

Additional report on index-linked bonds

1. Introduction

This additional report is an update of the 2005 report on inflation-linked bonds (index-linked bonds)¹, as promised to the Dutch Lower House of Parliament during the legislative consultations concerning the 2007 financial accounting on 24 June 2008. During those consultations, the Lower House specifically asked about 1) the risks of index-linked bonds for the government, 2) the impact of index-linked bonds on the stability of the EMU balance based on the current budgetary rules, and 3) the importance of index-linked bonds for pension funds and savers.

This update is structured as follows. Section 2 presents a brief summary of the principal conclusions from the 2005 report. Section 3 analyses the developments on the market for index-linked bonds. Section 4 describes the costs and risks for the government, and considers whether including index-linked bonds in the government's debt portfolio is an attractive option from an economic perspective. Other arguments besides economic reasons may exist for issuing index-linked bonds. Section 5 analyses whether, based on current budgetary rules, the presence of index-linked bonds in the government's debt portfolio will help stabilise the EMU balance (the budget in the broader sense), moving away from signal values for the EMU debt and the 3% deficit criterion. Section 6 considers the importance of index-linked bonds for private parties such as pension funds and savers. It also focuses on the potential societal gains to be had from issuing index-linked bonds. Section 7 presents the conclusions.

2. Summary of the 2005 study

In 2005, the Working Group on the Budget in Real Terms (Ministry of Finance, Dutch Central Bank and Netherlands Bureau for Economic Policy Analysis) conducted an extensive analysis of index-linked bonds as an instrument. That study concerned (as does this update) index-linked bonds linked to the Dutch consumer price index (CPI). The findings arising from that study are summarised below, based on responses to three research questions.

1. Are index-linked bonds cheaper than nominal bonds (business case/efficiency)?

From an economic perspective, the trade-off between costs and risks in a debt portfolio is a key factor. Within the debt policy framework, index-linked bonds are less attractive than issuing nominal debt. The trade-off between amount and variability of the nominal interest costs (costs versus risk) is more favourable for a portfolio made up of nominal debt instruments than a portfolio of which part is funded using index-linked bonds.

¹ See *Index-Linked Bonds: Results of a study into the features of index-linked bonds viewed from the perspective of the Dutch State* (Working Group on the Budget in Real Terms, 2005). The full text of the report is available online (www.dsta.nl) in the 'Funding Policy' section.

2. Do index-linked bonds help increase the stability of the EMU balance?

In addition to economic considerations, issuing index-linked bonds may also be an attractive option if they help bring about a more stable EMU balance. If inflation increases, the budget balance should improve and issuing index-linked bonds may stabilise the EMU balance. As interest costs for index-linked bonds rise together with inflation, this would slow the improvement of the EMU balance. The reverse is also true. In 2005, there was a slight positive correlation between EMU balance and inflation. The EMU balance-inflation correlation, however, was not statistically significant and did not apply nearly 50% of the time. In practice, index-linked bonds offer virtually no hedge.

3. How interested are pension funds (demand side)?

On the pensions market, index-linked bonds are used as an instrument to hedge inflation risks and as diversification. The State should issue index-linked bonds because the supply is lacking or insufficient. Although linking the index-linked bonds to the Dutch CPI (rather than the European) is the most suitable option for hedging inflation risks, the match is not perfect, as pension obligations follow total payroll costs. That imperfect match may limit the appeal of index-linked bonds. Moreover, no significant inflation risk premium exists (as yet) that indicates that pension funds automatically prefer index-linked bonds over nominal bonds.

Conclusion

Based on these findings, the decision was taken in October 2005 that the Dutch State would not issue index-linked bonds. The principal argument was that adding index-linked bonds to the national debt portfolio would not offer any efficiency benefits. The addition of index-linked bonds would result in greater fluctuations in interest costs, without being balanced by commensurate savings. In terms of costs and risks in the budget, the existing (i.e. nominal) portfolio is economically more efficient.

3. Developments in the supply and demand of index-linked bonds

Pension funds are investing more and more of their capital in index-linked bonds. Figures from the Dutch Central Bank show that the proportion increased from 4% during Q1 2007 to 6% twelve months later. At present, the combined capital invested in index-linked bonds by Dutch pension funds totals €38 billion. This is illustrated by ABP, which has raised its target percentage for index-linked bonds in its portfolio from 4% in 2005 to an average of 7% for 2007-2009.² Index-linked bonds make it possible for pension funds to make pension schemes inflation-proof. If pension funds wish to achieve this without incurring any risks, they invest their entire capital in index-linked bonds. In practice, however, pension funds do not adopt that strategy in order to realise the same returns for lower pension contributions or to target higher indexation ambitions with the same contributions.

