



CPB Netherlands Bureau for Economic  
Policy Analysis

CPB Discussion Paper | 344

# The role of inflation-linked bonds

*Increasing, but still modest*

Ed Westerhout  
Ona Ciocyte



# **The role of inflation-linked bonds**

## **Increasing, but still modest\***

Ed Westerhout

Ona Ciocyte

February 10 2017

### **Abstract**

Although the market for inflation-linked bonds has expanded enormously, nominal bonds are still the main instrument to finance public debts. This paper seeks to explain why. It focuses on the Eurozone countries for which the standard argument that inflation-linked bonds may help to reduce inflation expectations, is less relevant. The paper demonstrates that inflation-linked bonds suffer from a lack of liquidity. Further, governments may find the use of inflation-linked bonds less attractive as these bonds amplify the volatility of the public deficit ratio. Two pieces of empirical evidence support our argument.

### **Keywords**

Inflation-linked bonds, public debt, inflation risk, liquidity

### **JEL codes**

G12; H63

\* The paper has benefitted from discussions with Roel Beetsma, Bart Boon, Casper van Ewijk, Jakob de Haan, Casper de Vries and various people at the Dutch State Treasury Agency of the Ministry of Finance, APG and CPB. Any errors are our own.

# 1 Introduction

Internationally, the role of inflation-linked bonds (ILBs) is growing. Among the major industrialized countries, the United Kingdom was the first to start issuing ILBs in 1981. The US followed in 1997. Countries in the Eurozone that have introduced ILBs are France (in 1998), Greece and Italy (in 2003), Germany (in 2006) and Spain (in 2014). Kraemer (2015) shows that, since 1996, the market for ILBs has been growing almost continuously. As of April 2012, the worldwide amount of ILBs outstanding was no less than \$2,000 billion.

Still, nominal bonds are the dominant financial instrument to finance public debts. Borensztein and Mauro (2004) report that in 1999 in two countries the share of inflation-linked bonds in the total public debt was over 50 percent: Chile featured a share of 62 percent and Israel one of 80 percent. In most countries that used ILBs at that time, the share of ILBs in the public debt was fairly small, however. In 11 out of 20 countries, the share was below 10 percent. January 2016 figures tell a similar story. The fraction of the public debt that is financed with ILBs is still sizeable in the UK: 28 percent. In many other countries the corresponding figures are much smaller: 11 percent in the US, 14 percent in France and 10 percent in Italy. Moreover, a large number of countries do not issue inflation-linked bonds at all.

Why do governments not rely more on ILBs? The advantages of inflation-linked bonds over nominal bonds are clear. ILBs offer protection against inflation risk. Therefore, they should be interesting for households, firms and governments as well. They should be particularly interesting for investors who want to hold on to their investments for very long periods, say twenty years or more. But there are also cons. The market for inflation-linked bonds is generally less liquid than that for nominal bonds, price indices carry a political risk and indexation often comes with a lag. Further, for the last fifteen years or so, inflation risk has been less relevant than it was in earlier times.

Apart from governments, private parties could also issue financial instruments of which the return is linked to some price index. However, the role of private parties is even smaller than that of governments. It is a puzzle why this is the case. Perhaps private parties consider the issuance of inflation-linked securities to be the domain of governments; or perhaps liquidity aspects, which play a pivotal role in this paper, are even more important at the firm level than at the national level.

This paper seeks to explain why the market share of inflation-index government bonds is so much smaller than that of nominal government bonds. Its focus is on the Eurozone. In

the Eurozone, countries are part of a common monetary regime. Here, the traditional argument to issue ILBs, namely to lower inflation expectations, is less relevant. The paper constructs an analytical model of the market for nominal and ILBs that are supplied by a government and that are held by risk-averse investors. The model offers two reasons why a government may find it unattractive to use inflation-linked bonds to finance its public debt. The most important one is liquidity risk. Because of liquidity risk, investors may be unwilling to step into ILBs. If so, a high rate of return is necessary to induce them to buy these bonds, thereby increasing the debt service of the government. Obviously, it is true that liquidity risk is counteracted by the risk of inflation. However, we offer two pieces of empirical evidence suggesting that the liquidity premium may be larger than the inflation risk premium and that inflation risk cannot neutralize completely the risk of too little liquidity. Second, ILBs increase the volatility of the public deficit to GDP ratio. This may be an argument for Eurozone countries to rely not too much on these instruments as a higher volatility of the public deficit ratio means a greater likelihood that somewhere in the future reforms need to be implemented in order to avoid EU fiscal sanctions.

There is a huge literature on various aspects of inflation-linked bonds, such as inflation risk and the inflation risk premium (*e.g.*, Buraschi and Jiltsov (2005), Ang *et al.* (2008) and Bekaert and Wang (2010)), liquidity and the liquidity premium (*e.g.*, Campbell *et al.* (2009), Gürkaynak *et al.* (2010) and Fleckenstein *et al.* (2014)) and the public finance and macroeconomic effects of ILBs (*e.g.*, Bohn (1988), Campbell and Shiller (1996), Barro (1997) and Campbell and Viceira (2001)). Our paper brings together arguments that are offered in this literature in order to explain the non-dominant position of ILBs.

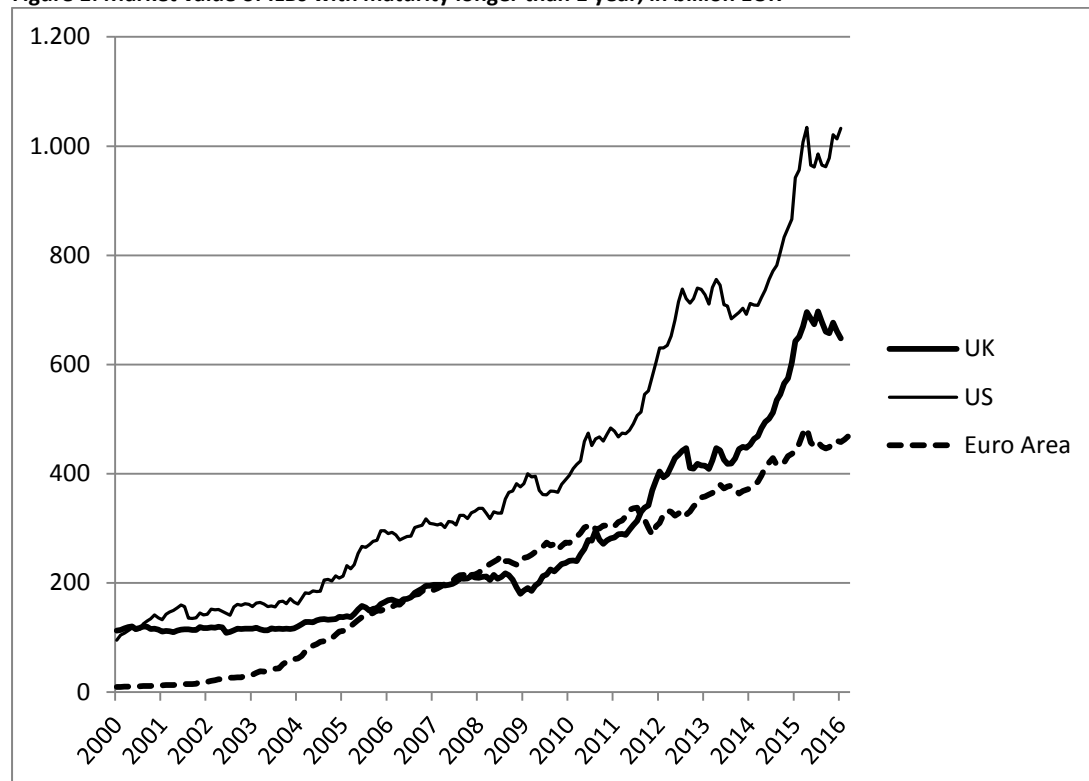
The paper is structured as follows. Section 2 presents some basic facts and figures. Section 3 reviews arguments pro and contra ILBs as an instrument to finance the public debt. Section 4 constructs the analytical model. Next, section 5 contains our assessment of the rate-of-return differential between nominal bonds and ILBs. Section 6 studies the particular case of the Netherlands. Finally, section 7 ends with a summary and a conclusion.

## 2 Facts and figures

The two most important markets for ILBs are those in the UK and the US. Figure 1 presents the development of the market value of the ILBs (with maturity longer than 1 year) in the UK, the US and the Euro area. It shows that in the last 15 years (2000-2015) the amount of ILBs in the US increased almost a factor ten and reached 1000 billion EUR. It also shows that

the UK is currently the second largest market for ILBs with a market value of about 660 billion EUR.

