International Real Yields[*]

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Abstract

I study market-implied real yields extracted from prices of inflation-linked government bonds for 9 developed countries. The liquidity premium is an important component of breakeven inflation rates. Unconditional real yield curves are upward-sloping, providing empirical support for habit models. The cross-country real rate equality is rejected. Across countries, real yields are strongly positively correlated while liquidity premia are moderately positively correlated. Low nominal yields following the Great Recession are mainly due to low real yields, although the inflation risk premia have also decreased.

Keywords: government bonds, inflation-linked bonds, liquidity premium, inflation risk premium, international comovement

JEL codes: E31, E43, G12, G15

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1 Introduction

Inflation-linked bonds provide a unique opportunity to observe market-implied real yields, because their cash flows are indexed to inflation. It is natural to consider sovereign bonds of developed countries as they tend to have low or insignificant default risk.

Market-implied real yields are of interest to both practitioners and academic researchers. For practitioners, real term structure contains valuable information about future real economic growth (voluminous literature starting with Harvey, 1988). Real yields also serve as the basis for the discount rates in the project valuation (e.g., Clarida, 2014). Furthermore, as inflation-linked bonds gain popularity as investment instruments (e.g., Viceira, 2007), it is important to understand how much of the compensation is from the real yield and how much from the liquidity premium (several papers starting with Gürkaynak, Sack, and Wright, 2010). Data on real yields also allows to disentangle nominal yield components: real yield, expected inflation, and the inflation risk premium. For investors seeking international diversification, comovement between inflation-linked yields in different countries is of primary interest as an input into the mean-variance analysis.

In academic research, observing real yields allows to test several term structure and international finance models. In the term structure literature, real yields can be used to discriminate between leading asset pricing paradigms. For example, workhorse asset pricing models differ in their predictions with respect to the unconditional real yield curve slope. The long-run risk model generally implies on average a downward-sloping real yield curve (Hasseltoft, 2012). The rare disasters model predicts a flat real yield curve (Gabaix, 2012). The habit model produces an upward slope if the intertemporal smoothing effect is dominant and a downward slope if the precautionary savings effect is dominant (Wachter, 2006).

The cross-section of international real yields also allows to test several theories of international finance. For instance, major macroeconomic models predict that in the absence of capital mobility and trade frictions, real risk-free rates should be equal across the world (see, for example, Mishkin, 1984, for a literature review). In terms of the international yield comovement, some models predict that it should be driven by real economy factors (for instance, Colacito and Croce, 2013, Heyerdahl-Larsen, 2014, or Stathopoulos, 2017), while others emphasize liquidity factors (for example, Kyle and Xiong, 2001, or Basak and Pavlova, 2013). Inflation-linked bonds are a particularly interesting instrument to study the topic because their prices are significantly affected by both real and liquidity factors, at least in the US (e.g., Gürkaynak, Sack, and Wright, 2010). Additionally, while it has been documented that nominal yields are strongly correlated across countries (e.g., Sutton, 2000, or Jotikasthira, Le, and Lundblad, 2015), it is not clear if this correlation is driven by real yields or inflation compensation.

Using prices of inflation-linked bonds, I construct monthly inflation-linked zero-coupon yield curves for 9 developed countries: United Kingdom (sample: January 2001-), Canada (June 2003-), United States (July 2004-), France (November 2004-), Sweden (September 2005-), Australia (September 2010-), Germany (April 2011-), Japan (June 2011-), and Korea (June 2013-).[1]

I document a number of unconditional and time series facts.[2] The main unconditional facts are:

1. Liquidity variables explain a substantial part of the variation in the spread between nominal and inflation-linked yields (the breakeven inflation rate), even after controlling for inflation expectations. The average liquidity premium in inflation-linked bonds compared to nominal bonds is economically large. For practitioners this implies that inflation-linked yields should not be used as a direct measure of real yields and breakeven inflation rates as a direct measure of inflation expectations.

2. Unconditional real yield curves are upward-sloping. The unconditionally positive real term structure accounts for most of the unconditionally positive nominal term structure, especially at maturities below 10 years. Theoretically, this is most consistent with the habit model of Wachter (2006) where the intertemporal smoothing effect dominates.

3. Unconditional real rates vary strongly by country. Theoretically, this suggests for an important role of non-tradable goods as the capital mobility between the countries in the sample is unrestricted.

4. Real yields are strongly positively correlated across countries. The liquidity premia are moderately positively correlated across countries. This supports models of both real factors and liquidity driven cross-country yield comovement.

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[1] The dataset of inflation-linked zero-coupon yields is available as an online appendix to this paper.

[2] Although many of the results are statistically and economically significant, they should be treated with a caution because the sample is relatively short.

The key time series facts are:

1. The liquidity premium varies over time with the pronounced spike during the Great Recession.

2. Low nominal yields since the Great Recession are mainly attributed to low real yields. Theoretically, the low real rates are consistent with the slowing down economic growth (e.g., Harvey, 1988), increased macroeconomic volatility, decreased real growth skewness (Bekaert and Engstrom, 2016), and the liquidity pressure from the central bank asset repurchase programs (D'Amico and King, 2013).