² See http://www.abp.nl/abp/abp/images/26.1065.07_LR_tcm108-45913.pdf

Both the demand for and supply of index-linked bonds are increasing. For example, over \$1,000 billion worth of index-linked bonds issued by governments is currently outstanding, compared with \$200 billion in 2000. Each country makes its own choices, based on local conditions and motives, resulting in different outcomes per country. The most frequently heard arguments are cost benefits, budget stabilisation and investor base increases. Countries that issue index-linked bonds include the UK, France, the US, Italy, Greece and, since 1996, Germany. Countries with high debts, whether in absolute or in relative terms, are particularly active on this market, stemming in part from a desire to increase the diversity of their debt portfolios. Increasing the investor base, by reaching investors who do not invest in nominal instruments may be a reason for issuing index-linked bonds. However, some countries with minor debt, such as Australia and New Zealand, also issue index-linked bonds or have issued them in the past. Conversely, an advisory committee to the US debt manager, consisting of representatives of banks and investment funds, recently recommended reducing the relative proportion of index-linked bonds issued in the country's debt financing on the grounds that issuing them was not an unqualified success from an economic perspective.³

Increased demand for Dutch index-linked bonds will theoretically cause premiums to rise, which in turn may also make it more attractive for the Dutch State to issue index-linked bonds. However, the supply of imperfect substitutes, such as German or French index-linked bonds, has also increased. These market developments constitute grounds for conducting a new analysis of the economic attractiveness.

4. Costs and risks associated with index-linked bonds

In line with IMF recommendations, the objective of the majority of debt managers is 'to finance public debt at low costs with acceptable risks'.⁴ This is also the Dutch State's objective. The Dutch State Treasury Agency applies a benchmark to assess this. The interest costs payable for the actual instruments is compared with that benchmark, and the result is then accounted for. For the Netherlands, the benchmark for the 2008-2011 period consists of the continual notional issuance of seven-year nominal bonds.⁵ If the issue of a particular instrument leads to cost gains compared with the benchmark, assuming a particular risk, the Dutch State Treasury Agency has an immediate incentive to issue that instrument. Naturally, those cost benefits are considered in conjunction with the implications for the current financing strategy. By definition, new instruments can only be introduced 'at the costs' of other instruments.

³ See <http://www.ustreas.gov/offices/domestic-finance/debt-management/quarterly-refunding/07-30-2008/tbac-report.pdf>

⁴ See *Guidelines for Public Debt Management* (IMF, 2001).

⁵ See *Risk Management of the National Debt. Evaluation of the 2003-2007 Policy & 2008-2011 Policy* (Ministry of Finance, 2007).

Cost of index-linked bonds

In order to map out the possible cost benefits of index-linked bonds, it makes sense to compare index-linked bonds and nominal bonds. The interest costs for nominal bond and index-linked bonds can be summarised as follows:

- Interest costs for nominal bonds = real interest *plus* expected inflation over the bond's term to maturity *plus* inflation risk premium *plus* liquidity premium.
- Interest costs for index-linked bonds = real interest *plus* actual annual inflation *plus* liquidity premium.

As regards the costs incurred by the State, the appeal of index-linked bonds is therefore determined by 1) the difference between actual annual inflation and expected inflation during the term to maturity, 2) inflation risk premium, and 3) the difference in liquidity premiums.

Inflation projections: index-linked bonds are profitable for the government if actual inflation until the index-linked bonds matures is less than projected when the bond was issued. This consideration was a factor in the UK during the 1980s when the British government succeeded in reigning in high inflation, using a combination of strict monetary and budgetary policies. The lower rate of inflation enabled the UK to realise substantial savings. Given current circumstances, and in part owing to the ECB's credibility, there is less evidence that inflation is structurally overestimated or underestimated. Consequently, the analysis of the cost benefits of index-linked bonds now focuses primarily on inflation risk premiums and liquidity premiums.

