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The Rationale and Design of Inflation-Indexed Bonds

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Abstract

A number of industrialized countries have recently offered inflation-indexed bonds. Some members of another group of countries that had earlier adopted more comprehensive indexation in response to high inflation have taken steps to reduce the scope of indexation in their economies. This paper surveys debt management, monetary policy, and welfare arguments on the use of inflation-indexed bonds, and relates these to the experiences of various issuers. The paper also considers some important design features of indexed bonds.

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SUMMARY

Although economists have long promoted inflation-indexed bonds as a useful tool for debt management and monetary policy, such bonds remain the exception. Against their use is the belief that indexation fuels inflation through feedback on prices and expectations. This view is bolstered by the experience of several countries where, partly owing to inflation, indexation became widespread beginning in the 1960s and 1970s. Indexation of financial markets in particular was seen as an expedient to promote domestic savings and capital formation. By the 1980s the inflation performance in a number of these countries had deteriorated, in some cases to the point of hyperinflation. Some have since taken steps to reduce the scope of indexation.

In recent years, another group of sovereign borrowers has successfully integrated inflation-indexed bonds into existing debt programs and promoted them because of their purported benefits to issuers and purchasers alike. Their benefits include improved social welfare, lower debt costs, easier implementation of monetary policy, enhanced monetary policy credibility, and the development of domestic capital markets. Their experience supports a fundamental argument in the literature—that there is no necessary connection between indexation and inflation. If inflationary biases result from indexation, they can be offset by other policies.

Design considerations are important to the success of indexed-bond programs. Decisions must be taken about the choice of the index and its lag, how indexation is applied, term-to-maturity, and taxation. Indexed bonds, provided they are introduced in countries committed to contain inflation, offer benefits that may ensure continued growth and acceptance. The decision by the U.S. Treasury to introduce these bonds continues that trend and may accelerate the adoption of indexed bonds elsewhere.

I. INTRODUCTION

Inflation-indexed bonds are financial instruments that attempt to protect the bonds' purchasing power by tying interest and principal payments to an index of price changes. Indexed bonds include two types of compensation, a real rate of return plus a compensation for the erosion of purchasing power. Traditional nominal bonds include only a single nominal component of return, which is fixed at the time of purchase. The return on a nominal bond implicitly comprises an expected or required real rate of return, plus an estimate of inflation over the life of the bond. On an indexed bond, the real return is fixed ex-ante, and the nominal return is calculated ex-post; at the time of purchase the real return is certain, and the nominal return is uncertain. For nominal bonds, the nominal return at the time of purchase is certain, the real return uncertain.²

In principle, bond payments could be tied to any index, including for example wages, commodities, and foreign currencies. In practice, most indexed bonds are tied to a broad measure of prices, typically the consumer price index. Inflation-indexed bonds are the focus of this paper.

A long line of distinguished economists have been strong proponents of indexed bonds—including Jevons, Marshall, Irving Fisher, Keynes, Musgrave, Milton Friedman, and Barro. However, the introduction of indexed bonds has to date been exceptional, save in inflationary circumstances which gave the authorities little scope to do otherwise. The main arguments in favor of indexed bonds are cost-savings (benefitting the issuer), completing financial markets (to the benefit of lenders), and strengthening the tools, credibility and commitment to monetary policy (principally to the benefit of the central bank). In economies in transition, where monetary policy credibility and commitment may not be well-established, indexed bonds may also enable governments to extend the maturity of their debt, and foster the development of long-term capital markets. Counter-arguments are generally that cost-savings are negligible or non-existent, and that indexed bonds perpetuate or exacerbate inflation. Support for the latter argument is often based on stylized facts and failures of comprehensive indexation in a number of countries through periods of high and volatile inflation during the 1970s and 1980s.

Since the 1980s, however, a new group of issuers has adopted indexed-bond programs. In these cases, the decisions were not dictated by the inflation circumstances at the time, or in a sense imposed on the issuer by the bond market as a last-ditch effort to preserve long-term capital formation in the domestic currency. In contrast to the countries in the prior group, the latest countries to introduce indexed bonds had generally already established a commitment and credible policies to good inflation performance. These countries have successfully

²The respective ex-ante returns are certain for zero coupon bonds, on which there is no reinvestment risk, but may vary on coupon bonds owing to the uncertainty of reinvestment rates for the bonds' interim cash flows.

integrated indexed bonds into existing debt management programs. In this group, the introduction of indexed bonds has been justified on the basis of cost-savings, complete markets and monetary policy credibility.

There have been significant differences in the design of indexed bonds. These differences have affected market development and acceptance of the bonds, which in some instances have been slow to build. Illiquidity of the new instruments themselves has played a role in the slower pace of development.

The paper is organized as follows. Section II surveys arguments for and against indexed bonds. Where possible, this discussion is related to government issuers' experiences and practices. Section III investigates briefly instruments that have some similar properties to indexed bonds (bonds denominated in foreign currencies and short-term or floating-rate instruments), but also points out the fundamental differences. It also touches on the question why indexed bonds are not more prevalent. Section IV looks at the design of indexed bonds, again in relation to issuer practices. The final section includes a summary of considerations on the design and decision to issue indexed bonds. Appendix I surveys features of indexed bonds by selected government issuers today.

II. THE RATIONALE FOR INDEXED BONDS

Indexed bonds have long been promoted on the basis of a number of compelling economic and financial arguments. Nonetheless, issuers of indexed bonds remain the exception; a subsection in the section following is devoted to the question why they are not more prevalent. The merits of indexed bonds are considered under six headings below. In some cases the arguments cut both ways, and pros and cons are considered together. In addition, because there are two sides to every transaction, benefits to the issuer may be at the expense of the purchaser (and vice versa), so that the effect on welfare is unclear.

A. Social Welfare

Market completeness

It has long been argued that indexed bonds fill a void in financial markets, or that financial markets are incomplete.³ One area where they may be incomplete is in the provision of riskless securities. Governments may be uniquely able to provide riskless securities, both in terms of credit risk and purchasing power risk, by offering real return bonds and by virtue of their

³Where markets are complete and efficient, with no distorting taxes, the paths of debt and taxes can be shown to be irrelevant, following the debt neutrality theorems of Barro (1974) and others. Here it is assumed that debt management is not neutral, either because markets are incomplete, taxes distort, markets are segmented, etc., so that choices do matter.

powers of taxation. By issuing securities which complete markets, governments might also reduce their costs of funding. Buyers can match indexed bonds against (chiefly long-term) liabilities that vary with the price level. Prime examples of these liabilities are individuals' retirement savings, pension funds, some insurance contracts, and social security schemes. In each case, the liabilities are typically long-term and tied to the purchasing power of money. The matching against long-term, price sensitive liabilities is the reason indexed bonds are primarily held in these portfolios in countries such as Australia, Canada, and the United Kingdom (U.K.), where inflation has been relatively well-behaved and indexed bonds co-exist with nominal bonds.

If other financial assets were good inflation hedges, the need for indexed securities would be less compelling. It was once generally believed that equities hedged well against inflation, but this has been disproved by the experience of the last two decades. The real return on equities, particularly in low-to-moderate inflation countries, correlates negatively to inflation. This supports the modern view that inflation cannot be traded for growth or employment, but brings significant and pervasive economic costs. Neither have long-term nominal bonds proven a good hedge, because inflation has been difficult to anticipate. Short-term bonds and money-market instruments by their nature have less price risk than their long-term counterparts. But, they too have proven poor inflation hedges, and provide on average a lower yield (because the yield curve is normally upward sloping). Simple correlations of real returns on various financial assets against inflation using long-term (1926-1994) U.S. data, for example, are negative for common stocks (-0.22), long-term corporate and government bonds (-0.58 and -0.56, respectively) and treasury bills (-0.75).⁴

Government intervention to complete financial markets may therefore be indicated in certain circumstances. But, based on the Italian experience with indexed bonds, Penati et al. (1995) caution against government financial innovation for its own sake, especially in cases where demand is untested. Rather than experiment, they advise that a treasury limit itself to issuing instruments in private markets which already exist, selecting those in which the government has a natural comparative advantage as a low cost supplier.

Incentives to saving

Another purported benefit of indexed bonds, stemming in part from their ability to complete financial markets, is that they can boost the savings rate. Bach and Musgrave (1941) argued further that indexed bonds represent a non-inflationary form of savings, because the alternative to holding indexed financial assets may be real assets, especially durable goods. During periods of accelerating inflation, transfers of wealth from financial assets into real goods may intensify inflationary pressures. Indexed bonds could both encourage saving and slow inflationary spending. Corporations and institutions could use indexed bonds as an

⁴See Ibbotson (1995).

alternative to investment in commodities and real inventories, further dampening otherwise pro-cyclical behavior.⁵ Levhari (1983) provides support that indexed bonds tend to encourage savings in the presence of inflationary pressures.

In countries facing high or hyperinflation, inflation-indexed debt or debt indexed to a foreign currency may be the only viable vehicles to encourage savings in financial assets in the domestic currency, as opposed to real or foreign assets. On this point, Baer and Beckerman (1980), who otherwise expressed strong reservations about the efficacy of widespread indexing in Brazil, acknowledged that the principal benefit was that it initially permitted accumulation of public and private savings in spite of inflation and, furthermore, that the "quality" of savings improved, by for example, lengthening the average term of financial assets.

Fischer (1975) argued that the government should provide indexed bonds for small savers. Because the transactions and information costs of acquiring equities, as inflation hedges, were too high, equity ownership by individuals has remained low. However, the proliferation of mutual funds in many countries has since made diversified equity ownership easily available to the public. Nevertheless, because equities have proven poor inflation hedges there may be a good reason to introduce retail indexed bonds.

Distributional arguments

It has also been argued that indexed bonds provide distributional benefits. Unanticipated inflation implies unintended transfers of wealth and income from lenders to borrowers. "The propensity of indexing to shift but not eliminate the uncertainty effects of inflation," Samuelson (1988) explained, "ensures that the effects of indexing will be primarily distributive in nature."

Because some lenders, such as retired individuals or those saving for retirement, are often presumed to be those most disadvantaged and least able to protect themselves from inflation, indexed bonds have been recommended on the basis of social equity. Friedman (1974) further argued that "the government (*cum* monetary authority) created the inflation in the first place and therefore has the responsibility to provide means by which citizens can protect their wealth." The government should do this by indexing both its liabilities (bonds) and the income tax system. With nominal bonds, purchasing power risk is borne by the purchaser; with indexed bonds this risk is transferred to the issuer. By indexing its liabilities, the government would give back to the public part of the inflation tax for which it was responsible.⁶

⁵Dampening real inventory swings would subdue booms and busts in business cycles, as discussed below.

⁶This thought was taken up by Donald Brash, New Zealand Reserve Bank Governor, in a
(continued...)

B. Cost-Effectiveness and Debt Management Considerations

As far back as Keynes, economists have argued that indexed bonds could reduce government borrowing costs. If the market overestimates future inflation, government will reduce borrowing costs by issuing indexed bonds rather than nominal bonds. This may occur because, for example, investors' expectations are not completely forward-looking or rational. Alternatively, the government, because it is able to influence inflation through its policies, may have better information about the future course of inflation, or perhaps has more faith in its commitment to contain it than the public does. In these cases a treasury can lower its costs by issuing indexed bonds. The Fisher identity states that the nominal interest rate (i) is the sum of the real rate (r) plus expected inflation (p_e):⁷

$$i = r + p_e$$

If p_e , which is established in the market, is a biased estimate (too high) of actual future inflation (p^*), then the government would capture the difference ($p_e - p^*$) by issuing indexed bonds.

For the debt manager, active management of the debt portfolio by switching between indexed and nominal bonds requires taking a (real) rate view against the market. It is similar to the decision facing private managers of fixed income portfolios.⁸ Wins and losses depend on the ability to out-forecast the market, and it is a two-edged sword: if the public's inflation expectations are below that of the issuer, or the public underestimates the amount of future

⁶(...continued)

speech extolling the merits of New Zealand's indexed bond program. He stated, "I am convinced that issuing inflation-adjusted bonds has great benefit to the ordinary New Zealand saver. To put this in context, it is worth recalling that inflation is a process, sanctioned by the Government and the central bank, which enables borrowers to steal from savers... Issuing inflation-adjusted bonds is the best way of saying that, even if some future Government decides to sanction theft-through-inflation, the present Government does not approve of such theft, and is willing to provide a means by which savers can protect themselves against it." See Brash (1995).

⁷The equation holds as written if rates are continuously compounded; with periodic compounding, the equation should be adjusted:

$$= r + r * p_e + p_e$$

At low interest rates, the middle term will be small, and may be safely omitted.

⁸A rate view can also be taken by altering the portfolio duration: shortening it when rates are expected to rise, lengthening it when they are expected to fall.

inflation, then the borrower is better off issuing nominal debt. During the 1970s, when investors underestimated inflation in many countries, borrowers were better off issuing nominal debt, since real returns were persistently negative. Consciously or not, governments levied and benefitted from the inflation tax. In the decade following, however, nominal and real interest rates in many industrial countries remained stubbornly high and inflation expectations were slow to fall. Issuers then would have profited by switching to indexed bonds. These are ex-post rationalizations, while portfolio decisions must be taken ex-ante. It would be difficult for a government debt manager to take decisions, adjust and implement on an ongoing basis switches to the nominal/indexed bond mix, simply to profit from perceived market misjudgments about future inflation, nominal and real rates. Furthermore, while it may be true at a point in time that public expectations vis-à-vis inflation exceed (or lie below) actual future inflation, systematic errors are unlikely to persist over long periods. It is more likely that such forecasting errors cancel out over the long run.

Nonetheless, the perception that inflation expectations were excessive was part of the reason indexed bonds were introduced in the U.K., and more recently for reissuing them in New Zealand.⁹ In both cases, the authorities cited a lack of credence in their inflation-fighting policies, which the market seemed either to ignore, or to not believe. Inflation expectations implied by the yield curve exceeded the intentions or expectations of the respective governments. The authorities had more faith in their policies and commitment to lower inflation than the public, perhaps because they had some control over the outcome or because they assumed they were better forecasters, and could benefit by betting on the actual inflation outcome.

As indicated, betting against the market on the future course of inflation implies that the decision to issue indexed bonds is not a long-term commitment—when the market's inflation expectations fall below the treasury's, it is time to stop issuing. Such behavior would affect market liquidity, and require a liquidity premium on indexed bonds. Altering the debt portfolio

⁹Again, the comments of the New Zealand Reserve Bank Governor are pertinent. He stated that while the Australian and U.K. governments were borrowing at real rates of 3.8 and 5.5 percent respectively through indexed bonds, "We, on the other hand, have been borrowing at real yields of 7 to 8 1/2 percent, if we can assume that the underlying inflation will average 1 percent over the life of the bond. Therein lies the rub: the fact that we have been obliged to borrow at 9 percent in nominal terms very strongly suggests that most people, here and abroad, do not believe that our inflation will average 1 percent over the next decade... So this Government, and today's taxpayers, pay a penalty. By issuing inflation-adjusted bonds, the Government avoids paying this penalty. Instead of borrowing at 7 percent in real terms, it borrows at a rate which, presumably, would be akin to the real interest rate at which Australia borrows using inflation-adjusted bonds, less than 6 percent." See Brash (1995). The New Zealand Reserve Bank has an explicit inflation target of between 0 and 2 percent measured quarterly.

duration using existing instruments such as treasury bills and bonds is likely a superior way to bet against the market, because it is simpler, quicker and less disruptive to market liquidity than gearing up and shutting down a new borrowing instrument.

Portfolio bets are a zero-sum game, where the treasury's gains are the market's losses.¹⁰ But there is another sense in which indexed bonds may prove cost-effective, where there is a welfare improving net gain. Indexed bonds can be viewed as providing a form of insurance—purchasing power insurance—to investors. Insurance is an option on a contingent outcome, and cannot be worth less than zero. If investors are willing to pay for this insurance, then the issuer should lower the cost of debt. Thus:

$$i \quad \equiv \quad r \quad + \quad p_e \quad + \quad \delta$$

where a risk premium (δ), based on the variability in inflation, is included in the basic Fisher identity.

Investors are ultimately interested in the real return (r) on their investment. On nominal bonds they receive the nominal rate (i), and thus bear the onus and risk of future inflation ($p_e + \delta$). On indexed bonds, however, investors receive r with certainty, and the issuer bears the costs of the inflation components p_e and δ , rearranging terms in the above equation. With a straightforward reallocation of risk from one party to another, there is no net gain: government has reduced its borrowing costs by the amount of the risk premium, assuming its expectations of future inflation are correct on average, but has taken on the risk of inflation volatility itself.¹¹ Inflation could also be less than expected, an outcome against which the issuer may want to protect itself by buying its own option. If expectations are in long-run correct, then the two options may cancel out. If, however, governments are neutral to financial risk, perhaps because they have an infinite planning horizon, because of their size, or because they exert some control over the inflation outcome, they may be able to internalize or simply ignore this risk. Borrowing costs would decline by the amount of the inflation risk premium, which has been absorbed by the government issuer.

¹⁰This is the essence of theorems of debt neutrality, as for example in Levhari (1983): the government must service its liabilities, imposing costs on the public that offset the benefits of the program.