3. The inflation risk premium has been moderately decreasing in most countries. This is theoretically consistent with the declining correlations between real and nominal factors documented in several papers starting with Hasseltoft and Burkhardt (2012).

2 Related Literature and Contribution

I contribute to the literature on market-implied real yields. The literature is almost nonexistent outside of the US and UK. Roll (2004) provides a preliminary analysis of the US inflation-linked bonds. Gürkaynak, Sack, and Wright (2010) construct the US inflation-linked and real yield curves. Several papers including Abrahams et.al. (2016), Andreasen et.al. (2016), D'Amico, Kim, and Wei (2016), and Pflueger and Viceira (2016) estimate the liquidity premium for the US inflation-linked bonds. They document that the liquidity premium is economically large and spikes during the Great Recession. Grishchenko and Huang (2013) and Chen, Engstrom, and Grishchenko (2016) use inflation-linked bonds to estimate the US inflation risk premium. Campbell, Shiller, and Viceira (2009) and Christensen and Rudebusch (2017) point out that the US real rates have been declining during the past two decades. Wright (2016) uses options data to study ex-ante real rate uncertainty.

My contribution to the US term structure literature is twofold. First, I provide a number of new stylized facts. For instance, the real yield curve slope increase since the Great Recession has not been documented yet. Second, I confirm previously documented phenomena using market-implied real rates. For example, the positive covariance between real yields and expected inflation (the absence of the so called Tobin-Mundell effect), has not been documented using market-implied real rates.

The evidence on the UK real term structure has been contradictory. For instance, there is little agreement on the average slope of the UK real yield curve. Evans (1998) finds a negative slope. Joyce, Lildholdt, and Sorensen (2010) document essentially a flat real term structure. Verdelhan (2010) argues for the hump-shaped real yield curve. Finally, Heyerdahl-Larsen (2016) estimates a positive slope. None of these studies control for the liquidity of inflation-linked bonds. This might be problematic. For example, the liquidity premium is an important component of the UK 20 year inflation-linked bond (Pflueger and Viceira, 2016). Additionally, the US analysis suggests that the liquidity premium varies with the bond maturity. I provide an extensive UK real term structure analysis, controlling for liquidity.

My major contribution is to analyze market-implied real yields outside the US and UK. Studying international market-implied real yields is interesting for at least two reasons. First, the extant analysis has been limited to two relatively short time series (the US and UK). Second, it often failed to arrive to the consensus on important topics (e.g., on the real yield curve slope or the liquidity premium dynamics during the Great Recession).

The literature on market-implied real yields outside the UK and the US is thin. Ejsing, Garcia, and Werner (2007) estimate the unified Euro area inflation-linked yields between 2004 and 2007, treating Germany, France, and Italy as the same country. Garcia and Werner (2011) extend their analysis to 2010. Hördahl and Tristani (2010) estimate the unified Euro area inflation-linked yields from 2004 to 2008, treating Germany and France as the same country. Pericoli (2014) estimates French inflation-linked yields between 2002 and 2012. None of these studies controls for the liquidity premium. This might be a serious omission. For instance, Fleckenstein (2013) shows that French, German, and Italian inflation-linked bonds are “too cheap” during the times of limited liquidity. Furthermore, these papers concentrate on estimating inflation-linked yields and devote little attention to term-structure properties. To the best of my knowledge, I am the first to provide a comprehensive market-implied real yields analysis for a set of developed countries, controlling for liquidity.

This paper is the first study of cross-country long-term real rates comovement. The previous work has been evolving around short maturities (1 year or below) and model-implied real rates (e.g., Mishkin, 1984, Barro and Sala-i-Martin, 1990, Gagnon and Unferth, 1995, or Holston, Laubach, and Williams, 2017).

3 Data and Methodology

The data consists of inflation-linked and nominal zero-coupon yields. Inflation expectations and liquidity proxies are used to adjust inflation-linked yields for the liquidity premium over nominal yields.

3.1 Zero-coupon Yields

I start with the set of G7 countries. Although it has a relatively long history of issuing inflation-linked bonds, I exclude Italy from the analysis. This is because I would like to abstract from default risks and its recent credit rating has been relatively low. I include Australia, Korea, and Sweden into the sample. These countries have had high credit ratings and the history of issuing inflation-linked bonds to construct yield curves for several years.

I operate with annual zero-coupon yields defined as $y_{n,t} = -\frac{1}{n} ln P_{n,t}$, where $P_{n,t}$ is the time t price of a zero-coupon bond which pays 1 unit in n years. I use end of month yields. I focus on maturities above 2 years. The yields for shorter maturities are tricky to extract from inflation-linked bonds because of the indexation lags discussed below. Maturity range upper bounds are highly country-specific as inflation-linked bond programs vary by country. For instance, only long maturities are available for Canada and only short maturities for Japan.