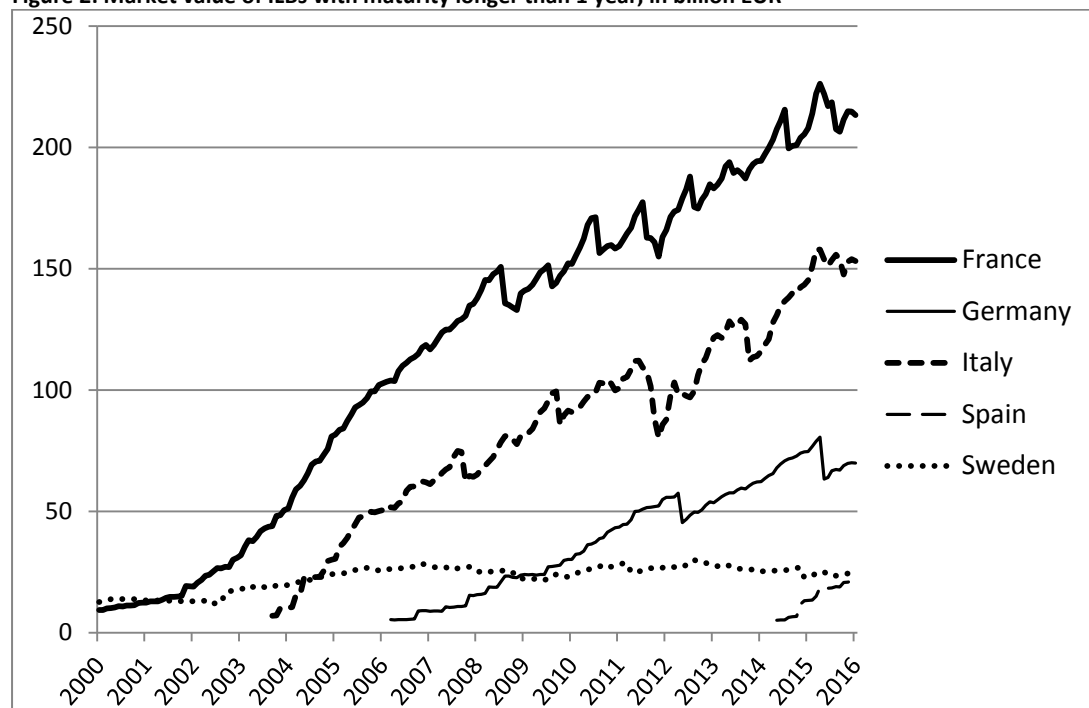
**Figure 1: Market value of ILBs with maturity longer than 1 year, in billion EUR**



The yearly marks are for January values

Source: Barclays ([https://index.barcap.com/Benchmark\\_Indices/Inflation-Linked](https://index.barcap.com/Benchmark_Indices/Inflation-Linked))

**Figure 2: Market value of ILBs with maturity longer than 1 year, in billion EUR**



The yearly marks are for January values

In the Euro area ILBs are issued in much smaller amounts. France is the leader in terms of the amount of outstanding ILBs (see figure 2). Italy and Germany fall behind but have been increasing the amount of ILBs quite fast since the first issuance. Spain and non-euro country Sweden have issued relatively small amounts of ILBs.

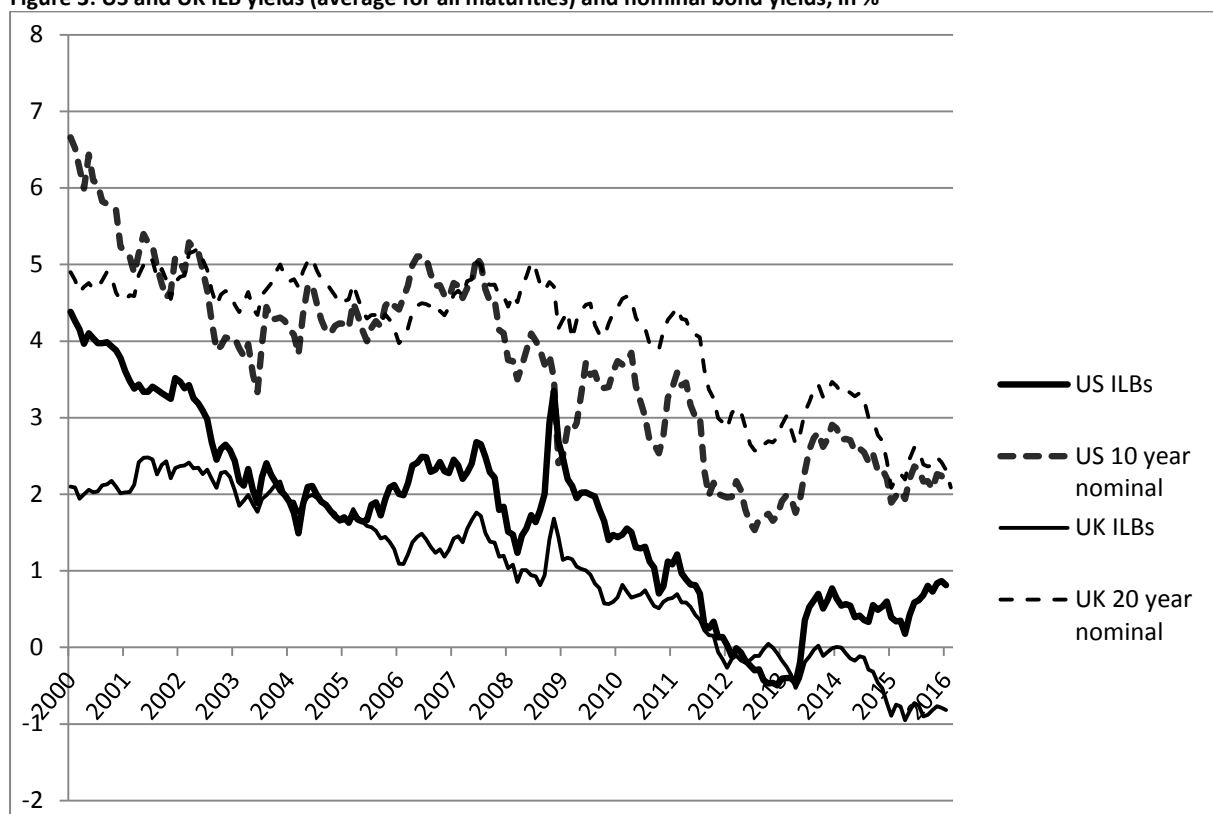
Despite their expansion, ILBs are still dominated by nominal bonds. In January 2016 ILBs account for about 11% of the issued bonds<sup>1</sup> in the US and 28% in the UK. In the Euro area countries the ILBs share in the issued bonds is 14% in France, 6% in Germany, 10% in Italy and 3% in Spain.

Figure 3 presents the yields on ILBs and nominal bonds in the US and the UK. As to nominal bonds, we take the maturity that comes closest to the maturity of ILBs. As the life of ILBs in the US in 2000-2016 ranges from 8.5 to 14.5 years with a mean of 10.3 years, we use the yield on a 10-year nominal bond as a benchmark. The average life of ILBs in the UK in 2000-2016 is 18.1 years, so here we take the yield on 20-year nominal bonds as a benchmark.

---

<sup>1</sup> We calculate the share of the ILBs as the market value of ILBs, divided by the sum of the market value of ILBs and nominal bonds. We use data from Barclays. The market value figures exclude bonds with maturities less than 1 year.

Figure 3: US and UK ILB yields (average for all maturities) and nominal bond yields, in %



Source: ILB yield data is from Barclays ([https://index.barcap.com/Benchmark\\_Indices/Inflation-Linked](https://index.barcap.com/Benchmark_Indices/Inflation-Linked)) and nominal bond yield data is from Datastream.

For the US we see that from 2000 till the beginning of 2008 the difference in yields on nominal bonds and ILBs varied in the range of 150 to 250 basis points (bp). At the end of 2008, during the financial crisis, the yield on the ILBs jumped and reached the level of the yield on nominal bonds. However, quite quickly the yields decoupled again and the difference returned to a level of about 150-200 bp till 2015.

In the UK the yield difference was higher on average than in the US in the period 2000-2016, namely in the range of 250-350 bp.<sup>2</sup> An explanation for this may be that the UK bonds have somewhat longer duration than the US bonds and are therefore more subject to inflation risk. Another explanation may be that liquidity is less of an issue in the UK, where the government bonds' market share for ILB bonds is substantially larger than in the US.

<sup>2</sup> The UK figures do not display the same collapse of the BEIR during the financial crisis as the US figures. Partly, this is due to our choice for bonds with 20-year maturity. If we had used bonds with 10-year maturity, we would have seen a bigger drop of the BEIR during the financial crisis (not reported for brevity). Partly, this may also indicate that liquidity risk is less important in the case of the UK. The corresponds with the fact that the share of ILBs in the public debt is much larger in the UK than in the US and with the observation as displayed in figure 3 that the yield differential between ILBs and nominal bonds is structurally higher in the UK than in the US.