Inflation risk premium: the issuance of index-linked bonds may be an attractive option if investors are willing to pay a premium for the State's assumption of the inflation risk. In practice, the inflation risk premium is impossible to measure directly, and estimates are necessarily somewhat uncertain. In the mid-1990s, academic literature still worked on the premise of an inflation risk premium of 50 to 100 basis points.⁶ Recent studies reveal a substantially lower inflation risk premiums, probably caused by low and stable rate of inflation over the past decade. In developing its long-term projections, the ECB assumes an inflation risk premium of approximately 20 to 30 basis points.⁷ Other estimates for index-linked bonds maturing over ten years vary from around 20 basis points for France to 7 basis points for Germany. Another study finds a negligible and insignificant inflation risk premium for the euro zone as a whole.⁸ Moreover, it is doubtful whether these estimates provide a proper indication of the inflation risk premium that investors might be willing to pay for Dutch index-linked bonds. Dutch pension funds may be prepared to pay a higher premium for such bonds owing to the conditional indexation ambitions for Dutch inflation in many pension agreements. At the same time, however, inflation risk premiums vary over time and might be higher during periods of more volatile and less predictable inflation.

⁶ See Campbell, J. and R J. Shiller, 1996. "A Scorecard for Indexed Government Debt," NBER Working Papers 5587

⁷ See, for example, ECB, Monthly Bulletin July 2006 (pp. 59-68) and Monthly Bulletin April 2007 (p.28).

⁸ Cappelletto and Guéne (2005), Measuring market and inflation risk premia in France and Germany, ECB working paper 436. Hordahl and Tristani (2007), Inflation risk premia in the term structure of interest rates, BIS working paper 228. It should be noted that neither study includes a correction for liquidity premiums, and as a result slightly overestimate the inflation risk premiums. That overestimation does not apply to the net benefit for the issuer.

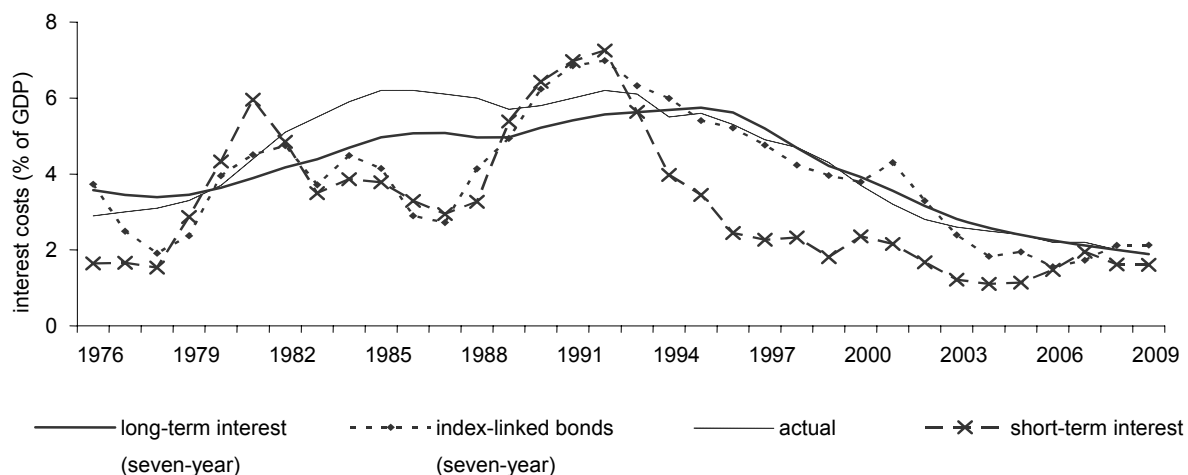
Liquidity premium: introducing a new instrument and issuing a small volume of bonds will entail additional costs for the debt manager in the form of a liquidity premium. The reverse is also true: the larger the bond, the more it is traded and the lower the premium. Projections for US index-linked bonds show a liquidity premium of 5 to 25 basis points, depending on the amount of the outstanding debt. Premiums may be higher for new instruments upon issuance. At the same, it is plausible that the liquidity premium for nominal bonds may rise slightly if index-linked bonds are issued at the expense of the issuance volume of other, nominal instruments, causing overall finance costs to increase.⁹

Risks associated with index-linked bonds

The possibility of a cost benefit will have to be weighed against the risk associated with a particular instrument compared with other financing strategies. A simple ex post exercise serves to illustrate the higher risk of index-linked bonds for the Dutch debt manager. Figure 1 shows the actual interest costs over the 1976-2007 period, and the interest costs for three simulated portfolios. The first of these is a portfolio containing only seven-year nominal bonds, with 1/7th of the debt being refinanced every year at the then current nominal capital market interest rate. The second portfolio consists exclusively of index-linked bonds, meaning that the interest costs comprises, on the one hand, the annual refinancing of 1/7th of the debt at real interest rates, and on the other, the entire debt at inflation rate. The third portfolio consists only of money market instruments. Every year, the entire debt is refinanced at short-term interest rates (see Appendix 1 for an explanation of the method used).

