.34**		**13.01**	**4.25**
1909	7.9%	1.5%	2.3%		1.1%	0.0%	0.133	5.15	8.08		12.74	4.25
1908	9.5%	4.5%	2.3%		-2.1%	0.0%	0.123	5.08	7.90		12.60	4.24
1907	-1.2%	-0.1%	4.5%		2.2%	0.0%	0.113	4.86	7.72		12.88	4.24
1906	2.5%	2.8%	4.0%		1.1%	0.0%	0.114	4.87	7.39		12.60	4.24
1905	0.1%	2.8%	2.6%		0.0%	0.0%	0.111	4.73	7.11		12.47	4.24
1904	-0.4%	2.8%	2.7%		1.1%	0.0%	0.111	4.60	6.93		12.47	4.24
1903	0.3%	0.6%	3.4%		1.1%	0.0%	0.112	4.48	6.75		12.33	4.24
1902	3.9%	2.8%	3.0%		0.0%	0.0%	0.111	4.45	6.53		12.20	4.24
1901	-3.0%	0.4%	3.2%		-1.1%	0.0%	0.107	4.33	6.34		12.20	4.24
1900	**1.7%**	**-3.1%**	**3.7%**		**5.8%**	**2.7%**	**0.110**	**4.31**	**6.14**		**12.33**	**4.24**
1899							0.109	4.45	5.92		11.66	4.12

A Note on Sources

Irish Equity Returns

1900-1933, Dimson, Marsh & Staunton (2002) capitalisation-weighted index of 70 Irish stocks with estimate of dividend yield based on UK stock market.

1934-1984, the Central Statistic Office (CSO) Price Index of Ordinary Stocks and Shares of Companies incorporated in Ireland (except Railways) again with dividend yield assumed to follow that of the UK (see Whelan (1999)).

1984-87 from sources described in Whelan (1999) and from 1988 we use the Irish Stock Exchange Equity Index Total Return - Overall.

Irish Gilt Return

1900-1998 as the notional return on a 20 year gilt as described in Whelan (1999), updated from return on notional 10 year gilt as in Dimson, Marsh & Staunton (2002).

Irish Cash Return

1900-1969 as Whelan (1999);

1970-2001 the Irish Treasury Bill Return in Dimson, Marsh & Staunton (2002).

Irish Property Return

1984-2001 The Society of Chartered Surveyors/Investment Property Databank, Index of Total Return

1970-1983 The Jones Lang Wootton Irish Property Index, Overall Index.

Irish Price Inflation

Sources as Whelan (1999), with inflation updated by releases from the CSO.

Irish Wage Inflation

Based on the increase in the hourly wage of carpenters over the calendar years, sourced from the Building & Allied Trades Union from 1919 to 1999, and prior to 1918, from D'Arcy (1989). Figures are sourced from the Construction Industry Federation from 1999.

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Appendix II: Real Returns on Irish Financial Assets, 1900-2001.

Year Ending	Real Irish Equity Return	Real Irish Long Bond Return	Real Irish Cash Return	Real Irish Property Return
2001	-2.5%	0.7%	0.3%	3.9%
2000	**9.3%**	**3.2%**	**-1.5%**	**20.8%**
1999	-1.2%	-10.1%	-0.5%	26.8%
1998	23.4%	15.4%	3.7%	35.9%
1997	49.9%	18.4%	4.2%	23.0%
1996	23.7%	11.7%	3.5%	16.9%
1995	22.1%	15.2%	3.9%	10.5%
1994	-1.3%	-11.9%	3.5%	12.9%
1993	56.7%	37.9%	7.8%	5.4%
1992	-9.9%	1.2%	12.6%	-4.2%
1991	14.8%	13.6%	6.8%	-3.8%
1990	**-31.1%**	**-0.9%**	**8.6%**	**8.6%**
1989	25.0%	-3.0%	5.2%	29.2%
1988	38.5%	28.8%	5.3%	14.8%
1987	-6.9%	26.9%	7.9%	6.5%
1986	46.6%	3.1%	9.0%	2.8%
1985	51.9%	26.6%	7.1%	-4.9%
1984	-8.0%	4.6%	6.7%	-7.1%
1983	69.3%	7.2%	3.4%	-5.4%
1982	-20.4%	26.4%	4.7%	-2.0%
1981	-20.5%	-16.8%	-5.7%	-1.2%
1980	**2.7%**	**1.9%**	**-1.7%**	**10.7%**
1979	-17.9%	-18.0%	-1.9%	15.4%
1978	36.1%	-11.2%	0.9%	27.2%
1977	69.9%	33.2%	-2.1%	12.8%
1976	-30.7%	-5.8%	-7.2%	-7.5%
1975	54.8%	12.7%	-5.1%	-17.6%