¹¹This is the thrust of Baer and Beckerman's (1980) criticism of Brazilian indexation: "the introduction of index-linking in any particular financial sector has always entailed a shift in the burden of inflation risk from one side of the market to the other. In many cases, the parties to whom the risk was shifted proved as reluctant to bear it as the parties from whom the risk was shifted; and so, in one way or another, the risk was finally shifted to the government (e.g., the index-linked government bonds), to a government dependency (e.g., the Housing Finance System), or to the banking system (e.g., the agricultural credit system)."

The inflation risk premium is an empirical issue. Its value no doubt varies significantly through time and place. Higher inflation may be associated with a greater variability in inflation, therefore a higher inflation risk premium.¹² Estimation is complicated by the fact that both p_e and δ are unobserved in the Fisher equation. In the long run it may be assumed that forecasting errors cancel out, but as Munnell and Grolnic (1986) point out, in the short run the absolute level of forecasting errors ($p_e - p^*$) is likely to swamp the value of the risk premium (δ) at any point in time, making ex-ante estimation of the cost savings from issuing index bonds a problem. Furthermore, Penati et al. (1995) posit an inflation risk premium that also applies to indexed bonds, because changes in real interest rates and expected inflation may not be independent.

An early estimate by Bodie, Kane and McDonald (1986) found the inflation risk premium on long-term U.S. bonds increased from 0.53 percent to 4.20 percent from September 1979 to December 1981. Another estimate (by John Campbell, discussed in Shen (1995)), also using U.S. data, ranged from -0.25 percent to +1.35 percent, with the most likely number +0.5 percent.

Italy issued only one indexed bond, in 1983, which was not very successful. Penati et al. (1995) attempted to measure its ex-post savings to government.¹³ They estimated savings of from 12 to 20 percent against three borrowing alternatives (a single floating rate note, rollover of one-year treasury bills, and a basket of securities with similar characteristics to the outstanding debt) over the ten-year period the indexed bond was outstanding. The authors noted that inflation declined unexpectedly during the period, there was probably a large liquidity premium attached to the issue, and that the selling price of the privately placed issue may have been artificially high. Though these factors may have biased upward the savings estimate, the authors concluded that the possibility of significant savings to the issuer of indexed bonds could not be dismissed.

Evidence in the U.K. also points to cost savings from the issue of Indexed Gilts (IGs) over conventional debt. Deacon and Derry (1994), using recent data, estimate the premium to be in the range of 3 to 5 percent, although because of the small sample the result was not statistically different from zero. Breedon (1995) estimates inflation expectations implied by IGs exceeded actual inflation by 1.7 percentage points on average. Penati et al. (1995) estimated savings of approximately 300 basis points based on the difference between inflation risk premium curves for nominal and indexed bonds.

¹²Penati et al. (1995) model the inflation risk premium in Sweden, however, and find a low inflation scenario results in higher estimates of the inflation risk premium than a high inflation scenario.

¹³The authors cite several reasons for the issue failure: it was too small to be liquid, the indexation had a one year lag, and the price index was unfamiliar to investors.

Using the newly issued zero coupon Swedish 10 and 20 year indexed bonds, Penati et al. (1995) also derived inflation risk premia estimates based on two inflation scenarios. Savings in the low inflation scenario were large, about 400 basis points at 10 years, and 500 basis points at 20 years. Perhaps counter-intuitively, since higher inflation would seem to imply higher inflation risk, the differentials declined to 130 and 160 basis points at the higher inflation scenario.¹⁴ Nevertheless, given their estimates for savings in three countries (Italy, Sweden, and the U.K.) of up to several hundred basis points, they concluded that cost-savings provide a strong case for the issuance of indexed bonds.

As a long run proposition, if forecasting errors cancel out, the issuer will on average save the amount of the risk premium, which is assumed to be positive.¹⁵ Clearly, the higher estimates would result in significant savings to government debt managers, however, with the huge deficits, debts and borrowing programs facing many countries today, even a small basis point saving could result in significant total savings to the treasury.

Another line of thinking, following Calvo and Guidotti (1989), is that real debt service costs may be minimized by indexed bonds through enhancements to monetary policy credibility. Because an issuer of a mix of nominal and indexed bonds stands to gain less by levying a given amount of inflation tax, it will be less likely to use this avenue than if it issues purely nominal debt. Monetary policy credibility will be enhanced and inflation and debt servicing costs will be lower if a portion of the debt is indexed.

A counter-argument that the U.S. Treasury had made in the past is that the liquidity of indexed bonds may be so low that the market would be inefficient. This would be accentuated if the tax treatment of indexed bonds made them attractive only to non-taxable investors. Investors might then demand a significant liquidity premium, and an issuer's costs may in fact rise if the liquidity premium exceeds the inflation risk premium. Evidence from the U.K. gilt market bears out the lower liquidity of the IG market versus conventional bonds. The bid/offer spread on large trades is said to be 1/2 point on IGs against only 1/16 on conventionals. IG spreads are also reported to have been narrowing however, and secondary trading is

¹⁴Their explanation was that the shape of the yield curve reflects expected movements in inflation expectations and risk premia, so that higher inflation expectations explain a greater proportion of market prices, therefore risk premia must explain a lower proportion.

¹⁵Shen (1995) points out the possibility of a negative risk premium, because issuers are also exposed to inflation risk. If issuers are more inflation risk averse than lenders, then they may require a premium for issuing such bonds. In this case the value of an option to the issuer would exceed the value of an option to investors. However, it may be plausible to assume that if governments are not inflation-risk neutral, they are at least less risk averse than lenders, and the risk premium is likely positive.

increasing.¹⁶ Liquidity in indexed bond markets in Canada and Australia is also lower than for nominal bonds. Governments can possibly influence this liquidity premium, through measures to promote secondary market activity by, for example, creating large benchmark¹⁷ issues through reopenings, allowing indexed bonds as collateral for repo transactions, or designating specialized market-makers for indexed bonds. To promote the market for its indexed bonds, in the 1960s Brazil allowed commercial banks to satisfy reserve requirements by holding indexed bonds, allowed exchanges of old nominal bonds for the new bonds, and also reduced certain tax liabilities for purchasers of indexed bonds. Special measures to enhance the marketability of indexed bonds, or any government debt instruments for that matter, can however lead to significant capital market distortions that can be difficult to eliminate, particularly tax preferences.

Another debt management argument is that by issuing indexed debt a treasury would stabilize the real cost of its debt. This may be especially desirable since government real tax revenues move closely in line with inflation,¹⁸ and enables a government to better match its revenue and expenditure streams. Stabilizing the real cost of debt may also contribute to smoothing of tax rates by isolating future budget constraints, which itself is a desirable debt management goal that can lower debt servicing charges, as discussed by Barro (1979).

In summary, if governments are neutral to risk, they can benefit by bearing inflation risk by issuing indexed bonds. The current empirical estimates of the inflation risk premium may relate to a period in which inflation expectations were abnormally high, thus exaggerating the size of the inflation risk premium, and hence the long-run cost-savings that indexed bonds could be expected to deliver. However, the evidence does not contradict the hypothesis that a positive risk premium exists. At the same time, at least for countries with low to moderate inflation, government issuers of indexed bonds would achieve a more predictable pattern of

¹⁶See Bank of England (September 14/15, 1995).

¹⁷Benchmarks issues are recently issued current coupon bonds at specified maturities in which secondary market trading tends to concentrate. Issuers can increase the liquidity of these issues by adding to their size by subsequent offerings of bonds with the same coupons, features and maturity dates. Because of the high level of trading activity in these issues, the liquidity premium by definition is minimal, or zero.

¹⁸This may result from a higher inflation outcome from stronger economic activity, combined with a progressive income tax regime. However, in countries facing very high rates of inflation, lags in tax collections may result in lower real government revenues (the so-called "Tanzi" effect).

real cash outflows (at the expense of a less predictable pattern of nominal cash outflows), and because revenues may move more or less in line with inflation, a better matching of revenues to expenditures, for a more predictable overall budgetary position.¹⁹

C. Indexed Bonds as an Aid to the Implementation of Monetary Policy

Tobin (1963) argued that a government that issued inflation-indexed bonds would have a superior instrument for economic control, because indexed bonds are a closer substitute for physical or equity capital than conventional bonds. Thus, by using indexed bonds in their fiscal and monetary operations, the government and central bank would be better able to influence the equilibrium supply price of capital.

Changes in real interest rates on indexed bonds can provide valuable information on investment and savings, and on the prospects for economic growth. A rise in real rates, assuming a constant level of savings, for example, may indicate an increase in planned investment. Indexed bonds can also provide useful information to policy makers about inflation expectations, as well as an indication of the credibility of monetary policy. Subtracting the real yields on indexed bonds from the nominal yields on conventional bonds gives an instantaneous measure of expected inflation. Hetzel (1992) argued the U.S. Treasury should issue half its debt in each of nominal and indexed bonds, to aid the Federal Reserve Board in its conduct of monetary policy, as well as to enhance the Board's credibility as an inflation fighter. Because both bonds would be quoted continuously and simultaneously in the market, any change in government policy, either fiscal or monetary, or a demand or supply shock, would be instantaneously reflected in the prices of the two bonds. The change in the yield spread between the two bonds provides a current measure of the public's inflation expectations. And if both bonds were issued at various maturities along the yield curve, an inflation expectations curve could be derived, showing both short-term and long-term inflation expectations.

However, a number of problems have been identified with using indexed bonds to extract inflation expectations. First, the existence of an inflation risk factor means that the yield spread includes two components: expected inflation plus the inflation risk premium. If, in the absence of an explicit estimate, the risk premium is assumed to be stable over time, or alternatively, that it is small, then it may be safely ignored because it nets out or is unimportant. However, the evidence presented above points to an unstable premium that may not be small. Both the level and changes in inflation expectations would thus be biased. On the other hand, the public's perceptions of the risk premium itself also constitutes valuable information to policy makers, so that the inability to disentangle inflation expectations from the inflation risk premium still provides valuable information. A shock that, for example, caused the yield

¹⁹The budget position is complicated by the tax treatment of indexed bonds, discussed further in Section IV.

spread to widen, could alert policy makers that the bond market was demanding more inflation compensation, because expectations of future inflation were higher or because inflation volatility was deemed to be greater.

A second argument against the use of indexed bonds as an indicator to help guide monetary policy is that inflation expectations are often wrong. Policy makers would be foolish to base their actions on changes in the public's faulty inflation expectations. Monetary policy actions based on a non-discretionary rule tied to systematically biased inflation expectations would lead to instability. Certainly, expectations are often wrong, be they in the stock market or horse races.²⁰ However, it may also be argued that it is the expectations, rather than the ex-post predictive ability of a certain constituency (in this case a large and important one, the bond market) that is of most interest to policy makers. Hetzel (1992) argues further that even if inflation expectations are found ex-post in some way to be deficient, this simply provides further incentive for the central bank to "alter monetary policy to ensure that at least in the long term the price level would be easy to predict."

Third, the presence of a liquidity premium for indexed bonds would cause the yield gap between nominal and indexed bonds to underestimate inflation expectations, although again, if constant over time, changes to the yield gap would still provide unbiased information. A complete curve of inflation expectations also requires bonds of comparable maturities, which are typically not available in underdeveloped markets.

Fourth, lags in the application of the index to indexed bonds distort the information content of inflation expectations. The longer the lag and the shorter the maturity of the bond, the greater the distortion. For very long term bonds, however, the distortions will be small.

Finally, information from the yield gap between nominal and indexed bonds could be distorted by differential tax treatments for the two bonds. In the U.K. for example, where capital gains have been tax-free, the generally lower nominal coupon payments on IGs than on conventional bonds may raise demand for indexed bonds purely on the basis of the tax differential, thus distorting the information on inflation expectations.²¹ However, because IGs are held primarily by non-taxable investors and for long-terms, the extent of this distortion may also be small.

²⁰If inflation expectations were shown to be systematically biased, which may be unlikely, then the yield gap would still provide the authorities with useful information, after adjusting by the amount of the bias.

²¹Part of the inflation compensation on the type of indexed bond issued in the U.K. is through adjustments to the principal, unlike on nominal bonds where compensation for expected inflation is through the coupon rates.

The Australia Treasury has indicated that cursory readings of the yield gap since its Treasury Indexed Bonds (TIBs) have been reissued have consistently overstated mean inflation expectations derived from survey data or expressed by financial market commentators. The distortions are such that the yield gap is not seen as an accurate gauge of inflation expectations and therefore carries little or no weight in monetary policy decision-making. On the other hand, while there are potential pitfalls in using indexed bonds to measure inflation expectations, more information is preferable to less. Central banks do not generally use a single indicator to guide monetary policy, but rely on a wide range of information, which could include indexed bond yields. For example, the Bank of England produces inflation expectations data from IGs on a daily basis as one of its policy indicators and as a gauge on monetary policy credibility.²² Furthermore, the magnitude of the possible distortions between nominal and indexed bonds may be small in relation to the inflation expectations. And, if the distortions are assumed constant through time, the changes in the yield differentials between the two bonds will still provide useful information on the movement in expectations. Alternative measures of inflation expectations, through sampling techniques or models, are likely to prove more costly, less accurate, less timely and more difficult to interpret than the more-or-less direct observations available through indexed bonds.

D. Indexed Bonds as an Aid to Develop Capital Markets

In the 1820s, British economist Joseph Lowe wrote that indexed bonds could help promote the development of the capital market through lowering risk and improving the marketability of these securities. More recently, Stanley Fischer (1983a) stated "Governments in inflationary difficulties issue indexed bonds, and those that can avoid it, do not." While the experience up to that time supported this statement, subsequent issuers such as Australia, Canada, New Zealand, and, arguably, the U.K., contradict it. Where inflation is a problem, or in nascent capital markets where governments may not have established monetary credibility, indexed bonds can help foster market development. Indeed, in cases of high, or hyperinflation, indexation may be the only method by which capital may be mobilized. Thus, a number of South American countries including Argentina, Brazil, and Chile, along with Israel, first issued indexed bonds to prevent the collapse of their long-term capital markets. Finland and France²³ did so as part of their post-War stabilization programs, as did Hungary in the face of hyperinflationary pressures. Prior to 1988, Italy was only able to tap markets through floating rate

²²However, problems with the long (8-month) index lag, lack of short-maturity IGs, and tax distortions, cause them to consider the measure for yields only beyond two years (see Bank of England (September 14/15, 1995)).

²³France issued bonds indexed to the price of gold in 1946. These bonds were refinanced on maturity in 1973, but with the skyrocketing price of gold during the 1970s, the bonds proved very costly. The bonds have since matured.

debt or treasury bills. Its 1983 indexed bond, while not regarded as a success, allowed the country to at least fix a portion of its real borrowing costs for a period of ten years, something which it could not do through nominal debt.

Jud (1978) points out that "Indexing was extremely useful in promoting the growth and development of Brazilian capital markets. In essence, indexation made it possible to maintain positive real rates of interest in an inflation-plagued economy." Similar successes enabled Chilean and Colombian capital markets to continue to function. Baer and Beckerman (1980) also acknowledge indexation's success in permitting the accumulation of public and private savings despite inflation in Brazil. They point to increases in the quality of private savings, including an increase in voluntary, as opposed to involuntary or inflationary, forms of saving—for example, government bonds and private savings accounts versus (inflation) taxes, or hoarding or accumulation of real assets, such as gold, as inflation hedges—and lengthening the maturity of debt. Although the effect on aggregate savings is hard to interpret because of its volatility, the authors conclude that "the fact that the flow did not fall in real terms might be regarded as a success of index-linking, given the high rates of inflation over the period."²⁴ They also highlight the success of the passbook savings program of the Housing Finance System, particularly significant "because it shows that voluntary savings can be accumulated, even in inflationary developing countries, as long as the savings media are inflation-proof."

Indexation in Brazil was initially regarded a second-best solution, an expedient because inflation could not be controlled immediately. While taking a gradualist approach to containing inflation, the authorities expected that indexation would only be temporary. But high and volatile inflation persisted in that country for long periods, and indexation itself played a major role.

Kapur (1980) views indexation as a favorable policy choice for newly liberalized, less-developed economies. By mitigating some of the potentially adverse short-run effects of dealing with inflation shocks, indexation may prevent countries from back-sliding on reforms. Indexation is a lubricant that allows reforms to proceed in the face of adverse economic developments along the way. However, without concomitant policies to contain inflation, particularly in lesser developed or newly liberalizing countries where such policies may lack credibility, indexation is more likely to introduce destabilizing influences of endemic inflation.

E. Monetary Policy Credibility and the Promotion of Price Stability

The most serious charges against indexed bonds, and indexing in general, turn on these possible negative effects on inflation, inflation expectations, and policy credibility. Indexing may signal a lack of commitment by governments to price stability, or weaken the market's trust in another nominal anchor such as a fixed exchange rate. By making the consequences of

²⁴In any case, indexation would be expected to produce only a one-time effect on the savings rate.

inflation easier to live with there will be less motivation, either by governments or the public, to maintain stable prices. It is a serious charge, since the consequences and costs of inflation are well-known.²⁵

Fischer (1983a) distinguishes three senses in which indexation may be inflationary: (i) a higher one-time effect of an inflationary disturbance on an indexed economy than a non-indexed one, (ii) through a higher average inflation rate, or (iii) where the equilibrium price level is rendered unstable, resulting in runaway inflation or simply random price movements. His model tests various forms of indexation—wages, financial assets and taxes. Each tends to exacerbate inflation in the presence of any inflationary shock, and is inflationary in the first sense. In addition, dynamic effects may cause an overshooting of the equilibrium price level in later periods (i.e., indexation is inflationary in the second sense). Finally, there are cases where indexing could render the system unstable (the third sense), depending on the effects on the government's real budget position. An unindexed tax system acts as a drag to stabilize an inflation shock. However, if taxes are also indexed, then the model is prone to instability if the budget position is in deficit. But, stability is independent of whether or not the debt is indexed, thus bond indexing by itself is not a source of instability. Thus that the outcomes in his model do not follow necessarily: "there is no inevitable theoretical link between indexing and inflation." They stem rather from the likely monetary/fiscal policy mix of the government which chooses to index, in particular the link between budget deficits and money growth. Indexing enters the inflation process through the budget deficit, which is in part financed through the printing of money, in part through borrowing. Other accompanying monetary and fiscal policy choices are still available to the authorities to counter the potential inflationary effects of indexing. For example, if monetary policy can react to disturbances within the current period, it can stabilize the price level completely.