The US zero-coupon inflation-linked yields are from Gürkaynak, Sack and Wright (2010). The UK zero-coupon inflation-linked yields are from the Bank of England website. For other countries I construct inflation-linked yield curves using mid prices of inflation-linked bonds from Bloomberg.[3]

Table 1 documents that inflation-linked sovereign bonds are an important asset class in many developed countries, both in terms of their absolute value and relative to nominal bonds. For instance, in terms of the relative importance, inflation-linked bond share is

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[3] I find Bloomberg marginally more comprehensive than Datastream. All prices in Datastream are also in Bloomberg but a small number of Australian and French inflation-linked bonds don't have prices in Datastream. The impact of these Bloomberg specific bonds on the results is negligible. For the issues available from both databases, Bloomberg and Datastream prices are identical.

usually around 10% of the nominal bonds of the similar maturity[4]. Inflation-linked bonds are relatively most important in Sweden and the UK, where their share is over 30% of the nominal bond market. Figure 1 illustrates the availability of inflation-linked bond prices by country. The sample length and the maturity choices are made based on the availability of bonds and liquidity proxies, discussed in Appendix A, and are summarized in columns 5 and 6 of Table 1.

Given the prices of inflation-linked bonds, I fit Nelson-Siegel (1987) yield curves to construct zero-coupon yields. I choose Nelson-Siegel (1987) methodology instead of Svensson (1994) for two reasons. First, it requires fewer (4 versus 6) parameters. Figure 1 shows that there are relatively few bonds in the early part of the sample, making the estimation of a more complex model challenging. Second, using Svensson (1994) methodology requires having a long maturity (20-30 years) bond. Figure 1 illustrates that many countries in the sample don't satisfy this requirement.[5] Another option would be to estimate spline-based curves (e.g., Anderson and Sleath, 1999). However, despite their superb statistical fit, unless a very high number of bonds is available, they often produce jagged yield curves. This would be awkward given my focus on macroeconomic and policy analysis.

Under Nelson-Siegel (1987) parametrization, time t n-period ahead zero-coupon yield is:

$$y_{n,t} = \beta_0 + \beta_1 \frac{1 - e^{-\frac{n}{\tau_1}}}{\frac{n}{\tau_1}} + \beta_2 \left(\frac{1 - e^{-\frac{n}{\tau_1}}}{\frac{n}{\tau_1}} - e^{-\frac{n}{\tau_1}} \right), \tag{1}$$

where β_0, β_1, β_2, and τ_1 are model parameters. For each country-month combination, I estimate these parameters to minimize the sum of squared deviations between observed and predicted bond prices weighted by the inverse bond duration.[6]

In addition to the liquidity premium discussed in section 3.2, there are two properties which make inflation-linked yields different from real yields: the deflation protection and the indexation lag. The principal (but not coupon) payments on inflation-linked bonds are deflation-

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[4] Inflation-linked bonds are predominantly medium and long-maturity bonds in developed countries, because short-term inflation risk in these countries is small (see, e.g., Roll, 2004, Garcia and van Rixtel, 2007, or Bekaert and Wang, 2010).

[5] As a robustness check, I estimate Svensson (1994) inflation-linked yield curves when there are enough bonds and there are long-maturity bonds. The results are economically and statistically very close to Nelson-Siegel (1987) estimates.

[6] Minimizing the duration weighted prices squared deviations results in essentially the same yield curve as minimizing the yields squared deviations, but is computationally much faster.

protected.[7] This increases inflation-linked bond prices compared to real bonds, because their payoff in the states where there is a deflation over the lifetime of the bond is higher. The value of the deflation protection is usually negligible, because it requires the deflation over the lifetime of the bond (Roll, 1996). Grishchenko, Vanden, and Zhang (2016) estimate that the US 10 year inflation-linked bond deflation premium was around 1 basis point annually at its maximum. Grischchenko, Vanden and Zhang (2016) and Christensen, Lopez, and Rudebusch (2016) estimate that the US 5 year inflation-linked bond average deflation premium has been close to 0. However, it spiked to around 30 basis points during the period of low expected inflation (late 2008). Importantly, this estimate is based on statistical models of expected inflation. These statistical models imply that the US 5 year expected inflation was around -1.5% annually in late 2008 (see, e.g., Figure 1 in Christensen, Lopez, and Rudebusch, 2016). At the same time, survey inflation expectations (which tend to outperform statistical models, as shown, e.g., in Ang, Bekaert, and Wei, 2007, or Table VI in Christensen, Lopez, and Rudebusch, 2016) had been much higher during late 2008 (between +1.5-2% annually). This would imply the deflation premium close to 0 basis points. Based on survey inflation expectations, other countries in my analysis are also unlikely to experience a long-term deflation. The country with the strongest deflationary pressures is Japan, which issues 10 year inflation-linked bonds (see Figure 1). However, over any recent 10 year period, the inflation has been clearly positive in Japan. Additionally, the majority of Japanese inflation-linked bonds in my sample were issued before 2013 and do not have the deflation protection. Thus, given the prior evidence suggesting the insignificant value of the deflation protection, I ignore it in my analysis.