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Year Ending	Real Irish Equity Return	Real Irish Long Bond Return	Real Irish Cash Return	Real Irish Property Return
1974	-54.3%	-31.1%	-6.5%	-10.0%
1973	-22.5%	-17.9%	-2.3%	20.0%
1972	63.6%	-10.2%	-2.4%	10.4%
1971	4.3%	9.6%	-2.2%	9.8%
1970	**-14.7%**	**-7.9%**	**-2.0%**	**2.7%**
1969	-14.7%	-7.9%	0.8%	
1968	33.9%	-5.2%	1.9%	
1967	23.9%	-1.5%	3.4%	
1966	-5.4%	0.1%	2.4%	
1965	-6.6%	1.7%	3.0%	
1964	7.9%	-7.5%	-2.0%	
1963	27.3%	-0.3%	-0.7%	
1962	20.0%	15.5%	0.7%	
1961	16.3%	-6.5%	2.7%	
1960	**19.6%**	**-4.6%**	**2.2%**	
1959	47.6%	4.2%	5.3%	
1958	19.9%	8.8%	1.9%	
1957	-5.1%	-7.9%	-0.8%	
1956	-15.3%	-1.8%	2.5%	
1955	1.1%	-7.9%	-1.4%	
1954	15.2%	4.8%	1.4%	
1953	4.8%	6.4%	1.0%	
1952	-29.8%	-7.0%	-5.7%	
1951	0.0%	-12.6%	-8.9%	
1950	**6.9%**	**1.6%**	**-1.2%**	
1949	-3.6%	-3.4%	-0.3%	
1948	-5.4%	-0.7%	-1.7%	

Year Ending	Real Irish Equity Return	Real Irish Long Bond Return	Real Irish Cash Return	Real Irish Property Return
1947	-2.2%	-9.5%	-4.7%	
1946	22.1%	7.4%	2.2%	
1945	11.7%	6.7%	0.2%	
1944	8.7%	3.8%	0.3%	
1943	5.5%	-5.7%	-6.2%	
1942	2.8%	-10.6%	-12.3%	
1941	7.9%	-4.2%	-8.8%	
1940	**-13.8%**	**-2.0%**	**-9.4%**	
1939	-14.1%	-6.4%	-7.2%	
1938	-1.3%	1.1%	1.2%	
1937	-4.6%	-8.6%	-5.6%	
1936	14.1%	0.4%	-1.9%	
1935	7.2%	-3.1%	-2.5%	
1934	1.3%	11.1%	0.2%	
1933	8.9%	2.7%	0.1%	
1932	-1.9%	29.1%	8.5%	
1931	-0.4%	3.7%	5.5%	
1930	**20.4%**	**16.9%**	**9.3%**	
1929	0.6%	-1.0%	3.5%	
1928	16.2%	5.2%	3.6%	
1927	13.8%	14.4%	12.6%	
1926	5.0%	2.8%	4.0%	
1925	3.7%	4.5%	6.9%	
1924	2.1%	3.1%	-0.3%	
1923	15.3%	4.9%	4.4%	
1922	38.0%	33.0%	22.7%	
1921	23.6%	24.4%	15.9%	
1920	**-22.8%**	**-16.7%**	**-8.1%**	

Year Ending	Real Irish Equity Return	Real Irish Long Bond Return	Real Irish Cash Return	Real Irish Property Return
1919	-7.6%	-8.6%	-1.9%	
1918	6.5%	-4.7%	-10.1%	
1917	-11.5%	-16.7%	-13.0%	
1916	-15.2%	-18.0%	-11.4%	
1915	-24.2%	-21.5%	-15.7%	
1914	3.0%	6.9%	5.0%	
1913	-1.5%	-0.1%	2.4%	
1912	-4.6%	-1.3%	0.5%	
1911	-4.8%	0.7%	1.9%	
1910	**1.6%**	**-0.5%**	**1.1%**	
1909	6.7%	0.4%	1.2%	
1908	11.8%	6.7%	4.5%	
1907	-3.3%	-2.3%	2.3%	
1906	1.4%	1.7%	2.9%	
1905	0.1%	2.8%	2.6%	
1904	-1.5%	1.7%	1.6%	
1903	-0.8%	-0.5%	2.3%	
1902	3.9%	2.8%	3.0%	
1901	-1.9%	1.5%	4.3%	
1900	**-3.9%**	**-8.4%**	**-2.0%**	

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Appendix III: A Brief History of Fixed Interest Markets, 3000 BC to 17th Century

The early history of interest rates, from the great Mesopotamian civilisations of Sumer (3000 B.C.–1900 B.C.), Babylonia (1900 B.C–732 B.C.), through the Hellenistic period to the Roman Empire, might not appear particularly relevant to the investor of the 21st century A.D., but, as always, it throws light on modern practices. In fact, the three thousand year period before Christ has probably more in common with modern conditions that the millennium and a half after Christ (see Diverting Digression 1).