Fischer also tests the relationship between indexing and inflation following the 1974 oil-price shock, using cross-sectional data of 40 countries with varying degrees of indexing.²⁶ Counter to the theoretical implications of his model, he finds no evidence that countries with indexing experienced significantly larger inflationary consequences than those without. He concludes that indexed countries indeed used other policy responses to mitigate the inflationary impact of the oil shock, while less indexed countries accommodated the shock.²⁷

²⁵See, for example, Selody (1990) for a discussion.

²⁶Dummy variables were included for wages, taxes, social security, investment and government bonds. Values were assigned based on the author's judgment, without any attempt to quantify the extent of indexation of the parameter in each country at the time.

²⁷The only variable which did show some statistical significance was bond indexing, when measured after a lag of four years. However, while the author surmised "perhaps bond indexation in particular is introduced in countries that have decided not to pursue counter-

(continued...)

Others have investigated the effects of indexation on inflation. Kapur (1982) looks at lesser developed countries and fully endorses indexation, provided that "the monetary base should be actively manipulated... to ensure price determinacy." A nominal anchor is required in a system in which all values are specified in real terms. In a closed economy this could be provided by the money supply, in a small open one through the exchange rate. Levhari's (1983) model, which supports the proposition that indexing encourages savings under inflationary conditions, is nonetheless "rather indeterminate concerning the effect on inflationary pressures."

A counter-argument to charges that indexation is inherently inflationary is that indexed bonds remove an important incentive to inflate. Attempts to reduce the real deficit burden by creating unanticipated inflation or levying an inflation tax to pay down government liabilities cannot succeed when government liabilities are indexed. Therefore, governments have no vested interest in inducing future bouts of unanticipated inflation, and are more likely to focus on maintaining price stability as an appropriate monetary objective. Issuing indexed bonds would enhance monetary policy credibility. The argument is stronger if, as suggested by Friedman (1974), the tax code is also indexed. There is little opportunity to reallocate wealth from the private to public purse through inflation when both sides of the government balance sheet are indexed.

Barro (1995), who fully endorses indexed bonds and regards the typical reliance of governments on nominal debt as a mistake, nonetheless recognizes that recent movements toward more independent central banks and greater commitments to price stability can substitute for indexed-bond programs: "In these arrangements, nominal debt is more like real debt, and the choice between indexed and conventional bonds becomes less important."

If, as Fischer postulated, the consequences of indexing on inflation are ultimately affected by other policy choices, then policy commitment and credibility matter a great deal. It is possible that widespread indexing will exacerbate inflation disturbances, and as discussed below, there have been a number of failures; however, given appropriate fiscal and monetary policies, there is no necessary connection between the two. The introduction of indexed bonds in the presence of a strong and credible commitment to price stability should not be seen as a step towards fiscal imprudence or monetary irresponsibility.²⁸ And indexed bonds can themselves provide information on monetary policy credibility through the divergence between inflation expectations in the market and inflation targets or commitments announced by the government. Hallsten (1993) points out that timing of the introduction of indexed bonds could

²⁷(...continued)

inflationary policies," he dismissed this as a possible statistical aberration and suggested no great weight should be placed on this result due to the long adjustment period.

²⁸Of course, were the central bank able and nimble enough to ensure price stability, there would be no need for indexed bonds, so there remains this nuance of contradiction.

be important. If inflation and inflation expectations are low, then the introduction of an indexed bond program would be unlikely to fuel inflation expectations. The converse may be equally true. Again, the issue hinges on perceptions and credibility.

F. De-Indexation and the Failures of Financial Indexation

While indexation provides agents with a mechanism to cope with changes in the price level, no system of indexation can be comprehensive enough to completely isolate an economy from the real effects stemming from inflation, especially very high inflation. At the limit, under hyperinflation, indexing inevitably breaks down, owing to the lags by which indexed contracts are adjusted. Indexing can therefore contribute to inflation inertia, adding to the difficulties of implementing policies to bring down inflation. And because the costs of government policy choices to contain inflation are typically realized before the benefits, the temptation is always to delay adjustment—a time-consistency problem. Inflation may persist because indexing offers governments, and the public, a way to live with inflation.

Indexation may also distort credit allocation, if it is selectively applied in capital markets. Governments, almost without exception have been the first and main issuers of indexed debt, while corporations, for reasons discussed below, have rarely issued it. Under conditions of high inflation, banks have also offered indexed deposits. Veneroso (1982) argues that fully indexed instruments captured a disproportionate volume of funds in Brazil, Chile, and Colombia. Large inflows of indexed liabilities to the housing sector resulted in excessive housing construction in Colombia, and in Brazil in a speculative explosion of urban land prices. Furthermore, fixing short-term deposit rates according to a backward-looking indexation formula may suffer the same disadvantages as a system of administered interest rates—rates which may diverge widely from market clearing rates. The volatility of the resulting financial flows through the banking sector can ultimately affect their solvency when intermediaries are unable to match their books, as for example occurred in Chile in the mid-1970s and in Israel in the early 1980s.

The details of various approaches to de-index an economy illustrate some of the dangers of widespread indexation and the difficulties in reversing it once firmly established. A gradual approach has been attempted by Chile and Iceland. Each country has a long history of pervasive indexation, and has struggled at times with high and variable inflation. Israel, which has also had inflation problems, has no specifically announced policies to de-index. Other countries have attempted more vigorous approaches to de-indexing: Finland was immediately successful, while Argentina and Brazil endured several failures before their most recent attempts. But the failures can be ultimately credited to the lack of appropriate monetary and fiscal policies to reduce inflation, rather than indexation alone.

Chile is sometimes pointed to as a country in which comprehensive indexation (including the exchange rate) has done the best job of isolating the economy from the real effects of high and variable inflation, without experiencing the "stop-go" effects often attributed to various policy initiatives taken in neighboring Brazil or Argentina, for example. It has chosen to follow a

gradual path of de-indexation along the path to more stable prices. A small open economy, Chile has experienced variable inflation of between 7 and 30 percent since 1981. Current policies reflect a view that rapid de-indexation could damage confidence and discourage financial savings. Allowing inflation to fall to the level of industrial countries minimizes the output costs of abolishing indexation, and indeed would make indexation largely redundant.

Iceland has issued indexed bonds continuously since 1964, and virtually all financial contracts, including short-term bank deposits, later became tied to a price or foreign exchange index. In conjunction with financial market liberalization and other reforms begun in the mid-1980s, the government intends to decrease the scope of financial indexing. The minimum term on loans and obligations to which indexing can apply has been increased in stages (currently at least two years for loans and obligations, and one year for deposits), with a goal to eliminate indexing from instruments with a maturity under seven years by the year 2000. During the period from 1993 to 1995, the Government imposed a 5 percent ceiling on real yields on indexed bonds, which the central bank as market maker was obliged to maintain.²⁹ In 1995, the National Debt Management Agency began auctioning 2-, 3- and 5-year nominal Treasury notes. While not implying causality, inflation has fallen markedly since 1990, to well below the OECD average. De-indexing of the financial system and the progress to price stability, including increased credibility in the commitment, have gone hand-in-hand.

Israel has long endured comprehensive indexation, and a generally poor inflation record. The government's attempts to wrestle inflation down from the late 1970s through the mid-1980s failed. However, the policies in general did not seek to abolish indexation; rather they attempted to operate alongside or through the existing indexation mechanisms to stabilize the rate of inflation. One attempt, in September 1982, sought to stabilize inflation at 5 percent per month, based on a view that inflation largely results from ingrained, self-fulfilling expectations. By limiting the monthly depreciation of the currency and administered price increases for basic commodities, the government anticipated public expectations, followed by changes in actual prices, to coalesce around this arbitrary level. Once achieved, it was argued that further reductions could be engineered in a similar manner. However, without a change in other underlying policies which fueled inflation, including a large budget deficit and subsidies of basic commodities financed by monetary expansion, the attempt failed. Following this failure, complete currency substitution was also suggested as a policy alternative. Although the latter policy was not formally adopted, the effects of inflation had already caused many wealth-holders³⁰ to opt for investments linked to or denominated in foreign currencies, primarily the U.S. dollar. The acceleration of inflation left even holders of domestic currency denominated

²⁹However, other steps have been taken to strengthen central bank independence, most notably through closing the overdraft facility to government in 1992-93, the auctioning of government debt, and moving to indirect instruments of monetary control.

³⁰Capital controls prevented Israeli residents from holding foreign currency deposits, however immigrants were exempted, as were business and commercial accounts.

indexed debt unprotected, owing to the lag by which values were corrected for inflation.³¹ It is an illustration that even in highly indexed economies agents cannot fully protect themselves from the effects, and costs, of inflation. The 1985 stabilization plan, which established the exchange rate as a nominal anchor and prohibited central bank financing of government spending, successfully ended the inflation spiral. It also set the stage for the development of nominal, domestic currency denominated financial instruments. The government has no formal policies to limit the scope of indexation, but the central bank, as the government's fiscal agent, has since 1992 begun to switch the composition of government debt towards unlinked from CPI and currency-linked borrowings. The percentage of unlinked tradable government bonds issued in 1995 rose to 42 percent from only 17 percent in 1994. Nevertheless, indexation remains widespread, with about 90 percent of financial contracts indexed. Progress towards de-indexing of financial contracts will thus be determined by the demand and supply for linked/unlinked securities in the market, not by government edict.

In Finland, financial market indexation was introduced immediately after the Second World War in connection with indemnity payments to war evacuees, and later became both comprehensive and extensive. By 1967, indexed deposits totaled about 35 percent of total deposits, and almost 75 percent of outstanding bonds were indexed. Index clauses in both financial markets and labor markets were simply prohibited by a government act in 1968. While the extent to which markets were indexed was lower than, for example, Argentina, Brazil or Chile, and certainly the inflation performance was far better, ranging from 1.6 percent to 10.4 percent in the decade prior to de-indexing, the ease with which it was accomplished was considered surprising.

Argentina, which first offered indexed government securities in 1973, formally banned indexation in all contracts under the Convertibility Law of 1991. The cornerstone of this program was fixing a parity exchange rate to the U.S. dollar, supported by a currency board type of arrangement which mandated full coverage of the monetary base with gross international reserves. Inflation, which peaked at over 3,000 percent in 1989, was brought down abruptly, to about 4 percent by 1994. In contrast to Brazil, where it has never been a major factor, currency substitution became even more widespread in Argentina following its latest stabilization program. Dollarization in the financial markets had been elevated by an earlier effort to halt inflation in December 1989, when the government forced the conversion of time deposits and public sector debt into U.S. dollar denominated government securities (BONEX 89). While both U.S. dollar and peso denominated securities now exist, including an increase in the volume of nominal contracts, almost all maturities extending beyond a few months are denominated in the foreign currency.

³¹The ex-post correction was reduced from a quarterly to a monthly basis in 1984, but under the circumstances of accelerating inflation was insufficient to prevent real rates from declining. The problem of index lags is discussed in Section IV, below.

Indexation of financial instruments was formally sanctioned in Brazil in 1964, leading to general indexing which enabled that economy to function and grow for many years despite prolonged high inflation. Indexation also allowed Brazil to avoid widespread currency substitution, unlike neighboring Argentina and Bolivia. However, the feedback effects of indexing on inflation contributed to considerable financial market instability.³² Indexing discouraged the demand for nominal financial assets. As inflation increased, the Brazilian authorities opted to shorten the term of the public debt to minimize interest costs and any resulting inflationary pressures from the growing budget deficit. This led to the "overnight system," which linked all rates to the central bank determined overnight rate.

Early attempts by the government to limit the extent and impact of indexation included editing out certain components from the price index (oil and food, etc.), applying monetary correction fully only below a certain inflation rate, and, in 1980, applying reducing monetary correction to only about half the prevailing inflation rate. The government later launched a series of stabilization plans from 1986 through 1991, each of which ended in failure. The March 1990 Collor I Plan took the extraordinary step of blocking financial assets above a minimum balance for a period of 18 months. The blocked assets earned 6 percent plus indexation, paid out in equal monthly installments over a 12 month period. As with the previous efforts, inflation was temporarily quieted, but the effect was not lasting, and in 1993 it peaked at over 2,700 percent. This led to the Real Plan, another heterodox approach to macroeconomic stabilization directly at bringing inflation down and keeping it down. The Plan included fiscal and monetary policy tightening, a move to a floating exchange rate subject to a floor against the U.S. dollar, and limits and freezes on wage adjustments. It also introduced, on a temporary basis, a new unit of account (the URV or Real Unit of Value) intended to synchronize price adjustments daily and replace backward-looking with almost contemporaneous indexation. Under the third phase of the Plan, indexation on non-financial contracts under one year was simply prohibited, subject to grand fathering of existing contracts. However, for short-term financial contracts, indexation was permitted provided it was based on the Reference Interest Rate (TR), which is linked to the yield on 30-day certificates of deposit.³³

In contrast to the predecessor plans, the Real Plan has thus far succeeded in producing a substantial and, to this point, lasting, reduction in inflation. Lower inflation has enabled the government to extend the average maturity of the public debt, to reduce the share of indexed

³²See Baer and Beckerman (1980) and Ize and Mackenzie (1992) for descriptions dealing with the late 1970s and 1980s respectively.

³³TR is calculated daily as the average interest rate on 30-day CDs of the main financial institutions over the previous 3 days, minus 1.02 percent which is intended to account for taxes and real interest rate components.

or floating rate debt, and since January 1996, to begin to offer longer term fixed rate bonds. However, indexed and floating rate debt are still offered, and there are no announced plans to further limit or prohibit them.

The above examples illustrate the difficulties associated with de-indexing. The longer the history, the higher the inflation uncertainty, and the more comprehensive and entrenched the system of indexation, the greater the resistance and difficulties to get rid of it. In countries where indexation and inflation is well-contained, for example to a small segment of the bond market, as in Australia, Canada, and the U.K., there would appear to be little risk or adjustment costs in ceasing to issue government indexed bonds. However, in other instances, particularly in lesser developed countries, strictly limiting indexation to the debt markets may prove more difficult. Labor and financial market indexation have tended to develop in response to inflation problems, thereby "institutionalizing" inflation. Widespread indexation may also raise the costs of stabilization, and typically prolongs the adjustment to disinflation. The examples also highlight that indexation may only be a symptom, like inflation, of other deeply-rooted problems. Unless the causes, such as an unsustainable fiscal position or monetary accommodation, are also addressed, the resistance to de-indexing will be strong, and agents may seek to protect themselves from inflation through, for example, substitution into foreign currencies.

G. Real Effects and Macroeconomic Stabilization

A number of early proponents of indexed bonds, including Jevons, Marshall, and Irving Fisher, and later Milton Friedman, argued that comprehensive indexing could effectively modulate business cycles and reduce the unemployment costs of policies to stabilize the price level. With perfect indexation, the supply curve is vertical, even in the short-run. Because of rigidities, real wages and other factor costs tend to fluctuate counter-cyclically with inflation, thereby increasing the amplitudes of the business cycle. As inflation rises in a buoyant economy, real wages fall and businesses overinvest based on (part illusory) profit increases. Furthermore, the effects of policies to lower inflation would be compromised by price rigidities, since relative prices would change as a result of such policies, thus distorting quantities of real variables.

In the financial sector, if nominal loan rates do not keep pace with unanticipated changes in prices, nominal and real interest rates would tend to move in opposite directions, with similarly adverse consequences for real output. This too would encourage over-investment when inflation is accelerating and real rates are falling, contributing to booms and later busts. Indexed bonds, by ensuring rapid adjustment in nominal rates to the rate of change in prices, would help stabilize the real cost of borrowing over the cycle and help stabilize real activity. The argument is, however, predicated on a slow adjustment in nominal rates to actual or anticipated inflation. Bond markets today are very much forward looking and react quickly to news and changes in expectations.

It has also been argued that indexed bonds could significantly reduce the risk of a firm, if prices for the firm's output fluctuate in line with a broader index of prices. By issuing liabilities which also correlate to the price level, profit margins can be better isolated, enabling firms to reduce risk, although much the same effect could be achieved through futures markets for the firm's output. When inflation is very high, however, the variation in relative prices, including that of the firm's output, may tend to widen. Indexing bonds against a broad measure of prices, such as the CPI, may not hedge the issuer. On the other hand, issuing bonds indexed to a narrow composite of prices, or in the limit, the single price of the firm's output, may not attract sufficient demand to make the issue viable. Because tax revenues tend to correlate with inflation, the government may be better positioned to hedge inflation risk, and hence would be more likely issuers of indexed bonds.