⁹ Another measure for liquidity premiums is to compare different funding strategies. For example, a combination of an index-linked bond (paying ten-year real interest and actual annual inflation) and an inflation swap (paying break-even inflation and receiving actual annual inflation) involve the same returns and risks as a ten-year nominal bond. The difference between these strategies has lately been around 10 to 30 basis points for German and French bonds.

Figure 1. Actual interest costs, interest costs for a seven-year nominal portfolio, interest costs for a seven-year inflation-indexed portfolio and interest costs for a money market portfolio, 1976-2007.



Source: own calculations based on data supplied by the Netherlands Bureau for Economic Policy Analysis, Central Economic Plan (CEP) 2008, Appendix 2

This ex post analysis shows that the variability of interest costs for a portfolio containing only inflation-indexed bonds displays greater similarities with a money market portfolio than with a nominal seven-year portfolio (and with the actual interest costs). As with financing on the money market, an index portfolio is cheaper during periods with unexpectedly low inflation (around 1986). Conversely, during periods of high inflation (around 1980 and 1992), the interest costs for a portfolio of index-linked bonds are higher than the interest costs for nominal capital market bond portfolios. Over the period as a whole, the difference in the interest costs for portfolios of index-linked bonds and of nominal capital market bonds is minor (0.2% of GDP per year) – in favour of index-linked bonds. The risk, measured against the standard deviation, is much higher, however, at 2.3% of GDP for the indexed portfolio compared with 1.1% of GDP for the nominal capital market portfolio. In other words, assuming a normal distribution, the interest costs for an index portfolio deviates from the long-term average by more than 4.6% of GDP, compared with 2.2% of GDP in the case of a nominal portfolio.

This exercise only shows debt portfolios consisting entirely of nominal bonds, money market instruments or index-linked bonds. Given a negative correlation between the interest costs for various instruments, diversification benefits occur if several instruments are mixed. To illustrate this, the interest costs and the risk (defined as twice the standard deviation – SD – of the interest costs) of 66 portfolios have been calculated. The 66 portfolios are mixes of the instruments specified previously, with the relative proportions of each instrument calculated in steps of 10%. It is further assumed that index-linked bonds provide savings on inflation risk premiums of 30 basis points. The results of this exercise are set out in

Figures 2 and 3 (see Appendix 1 for a technical explanation).¹⁰

Figure 2 Costs and risks associated with different debt portfolios, 1976-2007

risk (% of GDP, 2x SD)

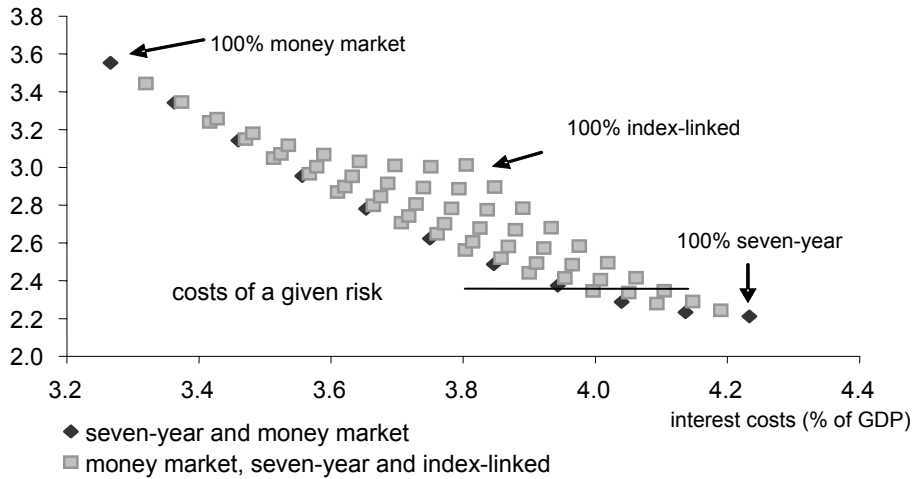
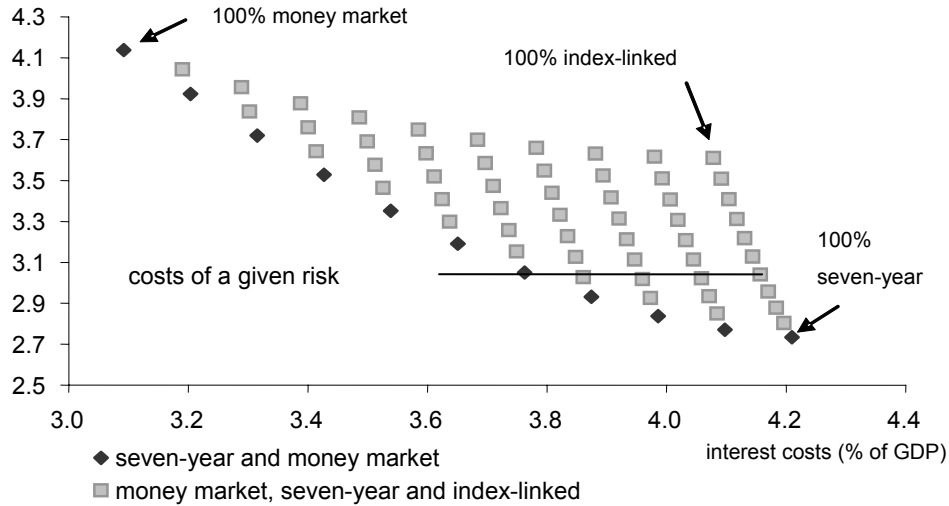