The second issue with inflation-linked bonds is that coupon and principal payments are indexed with the lagged values of inflation. In my sample, the UK has the longest indexation lag of 8 months. Other countries have indexation lags between 2 and 3 months. Inflation-linked bonds do not hedge inflation during that period. This makes their yields different from real yields. Evans (1998) and Risa (2001) estimate that the average indexation lag premium is a couple of basis points in the UK, where the indexation lag is the longest. Grishchenko and Huang (2013) and D'Amico, Kim and Wei (2016) show that the indexation lag premium is unconditionally close to 0. However, it can conditionally be dozens of basis

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[7] Except for Canadian, British, and some of Japanese and Korean bonds. In Korea and Japan the earlier issues don't have deflation protected principals and later issues, starting from 2010 in Korea and 2013 in Japan, have deflation protected principals.

points for short maturity US bonds. To account for the inflation indexation lag, I follow Gürkaynak, Sack, and Wright (2010). I exclude short maturity (below 24 months) bonds, where the lag premium is the largest, and ignore the indexation lag for longer maturity bonds.[8]

The nominal zero-coupon yields are available directly for all countries. The sources and the estimation details are in Appendix B.

3.2 Liquidity Differential between Inflation-linked and Nominal Yields

The US evidence suggests that inflation-linked bonds are less liquid than nominal bonds (e.g., numerous papers starting with Gürkaynak, Sack, and Wright, 2010). Pflueger and Viceira (2016) also show that the 20 year UK inflation-linked bond is subject to the liquidity premium.

To estimate the liquidity premium, I follow Gürkaynak, Sack, and Wright (2010).[9] Let $b_{n,t}$ be time t and maturity n breakeven inflation rate ($b_{n,t} = y_{n,t}^{nominal} - y_{n,t}^{inflation-linked}$), l_t a vector of liquidity proxies, and π_t^e a vector of inflation expectations. For each country-maturity combination, I run the following OLS regression using the end of month data:

$$b_{n,t} = c_1 + c_2 l_t + c_3 \pi_t^e + \epsilon_t. \tag{2}$$

Given the slope coefficients $\hat{c}_2$ from (2), the liquidity premium in inflation-linked yields over nominal yields is $L_t^n = -\hat{c}_2 l_t$. Following Gürkaynak, Sack and Wright (2010), I normalize the level of the liquidity premium to 0 at the end of the month when it was the lowest.[10] The

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[8] The indexation lag also biases the breakeven inflation rate calculations. The time t nominal rate corresponds to the period between time t and time $t+n$, where n is the bond maturity. The inflation-linked bond hedges the inflation between time $t-l$ and $t+n-l$, where l is the indexation lag. However, given that l is small compared to n, this difference is usually ignored in the literature (e.g., Gürkaynak, Sack, and Wright, 2010).

[9] The methodology is originally from Chen, Lesmond, and Wei (2007).

[10] This implies that the liquidity premium is measured relative to the liquidity value at that time. As a robustness check, I also implement the liquidity level normalization as in Pflueger and Viceira (2016): the liquidity premium is normalized to 0 in the world of "perfect liquidity", where off-the-run spreads and inflation-swap spreads are 0 etc. This results in slightly higher unconditional liquidity premium levels in most countries. The correlation between two liquidity premia is 1.

real yield is then computed by subtracting the liquidity premium from the inflation-linked yield. The purpose of including inflation expectations as controls in (2) is to ensure that liquidity variables don't pick up the fluctuations in expected inflation.

Following Pflueger and Viceira (2016), I extend Gürkaynak, Sack, and Wright (2010) to include several measures of inflation-linked bond liquidity into vector l_t in (2). In particular, I use three types of liquidity proxies: the nominal off-the-run spread, the relative transaction volume of inflation-linked bonds, and indicators of the arbitrage activity in the inflation-linked bond market.

The end of month nominal off-the-run spread is the difference between yields of the most recent and older nominal bonds of the same maturity offering almost identical cash flows (Krishnamurthy, 2002). The spread has been associated with the time-varying market-wide desire to hold only most liquid instruments (e.g., Hu, Pan, and Wang, 2013). Following Hu, Pan, and Wang (2013), I construct the off-the-run spread by taking the nominal yields from the previous subsection, which are estimated using the cross-section of all bonds (most of which are off-the-run), and subtracting the on-the-run yield of the same maturity from Bloomberg. As on-the-run yields are not available for all maturities, I use the off-the-run spread of the closest available maturity.[11] Although the off-the-run spread is not directly linked to the inflation-linked bond liquidity, voluminous literature, starting with Chordia, Sarkar, and Subrahmanyam (2005), suggests that there is strong commonality in liquidity between different markets.

The relative transaction volume of inflation-linked bonds is the market value based trading volume of inflation-linked bonds divided by the aggregate trading volume of inflation-linked and nominal bonds. Theoretically, the relative transaction volume might reflect the illiquidity arising from search frictions (e.g., Duffee, Garleanu, and Pedersen, 2005). If data permits to better match the maturities of nominal and inflation-linked bonds, I do so.