H. Survey of Issuers' Rationale for Introducing Indexed Bonds

Table 1 lists a number of government indexed bonds, and the issuer's stated or implied rationale for their introduction. The country experiences fall broadly into two extremes. The first includes instances where high inflation left issuers with little choice but to index their obligations to the price level, or face the prospect of a collapse of long-term capital formation in the domestic currency (or ultimately, rejection of the domestic currency resulting in widespread currency substitution). Several Latin American issuers (Argentina, Brazil, Chile, and Colombia) as well as Israel are examples. It can be argued that comprehensive indexation was imposed upon them and that their policy choices were limited by the inflationary circumstances at the time. At the other end are governments which have issued indexed bonds under low or moderate inflation conditions, as a complement to existing nominal bond programs. Examples here include Australia, Canada, New Zealand, and the U.K.³⁴ In these cases, the justification has been cost-savings, completing financial markets, and as an aid to the implementation of monetary policy.

The U.S. Treasury has announced (on May 16, 1996) that it will begin to offer indexed bonds. Treasury Secretary Robert Rubin said the bonds have the potential to raise the national savings rate, and expects them to provide both cost-effective financing for the government and a haven from inflation for long-term investors. Furthermore, the bonds would provide a ready indication of market expectations of inflation, something which the Federal Reserve, including its current Chairman, Alan Greenspan, has long argued will be a valuable tool to economic forecasting and its implementation of monetary policy.

³⁴Although here too the markets may have influenced the issuer's hand; for example, accelerating inflation (the U.K.), or burgeoning deficits (Canada), constrained the debt manager's room for maneuver at the time.

Table 1. Recent Issues of Inflation-indexed bonds

Country	Instrument	Dates Issued	Rationale for Issuing
Argentina	<p>The first indexed bonds were offered in 1973: Valores Nacionales Ajustables (VNA), Bonos Generales de Ahorro Ajustable followed in 1975. Prior to the 1991 collapse of indexation a number of inflation-indexed bonds circulated, including BARRA, TERMOBONO I, VAVIS, and FEDERACION, with terms ranging from one to ten years.</p>	<p>From the early 1970s through to the banning of comprehensive indexation following the Convertibility Plan in 1991; since then most government debt has been denominated in foreign currencies (BOCONs).</p>	<p>First issued indexed government bonds (and indexed the tax system) to enable financing of large budget deficits and maintain a viable market for long-term government bonds under conditions of high inflation.</p>
Australia	<p>Treasury Indexed Bonds (TIBs)</p>	<p>Introduced July 1985; discontinued in 1988 due to budgetary circumstances and lack of investor demand; recommenced program in 1993 (capital-indexed TIBs only).</p>	<p>To provide cost-effective financing and to reduce overall risk of the government's portfolio of liabilities; to lengthen the maturity of government debt; to complement government's retirement incomes policy by offering an "inflation-proof" asset to pension and insurance funds.</p>
Brazil	<p>Readjustable National Treasury Obligations (ORTN); National Treasury Obligations (OTN); Treasury Bonds (BTN); National Treasury Notes (NTN).</p> <p>(Since 1964 most financial contracts have been indexed to inflation).</p>	<p>1964 to present.</p>	<p>To promote the development of capital markets and provide a non-inflationary means to finance the large federal deficit; (Jud (1978) argues providing inflation-proof capital assets for investors was always a secondary consideration to other macroeconomic objectives, as evidenced by the many discretionary changes to the indexing regime, even if such changes sacrificed the interests of the owners of capital).</p>
Canada	<p>Real Return Bonds (RRBs)</p>	<p>1991 to present.</p>	<p>Diversify the government's marketable bond program in a cost-effective manner.</p>
Chile	<p>Most financial instruments over 90 days are denominated in UF, a unit of account linked to the consumer price index with a one-month delay. Indexed government debt includes: Pagaré Reajutable Pago Cupones (PRCs); Pagaré Reajutable del Banco Central (PRBCs); Pagaré Capítulo XVIII y Capítulo XIX (PCDs).</p>	<p>The first indexed bond was issued in 1956. The system of indexing based on "unidad de fomento" (UF) was introduced in 1967.</p>	<p>Comprehensive indexation evolved in response to prolonged inflation.</p>

Table 1. Recent Issues of Inflation-indexed bonds

Country	Instrument	Dates Issued	Rationale for Issuing
Colombia	Savings and loan accounts were denominated in a standard unit of account, UPAC, based on a moving average of interest rates on 90-day deposits.	Government bonds were first issued in 1967.	To promote domestic savings by raising real interest rates, which had been negative.
Finland	10-year "Amortization Loans"	Beginning 1945; widespread financial indexation which followed was abolished in April 1968.	Bonds were initially issued in connection with indemnity payments to evacuees from territories turned over to the Soviet Union following WWII; high inflation was expected and the state of government finances was such that cash settlement was not feasible.
Iceland	Virtually all long-term financial contracts are indexed.	The first government indexed bonds were issued in 1964; widespread financial market indexation developed in the mid-1970s.	In response to persistently negative real interest rates resulting from inflation, financial indexation was introduced to promote and protect savings and improve credit allocation.
Ireland	Savings Bonds; National Instalment Savings.		Provides a tax-free non-marketable savings vehicle for retail investors.
Israel	Sagi; Galli; K fir. (Over 90 percent of domestic debt is indexed to consumer prices, including deposits, mortgages, and government and corporate bonds).	From the mid-1950s.	Preserve long-term capital markets despite continuing high inflation.
Italy	Certificati del Tesoro a Tasso Reale	A single 10-year issue was sold in August, 1983.	Extend maturity of government debt, enhance policy credibility, and lower borrowing costs.
Mexico	Bonos Ajustables del Gobierno Federal (Ajustabonos) Federal Government Development Bonds (UDI bonos)	June 1989 to present. May 1996.	Introduced along with Bonos de la Tesorería de la Federación (Tesobonos, indexed to the market dollar exchange rate), as part of financial market liberalization and reforms to move government financing from direct credit from banks to placements of public debt on the market. In announcing the new UDI bonos, the authorities noted that by guaranteeing a real interest rate and eliminating inflation uncertainty, the Government will lower its funding costs.

Table 1. Recent Issues of Inflation-indexed bonds

Country	Instrument	Dates Issued	Rationale for Issuing
New Zealand	<p>Inflation-Adjusted Bonds (IABs) (Earlier offering of non-marketable Inflation-Adjusted Savings Bonds (IASBs) to retail investors was discontinued).</p>	<p>First issued in 1977, discontinued 1984, and reintroduced November 1995.</p>	<p>The proceeds were to be used to retire foreign-currency debt. The RBNZ Governor also explained that these bonds are designed to:</p> <ul style="list-style-type: none"> (i) reduce real borrowing costs vis-à-vis domestic borrowing; (ii) aid in the implementation of monetary policy by providing a measure of inflation expectations; (iii) strengthen the commitment of the government, as perceived by both New Zealanders and foreign investors, to price stability; and (iv) to provide small savers with an appropriate riskless investment for their retirement savings.
Norway	<p>Verdi-Spar</p>	<p>Last issued in 1982.</p>	<p>Retail savings vehicle, abandoned because of reduced tax rates and lower inflation.</p>
Poland	<p>Inflation-indexed Treasury Bonds</p>	<p>1992 to present.</p>	<p>To promote government budgetary financing in the domestic market, especially from the non-bank public.</p>
Sweden	<p>Index-linked Treasury Bonds</p>	<p>1994 to present.</p>	<p>Long-term cost-minimization. The National Debt Office stated, "The high inflation risk premiums in the conventional bond loans induced the Debt Office to issue [this instrument], although the prospects of [it] being particularly liquid are not very bright."</p>
United Kingdom	<p>Index-linked Gilts (IGs)</p>	<p>March 1981 to present. Non-marketable index-linked retail retirement savings bonds were first issued in 1975.</p>	<p>Minimize long-term financing costs, taking account of risk and ensuring debt management policy is consistent with monetary policy. IGs were first issued in a period when the long-term bond market faced collapse due to rising interest rates. The Page Report (1973) and Wilson Committee (1980) had recommended issuing indexed bonds to complete the market by offering protection from inflation for small savers and pension funds, and as a way to reduce the effects of inflation on the real government budgetary position.</p>

III. ALTERNATIVES TO INDEXED BONDS

Two instruments share similar properties with indexed bonds—short-term or floating rate debt and debt denominated in foreign currencies—although there are also important differences.³⁵ Both are far more prevalent than indexed bonds and they are discussed briefly below. This section concludes with a brief survey of the literature addressing why indexed bonds are not more common.

A. Short-Term or Floating Rate Debt

Short-term or floating rate notes would entail lower inflation risk than longer term bonds if inflation were more predictable over the near term than over the long term. Current inflation, or the inflation experience in the recent past, may better proxy inflation in the near future. Alternatively, inflation forecast errors, which generate errors in required real rates of return, are corrected sooner on short-term than on long-term contracts. Therefore, required real rates of return will be more stable on short-term than on long-term debt. Governments have less room to levy an inflation tax and therefore will pay a lower inflation risk premium on short-term obligations. Floaters may have a further advantage over other short-term debt through lower risk of default because the issuer comes to market fewer times and for smaller amounts than for straight short-term debt.

In general, however, government debt managers are loath to compress their maturity structures into short-term obligations,³⁶ because of the risk of interest rate fluctuations on the debt burden. While short-term debt better equips investors to isolate real returns, issuers correspondingly increase their risk. It has also been argued that over reliance on short-term debt may reduce monetary policy credibility and commitment, because policy makers would be more exposed to choices and trade-offs between tight money policies to contain inflation and the budgetary impact of higher short-term rates—a time consistency problem.

High and volatile inflation pressures issuers to resort to short-term financing because investors demand a high premium to purchase long-term obligations. Brazil, which drastically shortened the maturity of its public debt to lower its debt costs, is an extreme example. Eventually all debt became tied to the overnight rate, set daily by the central bank. And in Italy, through much of the 1980s treasury bills and floaters (Certificati di Credito del Tesoro—CCT) were the only source of Treasury funding, because of the high inflation risk premium. Penati et al. (1995), however, find that little was gained by the Italian authorities from issuing CCTs, which ex-post were even more expensive than fixed coupon bonds.

³⁵Bonds indexed to real commodities, such as gold or oil, have been rare, and are not discussed in this paper.

³⁶This behavior indicates governments are not risk-neutral.

B. Foreign Currency Debt

Like indexed bonds, debt denominated in a foreign currency (FCD) cannot be depreciated through domestic inflation. Thus, for the same reason it may enhance monetary policy credibility, since there is nothing to be gained by promoting inflation at a later date. A foreign currency issuer taps into the inflation outlook and monetary policy of the foreign country.

FCD has an advantage over indexed bonds in providing a contemporaneous, all-encompassing "index" that may encompass a forward-looking element. Inflation-indexed bonds in practice are based on past inflation, and also face problems concerning the choice of index. FCD may appeal more to foreign than domestic investors, except perhaps in countries facing high currency substitution, where inflation has destroyed confidence in the domestic currency. The issuer may thus face a larger liquidity premium for a series of fragmented borrowings in foreign markets than if all government debt were concentrated in the domestic market. FCD exposes the issuer to exchange rate risk, the source of which can spring from developments in either country. This risk can be hedged in forward markets, although at further cost to the issuer. Issuers therefore invariably look to countries with well-developed capital markets and good inflation track records.

New Zealand offers a recent example of the trade-offs between domestic indexed bonds and FCD. Following a turnaround from its fiscal problems in the 1980s, much of which had been financed through borrowings in foreign currencies, the government's initial steps at fiscal consolidation were directed to paying down these foreign currency liabilities. The central bank argued however that by its actions the government displayed a lack of commitment in its own policies to bring inflation down below its target of less than 2 percent. If the government truly believed it would achieve its own inflation targets, it should have been repurchasing its domestic debt, which at the time carried much higher nominal yields and inflation premiums than foreign debt. The New Zealand Reserve Bank fully supported the reintroduction of indexed bonds in the domestic market in 1995, as a credibility enhancing tool, especially vis-à-vis foreign investors in light of the Government's decision to repay all FCD.³⁷

³⁷The Reserve Bank Governor's remarks (Brash, 1995) illustrate this point: "Today, we are not opposed to the Government's intention to repay all net foreign-currency debt, in part because interest rates in New Zealand are now much closer to those in major overseas markets but mainly because Government has also announced its willingness to issue an inflation-adjusted bond. Why should Government's willingness to issue an inflation-adjusted bond be relevant to Government's intention to repay foreign debt? Because, from the point of view of both Government's debt management and monetary policy credibility, foreign currency debt and inflation-adjusted bonds have very similar properties. Foreign-currency debt can not be inflated away by the New Zealand Government. New Zealand dollar debt can be inflated away by the New Zealand Government, and it is precisely because of this risk that we are currently having to pay such high real interest rates to borrow money in the form of

(continued...)

In 1994, against the background of recurrent pressures on the peso and the maintenance of an exchange rate band, Mexican authorities encouraged the substitution of dollar-denominated tesobonos for peso-denominated government bonds (cetes, bondes, and ajustabonos). The circulation of tesobonos rose by US\$26.4 billion, and may have helped stabilize financial markets during 1994. However, by the end of the year investors' concerns regarding the ability of the Government to repay maturing tesobonos, in the context of declining international reserves, intensified pressures on the peso and exacerbated the financial crisis.

C. What Explains the Infrequency of Indexed Bonds?

Except in cases where inflationary circumstances forced them to do so, few governments, and fewer private borrowers, have issued indexed bonds. Given the purported benefits, the economic literature has addressed the reason for their relative scarcity.

One starting point may be so-called debt neutrality theorems, following Barro (1974). Using reasoning not unlike the Miller-Modigliani theorem for corporate financial structure, these theorems argue that under restrictive assumptions government debt structure is irrelevant. However, it has also been pointed out that this does not explain why government debt came to be nominal in the first place.

Fischer (1983a) speculated that various frictions associated with indexed debt are responsible for the scarcity of that debt. These frictions include delays in gathering and disseminating price data and choice of the index itself, and costs of innovation to the new instrument for both borrowers and lenders, are responsible. When inflation remains well-behaved, there may be little demand for such instruments, hence little impetus for innovations. As prices become less stable, demand for indexed bonds should rise and may lead to their emergence (Fischer 1975). Liviatan and Levhari (1977), however, pointed out that while inflationary uncertainty stimulates demand for indexed bonds, there are two sides to a transaction. What benefits borrowers disadvantages lenders, and when demand for indexed bonds is stimulated, supply is discouraged. The result is indeterminate, although their model did not explain, in the U.S. context, the complete absence of indexed bonds.

Other considerations may include market participants' distrust of an indexation mechanism which is calculated and disseminated by the issuer itself, or by an agency under its control. Fears of political tampering or insider trading would dampen demand for government indexed debt. An unindexed tax code reintroduces inflation risk on an after-tax basis to indexed bonds,

³⁷(...continued)

conventional bonds. Repaying all foreign-currency debt without providing the option for investors to buy inflation-adjusted bonds would inevitably raise questions in the minds of actual and potential buyers of New Zealand dollar conventional bonds about the risk of expropriation-by-inflation, and thus contribute to higher long-term interest rates and reduced credibility of the commitment to maintain low inflation."

and tax accrual rules may advance income tax liabilities prior to the cash receipt of interest. This may limit their appeal to non-taxable accounts. Reduced demand may in turn require a liquidity premium, further reducing their appeal.

The lack of corporate issuance of indexed bonds has other plausible reasons.³⁸ Again, taxes may play a significant role. The non-indexation of corporate income taxes causes taxes to increase with inflation. Profitably would decline with inflation, and indexing of liabilities would compound the problem, since the real value of the liabilities is not eroded as in the case of nominal debt. In the U.S., uncertainty as to the treatment of interest on indexed bonds as an eligible expense has been cited as an explanation for the lack of corporate issuance (if inflation compensation cannot be expensed, nominal bonds would clearly dominate). The choice of an appropriate index may be more of a problem for a firm than a government, as the hedging properties of a broad-based index of prices against tax revenues may generally suit a government, but may not correlate with the specific prices charged by a firm or industry. A narrower, firm- or industry-specific index on the other hand may not generate sufficient investor demand, necessitating a large liquidity premium.

Fischer (1983b) offered two possible reasons for the absence of corporate issues in the U.S.: relative stability in the country's inflation rate,³⁹ and the possibility that expectations of inflation by borrowers have been systematically higher than those of lenders. As explained above, the latter is difficult to support as a long-term proposition. He also observed, that even if it were true on average at a point in time, neither borrowers nor lenders have homogeneous expectations, so that there may remain niche markets for indexed securities.

A number of economists have argued that government has a role to play in fostering the market for index bonds, since it is unlikely such bonds would develop on their own through the private sector.⁴⁰ For example, several articles from the Federal Reserve Board, and echoed by Chairman Greenspan, have strongly urged the use of indexed bonds by the U.S. Treasury, until recently without avail (see Munnell and Grolnic (1986); Hetzel (1992); and Shen (1995)).

³⁸Even in Brazil, where indexing became near universal over the past three decades, corporations issued almost no inflation-indexed bonds, nor for that matter any kind of domestic currency debenture, preferring to tap foreign currency markets.

³⁹Although he observed that an increase in variance of inflation at the time the article was written "may well lead to the emergence of privately issued indexed bonds."

⁴⁰Marshall and Fisher were early proponents of this role for government; see also Tobin (1963), Friedman (1974), and Fischer (1983a).