The figures tell us that during 2000-2016 the yields on ILBs have been decreasing, mimicking the decline in interest rates on nominal bonds. The same pattern can be observed for other countries (not reported here for brevity). They also indicate that the break-even inflation rate (BEIR), defined as the difference between the nominal interest rate on nominal bonds and the real interest rate on ILBs, is far from constant. In particular during the financial crisis the BEIR decreased significantly in the US. As we will see below, this can indicate a change in expected inflation, in the inflation risk premium or in the liquidity premium. Given that the financial crisis featured high uncertainty and a flight to liquidity, a jump in the liquidity premium seems to be the most likely explanation (Campbell *et al.*, 2009).

### **3 The pros and cons of ILBs**

Why are nominal bonds a far more important debt financing instrument than ILBs? Long-term ILBs seem to be the ideal vehicle for intertemporal trade. Unlike nominal bonds, they free investors from inflation risk. Unlike short-term bonds, they free investors from real interest rate risk (Barro, 1997). Campbell and Viceira (2001) describe a specific simulation in which ILBs could result in a welfare gain no less than 33 percent of investor wealth.<sup>3</sup>

#### *Inflation risk and liquidity*

One could argue this overstates the role of ILBs. Indeed, investors can use alternatives such as equity to hedge against inflation uncertainty. This hedge is imperfect however; the correlation between equity returns and inflation is weak (Bekaert and Wang, 2010). Alternatively, one could argue that investors can allocate their wealth to nominal bonds with short maturity. Again, these are second-best policies however, since these assets offer only partial insurance against inflation and interest rate risk. Yet another investment strategy would be to combine different financial products such as to hedge against inflation. Garcia and Van Rixtel (2007) argue that such replicating strategies are unable to provide an “effective and stable hedge over long periods” (Garcia and Van Rixtel, 2007, pp. 13-14). ILBs thus do seem to help to complete financial markets. They help investors to protect their

---

<sup>3</sup> This figure should be seen as a maximum. Campbell and Viceira (2001) state that halving the coefficient of relative risk aversion reduces the welfare gain with two-thirds, to 11 percent of investor wealth. Moreover, both calculations are based on a model that is estimated for the 1952-1996 period, a period with high inflation. A calculation based on a model that is estimated for the 1983-1996 period yields substantially lower gains. “The Volcker-Greenspan monetary regime has greatly reduced long-run uncertainty about inflation and has correspondingly reduced the benefits of eliminating inflation risk entirely.” (Campbell and Viceira, 2001, p. 118).

investments against inflation risk. But not only investors benefit from ILBs. ILBs may also make the public debt more stable over time.

Liquidity or, better, a lack thereof, is the other side of the coin. Traditionally, markets for ILBs have been smaller than those for nominal bonds although, as we have seen above, they have been growing. On top of that, trade in ILBs has traditionally been less frequent than trade in nominal bonds. For both reasons, markets for ILBs are less liquid, which makes ILBs a less attractive instrument to include in one's portfolio. Therefore, we cannot rule out the case in which the risk reduction that comes from a better portfolio diversification cancels against the additional risk through lower liquidity.

### *Time inconsistency and stabilization policies*

The literature on monetary policies stresses a different argument for ILBs. ILBs do not share with nominal bonds that unexpected inflation reduces the debt service in real terms and therefore do not invite the monetary policymaker to produce unexpected inflation (Kydland and Prescott, 1977). Hence, ILBs may help to lower inflation expectations and thus inflation, which benefits societies that suffer from high inflation.

Interestingly, there is a related argument that runs counter to this argument. It says that if society is protected against inflation risk, it may become less averse to this risk. This lower risk aversion may then give way to higher rates of inflation than would be observed otherwise (Fischer and Summers, 1989).

On the other hand, Bohn (1988) stresses that nominal bonds render inflation effective policies to stabilize the economy. He shows formally that in a world in which the public debt is fully financed with ILBs, the introduction of a small amount of nominal bonds would be welfare-increasing.

For countries in the Eurozone, the above arguments may be less relevant. As the decision-making on monetary policies takes place on the level of the Eurozone, the amount of nominal bonds outstanding in the Eurozone would, according to the time-inconsistency and stabilization argument, determine inflation. Even a substantial switch in an individual country towards ILBs would in general exert only a small effect on this amount of nominal bonds. Moreover, the fact that the ECB is set up as an institute that is formally independent of policymakers in the Eurozone and that has price stability as its sole objective weakens the role of both the time-inconsistency and the stabilization argument.

### *Other factors*

One reason for governments not to use ILBs to finance their debts is redistribution. For the use of ILBs implies that the government transfers inflation risk from investors to tax payers – assuming that changes in the public debt induce changes in taxes at some point in time. If (international) investors are considered to have a larger risk bearing capacity than tax payers in general, this type of redistribution may be welfare-decreasing.

Another reason for governments to favor the issuance of ILBs is that supplying bonds in different varieties may help to attract more investors (Wolswijk and De Haan, 2005). This would be particularly relevant in the euro area, where capital markets have become more competitive since the introduction of the euro. Another argument is that issuing public debt may spur the development of a market for inflation linkers that can subsequently also be issued by private parties. Campbell and Shiller (1996) argue that creating a market for ILBs has public-good properties, which would justify that governments supply ILBs.

Note that perfect price indexation is not possible in practice. The protection that ILBs offer against inflation is mostly not 100 percent. One reason is that adjustment to inflation often comes with a lag; a lag of three months is certainly not unusual (Kraemer, 2015). Another reason is that the price index used for indexation may differ from the true price of living for small or large groups of households. ILBs also carry a political risk: the government may manipulate the price index or switch to another definition of the price index during the ILBs life.

## **4 An analytical model of ILBs**

To view more formally the role of inflation risk and liquidity risk, we now construct an analytical model. The model describes the market for nominal and inflation-linked bonds that both are supplied by the government. A representative investor decides on the demand for the two types of bonds. The rate of return on ILBs adjusts to achieve equilibrium on the two markets. The rate of return on nominal bonds is a given, linked to aspects of the world economy that the government is unable to influence. The model delivers an expression for the rate-of-return differential between inflation-linked and nominal bonds which may be assumed to be a major factor that drives the decision of the government to issue inflation-indexed bonds in the first place.

The model is stylized: it abstracts from institutional details in order to focus upon the more fundamental role of inflation risk and liquidity risk. It abstracts also from intertemporal

aspects that are prominent in some other models (Fischer (1975), Campbell and Viceira (2001), Campbell *et al.* (2009)) since these aspects are not highly relevant for our purpose. It also abstracts from other financial instruments. This is without implications as long as these other instruments do not affect the trade-off between nominal and inflation-indexed bonds. As we will see, our model predicts a non-negative liquidity risk premium differential between ILBs and nominal bonds. This is at odds with empirical evidence (Pflueger and Viceira, 2013) that in typical cases this premium differential is negative. However, our model could easily be generalized to be able to predict a negative liquidity premium differential as well.<sup>4</sup>

We adopt a mean-variance specification to describe utility of the representative investor:

$$u = E(r_p) - \frac{1}{2} \beta \text{Var}(r_p) \quad (1)$$

Here, we use  $u$  to denote utility and  $r_p$  to denote the real rate of return on the investor's portfolio. The parameter  $\beta > 0$  denotes his coefficient of risk aversion,  $E(\cdot)$  is the expectations operator and  $\text{Var}(\cdot)$  is the variance operator.

The investor allocates his wealth over nominal bonds and inflation-linked bonds, so the portfolio rate of return weighs the rates of return on the two bonds:

$$r_p = \left( \frac{B^N}{B} \right) (i^N - \pi) + \left( \frac{B^R}{B} \right) \tilde{r}^R \quad (2)$$

Here, we use  $B^j$   $j = N, R$  to denote the demand for bond type  $j$ ;  $N$  refers to nominal bonds and  $R$  refers to (real) ILBs.  $B^N$  and  $B^R$  add up to  $B$ , the investor's wealth which we take as given:  $B = B^N + B^R$ . Further,  $i^N$  denotes the nominal rate of return on nominal bonds and  $\pi$  the rate of inflation with mean  $E(\pi)$  and variance  $\text{Var}(\pi) \geq 0$ .  $\tilde{r}^R$  denotes the real rate of return on the inflation-linked bond, to be defined below. As reflected in equation (2), we assume that the inflation-linked bond gives full and immediate protection against inflation.

---

<sup>4</sup> Similarly, our model predicts that the inflation risk premium is non-negative which is inconsistent with some empirical evidence (Pflueger and Viceira, 2013). A negative inflation risk premium is more difficult to explain than a negative liquidity premium. We think of two explanations for a negative inflation risk premium: imperfect indexation to inflation and an imprecise estimation of the liquidity premium (since the assessment of the inflation risk premium is conditional on an estimate of the liquidity premium).