Figure 3 Costs and risks associated with different debt portfolios, 1990-2007

risk (% of GDP, 2x SD)



For both periods presented the 'efficient frontier' (i.e. the imaginary line consisting of portfolios with the most favourable trade-off between costs and risks) is formed by exclusive mix forms of nominal money market and seven-year bonds (black dots). Index-linked bonds do not feature in the optimum mix. As such, the figures show that a cost benefit of 30 basis points is insufficient to compensate the additional

¹⁰ This ex post exercise only serves as an indication. Methodologically accurate, but time-consuming efficient frontier calculations assume a multitude of simulated interest scenarios. For example, see *Risk Management of the National Debt*, which is available online (www.dst.nl) in the 'Funding Policy' section.

risk associate with index-linked bonds. For the 1990-2007 period, the additional costs of a portfolio consisting of about 10% of index-linked bonds are around 0.1% of GDP for the same level of risk as for a portfolio containing only nominal money and capital market bonds. As the proportion of index-linked bonds rises, the distance to the efficient frontier increases. It should be noted, though, that the appeal of index-linked bonds depends on the period selected. For example, during the 1976-2007 period, portfolios with index-linked bonds are closer to the efficient frontier. Using this ex post exercise, it is possible to estimate the size of the risk premium that gives an identical cost-to-risk ratio for portfolios consisting of about 10% of index-linked bonds and portfolios without index-linked bonds. For the 1990-2007 period, the break-even point is approximately 100 basis points, and around 50 basis points for the 1976-2007 period. In other words, from an economic perspective, it is only beneficial for the Dutch State to issue index-linked bonds if investors are prepared to pay an inflation risk premium of 50 to 100 basis points for index-linked bonds (not including any liquidity premium).

This analysis is based on the assumption that index-linked bonds are issued structurally. However, it is possible to specify years (particularly after the fact) when index-linked bonds would have been beneficial to the Treasury in terms of costs and risks, particularly in years where unexpectedly high inflation coincided with low real interest rates. In such years, as was the case in 2001, for example, a low real interest rate may be fixed for an extended period. However, this is contingent upon the ECB managing to force inflation down, and as a consequence upon Dutch inflation also dropping structurally during the index-linked bond's term to maturity.

Costs versus risks

It can be concluded that the cost benefits of index-linked bonds are outweighed by the additional risks for the budget. Another consideration is that any issuance of index-linked bonds will, particularly initially, involve an additional liquidity premium. However, the inflation risk premium for index-linked bonds linked to the Dutch CPI is uncertain: it is possible that investors with specific inflation-indexed obligations will be prepared to pay a higher premium than French and German index-linked bonds, for example, currently include.

Issuing instruments for reasons other than cost effectiveness, for example, from a social perspective, does not fall within the mandate of a debt manager. Within the scope of that mandate, the debt manager has no incentive to effect such an issuance, since index-linked bonds do not help beat the benchmark.

From a broader perspective, though, reasons may exist for issuing index-linked bonds. A number of those reasons are discussed in the following sections. Several other grounds for issuing index-linked bonds that are discussed in professional literature (e.g. underpinning the credibility of inflation policy) are less relevant to Dutch index-linked bonds within the context of a European central bank charged with European monetary policy and as such are not addressed in this report.