The strength of the arbitrage activity has also been linked to the liquidity in inflation-linked bond markets (see Fleckenstein, 2013, for the international evidence). Following Pflueger and Viceira (2016), I use 2 proxies to control for such an activity. The main proxy is the end of month inflation-swap spread. It is defined as the price of a zero-coupon inflation-swap position paying fixed and receiving floating minus the difference between zero-coupon

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[11] For instance, if 7, 8, and 9 year on-the-run yields are not available, I use the 10 year off-the-run spread to adjust for the liquidity of the 8 year inflation-linked bond compared to the 8 year nominal bond.

inflation-linked and nominal yields of the same maturity. In the absence of market frictions, this spread should be 0. However, Fleckenstein, Longstaff, and Lustig (2013), Fleckenstein (2013), and Pflueger and Viceira (2016) show that the spread fluctuates strongly. The inflation swap prices are from Bloomberg. The inflation swap prices are not available for all maturities, so I use the inflation swap spread of the closest available maturity.

The inflation swap data is not available in some countries. Thus, following Pflueger and Viceira (2016), as the second best choice, I use the end of month difference in lending costs between non-collateralized and collateralized short-term loans. This proxies for the shadow cost of capital faced by arbitrageurs (Garleanu and Pedersen, 2011). Similarly to the off-the-run spread, this measure is not inflation-linked bonds specific, but its usage is justified given the strong commonality in liquidity between different markets (Chordia, Sarkar, and Subrahmanyam, 2005).

To control for expected inflation in (2), I use survey inflation expectations. Survey inflation expectations have been shown superior to statistical and financial markets forecasts, at least in the US (Ang, Bekaert, and Wei, 2007, or Table VI in Christensen, Lopez, and Rudebusch, 2016). Appendices C and D summarize inflation expectations and liquidity variables for different countries.

3.3 Reporting results

3.3.1 World Statistics

As there are 9 countries in the sample, it is convenient to summarize the general trends using their weighted average. Following Barro and Sala-i-Martin (1990), at each time point, I compute the world statistic (e.g., the world real rate) as the GDP weighted average of the respective statistics in the countries where the data is available for that time point. GDP weights are updated annually.

3.3.2 Samples and Maturities

As it can be seen from Table 1, samples vary a lot by country. To facilitate the cross-country comparisons, in most tables I report two samples. The first sample is from September 2005 to June 2016. For this sample, the data is available for France, Sweden, the UK, and the

US. The second sample is from June 2011 to June 2016. For this sample, in addition to 4 countries above, the data is also available for Australia, Germany, and Japan. For the space considerations, most of the results are reported for 5 year bonds, since this is the maturity available for the longest period of time in most countries.[12] It is also usually representative in terms of results.

3.3.3 Break-point Models

Nominal yield components exhibit several regimes, at least in the US and UK.[13] To test for regime shifts in my data, I use break-point models. I use break point models instead of full regime-switching models (Hamilton, 1989), because for my relatively short sample they deliver similar results while being structurally simpler.

Given the time series $\{x_t\}_{t=1:N}$, I estimate the model:

$$x_t = c_i + \mathcal{N}(0, \sigma), \text{ for } S_i \leq t < F_i, \tag{3}$$

where S_i and F_i are the start and end points of regime i, c_i is the mean value of the variable during that regime, and $\mathcal{N}(0, \sigma)$ is white noise with the standard deviation of σ.[14] Models are estimated by maximizing likelihood functions. Standard errors are square roots of diagonal elements in the inverse Fisher information matrix. The number and timing of break points is determined by minimizing Bayesian information criterion.

4 Real Yields and Liquidity Premia

I decompose inflation-linked yields into the real yield and liquidity premium components: $y_{n,t}^{\text{inflation-linked}} = y_{n,t}^{\text{real}} + y_{n,t}^{\text{liquidity premium}}$. Table 2 reports adjusted R^2:s from OLS regressions of breakeven inflation rates on inflation expectations and liquidity proxies, as in (2).[15] Ta-

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[12] Canada and Korea have very different samples from other countries. Canada has issued predominantly very long maturity inflation-linked bonds while the sample for Korea only starts in 2013. This complicates the quantitative comparison of many Canadian and Korean results to other countries. However, qualitatively the results are similar. Canadian and Korean results not reported in the main text are in Appendix E.

[13] Voluminous literature starting with Garcia and Perron (1996) for real rates, Evans and Wachtel (1993) for expected inflation, and Ang, Bekaert, and Wei (2008) for the inflation risk premium.

[14] I also allow σ to be regime-specific but it doesn't affect the results.

[15] Due to the space considerations, I don't report signs of individual explanatory variables. The signs are generally economically intuitive: e.g., inflation expectations have positive signs.

ble 2 indicates that inflation expectations explain between 25% and 70% of the variation in breakeven inflation rates depending on the country and maturity. This suggests that breakeven inflation rates might not be purely a measure of inflation expectations. Adjusted R^2:s from inflation expectations are the highest in the countries where the data starts after the Great Recession (Australia, Germany, Japan, and Korea). This is consistent with the US and UK evidence that non-inflation expectations components of breakeven inflation rates were particularly important during the Great Recession (Pflueger and Viceira, 2016). Inflation expectations variables are jointly significant in explaining inflation break-even rates at the 1% significance level for all countries and maturities. The statistical significance is evaluated using 10,000 samples of Bauer and Hamilton (2015) bootstrap, which has been designed to adjust for the small sample size.