Barro (1995) has argued that it is nominal bonds that are the comparatively recent innovation. Under the gold standard prior to the First World War, and the fixed exchange rate regime under Bretton Woods which only collapsed in the 1970s, he maintains government debt effectively was indexed. Government bonds have for the most part only become nominal this century with the ascendance of paper money standards. Second, he notes that the use of indexed bonds has been increasing, most notably among countries that are not subject to volatile inflationary pressures: Australia, Canada, New Zealand, Sweden, and the U.K.. Finally, the trend to more independent central banks with stronger commitments to price stability makes the difference between nominal and indexed bonds less important in any case.

IV. DESIGN CHARACTERISTICS OF INDEXED BONDS

A. Voluntary vs. Mandatory Indexing

Some early proponents of indexed bonds (including Alfred Marshall), and later ones (Milton Friedman), argued that indexing should be voluntary. Others (Stanley Jevons) felt it should be compulsory.⁴¹ Both Marshall and Friedman also suggested, however, that government would lead by example. Irving Fisher was more specific in the government's role in fostering the development of the market. He argued development should proceed in stages; initially indexing would be voluntary but government would encourage further development, first by passing legislation to provide a legal framework for such contracts, and second by compiling and promoting a suitable index number. Fisher felt that the arguments for indexing were compelling enough that over time indexing would become the norm, rather than the exception. He also indicated that indexation would have to be fairly widespread to be successful, and perhaps eventually made compulsory.

While Friedman (1974) agreed that indexation should be voluntary for private contracts, he proposed mandatory indexation for all government securities, as well as the entire tax system, in order to reduce the government's take and reduce its incentive to inflate. Hetzel (1992) has recommended an arbitrary 50/50 split between indexed and nominal government bonds to provide a gauge of public inflation expectations and a useful tool to guide monetary policy.

In general, indexation of long-term contracts has not been mandated or otherwise controlled, but has been left to determination by the market. Indexed bonds trade alongside nominal bonds in Australia, Canada, New Zealand, and the U.K. In Iceland, where long-term domestic loans are almost all indexed, the government does stipulate the indices and minimum terms-to-maturity to which indexing can apply. In countries where inflation has been especially high and variable, as in several in South America, the question of mandatory indexing of long-term contracts is less relevant; indexing has been rather the *sine quo non* for such contracts.

⁴¹For a summary of the history and evolution of economic thought on indexation, see Friedman (1974) and Humphrey (1974).

B. The Choice of Index

In principle, bonds could be indexed to any number of variables, including various price indices (GDP deflator, consumer prices, core consumer prices, producer prices), wages or earnings, output, specific commodities or foreign currencies. Borrowers and lenders are for the most part hedgers, seeking to offset assets against similar liabilities. Ideally, the index chosen would reflect the hedging requirements of both parties. However, these requirements may not coincide. A government issuer may prefer a link to a broad-based index such as the GDP deflator, since its revenues and expenses may best correlate with this measure of inflation. Retail investors may prefer indexing tied to consumer prices, corporate issuers to their own commodities or output, pension funds to wages or earnings. The U.K. Treasury first considered indexing gilts to a measure of average earnings, reasoning that indexed bonds would better hedge pension fund liabilities linked to wages and salaries. In the end, the authorities opted for a broader measure of inflation, the retail price index (RPI).⁴² The U.S. Treasury considered four different inflation indexes to use for its new bonds: the CPI for Urban areas (the one chosen), the Core CPI, the Employment Cost Index, and the GDP deflator.

To satisfy demand from diverse market segments, a government could issue several series of bonds, each tied to a separate index. It might assume its own assets or revenue stream would be sufficiently broad, or time horizon long enough, that it could absorb or ignore the risks associated with the movements in one index versus another. In practice, however, there are trade-offs between such segmentation and market liquidity. Government debt managers generally eschew smaller issues, on which they pay an implicit liquidity premium, in favor of large benchmark issues.

At least in low to moderate inflation countries, most domestic price indices move closely together over time, particularly over the periods covered by a long-term bond. Marshall observed a century ago that the particular index chosen may be a secondary, and perhaps relatively minor, consideration, as long as a comprehensive and relatively reliable measure is chosen. Market liquidity and transparency should be enhanced if a single price index is used as the benchmark. However, in circumstances of very high inflation, relative price changes may be extreme, such that no single index would be appropriate for either borrowers or lenders.

A potential problem is the measurement bias in price indexes of any kind. CPIs, for example, typically overstate true inflation because of these biases. However, if the biases are known and stable, they may not be a major problem for index-linked bonds, as bond prices would be

⁴²The RPI has been criticized because it includes the cost of mortgage interest payments (at nominal rates), and therefore introduces an element of double counting when used as the index for bonds.

expected to fully adjust for the discrepancy.⁴³ Still, indexes are subject to rebasings, both in the composition of the basket and the base date. The Bank of England for example offers IG investors safeguards against changes in the coverage of the RPI or its calculation that would be materially detrimental to bondholders' interests. In such an event, subject to the determination by the Bank, holders would be offered the right to redeem their stock.

Nevertheless, the reliability and integrity of index data is an issue in some countries. Bonds denominated in, or indexed to, a foreign currency do not suffer from this particular problem, and could be a logical alternative. If index data are leaked prematurely, there is potential for illicit trading profits, because any unanticipated inflation component will not have been imputed into current prices.⁴⁴ Therefore, the prospectus should carefully describe the index, who is responsible for its calculation, where and when it will be published, and how revisions, rebasings, and other changes to the index will be treated.

A potential conflict of interest exists where there is no clear separation between issuer of indexed securities and the inflation statistician. Jevons anticipated this, but felt that disclosure of the data behind the index would be remedy enough, since prices are public information. Even though a government has ultimate responsibility for both the securities and the index, questions about the reliability and integrity of the data do not usually arise. However, the quality of statistical data and independence of the public statistician do vary appreciably across countries. Where either is questionable, market acceptance of a government indexed bond may be inhibited.

The indexation regime can also be subject to outside political pressure. In Iceland, for example, the main index for financial instruments twice has been revised substantially. From 1979 through 1989, the credit terms index (CTI) was comprised of the cost of living index (CLI) weighted two-thirds, and the building cost index (BCI) weighted one-third. A protracted decline in real wages over the period adversely affected home buyers (mortgages are indexed) and other borrowers of indexed loans, and led to pressures to change the index. In 1989, a wage component (WI) was added to the CTI. The effect of the rebasing was significant: the new CTI rose by 7 percent less from the time of the change to early 1995 than the old index would have. Further pressure to minimize the effect of anticipated real wage increases on the debt servicing burden of households and firms resulted in another change, in 1995. The wage and building cost components were dropped, leaving the consumer price

⁴³See Shen (1995) for a discussion of this point.

⁴⁴See Huberman and Schwert (1985) for a discussion of the way inflation data is incorporated into indexed bond prices. Using Israeli data, they conclude that bond prices reflect about 85 percent of the new information about inflation as it occurs, while the remaining 15 percent is incorporated on the day following the announcement of the CPI, 15 days after the end of the inflation sampling period. Bond markets are thus fairly efficient in incorporating inflation data into current prices.

index (renamed from the old cost of living index) as the main financial index benchmark. This time the government's rationale was that using a consumer price index was in accord with other country practices, and despite the prior changes, would appear more permanent and credible. The latest change applies equally to outstanding indexed bonds.⁴⁵ Widespread dissatisfaction with Brazil's indexing during the 1970s led to several changes in the way it was applied, often to the detriment of existing bondholders.

In practice, most bonds have been linked to an index of consumer prices (CPI), as shown in Table 2. The reasons are that the CPI is widely disseminated and well understood, it is broad-based, it is rarely revised (this is particularly important for the pricing and trading of bonds in the secondary market), it is issued on a timely basis with a short lag (also important for secondary trading in bonds), and it contains information which, in principle, is available to all agents. One notable exception was the Italian bond issued in 1983 that was tied to the value added deflator. This index was not well understood, and has been cited as one reason for the issue's lack of success.

A related decision is whether bonds should be fully or only partially indexed. Limits may better match the requirements of some investors. For example, suggestions have been made in the U.K. to offer limited price index (LPI) gilts, indexed perhaps to the lower of the increase in the RPI or 5 percent. This would match the payout benefits of certain pension funds. Partial indexation may also be seen as a way to limit the feedback effects onto inflation.

However, circumscribing the extent of the indexation may weaken the monetary policy credibility argument for indexed bonds, although there are precedents. In Israel, some bonds were partially adjusted at the rate of 80 or 90 percent of the change in consumer prices. In Brazil, index-linking was altered on several occasions through the 1960s and 1970s, partly because of concerns about the feedback on prices of widespread indexation. Initially, changes were made to the lags and frequency of adjustments to the index-adjustment mechanism. In one case, "accidental" price shifts (such as in food prices due to weather conditions, and rises in international oil prices) were temporarily edited out. In another, the formula was based half on ex-post changes in a moving average of prices lagged 6 months, half on an official

⁴⁵The change in legislation was part of a broader package of reforms that include, *inter alia*, measures to gradually decrease the scope of financial indexation in Iceland.

Table 2. Inflation Index and Lags by Country

Country/ Bond	Index	Frequency	Lag	Limitations
Australia/ TBs	CPI "Weighted Average of Eight Capital Cities: All-Groups Index."	Quarterly average of the months.	Price movements up to 10 months prior to the interest payment enter the calculation (e.g., the November adjustment is based on the average movement in the CPI over the two quarters ending in the preceding June quarter).	n/a
Brazil/ ORIN	IGP-M, an index of general prices.	Initially quarterly, but later monthly.	1 month.	The index was subject to a series of changes during the 1970s and 1980s, including the introduction of a combination of pre-fixed and post-fixed monetary correction (the latter based on an official government forecast of inflation for the coming 12 months), changes to the pre-and post-fixed weights, fractional indexing when inflation exceeded 15 percent a year, and eventually limiting the amount of monetary correction to 54 percent of the inflation index.
Canada/ RRBs	CPI.	Monthly, with daily interpolation to calculate accrued interest.	3 months.	n/a
Chile/ PRCs PRBCs PCDs	UF (unidad de fomento), the unit of account introduced in 1967.	UF is linked to the CPI with a one-month delay; adjusted daily, beginning on the tenth day of month t, based on the change in CPI in month t-1.	1 month.	Indexed time deposits are not allowed for maturities less than 90 days, or on loans for less than 30 days
Iceland/ Fixed Rate Government Bonds	CPI (indexing against foreign currencies, including ECU and SDR is also permitted).	Monthly.	15-25 days.	Current government policy is to gradually limit the scope of financial indexation; indexed loans are now subject to a minimum maturity of 3 years, which will rise in stages to 7 years by the year 2000.
The reference index has changed several times: from 1979-89 the "credit terms index" (CTI) comprised the cost-of-living index (2/3rds weight) and building cost index (1/3rd weight); from 1989-1995 the CTI comprised the CLL, BLI and a wage index, (each equally weighted).				

Table 2. Inflation Index and Lags by Country

Country/ Bond	Index	Frequency	Lag	Limitations
Israel/ Sagi, Galil, Kfir.	CPI.	Monthly.	1 month.	In the mid-1970s, inflation compensation was reduced in stages to 90 percent and 80 percent of the CPI increase.
Italy/ Titoli Reali Irredimibili	Value Added Deflator.	Annual.	1 year (indexed to the deflator during the previous year).	n/a (bonds no longer issued).
New Zealand/ IABs	CPI (All Groups).	Quarterly average of the months.	Price movements up to 10 months prior to the interest payment enter the calculation.	n/a
Sweden/ Index-linked Treasury Bonds	CPI.	Monthly.	2 1/2 months	n/a
U.K./ IGs	RPI (Retail Price Index).	Monthly.	Up to 8 months, comprising 2 months for collection and publication of the RPI and 6 months to allow the next coupon payment to be known in advance, for calculation of accrued interest.	n/a

government forecast of inflation during the coming 12 months. A later formula replaced the government forecast with a constant assumed annual inflation rate of 15 percent (with a 20 percent weight), and a shorter adjustment lag.⁴⁶

The possibility of future changes to the application of indexing on government bonds would be reflected in a larger risk premium, and could hinder development of the market. Of course, arbitrary measures are not limited to indexed bonds. While indexed bonds preclude a government from using the inflation tax, in the limit a government could repudiate the debt. Or, it could freeze assets, as occurred in Brazil and Argentina at the start of this decade,⁴⁷ a measure which is unlikely to inspire investor confidence.

C. Application of Indexation to Bond Cash Flows

Bonds comprise periodic payments of coupon interest and principal repayment at maturity. Ideally, all cash flows on indexed bonds would be adjusted for changes in purchasing power. On "capital-adjusted" indexed bonds the coupon rate is specified in real terms. Interest payments equal the coupon rate times the inflation-adjusted principal amount. At maturity, the principal repayment is the product of the nominal or face value of the bond times the cumulative change in the index. This is how indexing is applied in Canada, New Zealand, and the U.K. The U.S. bonds, which the Treasury Department announced will be modeled after Canada's Real Return Bonds (RRBs), will also be of this type.

An alternative to the ongoing indexing of both interest and principal is to adjust only the interest payments, adding the (current) periodic inflation rate to the real coupon. The principal repayment at maturity is not adjusted. In this case, all of the adjustment comes through changes to the coupons. Australia, when it introduced indexed bonds in 1985, offered both types of bonds (called Capital-Indexed and Interest-Indexed bonds). While demand for these bonds was uneven, Capital-Indexed bonds proved far more popular. When the program was reintroduced in 1993, only Capital-Indexed bonds were offered.

⁴⁶The formula was set at $[0.8 * (\text{wholesale price index}) + 0.2 * 15\%]$ in 1976. The wholesale price index was a three-month moving average, lagged two months. Bondholders would lose whenever actual inflation exceeded the 15 percent per annum "prefixed" adjustment, and came out ahead when it was less. See Jud (1978) or Baer and Beckerman (1980) for further discussion of this and other formula changes.

⁴⁷In Brazil, bonds were remunerated at 6 percent plus indexation during the freeze.

Whichever method is used, the net present values on the two bonds is the same (this internal rate of return calculation is the conventional yield-to-maturity measure used in the market). However, since the patterns of the cash flows are different, the durations differ.⁴⁸ With positive inflation, duration of the interest-indexed bond is lower than the capital-indexed bond, since a greater portion of the former bond's cash flow is received earlier.⁴⁹ Clearly, the two bonds are not exact equivalents. The pattern of the cash flows is important for duration matching and portfolio immunization, particularly for pension funds and life insurance companies, two groups which may have a natural need for index-linked assets. Thus, the choice between the two fundamental designs may affect the issue's marketability, as was the case for Australia's bonds.

While the indexing of both principal and interest may be preferred on theoretical grounds, neither bond is risk-free. In addition to credit risk and liquidity risk, both bonds are subject to reinvestment risk, because real rates also fluctuate over time. Indexed bonds sold prior to maturity are subject to capital gains and losses owing to changes in real rates, in the same way that changes in nominal rates cause nominal bond prices to rise and fall.

D. The Problem of Index Lags

Ideally, interest payments for a given period would be corrected for inflation in the same period. However, unavoidable lags between the actual movements in the price index and the adjustment to the bond cash flows corrupt the inflation-proofing properties of indexed bonds. If adjustments to coupons and principal are applied with a delay of "n" months, the final "n" months of the life of the bond are not compensated by that period's inflation, leaving the investor unprotected against changes in inflation. During this period the bond essentially becomes nominal. Information about real yields is also distorted. The distortion is greater the longer the lag and the greater the variability in inflation. On long-term bonds the effect may be small. However, the distortion increases the shorter the remaining life of the bond (consider a six-month bond for which the return is based on inflation which occurred eight months ago, the lag for U.K. bonds). Because real rates are distorted, the information content from indexed bonds on inflation expectations will also be affected, particularly for short- and medium-term expectations, which may be of particular interest to the monetary authorities.⁵⁰

⁴⁸Duration is the weighted average term to maturity of a bond or portfolio, where the weights are the present values of all cash flows (coupons and principal). It is a superior measure of interest rate risk than maturity alone, although duration cannot capture certain risks such as non-parallel shifts in the yield curve, and thus is itself an imperfect measure.

⁴⁹The fact that yields-to-maturity on two clearly different bonds are the same highlights the deficiency of this measure.

⁵⁰In the U.K., the financial press reports real rates of return on IGs on the basis of different
(continued...)

The lags can arise in two ways. Inflation statistics can only be calculated and disseminated with a delay, typically a minimum of a half-month for a consumer price index. Thus, an index of prices in June may only be released in mid-July, and could apply only to a cash flow at the end of that month. Second, by convention, bond trades on the secondary market made between the bond's coupon dates include payment of accrued interest from the previous coupon date. The calculation is trivial for bonds with fixed nominal coupon bonds. For indexed bonds, however, the current coupon, which is the sum of a real rate plus (ideally) compensation for the current period inflation, is not known, because inflation for the months up to the next coupon date is not known. The calculation/dissemination lag problem may be relatively inconsequential at low or stable inflation rates. However, because bond interest payments are traditionally semi-annual, the second problem is potentially more serious. When the two lags are added together, the effects can be substantial, particularly on short- to medium-term bonds. In countries subject to high and volatile inflation, even short lags can have significant effects, subjecting indexed bondholders to increasing amounts of inflation risk, often exacerbated by the shorter term of debt in these countries. On long-term bonds the effect of the lags is less of a problem because the lag is a small fraction of the remaining term to maturity of the bond.