The nominal rate of return on nominal bonds is non-stochastic. The same holds true for the corresponding real rate of return, denoted as  $r^N$ :

$$r^N = i^N - E(\pi) \quad (3)$$

The real rate of return on the ILB will be taken stochastic. This rate of return may deviate from its expected value, given that we assume a non-zero probability that the investor needs to sell his inflation-linked bond at the end of the holding period for reasons that will be left unspecified. In particular, the bond price may at this point in time be higher or lower than expected. Hence, we adopt the following specification,

$$\tilde{r}^R = r^R - q\lambda \quad (4)$$

where  $r^R$  stands for the expected real rate of return on the ILB and  $\lambda$  stands for the capital loss in case of a forced sale.  $\lambda$  has mean 0, variance  $Var(\lambda) \geq 0$ , and is uncorrelated with  $\pi$ .  $q > 0$  is defined as the probability of a forced sale. Note that  $\lambda$  may be negative; if  $\lambda < 0$ , the investor earns a capital gain upon sale of the bond.

We make two further remarks. First,  $q$  is exogenous. We admit that the liquidity of a market is not a given, but something that can be changed, *e.g.*, through changing the size of the market. However, explaining the liquidity of a market from market characteristics is beyond the scope of the present paper. Second, in reality forced sales may occur also in case of nominal bonds. In this respect, our model oversimplifies reality. However, accounting for liquidity risk in the case of nominal bonds would not change the thread of our analysis as long as we assume that liquidity risk is larger for ILBs than it is for nominal bonds.

We have now the information we need to elaborate the investor's maximization problem. This is to choose the investment in nominal bonds that maximizes his utility, as specified in (1), given the amount of wealth that can be allocated over nominal and ILBs. We derive the following first-order condition, written directly in terms of the ex ante rate-of-return differential (the second-order condition for a maximum can easily be shown to hold true):

$$r^N - r^R = \beta \left( \frac{B^N}{B} \right) Var(\pi) - \beta \left( \frac{B^R}{B} \right) q^2 Var(\lambda) \quad (5)$$

Equation (5) allows us to distinguish two polar cases. The first is the case without liquidity risk ( $Var(\lambda) = 0$ ). The investor will then only want to invest in the nominal bond if he is compensated for the inflation risk that this brings about. Hence, in this case the rate of return on nominal bonds will be higher than that on ILBs. The second polar case is the case without inflation risk ( $Var(\pi) = 0$ ). The investor will then only want to invest in the inflation-linked bond if he is compensated for the liquidity risk that this brings about. Hence, in this case the rate of return on ILBs will be highest. In the more general case in which both types of risk are present, equation (5) shows that the rate of return on ILBs may be higher than, equal to or lower than that on nominal bonds, depending on the riskiness of inflation and illiquidity and the supplies of the two types of bonds. Henceforth, we will denote the two terms at the RHS of equation (5) the inflation risk premium and the liquidity premium respectively. Thus, the rate of return on ILBs is lower (higher) than that on nominal bonds if the inflation risk premium is larger (smaller) than the liquidity premium.

Importantly, the rate-of-return differential in equation (5) is an ex ante measure. Ex post, ILBs may be more expensive (cheaper) to the government, even if the ex ante rate-of-return differential is positive (negative). The following expression for the ex post rate-of-return differential shows clearly the role of inflation shocks and liquidity shocks:

$$i^N - \pi - \tilde{r}^R = \beta \left( \frac{B^N}{B} \right) Var(\pi) - \beta \left( \frac{B^R}{B} \right) q^2 Var(\lambda) - (\pi - E(\pi)) + q\lambda \quad (6)$$

We can use equation (5) also to derive an expression for a variable frequently encountered in the literature, which is the break-even rate of inflation (BEIR). This is defined as the difference between  $i^N$  and  $r^R$ , or, using (6):

$$BEIR = i^N - r^R = \beta \left( \frac{B^N}{B} \right) Var(\pi) - \beta \left( \frac{B^R}{B} \right) q^2 Var(\lambda) + E(\pi) \quad (7)$$

The BEIR is sometimes taken to be a measure of expected inflation. Equation (7) shows that in terms of our model this is only true if both the inflation risk premium and the liquidity premium are zero (or happen to cancel exactly against each other).

We can use the derived expression for the ex ante rate-of-return differential also to find an expression for the expected composite interest rate on the public debt. Assume that the government is the sole provider of the bonds that are held by the investor. Further, assume that the government does not trade in these bonds before they expire. Hence, government finances are not subject to liquidity risk. Let us denote the composite interest rate on the public debt as  $r_g$ . The expression for  $r_g$  then reads as follows:

$$r_g = \left( \frac{B^N}{B} \right) (i^N - \pi) + \left( \frac{B^R}{B} \right) r^R \quad (8)$$

A reduced-form expression for the expected interest rate on the public debt follows from taking expectations and using our result for the ex ante rate-of-return differential (5):

$$E(r_g) = r^N - \beta \left( \frac{B^R}{B} \right) \left( \left( \frac{B^N}{B} \right) \text{Var}(\pi) - \left( \frac{B^R}{B} \right) q^2 \text{Var}(\lambda) \right) \quad (9)$$

To derive the impact of the issuance of ILBs on this interest rate, we differentiate  $E(r_g)$  with respect to  $B^R/B$ , the share of ILBs in the total debt. This gives the following:

$$\begin{aligned} \frac{\partial E(r_g)}{\partial (B^R/B)} &= -2\beta \left( \left( \frac{B^N}{B} \right) \text{Var}(\pi) - \left( \frac{B^R}{B} \right) q^2 \text{Var}(\lambda) \right) + \beta \text{Var}(\pi) \\ &= -2(r^N - r^R) + \beta \text{Var}(\pi) \end{aligned} \quad (10)$$

where the second line arrives if we use equation (5) to rewrite the first term on the RHS of the first line.

Equation (10) shows that this interest-rate effect of ILBs depends negatively on the factor  $\beta \left( \left( \frac{B^N}{B} \right) \text{Var}(\pi) - \left( \frac{B^R}{B} \right) q^2 \text{Var}(\lambda) \right)$ . This factor is the marginal utility of ILBs that is due to a reduction of the investor's portfolio risk. Hence, equation (10) tells us that the more an investment into ILBs raises the investor's utility through risk reduction, the smaller will be the interest rate increase from increasing the amount of ILBs. Interpreted loosely, the higher

the added value of ILBs for the investor, the lower will be the interest rate on the public debt and the more attractive it is for the government to issue ILBs to finance the public debt.

Equation (10) shows that the derivative  $\partial E(r_g)/\partial(B^R/B)$  adds two terms. This expresses that an increase in the share of ILBs has two effects upon the interest rate on the public debt. The first effect, expressed in the first term on the RHS of (10), is a change in the weights of the rate of return on nominal bonds and that on ILBs; the second effect, expressed in the second term on the RHS of (10), is an increase in the rate of return on ILBs. As we have seen, the first term can have either sign; the second term, on the opposite, is non-negative. We do not want to put too much weight on this second effect, however. If we, contrary to our model, assumed that the government is only one of many suppliers of the two types of bonds and the government's debt policies have no effect upon financial markets (neither the interest rate on ILBs nor the interest rate on nominal bonds), the second effect would disappear.

The interest rate on the public debt may be assumed to be an important factor determining whether a government will be interested in using ILBs as a financing vehicle. Indeed, the lower is  $E(r_g)$ , the lower will be the average government's debt service. However, the average interest rate will likely not be the only factor in the government's decision; the variability of the interest rate and of the debt service may play a role as well.

We use the expression for the variance of this interest rate to analyse the role of ILBs:

$$Var(r_g) = \left( \frac{B^N}{B} \right)^2 Var(\pi) \quad (11)$$

Equation (11) shows that increasing the share of ILBs decreases the variance of the interest rate by reducing the impact of shocks in inflation.

This reduced volatility contributes to a more stable public debt ratio, but not to a more stable public deficit ratio. To see this, we write down expressions for the public debt ratio and the public deficit ratio, both based on the accumulation equation for the public debt. We start with the public debt ratio. We use  $Y$  to refer to GDP,  $G$  to refer to primary public spending and  $T$  to refer to tax revenues. All variables in capitals are in euros. We use an index -1 to indicate that the variable is dated one year ago. We then have the following:<sup>5</sup>

---

<sup>5</sup> For the ease of exposition of our argument, we define the nominal interest rate on ILBs multiplicatively in equation (12), i.e.  $(1 + r^R)(1 + \pi) - 1$ , whereas we have used an additive definition in the rest of the paper,

$$\frac{B}{Y} = \frac{G - T + (1 + i^N)B_{-1}^N + (1 + r^R)(1 + \pi)B_{-1}^R}{Y} \quad (12)$$

Now assume that primary spending and tax revenues are fully proportional with inflation. This need not hold in practice, but seems a reasonable approximation. We will return to this below. Under this assumption, we can write all the terms in equation (12) in terms of realized inflation:

$$\frac{B}{Y} = \frac{(1 + \pi)G_{-1} - (1 + \pi)T_{-1} + (1 + i^N)B_{-1}^N + (1 + r^R)(1 + \pi)B_{-1}^R}{(1 + \pi)Y_{-1}} \quad (13)$$

Equation (13) shows immediately that inflation shocks change the public debt ratio only because the interest rate on nominal bonds is unresponsive to inflation shocks. Hence, increasing the amount of ILBs (and decreasing that of nominal bonds) will render the public debt ratio more stable.