Table 2 documents that liquidity proxies contribute economically significantly to explaining breakeven inflation rates after controlling for inflation expectations in all countries except Sweden. In Sweden, adjusted R^2:s go down after the inclusion of liquidity proxies.[16] For this reason, I assume that all slope coefficients in equation (2) for Sweden are 0. The lack of the explanatory power by liquidity variables in Sweden is consistent with the evidence in Table 1, where Sweden has the second largest inflation-linked bond market relative to its nominal bond market.

Although the evidence varies strongly by country, on average, the inclusion of liquidity variables improves adjusted R^2:s by around 25% over inflation expectations. Liquidity variables improve adjusted R^2:s at shorter maturities (5 years and below) more than at long maturities (10 years and above) in all countries except Korea. Adjusted R^2 increases from including liquidity proxies are mostly statistically significant at either 1 or 5% significance level. Given that inflation expectations and liquidity proxies in (2) are highly autocorrelated, there is a danger of a unit root in regression residuals. In that case, adjusted R^2:s reported in Table 2 are likely to be artificially large (Granger and Newbold, 1974). To alleviate these concerns, Table 2 indicates that the augmented Dickey-Fuller test always rejects the presence of a unit root in regression residuals.

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[16] This holds true for each individual Swedish liquidity proxy as well.

4.1 Unconditional Properties

4.1.1 World Real Yield and Liquidity Premium

Panel A of Table 3 documents that between January 2001 and June 2016 the world average 5 year inflation-linked yield was 0.92%. The real yield and liquidity premium contributions were 0.45% and 0.47%, respectively.

Appendix F shows that unconditionally the vast majority of the world inflation-linked yield variance is due to the real yield variance. Appendix G shows that the world real yield and liquidity premium are unconditionally negatively correlated. From the inflation-linked bond investor's perspective, they provide a moderate hedge against shocks to each other as the corresponding covariance term decreases the inflation-linked yield variance by around 20%.

4.1.2 Country-specific Real Yields and Liquidity Premia

Panel B of Table 3 documents that unconditional 5 year real yields vary strongly by country. For instance, between September 2005 and June 2016 the average 5 real yield was -0.47% in the UK but 0.56% in Sweden.

Panel B of Table 3 indicates that cross-country differences in unconditional liquidity premia are also large. The magnitude of the US liquidity premium (0.57% for the 5 year bond) is consistent with the prior literature (e.g., Gürkaynak, Sack, and Wright, 2010). Large cross-country differences in real yields and liquidity premia translate into large cross-country differences in inflation-linked bond yields. For instance, between September 2005 and June 2016 the average 5 year inflation-linked yield was only 0.03% in the UK but 0.56% in Sweden. Panel C of Table 3 confirms the results.

Real yields in Panels B and C of Table 3 are historically low. For instance, Barr and Campbell (1997), Evans (1998), Madureira (2007), Ang, Bekaert, and Wei (2008), and Campbell, Shiller, and Viceira (2009) find 5 year real yields of around 2-3% in the US and the UK throughout 1980:s and 1990:s. At the same time, real yields in Panels B and C of Table 3 can not be considered an anomaly. For example, using the term-structure model, Ang, Bekaert, and Wei (2008) document that the US 5 year real yield has been well below 1% (and sometimes as low as -2%) throughout most of the 1950:s. The low real yields are consistent with a number of studies pointing out the low real rates in the US (Christensen and Rudebusch, 2017), UK (Guimaraes, 2012), and other developed countries (Holston, Laubach, and Williams, 2017) during the recent decade.

Theoretically, cross-country differences in real rates suggest for an important role of non-tradable goods as the capital mobility frictions are negligible in my sample (e.g., Mishkin, 1984). A default risk might also be a potential explanation. Although all countries in the sample have high credit ratings, not all of them have the highest credit ratings. However, this seems unlikely. For instance, the only 3 countries with the highest credit ratings throughout my sample are Australia, Germany, and Sweden. Panel C of Table 3 indicates that they have very different average 5 year real yields: 0.42% in Australia, -0.98% in Germany, and -0.33% in Sweden. The cross-country differences in real yields are consistent with the prior literature (e.g., Mishkin, 1984, Barro and Sala-i-Martin, 1990, Gagnon and Unferth, 1995, and Holston, Laubach, and Williams, 2017). However, that literature had been primarily concerned with short model-implied rates.

Appendix F documents that most of the inflation-linked yield variance is usually due to the real yield variance. Appendix F also indicates significant cross-country differences in standard deviations of inflation-linked yields. Appendix G documents that correlations between the liquidity premia and real yields are negative but economically small.

4.2 Time Series Properties

4.2.1 World Real Yield and Liquidity Premium

Figure 2 illustrates that the world real rate in the beginning of the 21^{st} century is around 2.5%. This is average by historical standards cited above. The real rate declines throughout the sample with the steepest drops happening during the Great Recession. After the Great Recession the real rate stays negative with a spike in 2013-14. This coincides with the Federal Reserve talks about ending the quantitative easing program.