5. Index-linked bonds and the stability of the EMU balance

Scientific literature devotes a great deal of attention to the ways in which debt management can help stabilise budget deficits.¹¹ If the EMU balance shows a positive correlation with inflation, adding index-linked bonds to the debt portfolio will mean that interest costs will follow the movements in inflation more explicitly. As a consequence, the interest costs will follow (more closely) the primary balance, resulting in a more stable EMU balance. The risk that cyclical causes may force the EMU balance over the 3% of GDP deficit margin is reduced, which in turn reduces the need for budgetary adjustments. This will limit the number of disruptions and as such will lead to gains in terms of prosperity.¹² At the same time, it would also imply that the government is a natural party to issue index-linked bonds.

The relationship between the EMU balance and inflation should, at least theoretically, be stronger following the decision at the start of this term of government to remove interest costs from the framework. As a result, unforeseen gains and losses from interest costs no longer lead to the budget being adjusted elsewhere. As such, the Lower House of Parliament asked whether the change in the budgetary system will lead to other conclusions than in 2005 as regards the desirability of introducing inflation-proof bonds.

The previous study from 2005 also considered the relationship between inflation and the EMU balance, and what role index-linked bonds might play in the context of that relationship. The analysis performed then disregarded the specific place of interest costs within the budget. It was assumed that movements in interest costs do not result in adjustments elsewhere in the budget. That analysis is repeated below, using more recent data.

Whether inflation shows a positive correlation with the EMU balance depends on the nature and frequency of shocks. In the event of a demand shock, both growth and inflation rise. Greater growth improves the EMU balance, as a result of additional tax revenue and lower expenditure on unemployment benefits. The opposite is true during a recession: the EMU deficit drops simultaneously with inflation. In both instances, index-linked bonds theoretically improve the stability of the EMU balance, lessening the effects by means of interest costs.

In the case of a supply shock, however, growth and inflation move inversely. In that situation, nominal bonds help to stabilise the EMU balance. The problem lies in the fact that both the nature and the frequency of shocks are unknown before they occur and that it is impossible to predict whether nominal bonds or index-linked bonds will be needed as stabilising factors.

Table 1 sets out the results of regressions that consider whether the EMU balance and inflation are linked. In addition to regression (1), which was also included in the original report, the estimates in the

¹¹ See Wolswijk, G. and J. de Haan, 2005, *Government debt management in the euro area: recent theoretical developments and changes in practices*, ECB occasional paper series no. 25.

¹² See Barro, R.J., 1997, *Optimal management of indexed and nominal debt*, NBER working paper no. 6197.

equation were revised using data from the most recent years, 2004-2007 (2). It also presents the results of a regression (3), which considers how robust the first two equations are. Finally, the possibility of whether inflation shows a delayed correlation with the EMU balance is considered (4).

Table 1. Inflation versus EMU balance^a

EMU balance_t = C + α * inflation_t + β * inflation_{t-1} + γ * EMU balance_{t-1} + ε . (t-value in brackets)

No.	period	C	α	β	γ	R ²	Durbin Watson ^b
1	1970–2003	-4.17* (-6.6)	0.31* (2.2)			0.13	0.47
2	1970–2007	-3.36 (-5.2)*	0.19 (1.3)			0.04	0.36
3	1971–2007	-0.08 (-0.14)	-0.06 (-0.6)		0.87* (8.6)	0.70	1.92
4	1971–2007	-0.12 (-0.2)		-0.05 (-0.6)	0.86 (8.7)	0.70	1.93

* = significant at 5%

a) The EMU balance has been corrected for the effects of surrendering the subsidies for housing corporations in 1995 and revenues from UMTS in 2000.

b) If a delayed endogenous parameter is included, the Durbin h is a better standard for autocorrelation in residues. This test also gives no indication of the existence of any autocorrelation in the final two equations.

Source: calculations based on data from the Netherlands Bureau for Economic Policy Analysis, Central Economic Plan (CEP) 2008.

Equation 1 shows a less significant influence of inflation (i.e. 0.3% point) on the EMU balance. The estimated parameter value is slightly higher than that found in the 2005 study, when a minor, less robust, relationship of 0.22% point was noted. The effect of adding the last three years is that the estimated parameter value is lower, while the relationship is no longer statistically significant. However, the results of these two regressions may be distorted by statistical problems (autocorrelation). This problem may be avoided by adding a delayed endogenous variable, i.e. the EMU balance (equation 3). The significant effect of inflation now disappears, and the correlation is virtually zero. Similarly, inflation has no delayed effect on the EMU balance (equation 4). All in all, the data offer insufficient evidence for a positive (and possibly delayed) effect of inflation on the EMU balance. As was already noted in 2005, the developments in the EMU balance and inflation only moved in the same direction in half of the years examined.