As indicated above, the same does not hold true for the public deficit ratio. Let us write down the equation for the deficit ratio that corresponds to equation (13). We use  $D$  to refer to the public deficit:

$$\frac{D}{Y} = \left\{ \frac{(1 + \pi)G_{-1} - (1 + \pi)T_{-1}}{(1 + \pi)Y_{-1}} \right\} + \left\{ \frac{i^N B_{-1}^N + ((1 + r^R)(1 + \pi) - 1)B_{-1}^R}{(1 + \pi)Y_{-1}} \right\} \quad (14)$$

The best way to see the role of ILBs is to focus on the debt service to GDP ratio, which is the second term on the RHS of equation (14). We derive expressions for the elasticity of the numerator and the denominator of this ratio with respect to the rate of inflation. Let us denote these elasticities as  $\epsilon_{NUM}$  and  $\epsilon_{DEN}$  respectively. We derive the following:

$$\epsilon_{NUM} = \left[ \frac{((1 + r^R)(1 + \pi) - 1)B_{-1}^R}{i^N B_{-1}^N + ((1 + r^R)(1 + \pi) - 1)B_{-1}^R} \right] \left[ \frac{(1 + r^R)(1 + \pi)}{(1 + r^R)(1 + \pi) - 1} \right] \left[ \frac{\pi}{1 + \pi} \right] \quad (15a)$$

---

*i.e.*  $r^R + \pi$ . If the unit period is a year,  $r^R$  and  $\pi$  are generally sufficiently small to render the quantitative differences between the two definitions negligible.

$$\varepsilon_{DEN} = \left[ \frac{\pi}{1 + \pi} \right] \quad (15b)$$

Inspection of equations (15a) and (15b) tells us two things. First, the two elasticities are generally different. This means that inflation shocks will change the public deficit ratio. Second, the elasticity of the numerator will generally be an order of magnitude larger than the elasticity of the denominator in absolute terms. This is because the second term on the RHS of (15a),  $((1 + r^R)(1 + \pi))/((1 + r^R)(1 + \pi) - 1)$ , will generally be much larger than unity.<sup>6</sup>

The first term at the RHS of (15a) shows the role of ILBs. This term is increasing in the amount of ILBs. Hence, conditional upon an initial amount of debt, the debt service to GDP ratio responds more strongly to inflation if the government relies more on ILBs to finance the public debt. If the primary deficit to GDP ratio, the first term on the RHS of equation (14), is independent of inflation, the same holds true for the public deficit ratio.<sup>7</sup>

As mentioned above, our assumption that primary public spending and tax revenues are fully proportional with respect to inflation may not hold true in practice. In theory then, if the primary deficit ratio would react very negatively upon a shock in inflation, inflation-indexed bonds could make the deficit ratio more stable. The appendix to this paper elaborates this point. It finds that this case can be rejected on the basis of empirical evidence on the relation between public deficit and inflation.

Our results for the public deficit ratio have direct relevance for countries in the Eurozone. Fiscal policies of Eurozone countries are subject to the rules of the Fiscal Compact. If ILBs reduce the stability of the public deficit ratio, this means that using ILBs to finance the public debt increases the likelihood that the deficit ratio somewhere in the future will surpass the level of 3 percent, thereby requiring the government to implement additional policies in order to avoid EU sanctions. Hence, the more stringent are EU fiscal policies, the less attractive it will be for the government to use ILBs to finance the public debt on account of this public deficit volatility effect.

---

<sup>6</sup> How much larger depends heavily on the level of the nominal interest rate. For example, if the nominal interest rate is only 1 percent, the second term on the RHS of (15a) equals 101. If the nominal interest rate is 10 percent, it equals 11.

<sup>7</sup> Beetsma en Westerhout (2016) show that the unconditional variance of the public deficit ratio is decreasing with the amount of ILBs in the very long run. The reason is that ILBs increase the stability of the public debt ratio.

## 5 The rate-of-return differential between nominal and ILBs

Generally, the composite interest rate on the public debt will be an important factor upon which a government will base its decision to use ILBs to finance the public debt. As we have derived above, the ex ante rate-of-return differential between nominal bonds and ILBs is one of the factors that determine how the interest rate on the public debt responds to an increase of ILBs. Hence, the sign of this ex ante rate-of-return differential tells us something about the attractiveness of using ILBs to finance the public debt.

In order to arrive at an estimate of this rate-of-return differential, we adopt two approaches. First, we look at the rate-of-return differential in a number of ILB issuing countries in 2001-2015. Second, we review the international literature on empirical estimates of the inflation risk premium and the liquidity premium (recall that the ex ante rate-of-return differential between nominal and ILBs equals the inflation risk premium minus the liquidity premium, see equation (5)).

In order to calculate the expected rate-of-return differential between nominal and ILBs, we use data on the yields of nominal bonds and ILBs and data on inflation.<sup>8</sup> This assumes that realizations coincide with expectations, which involves an approximation error. Note that this error may be relatively small as we focus on the rate-of-return differential: estimation errors that involve both types of bonds are inconsequential. Still, to further minimize the approximation error, we do the exercise for 5-year periods. Table 1 displays the calculated yield differentials for the countries encountered in figures 3 to 5 for three different time periods, 2001-2005, 2006-2010 and 2011-2015, in six countries, the UK, the US, France, Germany, Italy and Sweden.

---

<sup>8</sup> We would have preferred to use data on the rates of return of the two types of bonds as this comes closest to our analytical model. These data are unavailable. Note that this may be not that much of a problem, however, as we focus on a rate-of-return differential. If the prices of the two types of bonds are strongly correlated, the yield differential will be a reasonable approximation of the rate-of-return differential.

**Table 1: Yield differentials for six different countries and three different time periods**

		2001-2005	2006-2010	2011-2015
<b>UK</b>				
ILB average yield	(1)	2,00	1,08	-0,20
Nominal bonds average yield	(2)	4,70	4,45	3,04
Inflation average rate	(3)	1,44	2,74	2,28
Nominal bonds average real yield	(4)=(2)-(3)	3,25	1,71	0,76
Difference in yields	(5)=(4)-(1)	1,26	0,63	0,97
<b>US</b>				
ILB average yield	(1)	2,44	1,94	0,33
Nominal bonds average yield	(2)	4,44	3,91	2,32
Inflation average rate	(3)	2,39	2,35	1,55
Nominal bonds average real yield	(4)=(2)-(3)	2,06	1,56	0,77
Difference in yields	(5)=(4)-(1)	-0,38	-0,38	0,44
<b>France</b>				
ILB average yield	(1)	2,45	1,72	0,42
Nominal bonds average yield	(2)	4,29	3,82	2,11
Inflation average rate	(3)	2,02	1,70	1,24
Nominal bonds average real yield	(4)=(2)-(3)	2,27	2,12	0,88
Difference in yields	(5)=(4)-(1)	-0,18	0,40	0,46
<b>Germany<sup>1</sup></b>				
ILB average yield	(1)		1,52	-0,29
Nominal bonds average yield	(2)		3,12	0,69
Inflation average rate	(3)		1,62	1,42
Nominal bonds average real yield	(4)=(2)-(3)		1,50	-0,74
Difference in yields	(5)=(4)-(1)		-0,02	-0,44
<b>Italy<sup>2</sup></b>				
ILB average yield	(1)	1,53	2,23	2,55
Nominal bonds average yield	(2)	3,97	4,30	3,95
Inflation average rate	(3)	2,31	2,05	1,56
Nominal bonds average real yield	(4)=(2)-(3)	1,66	2,26	2,39
Difference in yields	(5)=(4)-(1)	0,13	0,02	-0,16
<b>Sweden</b>				
ILB average yield	(1)	2,77	1,58	0,19
Nominal bonds average yield	(2)	4,57	3,58	1,76
Inflation average rate	(3)	1,76	2,07	0,73
Nominal bonds average real yield	(4)=(2)-(3)	2,81	1,51	1,03
Difference in yields	(5)=(4)-(1)	0,04	-0,07	0,84

<sup>1</sup> - Germany ILB data starts in March, 2006, thus the average yields and inflation rate are calculated for the period from March, 2006.

<sup>2</sup> - Italy ILB data starts in September, 2003, thus the average yields and inflation rate are calculated for the period from September, 2003.

A few results can be derived from table 1. First, the yield differential can be positive or negative. The average of the figures is positive, but negative numbers are clearly not an exception. Second, differences between countries can be significant. In 2001-2005 for example, the figures for the UK and France differed 144 bp. That holds also true for a more recent time period: in 2011-2015 the figures for the US and Germany differed 88 bp. Third, there is important variation over time. Comparing 2011-2015 with 2006-2010, the yield

differential increased in the UK with 36 bp and in the US with 82 bp, whereas in Germany the differential decreased with 42 bp.