Panel A of Table 4 indicates that there is a break point in the world real rate in February 2008. The magnitude of the break is large: the average 5 year world real yield was 1.67% annually before February 2008 and dropped to -0.57% afterwards.

The liquidity premium in Figure 2 has a pronounced peak during the Great Recession. There is also a significantly smaller peak during the Greek debt crisis (2011-2012).

4.2.2 Country-specific Real Yields and Liquidity Premia

Figure 3 illustrates that all countries exhibit declining real yields patterns. Also most of them have a spike in real yields from mid 2013 to mid 2014. This coincides with the Federal Reserve talks about ending the quantitative easing program.

Break-point models results in panel B of Table 4 indicate that real yields are declining in all countries. There is always a breakpoint during the Great Recession in countries where there is data before the Great Recession. The countries where the data starts after the Great Recession also experienced economically strong real yields drops. For instance, the average 5 year real yield was -0.14% before January 2012 and -1.05% after that in Germany.

Theoretically, decreasing real yields have traditionally been attributed to the intertermporal smoothing effect driven by worsening economic growth prospects (e.g., Harvey, 1988). The precautionary savings effect operating through the increased macroeconomic volatility and decreased real growth skewness, has also been shown to generate large declines in real rates (e.g., Bekaert and Engstrom, 2016). In traditional New Keynesian models (e.g., Clarida, Gali, and Gertler, 1999) the monetary policy shouldn't significantly affect long-term real rates. However, Hanson and Stein (2015) show that with clientele effects, decreasing the short nominal rate (a policy implemented by many central banks during and after the Great Recession) can result in a significant decrease in long real rates. Finally, a part of the real rate decline can be attributed to the decline in the liquidity premium (the common liquidity premium for nominal and inflation-linked bonds, not the liquidity premium of inflation-linked bonds over nominal bonds) associated with the quantitative easing program. D'Amico and King (2013) and Christensen and Gillan (2016) estimate that the magnitude of this decline was around 20 basis points in the US.

Figure 3 illustrates that there was a spike in the liquidity premium in most countries during the Great Recession. The notable exception is the UK long-term (15 year) inflation-linked bond liquidity premium. This is consistent with the evidence for the UK 20 year inflation-linked bond by Pflueger and Viceira (2016). Interestingly, the shorter maturity UK inflation-linked bonds had strong liquidity premium spikes during the Great Recession.

The liquidity premium has fallen in most countries after the Great Recession. An exception is Canada, where the liquidity premium has stayed at essentially the Great Recession levels. France also exhibited a spike in the liquidity premium during the Greek debt crisis. The magnitude is the same as during the Great Recession. Interestingly, Germany doesn't have such a spike. The liquidity premium time-variation outside the Great Recession usually makes economic sense. For instance, the Japanese liquidity premium is the lowest in early 2014, coinciding with the Bank of Japan reviving the inflation-linked bond program.

5 Nominal Yields

I decompose nominal yields into real yields, expected inflation, and the inflation risk premium. To perform the decomposition, I use real yields from the previous section and survey inflation expectations described in Appendix D. The inflation risk premium, which is economically determined by the covariance between the real stochastic discount factor and inflation, is computed by subtracting the real yield and expected inflation from the nominal yield. The analysis is conducted at quarterly frequency, because inflation expectations are mostly available quarterly.

5.1 Unconditional Properties

5.1.1 World Nominal Yield Components

Panel A of Table 5 indicates that between 2001Q1 and 2016Q2 the world average 5 year nominal yield was 2.91%. The real yield, expected inflation, and the inflation risk premium contributed 0.47%, 2.33%, and 0.11%, respectively.[17]

Appendix H documents that over 80% of the world 5 year nominal yield variance is coming from the real yield variance. The rest is split equally between expected inflation and the inflation risk premium. Appendix I indicates that the world 5 year real yield and expected inflation are strongly positively correlated (correlation coefficient of 0.84) and their comovement accounts for around 20% to the world 5 year nominal yield variance. Thus, from the nominal bond investor's perspective, expected inflation and real rates exacerbate shocks to each other. This is the opposite of Mundell (1963) and Tobin (1965) effect. However, it is consistent with the activist Taylor (1993) rule where the monetary authority raises real

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[17] Note that real yields in Table 5 are slightly different from real yields in Table 3. This is because they are computed from quarterly instead of monthly data.

rates in response to the increasing expected inflation (Clarida, Gali, and Gertler, 2000).

5.1.2 Country-specific Nominal Yield Components

Panel B of Table 5 documents strong cross-country differences in levels of expected inflation and the inflation risk premium between 2005Q3 and 20016Q2. For example, the average 5 year expected inflation was 1.93% in France and 2.80% in the UK. The average 5 year inflation risk premium was -0.13% in Sweden and 0.25% in the UK. Panel C of Table 5 shows even stronger cross-country differences in levels of expected inflation and the inflation risk premium between 2011Q2 and 2016Q2. For example, the average 5 year expected inflation was 1.39% in Japan and 2.79% in Australia. The average 5 year inflation risk premium was -0.49% in Germany and 0.66% in Japan.