The absence of a correlation between inflation and the EMU balance may stem from any of a number of causes. The first possible cause is that the effects of policy are not taken into account, for example, budgetary rules and discipline. For example, if the projected inflation evokes a policy response, it will be difficult to detect a statistical correlation between inflation and the EMU balance. As such, it is theoretically possible that the current budgetary rules lead to a more robust relationship between inflation and the EMU balance. Another possible cause is that supply shocks also occur frequently. Finally, countless other variables impact the EMU balance, such as economic growth, exchange rates and oil prices. Oil price increases will have a substantial and immediate effect on inflation, while its impact on the EMU balance is more diffuse. Increased revenue from natural gas will be partially cancelled out over time

by higher unemployment benefits and reduced tax revenue, due to the slowing effect of higher oil prices on the economy.¹³

6. The importance of index-linked bonds for savers and pension funds

Index-linked bonds offer savers and pension funds the possibility of investing in inflation-proof instruments. What importance private parties attach to that possibility can best be inferred from their willingness to pay. However, that factor is difficult to determine in the absence of a market.

Theoretically, index-linked bonds are an attractive investment instrument for pension funds with defined benefit schemes. By investing in index-linked bonds, they reduce their inflation risk. Considering the large volume of defined benefit schemes in the Netherlands, the willingness of Dutch pension funds to pay for Dutch index-linked bonds may exceed the inflation risk premium paid in other countries¹⁴ (as discussed elsewhere in this update). Similarly, the older a pension fund's members are, the lower the targeted risk profile is. However, two factors should be considered here. Firstly, the conditional nature of indexation reduces the necessity to invest in index-linked bonds. This is in contrast to the situation in the UK, for example, where indexation arrangements are more binding. Secondly, it is the ambition of many Dutch pension funds to follow developments in wages over the long term, which also means that index-linked bonds are no perfect hedge.

The theoretic appeal of index-linked bonds to pension funds and savers is at odds with the relatively low inflation risk premiums as described in Section 4. Inflation risk premiums reflect the willingness of private parties to pay the government to assume the inflation risk. As the benefits of hedging the inflation risk at first seem to accrue directly to the pension funds and individual savers, there appears to be no reason for the government to issue index-linked bonds despite a minor willingness on the part of private parties to pay for them.

Another argument put forward is, however, that index-linked bonds bring external benefits and that the government should therefore set a trend by issuing index-linked bonds, even if the willingness among private parties to pay is limited and index-linked bonds do not help stabilise the EMU balance. The absence of a market related to risk-free real products may lead to the inefficient distribution of risks among those who are more and those who are less averse to risk. This may result in social costs. Two forms of market failure affect this situation. Firstly, as the government does not issue index-linked bonds, private parties have insufficient understanding of risk-free Dutch real interest rates. Secondly, it is possible that the costs of marketing such a new product would initially be too high. These forms of market failure could be eliminated or reduced if the government were to issue index-linked bonds¹⁵. Private

¹³ For example, see the scenarios in the Netherlands Bureau for Economic Policy Analysis, 2006, working paper no. 123, pp. 59-62.

¹⁴ This is less of a factor with defined contribution schemes, owing to the absence of concrete promises regarding benefits.

¹⁵ See Campbell, J. and R. Schiller (1996), *A Scorecard for Indexed Government Debt*, Cowles Foundation, discussion paper no. 1125.

parties could then also issue index-linked bonds, once they learn about risk-free real interest rates. This may be particularly appealing in sectors in which revenue is linked to inflation. In the UK and France, a number of private parties recently issued index-linked bonds, following the example of their respective governments.¹⁶

Moreover, the existence of a risk-free real interest curve and market projections for future inflation may create markets for derivative financial innovations that allow other parties to better hedge risks. Numerous innovations are possible, such as inflation-indexed savings products for individual pension build-up. Similarly, issuing index-linked bonds has stimulated inflation and real swap markets. Inflation swaps (real swaps) are transactions in which parties exchange the projected inflation (real interest) for the actual annual interest (real interest) over a period of time. The calculation of prices for such derivatives is much simpler if a market exists for index-linked bonds that do not involve any credit risk. However, the markets for such products in countries that issue index-linked bonds are as yet very meagre.¹⁷

7. Conclusions

Index-linked bonds and associated derivatives make it possible for savers and pension funds to hedge their inflation risks. Index-linked bonds and inflation derivatives make up a growing share of the portfolios of Dutch pension funds. Similarly, the number of countries issuing index-linked bonds is also rising steadily. Despite these developments, however, no indications exist that in the present situation index-linked bonds would result in lower borrowing costs for the State based on a given level of risk, compared with the current nominal money and capital market instruments. As such, in terms of the business case, the analysis does not present any grounds for revising the conclusions from 2005.