The approach adopted here to assess the ex ante rate-of-return differential between nominal and ILBs has two drawbacks. One concerns the approximation errors mentioned above. Another drawback is that there are small differences between the maturities of the nominal and ILBs that we compare. Therefore, we assess the size of the rate-of-return differential between nominal and ILBs also from a different angle: we review estimates made in the literature of the inflation risk premium and the liquidity premium. We focus on recent estimates as these might be most relevant for the near future.

### *The inflation risk premium in the literature*

Earlier studies of the inflation risk premium did not include data on ILBs or survey data. Indeed, Ang *et al.* (2008) analyzed US bonds yields and used only nominal bonds data. In their paper, the economy can be in four different regimes. Two regimes are dominant: the most common regime (with relatively high and stable inflation, and relatively low and stable real short-term interest rate) appears 72 percent of the time, whereas the next most common regime (with relatively high and volatile inflation and relatively low and volatile real short-term interest rate) appears 20 percent of the time. The authors estimate the inflation risk premium to be 31 bp for 1-year bonds and 118 bp for 5-year bonds in the first regime and 47 bp for 1-year bonds and 125 bp for 5-year bonds in the second regime. These estimates may be on the low side however as Ang *et al.* (2008) imposed that the one-quarter ahead inflation risk premium is equal to zero.

Bekaert and Wang (2010) review some of the papers that analyze the inflation risk premium. They notice that one should account for a liquidity premium in order to avoid underestimating the inflation risk premium (see also equation (7) of this paper). Bekaert and Wang (2010) criticize Grishchenko and Huang (2013) and Christensen *et al.* (2010) who report small or even negative inflation risk premiums for 5-year and 10-year bonds in the US for not accounting for the low liquidity of US TIPS before 2004.

The papers reviewed use data on ILBs and survey data on inflation expectations. Bekaert and Wang (2010) focus on papers that try to decompose yields on US bonds. Excluding Grishchenko and Huang (2013) and Christensen *et al.* (2010), these papers estimate the inflation risk premium to be 19-35 bp, 27-36 bp, and 51-216 bp for 1-year, 5-year and 10-year US bonds respectively. So, the papers using ILB yields data or survey data on inflation expectations yield lower estimates for the average inflation risk premium than

Ang *et al.* (2008). Note that this applies to average premiums; the estimates of the inflation risk premium vary over time and can be quite volatile.

Joyce *et al.* (2009) focus on UK bonds. They assess whether there was a change in the inflation risk premium after 1997 when the Bank of England was made operationally independent. They find that the inflation risk premium before 1997 is around 50 bp for very low maturities, increases to around 120-130 bp for 5- to 10-year maturities and decreases to 90 bp for 15-year maturities. However, after 1997 the inflation risk premium is around 20 bp for very short maturities, about 30-40 bp for 5- to 10-year bonds and slightly smaller for 15-year maturities. So, they conclude that UK central bank independence reduced the inflation risk premium substantially. Further, note that the estimates for the inflation risk premium after 1997 are lower than those for the US.

Pflueger and Viceira (2013) use their estimates of the liquidity premium to derive an estimate of the inflation risk premium. Their estimates are 52 bp for the US and -34 bp for the UK. These are average numbers; again, the estimates of the inflation risk premium vary substantially over time.

Hördahl and Tristani (2014) analyze the inflation risk premium in the US and the Euro area, taking French bonds as representative for the Eurozone. The US data is for the period from 1990 January to 2013 April (ILB data starts only in 1999 though) and French data is for the period from 1999 January to 2013 April (ILB data starts only in 2004). They analyze nominal bonds of 7 maturities and ILBs of 4 maturities, up to 10 years. The 3-year average inflation risk premium is estimated to be about 25 bp in the Eurozone and about 25-50 bp in the US. Both inflation risk premiums are quite volatile, especially in the US. The US estimate of the 3-year inflation risk premium varies from -120 bp in 2009 to 220 bp in 2013. The corresponding estimate in France varies from -50 bp to 100 bp. Similar results apply to 10-year bonds. Hördahl and Tristani (2014) further note that the inflation risk premiums correlate positively with inflation.

Auckenthaler *et al.* (2015) focus on the US. Accounting for both a liquidity premium and an inflation risk premium and using survey data on inflation expectations, they find the average US inflation risk premium to be 22 bp.

**Table 2: Inflation risk premium estimates**

Paper	Country	Data	Inflation risk premium in basis points for different maturities				
			1-year	2/3-year	5-year	10-year	15-year
Ang <i>et al.</i> (2008)	US	1952Q2-2004Q4	31–47		118-125		
Bekaert and Wang (2010)	US		19-35		27-36	51-216	
Joyce <i>et al.</i> (2009)*	UK	1992 Oct. to 2008 Feb	about 70 before 1997, About 30 after 1997		about 120-130 before 1997, about 30-40 after 1997	about 120-130 before 1997, about 30-40 after 1997	about 90 before 1997, about 30-40 after 1997
Hördahl and Tristani (2014)*	US	1990 Jan. to 2013 April		about 25-50 (3-year)		about 20	
Hördahl and Tristani (2014)*	Euro Area (France)	from 1999 Jan. (2004 for the ILB data) to 2013 April		about 25 (3-year)		about 35-40	
Pflueger and Viceira (2013)	US	1999Q1-2010Q4				52	
Pflueger and Viceira (2013)	UK	1999Q4-2010Q4					-34
Auckenthaler <i>et al.</i> (2015)	US	2001Q1-2011Q3				22	

\*These papers do not present the average inflation risk premium, but only the graphs for the dynamics (Hördahl and Tristani, 2014) or the term structure (Joyce *et al.*, 2009). The numbers we present are based on visual inspection of the graphs.

Table 2 summarizes the reviewed papers. This brings us to several conclusions. First, the range of estimates is wide. For 1-year bonds the US estimate is 19-47 bp and the UK estimate is 30-70 bp. Second, more recent sample data indicate lower inflation risk premiums. Thirdly, maturity matters: 3-year bond inflation risk premium estimate for the Euro area is about 25 bp, whereas 10-year inflation risk premium estimate is about 35-40 bp. Fourthly, the inflation risk premium is not a constant, but varies significantly over time. Finally, we observe a decrease in the inflation risk premium in the UK over time and relatively small inflation risk

premium estimates for the recent period in the Euro area. Both may be related to the increase in central bank independence in the period of analysis.

Given the volatility of the estimates across the literature and over time, it is dangerous to try to forecast the inflation risk premium for the future. However, if we must pick up a number, our overview suggests that a reasonable estimate of the current inflation risk premium in the Eurozone may be in the range of 20-40 bp.

### *The liquidity premium in the literature*

The liquidity premium has received far less attention in the literature than the inflation risk premium. Here, we review some recent estimates of the liquidity premium.

Shen (2006) analyzes the dynamics of the BEIR in the US in 1999-2006. He shows that the TIPS liquidity premium decreased since 1999. According to his estimates, in 1999-2006 the liquidity premium on 10-year ILBs fell by almost 25 bp, whereas the liquidity premium on 5-year ILBs fell by 7-8 bp. This corresponds with Bekaert and Wang (2010) who observes that after 2004 US ILBs have become more liquid. Bekaert and Wang (2010) also state that liquidity remains an issue. In particular, when there is a flight to safety, investors increase their demand for the most liquid securities, thereby increasing liquidity premiums on less liquid securities.

The latter is confirmed by Gürkaynak *et al.* (2010). Normalizing the liquidity premium to be 0 in April 2005, they estimate the liquidity premium to vary from 0 to about 140 bp for 10-year bonds and from 0 to 80 bp for 5-year bonds<sup>9</sup>. Further, the liquidity premium estimates are time-varying: for 5-year ILB they varied around 80 bp before 2004, decreased to about 20 bp in 2005-2007 and increased again during the crisis, reaching about 140 bp in September 2008, which is the last point in Gürkaynak *et al.* (2010). The dynamics for 10-year ILBs are similar.

Pflueger and Viceira (2013) present estimates of the liquidity premium for the US and the UK. In particular, their analysis identifies the liquidity differential between inflation-indexed and nominal bonds. In line with other work, the authors find that liquidity premium is quite volatile, both in the US and the UK. On average, the liquidity premium is estimated at 69 bp in the US and 50 bp in the UK.

---

<sup>9</sup> Gürkaynak *et al.* (2010) do not present exact numbers for the estimated liquidity premium. For our analysis, we rely on a visual inspection of the graphs in the paper.