On the U.K.'s IGs the index is lagged eight months, the minimum period that allows accrued interest to be calculated with certainty at all times; two months are for delays in reporting, and six months for the accrued interest calculation on semi-annual coupons. Because of the distortions from this long lag, Treasury authorities have investigated changes to the bonds' design. The single indexed bond issued in Italy carried an annual coupon, and had a one-year lag in indexation (another reason cited for the failure of the issue).

In Canada, the lag was reduced to about three months by adjusting the way accrued interest is calculated. Like the U.K.'s IGs, Canada's RRBs are capital-indexed bonds, with the real coupon rate applied to the bond's inflation-adjusted capital value. However, on RRBs accrued interest is based on cumulative movements in the CPI running from the last coupon date. On IGs, accrued interest is a straight-line or pro-rata share of interest for the next coupon (which therefore must be known in advance). RRB coupons and principal are adjusted by an index ratio calculated from the issue date (the "base date") to the current date (the "reference date"), each lagged three months.⁵¹ For example, the reference CPI for December 1 will be the CPI

⁵⁰(...continued)

assumed future inflation rates, such as 3, 5, and 10 percent, to deal with this index lag problem.

⁵¹In this case, the three month lag is to compensate for the lag in producing the CPI (about three weeks), plus a month to calculate the next month's index value to allow interpolation during the month, and another month to cover possible delays in the CPI release.

for September in that year, which is published in October. The reference CPI for other days in the month is calculated as a simple linear interpolation between the current and next month's CPI.

The problem could also be reduced by introducing indexed bonds with more frequent coupons. Both Australia and New Zealand indexed bonds carry quarterly coupons, because the CPI is only published quarterly, although the lag remains substantial. Both are based on the average percentage change in the index for two quarters ending in the quarter two periods prior to that in which the next interest payment and principal adjustment occur. Shen (1995) suggests issuing bonds with monthly coupons as a way to reduce the index lag effects. High frequency coupon bonds are, however, administratively burdensome and are rarely issued, although modern book-entry systems with direct deposit of interest to the holder's account significantly lowers these costs. The other extreme is zero coupon indexed bonds, which would eliminate altogether lags due to calculation of accrued interest, leaving only the relatively minor problem of the index announcement lag.

Another possibility would be to use an estimate or forecast of the remainder of the current period's inflation. This would require both parties to agree on the forecast convention, for example an extrapolation of past inflation or the current month's inflation, and in practice would be difficult to implement.

E. Coupon Frequency

Apart from the technical problems associated with index lags and accrued interest, other debt management and marketing considerations bear on the choice of coupon frequency.

Bonds have traditionally paid interest on a semi-annual basis. The main exceptions are in the Eurobond market, where coupons are annual, and zero coupon bonds, which pay no periodic interest.

Debt managers attempt to tailor instrument features to the needs of specific market segments.⁵² For example, zero coupon indexed bonds, which have long durations and no re-investment risk, may appeal to pension funds, individuals saving for retirement, or life

⁵²There is, however, a trade-off between market segmentation and providing large, fungible benchmark issues which may lower the issuer's cost of funding by increasing market liquidity.

insurance companies, because they closely match these segments' liabilities.⁵³ Sweden's Index-linked Treasury Bonds include 10- and 20-year zeros, although they have also introduced a 5-year coupon bond to cater to retail clients.

High frequency, monthly pay indexed bonds on the other hand may attract pensioners on fixed incomes or life annuities. As noted, Australian and New Zealand indexed bonds pay interest quarterly, although the choice also relates to the nature of the index (quarterly GDP deflator).

F. Term-to-Maturity

Indexed bonds tend to have medium- to long-term maturities. The main reason is that the risks of an incorrect inflation forecast are lower for shorter horizons, both because inflation may be more predictable and because of the shorter term of the instrument.⁵⁴ However, in circumstances where inflation is high and volatile, even relatively short-term contracts may be subject to indexing, as in several South American countries. However, within a medium- to long-term market the debt manager may attempt to tailor terms-to-maturity to particular segments of demand for indexed securities.

Hetzel (1992) argues that having indexed bonds of different maturities would offer a complete term structure of the public's inflation expectations. Regular issuance of 20-year indexed bonds would in 20 years provide a complete term structure of real rates. But, 20 years is a long time to wait; the U.K. Treasury, which like a number of other issuers has relied only on new issues of long-term indexed bonds, has indicated it is considering extending the program to shorter-term offerings, if there is sufficient demand, to complete the yield curve. Sweden, after first issuing a 20 year indexed-bond exclusively to institutional investors, in 1995 began selling one with a maturity of 9 years. Its Debt Office reported it had acted "mainly because certain investors had expressed a demand for shorter loans, but also with the object of

⁵³Zeros can be offered directly in market by the issuers, or can be created by market intermediaries by "stripping" coupon bonds (or through the reverse process, reconstituting coupon bonds by recombining strips). The strips market is greatly facilitated by book-entry systems, such as STRIPS in the U.S., or CDS in Canada. The advantage of letting the market handle it is that virtually any cash flow can be created, to custom tailor asset matches against investor liabilities.

⁵⁴In terms of the modified Fisher equation:

$$i \equiv r + p_e + \delta$$

For short-term contracts, unanticipated inflation risk is very low (so that $p_e \approx p$ and $\delta \approx 0$), which reduces to the basic Fisher identity:

$$i \equiv r + p$$

broadening the investor base to include retail investors."⁵⁵ The first U.S. indexed bonds, to be auctioned in January 1997 will have a 10 year maturity. Treasury officials have indicated other maturities will be added in 1997.

As noted above, index lags distort the information content of real rates and inflation expectations, making the yield gap curve less useful, especially for short-term securities.

G. Integration With the Debt Management Program

Many countries benchmark their debt management programs to explicit targets for term-to-maturity, duration, or a fixed/floating ratio.⁵⁶ On indexed bonds, the issuer assumes the inflation risk. Future nominal cash outflows are therefore uncertain and duration cannot be accurately calculated. One approach would be to calculate duration based on an inflation forecast. To calculate a fixed/floating ratio, the debt manager may decide to assign indexed bonds to the floating portion, even if indexed bonds have long terms-to-maturity.

H. Selling Techniques

Government debt managers can choose among a number of primary distribution techniques, including fixed-price public subscriptions or syndications, auctions, tap issues or private placements.

In developed capital markets there has been a clear preference in the past decade for primary auctions to price and distribute government securities, including in some instances indexed bonds. Concerns about market information, pricing consensus and liquidity for new instruments may lead the auction manager to choose uniform-price over multiple-price auctions. In Canada, where the first nine distributions of RRBs were by fixed price subscription through a syndicate of investment dealers, recent issues have been by uniform-price auction to primary distributors. Sweden's initial offerings of Index-linked Treasury Bonds in 1992/93 were also via uniform-price auctions, but the National Debt Office switched to the multiple-price format when the program was recommenced in 1995. It included a non-competitive facility for the benefit of small investors. New Zealand's Inflation-indexed bonds (IIBs) are also sold by uniform-price auction, while Australia now offers its TIBs through multiple-price auctions.

In an initial offering, the issuer faces an intractable pricing problem, because there is no secondary market benchmark. For this reason, the U.K. Treasury auctioned its first issue of IGs, to let the market decide. In the event, the market faced similar problems in assessing value; bids for the initial auction ranged from £80 to £130 for the bonds, which carried a

⁵⁵See The Swedish National Debt Office (1994/1995).

⁵⁶See Bröker (1993) for a discussion of liability management techniques in OECD countries.

2 percent real coupon. Fortunately, the uniform-price auction format saved some investors from an embarrassingly large "winners' curse", and the issue was priced at par. Following further problems in subsequent auctions, including less than full take-up of the stock, the auction format was abandoned. IGs have been issued solely by tap since 1988; however, the U.K. authorities have mooted the possibility of reintroducing auction "experiments" for these bonds.

It is likely the government debt manager will attempt to streamline its operations by using similar distribution networks for all its offerings, although there may be valid arguments in favor of special arrangements for relatively new, less liquid instruments. To promote the market for indexed bonds, the fiscal agent may decide to establish a separate network of market specialists in indexed bonds to provide liquidity and market-making support for the instrument. In return, specialists may be granted special or exclusive access to bid at auction or to a government-sponsored discount window or participation in central bank operations in these securities. As in the U.K., early TIB auctions in Australia were also plagued by market uncertainty to determine underlying value. Because these were multiple price auctions, the range of accepted real yields was as high as 200 basis points (Table 3). These poor results led to the subsequent sale of TIBs by fixed price subscription through a dealer panel when the program was restarted in 1993. At the same time, the government made it clear that this arrangement was temporary, until the market had developed enough to reintroduce public tenders. The dealer panel was disbanded in July 1994, and since that time distribution of TIBs has again been through multiple-price auctions. The range of accepted yields from March 1995 through February 1996 has been from 0 to 6 basis points.

Another consideration is the design of a retail distribution network. In the primary market where bonds are sold by auction, this can be effectively accommodated through non-competitive tenders at the auction average, as in Sweden. In countries selling bonds by tap, or fixed-price subscription through a selling syndicate, such as the U.K. and until recently Canada, the debt manager must consider the choice between commissions and market-determined bid/ask spreads for the retail market. The U.S. Treasury announced that, in addition to its regular indexed bonds which will be sold by auction, it would offer beginning in 1998, inflation-indexed U.S. Savings Bonds in denominations as low as US\$50 through its retail distribution network.

I. Market Participation and Turnover

In low inflation countries, where indexed bonds have been introduced recently, market participation has been narrower than for nominal bonds and generally has been dominated by institutions. This reflects their specialized nature as matches against chiefly long-term liabilities that move in line with inflation. Although broad distribution developed slowly in the U.K., for example, there are now over 100,000 registered holders of IGs, of which more than half are individuals. About 80 percent of the stock held by institutions is in pension fund and insurance

portfolios.⁵⁷ In Canada, where RRBs were first introduced in 1991, market breadth is far smaller, with no more than about 50 major institutions holding the bulk of the outstanding stock. Market participation in Australia's TIBs is also concentrated in superannuation and insurance portfolios.

Secondary market turnover in low inflation countries is also likely to be lower than for nominal bonds. Indexed bonds are unlikely to be used to make rapid adjustments to portfolio liquidity or for trading purposes, for example. Still, secondary market liquidity is a desirable feature for market participants. Illiquidity can impede primary market development and impose costs on the issuer. Evidence from the U.K., Australia, and Canada indicates much lower secondary market liquidity for indexed bonds than for nominal bonds. In the U.K., 1994 turnover in the conventional market was twenty-five times greater than in the IG market by value, compared to a market valuation ratio of between five and six times greater. Average trade size for IGs was also smaller, the number of trades per day lower, and the bid-offer spread higher than on comparable conventional bonds. The average monthly secondary market turnover of Canadian RRBs during 1994 was 3.5 percent of the stock. By comparison, the monthly turnover ratio for non-indexed Government of Canada domestic bonds was over 25 percent. Monthly turnover was also much lower for Australia's TIBs (21 percent) than for nominal government bonds (120 percent), based on 1995 data.

Secondary trading of bonds is conducted over-the-counter in many countries. Trading activity within the same market structure may facilitate arbitrage between nominal and indexed bonds. On the other hand, price transparency may be enhanced by listing indexed bonds on an exchange. This may be an important consideration if greater retail participation is sought. Indexed bonds are listed on exchanges in Iceland and Australia. In either case, the debt manager may designate market specialists to foster the secondary market in indexed bonds. In return, market makers may be granted special privileges, such as the exclusive right to bid for bonds at auction, or to participate in new issue syndications. Of the twenty Gilt-Edged Market Makers (GEMMs) in the U.K., only eight are active in the wholesale IG market. Authorities there have questioned whether the IG market would be better served by specialist IG market-makers.

⁵⁷See Bank of England (September 14/15, 1995).

Table 3. Australian TIB Issuance

Date	Issuance Method	Stock	Volume (\$ million)	Yields Accepted	Range Accepted	Average Yield			
30 July 85	Multiple-price auction	Aug 1995/ Aug 2005	55/	4.35-5.57/	122/	5.20/			
4 Nov 85			55	4.22-4.90	68	4.49			
5 Feb 86			15/ 50	5.29-7.00/ 4.88-4.98	171/ 10	6.61/ 4.97			
6 May 86			25/ 50	6.30-6.70/ 5.40-7.40	40/ 200	6.56/ 6.16			
5 Aug 86			25/ 50	5.22-5.47/ 4.98-5.46	25/ 48	5.42/ 5.36			
6 Nov 86			25/ 50	5.68-5.96/ 5.48-5.73	28/ 25	5.81/ 5.62			
10 Feb 87			Aug 1998/ Aug 2005	25/ 50	5.70-6.20/ 5.29-6.20	50/ 91	6.03/ 5.84		
12 May 87				25/ 50	5.74-5.95/ 5.55-5.75	21/ 20	5.91/ 5.71		
25 Aug 87				25/ 50	5.40-5.43/ 5.32-5.34	3/ 2	5.42/ 5.34		
10 Nov 87				25/ 25	5.09-5.09/ 5.04-5.08	0/ 4	5.09/ 5.07		
9 Feb 88				25/ 50	5.05-5.19/ 5.00-5.12	14/ 12	5.17/ 5.07		
Feb 93				Dealer Panel	Aug 2010	500	n/a	n/a	4.62
May 93						250	n/a	n/a	4.32
Aug 93						500	n/a	n/a	3.71
Nov 93	200	n/a	n/a			3.38			
May 94	Multiple-price auction	Aug 2015	400			n/a	n/a	4.88	
25 Aug 94			120	4.64-4.70	6	4.67			
22 Sept 94			75	5.25-5.50	25	5.39			
26 Oct 94			75	5.48-5.68	20	5.57			
2 Mar 95			75	5.54-5.54	0	5.54			
6 Apr 95			100	5.38-5.40	2	5.39			
4 May 95			100	4.94-4.97	3	4.96			
13 July 95			100	4.70-4.75	5	4.73			
7 Sept 95			100	4.70-4.76	6	4.74			
16 Nov 95			100	4.74-4.79	5	4.77			
1 Feb 96	100	4.58-4.61	3	4.60					

Another potential source of demand for indexed bonds is from individuals seeking purchasing power protection for their retirement savings. Retail interest in these bonds may be impeded by income tax accrual rules, unless there is a specific exemption or provision for individual tax-sheltered retirement savings vehicles. There is strong participation in IGs by individuals in the U.K. In Canada, encouragement of retail participation in RRBs has met with limited success despite the gradual move from defined benefit to defined contribution plans and the widespread use of tax-sheltered retirement savings plans with generous annual contribution limits. The last of two special tranches of RRBs of C\$100 million earmarked for the retail market was in early 1994. Members of the syndicate were paid generous commissions for placing the bonds with retail clients and the rest of the issue was allotted by tender. In Sweden, individuals were recently allowed to participate through primary dealers in the existing Index-linked Treasury Bonds, counter to the usual practice of separating wholesale and retail markets. Rather than create a separate retail instrument, the Debt Office opted to concentrate all demand through its regular auctions. This was motivated by the slow start to the program, and the fact that several auctions in 1994 were not fully subscribed.

J. Taxation

As in other matters in finance, taxation complicates the discussion of indexed bonds. Aside from general tax considerations, such as the taxation of capital gains that apply to all investments, taxes affect indexed bonds in two ways. First, they make after-tax yields on indexed bonds uncertain, despite the fact that pre-tax yields are certain. Taxes thus reintroduce inflation risk to indexed bonds. Second, the type of indexed bond and tax rule will affect the timing and present value of the tax. The demand, supply and equilibrium prices for indexed bonds will be affected.

The uncertainty of real after-tax yields

Income taxes reintroduce uncertainty into the after-tax returns on indexed bonds. An increase in inflation raises the nominal yield on indexed bonds, which increases the tax liability and lowers the after-tax yield. This is true even if pre-tax real yields do not change.⁵⁸ The only way to inflation-proof the investment is to exempt from tax the nominal adjustments due to inflation. But, this treatment would be preferential for indexed bonds compared with nominal bonds.

⁵⁸For example, consider an indexed bond guaranteed to yield a 4 percent real return. At 1 percent inflation, the pre-tax nominal return rises to 5 percent ($= 4 + 1$). At a flat 30 percent tax rate, the after-tax nominal return is 3.5 percent [$= 5 \text{ percent} * (1 - 0.3)$], and the after-tax real return is 2.5 percent ($= 3.5 - 1.0$). At 5 percent inflation, the pre-tax return rises to 9 percent ($= 4 + 5$), the after-tax nominal return to 6.3 percent [$= 9.0 \text{ percent} * (1 - .3)$], but the after-tax real return is only 1.3 percent ($= 6.3 - 5.0$).

While taxes reintroduce inflation risk to indexed bonds, the effect is lower for indexed bonds than for nominal bonds. Shen (1995) showed that whereas the effect of inflation on ex-post after-tax real yields on nominal bonds is one-for-one, the effect on indexed bonds is scaled down by the tax rate.⁵⁹

The fact that indexed bonds can no longer guarantee after-tax real yields also means that the information content from indexed bonds on real rates will be distorted, although at low inflation the distortion will be small. However, as Hetzel (1992) and Shen (1995) point out, information about inflation expectations embodied in the yield gap between nominal and indexed bonds would not be distorted if the tax treatment is the same for both types of bonds. Indexed bonds can therefore still be a valuable aid to monetary policy makers.