Two qualifications should be mentioned here. Firstly, the willingness of *Dutch* investors to pay for index-linked bonds linked to the *Dutch* CPI may be greater than the premium that investors pay for index-linked bonds linked to the French or European price index, based in part on the volume of Dutch pension savings and on the emphasis on defined benefit systems. Secondly, the need to limit risks may be less in the future. The older a pension fund's members are, the lower its targeted risk profile is. This may have a positive effect on the demand for index-linked bonds. As such, it is possible that as some point index-linked bonds may form an attractive economic alternative for financing the national debt.

In addition to economic arguments, other grounds may exist for why it would be desirable for the government to issue index-linked bonds. For example, index-linked bonds may help stabilise the EMU balance, if inflation and the EMU balance display a positive correlation. The reason for this is that interest costs will follow inflation in that scenario. This reasoning is reinforced by the fact that since the start of the current term of government interest costs have not been included in the expenditure framework, which

¹⁶ See Garcia, J.A. and A. van Rixtel, 2007, *Inflation-linked bonds from a central bank perspective*, ECB occasional paper series no. 62, p. 18.

¹⁷ Mitchell, O.S., J. Piggott, M. Sherris and S. Yow, 2006, *Financial Innovation for an Aging World*, NBER working paper no. 12444.

means that unforeseen gains and losses from interest costs do not cause the budget to change elsewhere. However, it is not simple to translate the effect of changes to the budgetary system into clear-cut and empirically-based conclusions about the effect of index-linked bonds on the stability of the EMU balance. As was the case with the previous study, insufficient evidence has been noted of a positive correlation between the Dutch rate of inflation and the EMU balance, and as such insufficient grounds exist for assuming that issuing index-linked bonds will result in a more stable EMU balance. However, the possibility should not be excluded that the current budgetary rules increase the robustness of the correlation between inflation and the EMU balance.

Another argument for structurally issuing index-linked bonds is that financial innovations may follow. The government could serve as the driving force behind a private market for inflation-indexed products. The desirability of such a scenario should be determined by comparing the societal benefits of this missing market with the additional costs that the government expects for a particular risk.

Appendix 1

This appendix sets out the calculation method used in Section 4.

The following formulas describe the annual interest costs for three different portfolios. For a portfolio containing:

- only money market instruments: $kr_t * S_t$
- only nominal seven-year bonds: $\sum (1/7 * Ir_{t-i} * S_{t-i}), i = 0, \dots, 6$
- only index-linked bonds: $\sum (1/7 * rr_{t-i} * S_{t-i}) + (\pi_t - rp) * S_t$

Where:

kr_t = short-term interest in year t

S_t = debt as a % of GDP in year t

Ir_t = long-term interest in year t

rr_t = real interest in year t

π_t = inflation in year t

rp = inflation risk premium (0.3%)

The interest costs of a combined portfolio are calculated as:

- a * interest costs money market + b * interest costs seven-year bonds and c * index-linked bonds, where the relative weights of a, b and c add up to 100%.

The standard used for the risk associated with combined portfolios is twice the standard deviation. For the simulated portfolios, the relative weights of a, b and c vary from 0% to 100%, in multiples of 10% for the respective instruments. Due to the benefits of diversification, the variance of a combined portfolio may be less than the variance of a portfolio consisting solely of a single instrument. This is the case if the covariance of two instruments is negative:

$$\text{VAR}(aX + bY) = a^2\text{VAR}(X) + b^2\text{Var} Y + 2ab*\text{Covariance}(X,Y).$$

All series used were taken from the Netherlands Bureau for Economic Policy Analysis (Central Economic Plan (CPB) 2008), Appendix 2: long-term interest, short-term interest, gross debt as a percentage of GDP and inflation (CPI). It should be noted that a more detailed estimate should be made of the risk, using scenarios (rather than using actual figures). An example of such an advanced, though time-consuming, method is available in *Risk Management of the National Debt*, which can be found online (www.dst.nl) in the 'Funding Policy' section.