**Table 3: Liquidity risk premium estimates**

Paper	Country	Data	Liquidity premium in basis points for 10-year ILB
Gürkaynak <i>et al.</i> (2010)	US	1999-2008	from 0 to about 140 bp
Hördahl and Tristani (2014)	US	January 1999-February 2013	37 (varying from 0 to 140 bp)
Hördahl and Tristani (2014)	Euro Area (France)	2004 - February 2013	10 (varying from 0 to 30 bp)
Pflueger and Viceira (2013)	US	1999Q1-2010Q4	69 (varying between 35 and 150 bp)
Pflueger and Viceira (2013)	UK	1999Q4-2010Q4	50 (varying between 0 and 100 bp) for 20-year bonds
Auckenthaler <i>et al.</i> (2015)	US	2001Q1-2011Q3	56 (varying from 0 to about 100 bp)
Auckenthaler <i>et al.</i> (2015)	UK	2001Q1-2011Q3	118 (varying from 0 to about 200 bp)
Auckenthaler <i>et al.</i> (2015)	Canada	2003Q4-2011Q3	154 (varying from 0 to about 280 bp)

Hördahl and Tristani (2014) estimate that the liquidity premium on 10 year US ILBs varies between 0 and about 130 bp (for the very short period in 2009).<sup>10</sup> Except of the peak at the end of 2008 and 2009, the liquidity premium was varying but below 80 bp. After 2009 the liquidity premium fell; in 2011-2013 it fluctuated around 40 bp. At the end of the period (2011-2013), the liquidity premium was lower than during the crisis but still very volatile (from 10 to 70 bp). Hördahl and Tristani (2014) report that in January 2004 – April 2013 the average liquidity premium in 10-year ILBs was 37 bp in the US and 10 bp in France.<sup>11</sup>

In an overview of the literature, Auckenthaler *et al.* (2015) argue that the liquidity premium on ILBs is quite high, especially in the first five years after bonds issuance and during a financial turmoil. They estimate the liquidity premium at 56 bp for the US, 118 bp for the UK, and 154 bp for Canada. However, their analysis may underestimate the liquidity premium as it assumes the minimum of the premium to be equal to zero. Further, the liquidity premium is found to be volatile in each of the three countries analyzed. For example, for the US they find that the liquidity premium was around 100 bp in 2000-2004, gradually fell to zero in the first half of 2008, and then increased to about 50 bp in 2009-2011. Similarly, the liquidity premium on ILBs in the UK varied around 100 bp in 2000-2006, fell to zero and increased to even above 200 bp during and after the crisis (till 2011).

<sup>10</sup> For the analysis we do a visual inspection of the graphs presented by Hördahl and Tristani (2014).

<sup>11</sup> Hördahl and Tristani (2014) liquidity factors regression for France has a rather low R-squared, so the estimated liquidity premium for France should be taken with caution.

Wrapping up, the liquidity premium on ILBs is found to be quite volatile. In general, liquidity premiums are high immediately after the first issuances. Further, the liquidity premiums were found to be relatively low in 2005-2008 before the crisis hit, spiking at the time of the crisis and decreasing afterwards without returning to pre-crisis levels. Providing a forecast of the liquidity premium may be as difficult as or even more difficult than forecasting the inflation risk premium. But if we must come up with a number, our overview suggests that the liquidity premium may be in the range of 10-150 bp.

## **6 The case of the Netherlands**

This section looks more closely at the Netherlands, a country that has not issued ILBs thus far. It raises two points. First, apart from the arguments reviewed above, one additional argument may be relevant. In the Netherlands, the bulk of household saving is done through pension funds that aim at providing price-indexed pension benefits to their participants. According to some observers (*e.g.*, Lever and Loois, 2016), this may indicate that there is huge latent demand for ILBs and issuing ILBs in the Netherlands could therefore be more attractive than in other countries. Second, to-be-issued ILBs could be indexed against a Dutch price index rather than a Eurozone price index. Would this make a big difference?

### *Dutch pension funds*

The Netherlands stand out when it comes to the role of pension savings. The savings that are made through pension funds form the major part of aggregate savings; the role for private savings is marginal. In particular, pension funds have accumulated 1250 billion euro of wealth at the end of 2015 (which amounts to 185 percent of Dutch GDP). Hence, the reasoning is that there may be huge latent demand for ILBs; Dutch pension funds would be willing to invest large amounts of wealth in ILBs if the Dutch government would start issuing them.

There are a few factors that qualify this argument, however. One is that some pension funds aim to index pensions against wages rather than prices. Probably more importantly, Dutch pension funds may want to shift only a fraction of their portfolios towards ILBs issued by the Dutch government. Indeed, other Eurozone countries like France and Germany have been supplying ILBs for some years now and Dutch pension funds have refrained from investing sizeable amounts into these ILBs. Actually, at the end of the second quarter of

2016, Dutch pension funds invested only a meagre 5 percent of their wealth into ILBs (DNB, 2016). Given that ILBs issued by the Dutch government would, apart from a country risk, be equivalent with ILBs issued by other Eurozone countries, it seems reasonable to assume that current investment in Euro ILBs would impose an upper bound on the potential investments by Dutch pension funds in Dutch ILBs. Should inflation pick up and should inflation risk become a more important factor, this assumption of an upper bound might become more difficult to defend, however.

Moreover, there is another argument that tends to reduce the demand of pension funds for ILBs. That is that investments in ILBs, contrary to investments in nominal bonds, tend to destabilize the nominal funding ratio of pension funds. Indeed, shocks in expected inflation change the liabilities of pension funds, but leave the value of their assets unchanged. As pension supervision is based on the nominal funding ratio, the more a pension fund invests in ILBs, the higher the probability that its funding ratio will at some point in time be too low, requiring the fund to cut pensions. This argument may carry some weight in the current situation in which pension funds are generally significantly underfunded. Moreover, it could help to explain why the current investments by pension funds in ILBs are so low. But it also suggests that the demand by pension funds for ILBs will continue to be low as long as their financial position does not show substantial improvement and the supervisory rules remain unchanged.

#### *Dutch inflation and Eurozone inflation*

Would it make a difference if the to-be-issued Dutch ILBs would be indexed against the Dutch CPI rather than the Eurozone HICP? Many Dutch pension funds base their indexation strategies on the development of the Dutch CPI and the latter price index correlates only imperfectly with the Eurozone HICP. The difference between the two price indices should not be overstated, however. For the period 2000-2015 the correlation between the two indices is 0.991. Hence, over the longer horizons most relevant for pension funds the difference between the Dutch CPI and the euro area HICP is rather small.

In addition, indexing against the Dutch CPI could imply a higher liquidity risk. Indeed, Gürkaynak *et al.* (2010), Hördahl and Tristani (2014) and Auckenthaler *et al.* (2015) have found that the liquidity premium correlates negatively with the volume of ILB trading and the ILB share in total government debt. Compared with the Eurozone average, the Dutch debt-to-GDP ratio is rather small (65.1 percent in the Netherlands against 90.8 percent in the Euro area in 2015 (Eurostat, 2016)). Hence, one would expect that opening a new market that

features little trading activity will involve larger liquidity risks than enhancing an existing market that features frequent trading, at least for a couple of years.

## **7 Summary and conclusions**

The market for ILBs is growing, but still small when compared to the market for nominal bonds. This paper raised the question why governments do not rely more on ILBs to finance their public debts?

The obvious starting point for an analysis of ILBs is that they protect investors from the risk of inflation. In this respect, ILBs outperform nominal bonds. However, ILBs are also known to be relatively illiquid. Combining the two elements, we have derived that the average rate of return on ILBs can be lower or higher than the one on corresponding nominal bonds (same issuer, same maturity). The former case is more likely when the inflation risk premium is high; the latter is more likely the less liquid is the market for ILBs.

Inspection of the yields on nominal bonds and ILBs during the last fifteen years suggests that the liquidity premium is substantial and may be even larger than the inflation risk premium. An overview of econometric estimates of the inflation risk premium and the liquidity premium in the literature leads to the same conclusion. The result may be not surprising, given that inflation has been historically low during the last fifteen years. The consequence is that ILBs may turn out to be a more expensive financial instrument than nominal bonds.

We have also derived that ILBs help to stabilize the public debt ratio, but add to the volatility of the public deficit ratio. The latter is a con for countries in the Eurozone because of the rules laid down in the Stability and Growth Pact. Combining these two results helps to explain why governments in euro countries do not rely much more on ILBs.

We have also looked at the case of the Netherlands, one of the countries that have not issued ILBs till now. Peculiar about the Netherlands is their high savings, organized through pension funds that aim to index their pension benefits to price inflation. Because of this indexation ambition, ILBs are a particularly interesting investment vehicle. Therefore, some observers expect that the demand for ILBs would be huge if the Dutch government would start issuing these instruments. We do not disagree, but warn that demand may turn out to be rather limited. Given that there are ample opportunities for pension funds to invest in ILBs issued by other euro countries, the fact that pension funds have refrained thus far from investing huge amounts in ILBs makes us think that pension funds will not change their ILB

holdings dramatically if the Dutch government were to issue ILBs. This may relate to the fact that ILBs add to the volatility of the coverage ratio of pension funds, which is particularly painful in the last years in which many pension funds witnessed a deterioration of their coverage ratios. Finally, we have argued that issuing ILBs indexed against the Dutch CPI rather than the Euro HICP would imply a much smaller market for Dutch ILBs, which could aggravate the problem of a lack of liquidity.