The after-tax yield uncertainty also means that indexed bond yields themselves may incorporate an inflation risk premium, although this premium would be lower than for nominal bonds. This could lower cost savings from indexed bonds to the government treasury.

The effect of income tax accrual rules

The second major influence comes through the application of income tax accrual rules. In keeping with the generally accepted accounting principle of booking revenues and expenses when they arise, income tax liabilities are generally levied coincident with the accrual of the source income. The accrual rules are designed to prevent tax deferral.

When applied to interest-indexed bonds, where all inflation compensation is paid through ongoing adjustment to the coupons, no special problems arise. However, with the more usual capital-indexed bonds, where both the coupons and the maturity value are adjusted for inflation, part of the ongoing inflation compensation is not paid out until maturity (or sale in the secondary market). If the tax accrual rule is applied to this bond, investors are liable to pay a portion of tax prior to the cash receipt of income. The problem is greater (i) the longer the maturity of the bond, and (ii) the higher the rate of inflation. Because indexed bonds may appeal to investors with long-term horizons, and demand may otherwise increase with perceptions of greater inflation risk, the impact may be pronounced.

⁵⁹In the example in the previous footnote, the nominal bond is priced to yield 5 percent when the real rate is 4 percent and the inflation expectation is 1 percent. It will pay the same after-tax nominal and real returns as the indexed bond (3.5 percent and 2.5 percent, respectively) if the expectation is realized. However, if inflation unexpectedly moves to the higher rate of 5 percent, the after-tax nominal return on the nominal bond remains at 3.5 percent, and the real return declines to -1.5 percent (= 3.5 - 5.0). Therefore, the decline in the after-tax real yield for the nominal bond is 4.0 percentage points [= 2.5 - (-1.5)], or the full amount of the unexpected inflation (= 5 - 1). In contrast, the decline in real after-tax yield for the indexed bond was only 1.2 percentage points (= 2.5 - 1.3), which equals the product of the full inflation change (4 percent) times the tax rate (.3).

The effect on demand and supply

Both above factors would lower demand for indexed bonds from taxable investors. The combined effect, particularly from the accrual rules, may limit the appeal of indexed bonds to non-taxable investors. This may occur naturally through market forces, or by government stipulation,⁶⁰ but would likely raise the cost to the issuer through a higher liquidity premium.⁶¹ This premium, plus the inflation risk premium that results because indexed bonds no longer guarantee real after-tax returns, may offset benefits to the treasury from the capture of the inflation risk premium on nominal bonds. Furthermore, addressing the income tax accrual problem by, for example, exempting from capital gains that portion relating to inflation, would reduce tax revenue. Overall, government debt managers may be reluctant to issue bonds to what may be perceived as a niche market.

There is another way that taxes could feed back to the issuer, and potentially alter the supply price. Echoing concerns of the U.S. Treasury about the potential effects on real rates and the costs of indexed bonds, Munnell and Grolnic (1986) showed how tax arbitrage possibilities between the differential yields on nominal and indexed bonds may drive real yields on indexed bonds up. Even if non-taxed accounts are the major purchasers of indexed bonds because of the accrual rules, they can still purchase nominal bonds. For example, a 10 percent pre-tax yield on a nominal bond may comprise a 3 percent required real return, 4 percent anticipation for inflation and 3 percent premium for taxes for taxable investors (a 30 percent tax rate). If indexed bonds are purchased only by non-taxable accounts, these bonds should yield 7 percent (= 3 percent real rate plus 4 percent inflation compensation). But, the potential indexed bond buyers have a choice between a certain 3 percent real yield on the indexed bond, and the uncertain, but expected 6 percent real yield on the nominal bond (= 10 percent nominal rate less 4 percent expected inflation). The wide differential could force real yields in the indexed bond market higher, close to 6 percent. However, the government's position would be roughly the same. If indexed bonds did not exist, non-taxable accounts would simply buy nominal bonds at the expected real rate of 6 percent. The government's real costs of issuing to non-taxable accounts would be roughly 6 percent in either case. To the extent to which it could issue indexed bonds to yield less than 6 percent, because for example it captures the inflation risk premium, the government would still reduce its borrowing costs.

⁶⁰When the U.K. first launched IGs in 1981, ownership was restricted to non-taxable accounts ("gross funds"). This allowed authorities to leave unresolved issues of tax treatment of capital revaluations on indexed bonds. It also provided an opportunity for a limited "test market" of the bonds. Subsequent tax changes were designed to bring the treatment of indexed bonds in line with conventional bonds, allowing IGs to tap the broader taxable market for debt securities. See Munnell and Grolnic (1986) for a discussion.

⁶¹As noted above, the evidence is that liquidity in the Canadian RRB, Australian TIB and U.K. IG markets is lower than for conventional nominal government bonds.

Tax treatment in practice

If income taxes are levied only on real values, so that illusory gains stemming from inflation are not taxed, these problems disappear. However, complete indexation of the tax code is a feature of countries where indexation, and perhaps inflation, is more generally accepted or entrenched. Brazil and Chile, where financial transactions were generally expressed in terms of an indexed unit of account, and Israel are examples.

Differential tax treatment of gains and losses due to inflation between indexed and nominal bonds will tend to favor one type of bond over the other. The U.K. is implementing changes to its income tax system to make the total return on IGs taxable. Coupon income on IGs, including the inflation adjustment component, remains fully taxable, the same as for conventional bonds. Capital gains, which had been tax-exempt, are now taxable, except that the "uplift" from inflation on IGs remains tax-free.⁶²

Another approach to the accrual problem would be simply to exempt all capital gains from tax. Capital income (capital gains and interest) has not been subject to tax in Iceland, where the financial market is subject to widespread indexation, although the government plans to introduce a withholding tax on interest income. Prior to the change described above, in 1985 the U.K. had abolished capital gains taxes on Treasury securities and certain corporate bonds (indexed bonds were also opened to the general public, taxable and non-taxable alike, in 1982). This introduced an asymmetry between nominal and indexed bonds, since the holders of the former paid taxes on coupon income which included a built-in inflation premium, where the latter received some inflation compensation in the form of non-taxable capital gains.

Alternatively, income tax accrual rules could be preserved, although this effectively limits the appeal of long-term indexed bonds to non-taxable accounts. This is the case in Canada, where RRBs are held primarily by pension funds and non-taxable insurance portfolios, along with a smaller amount in individual tax-sheltered retirement savings plans.⁶³ As noted, ownership for the first U.K. IG issue was restricted to pension funds, life insurance companies and charities, funds not subject to tax on income or capital gains. Despite the 1982 changes opening IGs to

⁶²The latest tax reforms are designed to foster development of a Gilt strips market (strips, or zero coupon bonds, are affected most by the application of the income tax accrual rules).

⁶³While ownership of RRBs is unrestricted, the prospectus warns: "Accrued Inflation Compensation for a series of Bonds must be included in a Bondowner's income... , notwithstanding that payment in respect thereof will not be made until Maturity for such series. Taxable Bondowners should have regard to their respective tax positions, particularly in the event that the Coupon Interest received at any relevant time is insufficient to cover the income taxes exigible on all interest required to be included in income in connection with the Bonds."

the general public, ownership is still skewed to non-taxed accounts. Interest on inflation-indexed U.S. Savings Bonds for the retail market, which will be offered in 1998, will not be taxed until the bond is cashed or matures, a tax advantage that the wholesale bonds will not share.

K. The Government Accounting Framework

Generally accepted accounting principles normally apply on nominal values, and treat revenue and expense as they accrue. The public accounts of government operations also operate on nominal values. However, receipts and disbursements are generally booked on a cash basis, reflecting the size and complexity of the government accounts.⁶⁴ On capital-indexed bonds, inflation compensation is split between interest and principal. With positive inflation, interest payments will be lower than on nominal debt, or on interest-indexed bonds. At maturity, the principal adjustment on the capital-indexed bond would balance the overall borrowing costs between the different financing options. However, the deferral of inflation compensation on the principal of this bond lowers the recorded budget deficit compared to nominal debt financing. This cosmetic improvement could be substantial for a large program of long-term capital-indexed bonds. To fairly present a government's financial position, adjustments to principal for indexed bonds should be accounted on an accruals basis.

V. CONCLUSIONS

Despite the relative infrequency of issuance by governments, indexed bonds have a long history, and their use and acceptance has been growing slowly, with notable recent introductions in a number of developed capital markets. The recent decision by the U.S. Treasury to issue indexed bonds, after decades of exhortations by a number of economists, including those at the Federal Reserve, may accelerate this process, and elevate inflation-indexed bonds into the financial market orthodoxy.

Issuance by corporate and other non-government borrowers remains rare, primarily for tax, risk (hedging) and other institutional reasons. Lower and less variable inflation may explain more general issuer disinterest in indexed bonds. For governments the fear of loss of credibility and inflationary consequences of index bonds may also partly explain the lack of more widespread use. However, the academic literature suggests no necessary connection between indexed bonds (or indexation in general) and inflation. The emergence of inflation depends on other circumstances and policies that are independent of indexation. Recent government issuers of indexed bonds in fact point to credibility enhancements that may result from issuing indexed bonds, by neutralizing the inflation tax.

⁶⁴New Zealand is an exception, having moved to an accrual basis for the public accounts.

On the other hand, indexation is not a panacea, nor a substitute for non-inflationary public policies. Widespread indexation would appear to make inflation easier to live with, and over time carries risks that it may "institutionalize" inflation into the economic and social structure.

Nonetheless, the introduction of indexed bonds carries several potential benefits. These include lower borrowing costs through capture of the inflation risk premium of investors who value this form of insurance, and providing a window on inflation expectations that can be used as another effective guideline for monetary policy implementation. Widespread use of indexed bonds may also encourage financial savings, intermediation, and the strengthening of capital markets, particularly for lesser developed economies and economies in transition.

In recent decades governments have issued indexed bonds for different reasons. Some high inflation countries adopted comprehensive indexation to preserve domestic capital formation, or in the limit to prevent the loss of domestic monetary policy control through currency substitution. Where indexation has become widespread it has tended to perpetuate, if not exacerbate, inflationary pressures, in part by making inflation easier to live with and accept, both for individuals and their governments. In this decade a number of countries with comprehensive financial indexation, such as Argentina, Brazil, and Iceland have taken specific steps designed to reduce the scope of indexation as a way to break the psychology of ingrained inflation expectations. Chile, which is often presented as a country which has adapted and performed well under comprehensive indexation, has chosen a more gradual path to de-index.

Several industrialized countries with better inflation performance, following the U.K.'s lead in the early 1980s, are seeking to build up their markets for indexed securities, for reasons of market completeness, cost-savings and policy credibility.⁶⁵ In these countries, indexed bonds have been a successful complement to traditional nominal bond programs, although market acceptance has been in some cases slow to build, hampered by illiquidity, as may be expected with any new instrument. However, the natural hedging properties of indexed bonds may more fundamentally limit their market appeal, such that they could not be expected to fully displace nominal bonds as the benchmark asset in developed capital markets.

In this regard, the design features of indexed bonds will be important to the success of a program. The main parameters are the choice of index (the broader the better), term of the issue (should generally have a long-term bias, but to be chosen with key market segments in mind), the index lag (the shorter the better, unambiguously), and the tax implications (to ensure consistency with the tax treatment for other instruments). Not least important, the index itself must be credible, subject only to infrequent revision (if at all), and calculated by an independent statistical agency.

⁶⁵It is interesting to note that four of the five industrial countries to have adopted formal inflation targets—Canada, New Zealand, Sweden, and the U.K.—another formalized mechanism to promote inflation-fighting credibility, have also introduced indexed bonds.

Timing of the introduction of an indexed bond program may also be critical to success, particularly if the bonds are being marketed as a precommitment to an anti-inflation policy. Poor timing could raise questions of credibility that could conceivably affect both the acceptance of the instrument and the success of the policy. In a period of volatile or rising inflation expectations, the signal could be perverse. While indexed bonds may benefit developing or transition economies by fostering the development of deeper and longer-term domestic debt markets, this may be overshadowed by market concerns over the ability of the monetary authorities to maintain the internal and external value of the domestic currency. In such circumstances, foreign currency debt may be a better choice.

Indexed bonds may be recommended in countries with established and credible policies to avoid inflation, and where they would provide a natural hedge for some market participants. They should not be marketed exclusively on the basis of inflation-fighting properties per se. In newly developing or transition markets, they could be envisaged as part of a concomitant package of fiscal and monetary reforms to foster longer term capital formation, along with strong commitments to price stability.

Details of Selected Inflation-Indexed Government Bonds

Issuer	Argentina
Instruments	n/a (Since the inception of the Convertibility Plan in April 1991, which banned all forms of indexation and linked the Argentine peso to the U.S. dollar at an exchange rate of one-for-one, most bonds have been dollar denominated and floating rate).
First issued	1973. Discontinued in 1991.
Discontinued series	<p>Valores Nacionales Ajustables (VNA) were peso denominated, tax-free bonds first offered in 1973; these were redeemed in advance of their maturity in 1982. Bonos Generales de Ahorro Ajustable were offered beginning in 1975, adjusted quarterly to changes in nonagricultural wholesale prices.</p> <p>Bonds indexed to inflation which were outstanding prior to the Convertibility Plan included: VAVIS: 4 series were offered from 1984 through 1987, 5 and 10 year terms, for housing finance; BARRA: 4 series offered in 1987/88, 1 to 3 year terms; FEDERACION: 10 year provincial government bonds issued in 1986/87; TERMOBONO-I: 7 year provincial government bonds issued in 1983 for energy plant financing.</p> <p>Other government bond issues prior to 1991 were linked to LIBOR rates (e.g., BAGON, TIDOL, LEDO, LECA, LECE, LEPE, TICO), or to a central bank financial index (e.g., TERMOBONO-II, BADE, BAFI).</p>
Maturities	Up to 30 years for Bonos Generales de Ahorro Ajustable. In 1990, prior to the Convertibility Plan, inflation-indexed government bond maturities ranged from one to 10 years.
Index	The first indexed bonds were linked to an index of nonagricultural wholesale prices. Later inflation-indexed bonds were linked to indexes of consumer prices (some VAVIS, BARRA), construction costs (most VAVIS), and wholesale prices (FEDERACION and TERMOBONO I).
Index adjustment	Adjustment on VNA was quarterly; later bonds were adjusted on the basis of monthly index changes.
Coupon rates	VNA were first offered in 1973 at 7 percent plus indexation; prior to the Convertibility Plan fixed coupons ranged from 3 percent plus annual capital adjustments on VAVIS (1984 Series 1) to 12 percent on FEDERACION bonds.
Percent of domestic debt outstanding	By 1975, transactions in indexed and floating rate government bonds accounted for 97 percent of the total value of all securities traded on the Buenos Aires Stock Exchange. Prior to the Convertibility Plan, the percentage of all outstanding austral-denominated bonds indexed to inflation fell markedly, as most new issues were being linked to LIBOR rates or to financial market indexes of the central bank.

Details of Selected Inflation-Indexed Government Bonds

Issuer	Commonwealth of Australia
Instrument	Treasury Indexed Bonds (TIBs). Two types of bonds exist: Capital-Indexed Bonds and Interest-Indexed Bonds. Since 1993 only Capital-Indexed Bonds have been issued. State governments have also issued indexed bonds.
First issued	1985.
Discontinued series	Program suspended in 1988 when budget went into surplus, and owing to disappointing auction results for TIBs. Program resurrected in February 1993, although only Capital-Indexed TIBs have been offered.
Maturity	From 1985 through 1988, 10 and 20-year tranches were auctioned. Since 1993, two tranches, maturing 2010 and 2015, have been sold, with numerous re-openings. Four issues now outstanding, maturing in August 1998, 2005, 2010, and 2015.
Index	Consumer Price Index: "Weighted average of eight capital cities: All-Groups Index," published quarterly by the Bureau of Statistics. On capital indexed bonds, a fixed real rate of interest is paid on the adjusted capital value and, at maturity, investors receive the inflation-adjusted capital value of their investment. Interest-indexed bonds keep the capital value of the bond constant but adjust the nominal rate of interest for movements in the CPI.
Index lag	Formula is based on the average percentage change in the CPI over the two quarters ending in the quarter which is two quarters prior to that in which the next interest payment falls.
Coupon rates	All issues carry a 4 percent real coupon. Average yield for the latest reopening of 2015 maturity was 4.60 percent (February 1, 1996).
Coupon frequency	Quarterly.
Amount outstanding	\$4,003 million (to February 1996).
Percent of domestic debt outstanding	3.9 percent (as at 6/30/95).
Secondary Market Turnover	Much lower than for unindexed government bonds. Monthly turnover for TIBs averages about \$0.74 million (20.6 percent), versus \$123 billion (120.0 percent) for nominal Commonwealth bonds (1995 figures).
Form	Book-entry through the Reserve Bank of Australia.
Denominations	\$1,000 and multiples thereof.
Selling technique	From 1985 through 1988, by multiple-price auction. On resumption of TIBs program in 1993, the first 5 placements were by fixed price subscription through a panel of dealers, owing to the small and developing nature of the market, and the uneven experience with TIB auctions (the range of accepted bids was as high as 200 basis points in 1986). Since August 1994, all bonds have been sold through multiple-price auctions (the range of accepted bids in the last 7 tenders has been from 0 to 6 basis points). In the secondary market, Treasury Indexed Bonds are listed on the Australian Stock Exchange, however, most trading takes place in the OTC market.
Taxation	Income by way of interest or discount or through capital accruals is liable to tax.
Eligible purchasers	No restrictions.