From the Dark Ages (i.e., after the fall of the Roman Empire) to the seventeenth century in Protestant Europe and the eighteenth century in Catholic Europe, the ethical position of those making interest-bearing loans was considered at best dubious but, more often, damning. Interest on a loan was considered a form of usury (here broadly defined as asking more in return than is given), which is forbidden in the Old and New Testaments.[30]

By the 9th century, doctrine had so hardened on the issue that usurers were excommunicated by the Synod of Pavia and, in the same century, Charlemagne became the first state to legislate against it. Civil prohibitions on usury spread across Europe over the next four centuries, reinforced by canon law and a consensus amongst theologians. Yet interest-bearing loans proved resilient to threat by state or church. A papal degree of excommunication in 1179 states:

"Since in almost every place the crime of usury has become so prevalent that many persons give up all other business and become usurers, as if it were permitted, regarding not its prohibition in both testaments, we ordain that manifest usurers shall not be admitted to communion, nor, if they die in their sin, receive Christian burial, and that no priest shall accept their alms."[31]

The pope at the time, Pope Alexander III, also made it clear that credit sales above the cash price was also usury.

Usury, thus conceived, was to profit from the presumed desperation of the borrower. However, with time, and certainly by the thirteenth century, a clear distinction came to be made between making good any loss suffered by the lender by reason of the loan and profiting from the loan. 'Interisse' is from the Latin verb 'intereo' which means 'to be lost'. Interest on a loan became justified only insofar as the lender would still financially prefer his money in-hand as opposed to the loan or, at best, to be indifferent between the two. Gradually, over the following few centuries, the distinction between compensating for a loss as opposed to an opportunity cost became blurred as capital markets developed. First, leading Protestants reformers (e.g., Luther, Zwingli, Calvin) in the fifteenth and sixteenth centuries deemed interest rates of 5% or less as perfectly acceptable. The Catholic Church weakened its prohibitions somewhat later, beginning early in the nineteenth century by allowing all lawful interest payments. Yet it took Rome more than a century to fully thaw on the issue – it was only in 1950 that Pope Pius XII accepted that bankers 'earn their livelihood honestly'. Even nowadays loans and their terms raise non-trivial ethical questions. For instance, is it just that first world banks loan to undemocratically selected state leaders, irrespective of the use that such loans may be put, and then enforce repayment from the poor population long after the head of state has been deposed?

The point of this brief survey of interest rate history is to show that the past was quite different to the present so that the current investor must interpret the last five thousand years of interest rate statistics wisely. In more modern times, for instance, the City of London only allowed interest-bearing loans since 1545 (and then the maximum rate of interest was 10%). As noted in the text, a parallel with modern market conditions can really only directly be made with Holland from the seventeenth and England from the eighteenth century.

[30] See Exodus 22: 25; Deuteronomy 23:19-20; Ezekiel 18:8; Luke 6:35.

[31] Quoted from Lewin, C., *Earliest Days* in *Life, Death and Money*, Renn, R. (Ed.), Blackwell, 1998.

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[A longer version of this paper, published by the Irish Association of Pension Funds, is available at http://www.iapf.ie/fpublications.htm.]

II. *A Promising Timing Strategy in Equity Markets.* (with Brian Lucey of Trinity College Dublin). Journal of the Statistical and Social Inquiry Society of Ireland, Vol. XXXI, 2001/2002 (forthcoming) and available at www.ssisi.com/journals.

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[A longer version, including a discussion of the underlying forces at work, *Irish Pension Funds: Size, Growth and Composition of Assets*, published by the Irish Association of Pension Funds, is available at *http://ww.iapf.ie/fpublications.htm*.]

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This booklet aims to repay a couple of hours of the reader's time with just enough knowledge to equip them to plan a pension in a prudent manner. It draws on the key lessons from five millennia of capital market history to inform the current pension saver in what to invest. It delves into economics and the mysteries of compound interest to estimate how much to save. It synthesises, in a common-sense approach pioneered by actuaries, a savings plan from the known past to deliver the targeted pension in the unknown future.

The appendices set out an authoritative summary of the performance of Irish capital markets over the 20th century and the evolution of related economic data series such as a wage and inflation rates.

Finally, the author attempts to breathe life into the subject by digressing with amusing stories to reinforce the serious point that the markets provide one of the last legitimate ways to separate the proverbial fool from their money.

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