We conclude that as long as inflation risk remains as low as it is today, ILBs may turn out to be more expensive than nominal bonds. Adding to this that ILBs destabilize public deficit ratios, we think this helps to explain why the market for ILBs is a factor smaller than that for nominal government bonds in the euro area.

## References

Ang, A., G. Bekaert and M. Wei, 2008, The term structure of real rates and expected inflation, *Journal of Finance* **63**, 797-849.

Auckenthaler J., A. Kupfer and R. Sendlhofer, 2015, The impact of liquidity on inflation-linked bonds: A hypothetical indexed bonds approach, *North American Journal of Economics and Finance* **32**, pp. 139–154.

Barro, R.J., 1997, Optimal Management of Indexed and Nominal Debt, NBER Working Paper 6197.

Beetsma, R.M.W.J. and C. van Ewijk, 2010, Over de wenselijkheid van de uitgifte van geïndexeerde schuld door de Nederlandse overheid, Netspar NEA Paper 30, Tilburg.

Beetsma, R.M.W.J. and E.W.M.T. Westerhout, 2016, A Comparison of Nominal and Indexed Debt Under Fiscal Constraints, CEPR Discussion Paper 11141.

Bekaert, G. and X. Wang, 2010, Inflation risk, *Economic Policy*, 755-806.

Bohn, H., 1988, Why Do We Have Nominal Government Debt?, *Journal of Monetary Economics* **21**, 127-140.

Borensztein, E. and P. Mauro, 2004, GDP-indexed bonds, *Economic Policy*, 165-216.

Buraschi, A. and A. Jiltsov, 2005, Inflation risk premia and the expectations hypothesis, *Journal of Financial Economics* **75**, 429-490.

Campbell & Shiller, 1996, A Scorecard for Indexed Government Debt, NBER Macroeconomics Annual 1996, vol. 11.

Campbell, J.Y., R.J. Shiller and L.M. Viceira, 2009, Understanding inflation-indexed bond markets, *Brookings Papers on Economic Activity*, Spring, 79-120.

Campbell, J.Y. and L.M. Viceira, 2001, Who Should Buy Long-Term Bonds?, *American Economic Review* **91**, 99-127.

Christensen, J. H. E., J. A. Lopez and G. D. Rodebusch, 2010, Inflation Expectations and Risk Premiums in an Arbitrage-Free Model of Nominal and Real Bond Yields, *Journal of Money, Credit and Banking* **42**, 143-178.

DNB, 2016, <https://www.dnb.nl/statistiek/statistieken-dnb/financiele-instellingen/pensioenfondsen/toezichtgegevens-pensioenfondsen/index.jsp>.

Eurostat, 2016,  
<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=teina225&plugin=1>.

Fischer, S., 1975, The Demand for Index Bonds, *Journal of Political Economy* **83**, 509-534.

- Fischer, S. and L.H. Summers, 1989, Should Governments Learn to Live with Inflation?, *American Economic Review* **79**, 382-387.
- Fleckenstein, M., F.A. Longstaff and H. Lustig, 2014, The TIPS-Treasury Bond Puzzle, *Journal of Finance* **69**, 2151-2197.
- Garcia, J.A. and A. van Rixtel, 2007, Inflation-Linked Bonds from a Central Bank Perspective, ECB Occasional Paper 62.
- Grishchenko, O.V. and J.-Z. Huang, 2013, The Inflation Risk Premium: Evidence from the TIPS Market, *The Journal of Fixed Income* **22**, 5-30; DOI: 10.3905/jfi.2013.22.4.005.
- Gürkaynak R. S., B. Sack and J. H. Wright, 2010, The TIPS Yield Curve and Inflation Compensation, *American Economic Journal: Macroeconomics* **2**, 70–92.
- Hördahl, P. and O. Tristani, 2014, Inflation risk premia in the Euro Area and the United States, *International Journal of Central Banking*.
- Joyce, M., P. Lildholt and S. Sorensen, 2009, Extracting inflation expectations and inflation risk premia from the term structure: A joint model of the UK nominal and real yield curves, Bank of England working paper 360.
- Kraemer, W., 2015, An Introduction to Inflation-Linked Bonds, Lazard Asset Management, [http://www.lazardnet.com/docs/sp0/6034/AnIntroductionToInflation-LinkedBonds\\_LazardResearch.pdf](http://www.lazardnet.com/docs/sp0/6034/AnIntroductionToInflation-LinkedBonds_LazardResearch.pdf).
- Kydland, F.E. and E.C. Prescott, 1977, Rules Rather than Discretion: the Inconsistency of Optimal Plans, *Journal of Political Economy* **85**, 473-491.
- Lever, M. and M. Loois (2016), Pensioen en rentegevoeligheid, Policy Brief 12, CPB Netherlands Bureau for Economic Policy Analysis.
- Ministerie van Financiën, 2008, Update rapport indexleningen, bijlage bij brief van de regering aan de Tweede Kamer 2008D06715, [http://www.tweedekamer.nl/kamerstukken/brieven\\_regering/detail?id=2008Z03255&did=2008D06715](http://www.tweedekamer.nl/kamerstukken/brieven_regering/detail?id=2008Z03255&did=2008D06715).
- Pflueger, C.E. and L.M. Viceira, 2013, Return Predictability in the Treasury Market: Real Rates, Inflation, and Liquidity, Harvard Business School Working Paper 11-094.
- Shen, P., 2006, Liquidity risk premia and breakeven inflation rates. Federal Reserve Bank of Kansas City.
- Wolswijk, G. and J. de Haan, 2005, Government Debt Management in the Euro Area – Recent Theoretical Developments and Changes in Practices, ECB Occasional Paper 25.

## Appendix

In the main text, we have derived that the response of the public deficit ratio to a shock in inflation is stronger, the more the government relies on ILBs to finance the public debt. This result is obtained under the assumption that primary public spending and tax revenues are fully proportional with inflation. Here, we show that a similar result is obtained if we replace this assumption with one that is based on empirical evidence.

The main text derives the following expression for the public deficit ratio:

$$\frac{D}{Y} = \frac{(1+\pi)G_{-1} - (1+\pi)T_{-1} + i^N B_{-1}^N + \left((1+r^R)(1+\pi) - 1\right)B_{-1}^R}{(1+\pi)Y_{-1}} \quad (14)$$

This equation reflects the assumption that primary spending and tax revenues are fully proportional in inflation. We do not want to impose that assumption here, so we rewrite equation (14) in terms of  $\mathbf{G}$  and  $\mathbf{T}$ :

$$\frac{D}{Y} = \frac{G - T + i^N B_{-1}^N + \left((1+r^R)(1+\pi) - 1\right)B_{-1}^R}{(1+\pi)Y_{-1}} \quad (A1)$$

To highlight the differences between nominal and ILBs, we rewrite this equation for the case where only nominal or only ILBs are used to finance the public debt. We also simplify by using  $\mathbf{P}$  to refer to the primary deficit, defined as the difference between primary spending and tax revenues:

$$\frac{D^N}{Y} = \frac{P}{Y} + \frac{i^N B_{-1}^N}{(1+\pi)Y_{-1}} \quad (A2)$$

$$\frac{D^R}{Y} = \frac{P}{Y} + \frac{\left((1+r^R)(1+\pi) - 1\right)B_{-1}^R}{(1+\pi)Y_{-1}} \quad (A3)$$

For both cases, we can derive an expression for the derivative of the public deficit ratio with respect to inflation:

$$\frac{\partial(D^N/Y)}{\partial\pi} = \frac{\partial(P/Y)}{\partial\pi} - \frac{i^N}{(1+\pi)^2} (B_{-1}^N/Y_{-1}) \quad (\text{A4})$$

$$\frac{\partial(D^R/Y)}{\partial\pi} = \frac{\partial(P/Y)}{\partial\pi} + \frac{1}{(1+\pi)^2} (B_{-1}^R/Y_{-1}) \quad (\text{A5})$$

Both Ministerie van Financiën (2008) and Beetsma and Van Ewijk (2010) have explored the relation between the public deficit ratio and the rate of inflation. The former does so for the Netherlands in the 1970-2007 period, whereas the latter focuses upon 14 EU countries in the 2000-2007 period. Despite the differences in data and regression approach, the two papers draw a similar conclusion: there is no statistically significant effect of inflation upon the EMU deficit ratio. Given that the share of ILBs in the public debt of these countries is small, we interpret this as evidence for a statistically insignificant effect of inflation upon the part of the deficit that is financed with nominal bonds:  $\partial(D^N/Y)/\partial\pi = 0$ . Combining this result with equations (A4) and (A5), we find that  $\partial(D^R/Y)/\partial\pi = \left((1+i^N)/(1+\pi)^2\right)(B_{-1}^R/Y_{-1}) > 0$ . Hence, the public deficit ratio will be more volatile if ILBs rather than nominal bonds are used to finance the public debt.



Publisher:

CPB Netherlands Bureau for Economic Policy Analysis  
P.O. Box 80510 | 2508 GM The Hague  
T (088) 984 60 00

March 2017 | ISBN 978-90-5833-766-5