Details of Selected Inflation-Indexed Government Bonds

Issuer	Brazil
Instruments	National Treasury Notes (NTN) are the largest element of the public debt market. Series B and C are indexed to inflation (IGP-M, the index of general prices), Series D, I, L, M, and R are indexed to the U.S. dollar, and Series A, F, H, and P are tied to a Reference Interest Rate (TR), which is linked to the yield on 30-day certificates of deposit.
First issued	Indexed bonds were first issued in 1964. Small amounts of NTN's were issued in 1991 and 1992, but they became the primary means of government financing beginning in 1994.
Discontinued series	Readjustable National Treasury Obligations (ORTN) , were first issued in 1964. Terms were from 1 to 5 years, initially with quarterly indexation based on the wholesale price index. The application of the index was changed several times. This included switches to a monthly readjustment, and a shorter adjustment lag. The index was subject to a series of changes during the 1970s and 1980s, including the introduction of a combination of pre-fixed and post-fixed monetary correction (the latter based on an official government forecast of inflation for the coming 12 months), changes to the pre-and post-fixed weights, fractional indexing when inflation exceeded 15 percent a year, and eventually limiting the amount of monetary correction to 54 percent of the inflation index. ORTNs were replaced in February 1986 (Cruzado Plan) by National Treasury Obligations (OTN) , which were in turn replaced by Treasury Bonds (BTN) following the Summer Plan in January 1989. BTN were 2 year notes indexed to monthly changes in the CPI.
Maturities	NTN-B and NTN-C have minimum maturities of 12 months. Maturities on other series range from 3 months to 25 years. NTN's have been emphasized by the central bank as part of a policy to lengthen the maturity of the public debt.
Index	IGP-M is an index of general prices, comprised of fixed weights of consumption, wholesale and construction price indexes. TR is calculated daily as the average interest rate on 30-day certificates of deposit of the main financial institutions over the previous three days, less 1.02 percent to account for taxes and real interest rate components. Phase III of the Real Plan, implemented July 1, 1994, stipulated that indexation of financial contracts for less than a year must be based on TR.
Index lag	Based on changes in the prior month's IGP-M.
Coupon rates	6 percent for NTN-C. NTN-B are zero coupon notes, which also pay 6 percent, plus the inflation correction at maturity.
Coupon frequency	Semi-annual bonds over 6 months (includes NTN-C). Notes issued for terms less than 6 months are sold at a discount (includes NTN-B).
Amount outstanding	5,755 million reals (year-end 1995).
Percent of domestic debt outstanding	NTN notes indexed to IGP-M represented 42 percent of the federal public debt at the end of 1993. This declined to just 5.3 percent at year-end 1995. Non-indexed debt ("Prefixado") rose to 42.7 percent from 26.4 percent over the same period (although not in a straight line; fixed rate debt in fact fell to zero in June 1994, owing to inflation uncertainty at the time of the introduction of the third phase of the Real Plan, which included the establishment of a new currency (the real) and a move to a floating exchange rate). Floating rate debt tied to the overnight rate of interest ("Over-selic") has offset much of the decline in inflation-indexed debt, climbing from a 3.8 percent share to 37.8 percent between year-end 1993 and 1995.
Secondary Market	Government bonds are not listed and trade OTC. Secondary market is very liquid, averaging US\$77 billion turnover (1994).
Selling technique	Sold in closed bid auctions on the first business day of each month.

Details of Selected Inflation-Indexed Government Bonds

Issuer	Canada
Instrument	Real Return Bonds (RRBs).
First issued	1991.
Maturity	30 years. The original issue, launched in December 1991, matures December 1, 2021 and was reopened 10 times from October 1992 through August 1995. A second issue maturing December 1, 2026 was launched in December 1995 and has been reopened once in 1996.
Index	CPI.
Index lag	Approximately three months. The reference CPI for the first day of any calendar month is the CPI for the third preceding calendar month.
Coupon rates	The coupon rate for all 12 issues has been 4 1/4 percent. The first issue was offered at par, or a real rate of 4.25 percent. Subsequent issues have been priced to yield from a low of 3.423 percent (February 1994) to a high of 5.054 percent (February 1995).
Coupon frequency	Semi-annual.
Amount outstanding	\$5,825 million (at 2/28/96).
Percent of domestic debt outstanding	1.1 percent (at July 1995).
Secondary Market Turnover	\$109 million/month compared with \$56.4 billion/month for nominal government bonds (1994).
Form	Global certificates are issued in fully registered form in the name of "CDS & CO.," a nominee of The Canadian Depository for Securities Limited ("CDS"), the central book-entry system for securities in Canada. Certificates are not available to beneficial owners.
Denominations	\$1,000 and multiples thereof.
Selling technique	The first nine issues were distributed at a fixed price through a syndicate headed by three to five lead managers. Two of the last three issues have been sold by "dutch," or uniform-price, auction to primary distributors of Government of Canada securities.
Taxation	There is separate treatment of coupon interest and inflation compensation. Coupon interest (4 1/4 percent for all issues outstanding) is generally included in income as received or accrued. Inflation compensation, of both interest and principal, must also be included in income (as interest) as accrued. Coupon interest and inflation compensation are exempt from withholding tax for non-residents of Canada.
Eligible purchasers	No restrictions. However, taxation of inflation compensation as accrued effectively limits sale of the bonds to non-taxable portfolios, including pension funds, life insurance companies, and individuals' Registered Retirement Savings Plans.

Details of Selected Inflation-Indexed Government Bonds

Issuer	Chile
Instruments	Pagaré Reajustable Pago Cupones (PRCs) are indexed coupon bonds now issued with maturities from 8 to 20 years. Pagaré Reajustable del Banco Central (PRBCs) are 90 day indexed discount notes issued by the central bank for monetary policy operations. Most financial contracts maturing in more than 90 days, including government and corporate bonds, money market instruments, savings deposits, mortgages and other loans, are expressed in terms of the "unidad de fomento" (UF), a unit of account linked to the consumer price index. About 60 percent of private financial assets, 71 percent of banks' loans and over 98 percent of central bank paper were indexed by year-end 1995.
First issued	Indexed bonds were first sold in 1956. The UF was introduced in 1967.
Maturities	Most financial contracts maturing in more than 90 days. Government bond maturities extend to 20 years (30 years officially).
Index	The Unidad de Fomento (UF), which is a unit of account based on movements in the CPI.
Index lag	Approximately one month. The UF is adjusted daily on a pro-rata basis beginning the tenth day of month, ending on the ninth day of month t+1 at which time it has increased by as much as the price level in month t-1.
Coupon rates	Real rates on 20-year central bank promissory notes have ranged between 5.6 percent and 7.4 percent since their introduction in 1993. Recent rate (June 1996) was 6.2 percent.
Percent of domestic debt outstanding	Over 98 percent of central bank paper is indexed.
Secondary Market Turnover	Trading of fixed income securities on Chile's stock exchanges almost doubled between 1990 and 1993 to \$27.5 billion (US dollar equivalent).
Selling technique	By Dutch auction each Tuesday and Thursday, except for the first and last Thursday of the month. Secondary trading is through stock exchanges.
Taxation	Since 1974, tax liabilities have also been indexed to the UF.
Eligible purchasers	No restrictions on foreign investors.

Details of Selected Inflation-Indexed Government Bonds

Issuer	Israel
Instruments	Over 90 percent of government debt is CPI-linked. The majority of remainder of the domestic debt is dollar-linked, with a small portion that gives the holder the option of dollar- or CPI-linking. Sagi (5 to 6 year maturities), and Galil (7 to 20 years) are fixed coupon bonds linked to the CPI. K'fir (4 to 25 years) are CPI-linked floating rate issues. Gilboa (3 to 20 years) are dollar-linked floating rate bonds. (Gilon (1 to 10 years) are non-indexed floating rate bonds, issued since July 1992).
First issued	The government began indexing both its borrowing and lending in the mid-1950s.
Maturities	Up to 25 years.
Index	CPI (in the mid-1970s, inflation compensation was reduced in stages to 90 percent and 80 percent of the CPI increase).
Index lag	One month.
Coupon rates	Range from 2 to 8 percent.
Amount outstanding	CPI-linked domestic government debt totaled NIS 173.3 billion out of total domestic debt of 190.0 billion (year-end, 1994). Optional, CPI or dollar-linked debt totaled a further 3.8 billion, and dollar-linked debt 10.3 billion.
Percent of domestic debt outstanding	91 percent.
Secondary Market Turnover	Average daily turnover on the stock exchange and OTC of NIS 86 million (1994).
Selling technique	Public auction.
Taxation	35 percent of the coupon payment.

Details of Selected Inflation-Indexed Government Bonds

Issuer	Mexico
Instruments	Los Bonos Ajustables del Gobierno Federal (Ajustabonos); Federal Government Development Bonds (UDI bonos).
First issued	3-year Ajustabonos - July 20, 1989. 5-year Ajustabonos - November 22, 1990. UDI bonos - May 1996.
Maturity	Ajustabonos, 3 and 5-years; UDI bonos, 3-years.
Index	INPC - National Index of Consumer Prices, published fortnightly.
Index lag	Two weeks.
Coupon rates	The real coupon, or base rate, is established at auctions every second week.
Coupon frequency	Quarterly for Ajustabonos; semi-annual for UDI bonos.
Amount outstanding	Ps33,695 million (at 12/31/93).
Percent of domestic debt outstanding	About 25 percent (at 12/31/93).
Form	Book-entry through the Banco de México.
Denominations	Ps100,000.
Selling technique	Primary sales by multiple-price auction to brokers, banks, finance and insurance companies and investment funds. Retail clients can purchase through brokers, who quote two-sided markets. Banks can bid for their own account or for clients, to whom a commission may be charged. Secondary market activity is published daily by the Bolsa Mexicana de Valores.
Taxation	For individuals, interest, income from the sale of bonds, and capital gains, including that corresponding to the principal are exempt from income tax. For legal persons, interest and capital gains is added to income and taxed as ordinary interest. For non-residents, interest and gains are exempt from income taxes.
Eligible purchasers	Can be acquired by legal and physical residents and non-residents of Mexico.

Details of Selected Inflation-Indexed Government Bonds

Issuer	New Zealand
Instrument	Inflation Adjusted Bonds (IABs).
First issued	November 1995 (other series issued from 1977 through 1984).
Discontinued series	<p>Two different series of index-linked bonds were issued starting in 1977, but discontinued in 1984:</p> <p>Inflation Adjusted Savings Bonds (IASBs) were sold to the retail market on a tap basis. The inflation adjustment was tax-free and compounding, on top of a 2 percent taxable real rate. Maturities were for a minimum of 5 years, except for superannuitants (in which case they were cashable on demand), or when applied to the purchase of a first home. The outstanding amount peaked at \$933 million in 1983, or 8.7 percent of the total domestic government debt. The last of these matured in 1994.</p> <p>Index Linked Stock were conventional, semi-annual coupon bonds sold to the wholesale market through tenders to primary dealers. Fixed coupons were adjusted by the percentage change in the CPI. Minimum purchase amount was \$5,000. The peak amount outstanding for this bond was \$1,878 million in fiscal 1986 (11.0 percent of total domestic debt).</p>
Maturity	30 years.
Index	The All Groups Consumer Price Index.
Index lag	The index adjustment is the average percentage change of two quarters ending in the quarter two periods prior to that in which the next interest payment and principal adjustment date occurs.
Coupon rates	4.5 percent (first issue in November 1995).
Coupon frequency	Paid quarterly in February, May, August, and September.
Amount outstanding	\$75 million (first tender on November 23, 1995). Reopenings scheduled for February, May, and June of 1996, to bring the volume to \$300 million in 1995/96.
Percent of domestic debt outstanding	Less than 0.3 percent (program just started).
Form	All government bonds are registered with RBNZ Registry Limited, a wholly owned subsidiary of the Reserve Bank. Transfers of government bonds are made through the RBNZ Registry with electronic transfers done through AUSTRACLEAR (domestic clearing and settlement system).
Selling technique	Uniform-price auction. Auction bidding is open to banks and institutions who are already registered with the Reserve Bank for bidding on conventional bonds. There are no primary dealers. Other institutions wishing to bid directly must apply to the Reserve Bank of New Zealand. Secondary market trading is OTC through brokers.
Taxation	The bonds are taxed in a similar way to conventional bonds. Institutional investors are taxed on a full accruals basis. Retail investors are taxed on coupons and inflation premia annually, with discounts and premia taxed on sale or redemption. Resident withholding tax applies.
Eligible purchasers	No restrictions, although direct auction participation is limited.

Details of Selected Inflation-Indexed Government Bonds

Issuer	Sweden
Instrument	Index-linked Treasury Bonds.
First issued	Fiscal 1993/94.
Discontinued series	Following the first five auctions, further auctions were postponed, because "the Debt Office did not accept the market's yield requirement." Beginning in January 1995, bonds were auctioned more often, in smaller amounts. In 1996, bonds were distributed by a tap facility.
Maturity	Four issues outstanding, of which three are zero coupon bonds. Loan 3001, first issued in 1994, matures April 1, 2014. In 1995, a second ten-year issue maturing April 1, 2004 was offered. Both bonds were re-opened on numerous occasions during 1995 (now issued via tap). In January 1996 a five-year zero, maturing in 2001 was added, targeted for the retail sector, along with a 4 percent coupon bond maturing 2008.
Index	CPI.
Index lag	Between 2 and 3 months.
Real rates	Real yields on the 10 year maturity ranged from 5.31 percent to 5.69 percent during the last half of fiscal 1995. For the 20-year maturity, real yields ranged from 4.62 percent up to 5.01 percent.
Coupon frequency	Three of the four issues are zeros. The fourth carries an annual 4 percent (real) coupon.
Amount outstanding	Face value of 25.7 billion kronor (discounted value of 11.6 billion kronor).
Percent of domestic debt outstanding	1.2 percent (as at 6/30/95).
Secondary Market Turnover	Secondary market activity is limited. Commissions to dealers are not levied on retail orders, rather the market operates through bid/ask spreads.
Form	Book-entry.
Denominations	To encourage retail participation, the minimum purchase has been lowered to kronor 5,000.
Selling technique	Since January, by tap issuance through eight primary dealers (out of total of thirteen primary dealers in government securities). Prior issuance was through auctions to primary dealers. Primary auctions were initially of the uniform-price type, out of concern for equity and the "winner's curse," given the developing nature of the market. In 1995, with the opening of the instrument to the retail market, auctions were switched to multiple-price format, with non-competitive tenders for the benefit of small, retail clients.
Taxation	Investors are fully taxed on real interest and inflation compensation as accrued. Changes to the taxation regime to simplify the treatment are pending.
Eligible purchasers	Initially, Inflation-linked Treasury Bonds were offered exclusively to institutional accounts. Beginning in the spring of 1995, the issues were opened up to the retail market, through changes to the distribution technique, and the addition of new issues better matched to the investment horizon of retail investors. Though counter to the practice in other Swedish government debt markets, the decision to target the retail market was explained by the Debt Office as follows: "Even though borrowing from private individuals involves higher costs, we expect that a broader market will lead in the long run to lower auction yields, which will push down the Debt Office's total borrowing costs."

Details of Selected Inflation-Indexed Government Bonds

Issuer	United Kingdom
Instrument	Indexed Gilts (IGs).
First issued	1981.
Maturity	13 issues outstanding, with maturities from 1996 to 2030. The first issue was a 15-year term. Subsequent new issues have ranged as high as 38 years.
Index	Retail Prices Index (RPI).
Index lag	8 months.
Coupon rates	Existing coupons range from 2 percent to 4 5/8 percent.
Coupon frequency	Semi-annual.
Amount outstanding	£23.4 billion (as at 3/31/95).
Percent of domestic debt outstanding	11 percent in nominal terms (17 percent in uplifted terms including the change in nominal principal).
Secondary Market Turnover	Turnover is much lower for IGs than for nominal gilts. For example, secondary turnover was £26 million per day for the 2 1/2 percent IG issue due 2024 (£2.2 billion outstanding in March, 1994), compared with £400 million for the conventional 5 year benchmark bond (£3.6 billion outstanding). Average number of trades per day were lower, and bid/offer spreads higher for IGs than for conventionals.
Denominations	n/a. (The book-entry system accommodates holdings in one penny increments).
Form	Certificates are available for retail investors, however, most gilts are held in book-entry form through the Central Gilts Office operated by the Bank of England.
Selling technique	Initially IGs were issued by uniform-price auctions. Early auction results were poor and the auction format was abandoned. Since 1988 IGs have been issued entirely by tap.
Taxation	Since 1982, IGs have been taxed on the same basis as conventional gilts. Coupon income, including inflation compensation, is taxed in full; principal repayment and capital gains and losses are not taxable. Recently announced reforms for the taxation of gilts will result in the total return, including capital gains on gilts being taxed as income for most investors. IGs will be included in the new regime, except that inflation compensation due to the principal repayment will remain tax-free.
Eligible purchasers	The first IG issue was restricted to funds not subject to tax, owing to unresolved questions about the tax treatment of indexed bonds. Since March 1982, when the tax treatment of IGs was brought into line with other Treasury bonds, IGs have been sold on an unrestricted basis.

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