Inflation expectations in Table 5 are low by historical standards. Mumtaz and Surico (2012) find the average inflation of 4-6% in developed countries throughout the second half of the 20^{th} century.

The international inflation risk premium evidence is limited. However, it suggests that values in Table 5 are historically low. Risa (2001) estimates the average UK 5 year inflation risk premium of 2.50% annually between 1983 and 1999. Ang, Bekaert, and Wei (2008) estimate the US 5 year inflation risk premium of around 1% annually between 1952 and 2004.

Appendix H indicates that real yield variances are the main contributor to nominal yield variances in most countries. The inflation risk premium variance was important in many countries (for instance, in France and Sweden). The expected inflation variance contribution was negligible. The dominant role of the real yield variance is in stark contrast with the prior evidence that most of the nominal yield variance is due to the inflation compensation (e.g., Risa, 2001, in the UK or Ang, Bekaert, and Wei, 2008, in the US). However, it is consistent with the recent low inflation variance in developed countries (e.g, Mumtaz and Surico, 2012, or Grishchenko, Mouabbi, and Renne, 2016).

Appendix I shows that real yields and expected inflation are positively correlated in most countries. Again this is the opposite of Tobin-Mundell effect. However, the contribution of the corresponding covariance term to the nominal yield variance is usually small. From the nominal bond investor's perspective, this implies that real rates and expected inflation do not provide a hedge against shocks to each other but also do not significantly exacerbate each others risks. The positive correlation is consistent with the US evidence for the long-term model-implied real yields (Ang, Bekaert, and Wei, 2008).

5.2 Time Series Properties

5.2.1 World Nominal Yield Components

Figure 4 illustrates that the world 5 year expected inflation and inflation risk premium have declined during and after the Great Recession. However, the magnitudes of their declines were small compared to the magnitude of the real rate decline. Panel A of Table 6 indicates that the world 5 year expected inflation dropped in two steps: from 2.54% average between 2001Q1 and 2005Q1 to 2.36% average between 2005Q2 and 2009Q2, and to 2.18% average between 2009Q3 and 2016Q2. Panel A of Table 7 documents that the inflation risk premium also had 2 breakpoints. It was 0.07% between 2001Q1 and 2003Q4, 0.36% between 2004Q1 and 2009Q1, and -0.05% between 2009Q2 and 2016Q2.

5.2.2 Country-specific Nominal Yield Components

Figure 5 illustrates that real yields have declined the most compared to expected inflation and the inflation risk premium in all countries. Expected inflation increased a little in Japan, Korea, and the UK, stayed approximately constant in France, and decreased somewhat in Canada, Germany, Sweden, and the US. The inflation risk premium has decreased in all countries except the UK and Japan.

Break-point model results in Panel B of Table 6 indicate that expected inflation has statistically significantly declined in 5 out of 9 countries. For instance, the US average 5 year expected inflation dropped from 2.43% annually between 2004Q3 and 2008Q2 to 2.28% during the rest of the sample. The magnitude of the decline is consistent with Grishchenko, Mouabbi, and Renne (2016). Interestingly, the UK expected inflation actually increased shortly after the Great Recession.

Panel B of Table 7 documents that the inflation risk premium has statistically significantly declined in 6 out of 9 countries. For instance, the US average inflation risk premium was 0.40% between 2004Q2 and 2008Q4 and dropped to -0.10% after that. The magnitude and timing of this drop are in line with Chen, Engstrom, and Grishchenko (2016). The decline in the US inflation risk premium during the 21^{st} century is consistent with the predictions of several macro-finance models, which attribute it to the increasing correlation between the real growth and expected inflation (Hasseltoft and Burkhardt, 2012; David and Veronesi, 2013; Ermolov, 2015; Song, 2017). The inflation risk premium declines were larger than expected inflation declines in most countries.

The decompositions in this section rely heavily on survey inflation expectations. However, Bauer, Rudebusch, and Wu (2014) and Wright (2014) have criticized survey inflation expectations for being too stagnant. Thus, I also repeat the analysis using inflation expectations from a statistical model. I obtain inflation indices in Table 1 from Bloomberg. I use ARMA(1,1) model. It has been shown to fit the inflation data in developed countries well (e.g., Mumtaz and Surico, 2012). I use the bootstrap procedure of Kilian (1998) to correct for the finite sample persistence bias,. Nominal yield decompositions are qualitatively similar to the reported results, so they are omitted for the space considerations.

There are two main differences between the statistical and survey inflation expectations results. First, the statistical expected inflation tends to be unconditionally higher than survey expectations due to the mean reversion to historical averages. The implication is that expected inflation is higher and the inflation risk premium lower in nominal yield decompositions. Second, during the Great Recession most of the countries exhibit 1-2 quarters of extraordinarily low inflation (and even deflation). Survey forecasts barely react to this (see, e.g., Figures 4 and 5), but statistical expectations drop strongly for a couple of quarters (see, e.g., Figure 1 in Christensen, Lopez, and Rudebusch, 2016, for the US evidence). This creates a temporary drop in expected inflation and a spike in the inflation risk premium. Given the short duration of the episode, the unconditional nominal yield decompositions are barely affected.

6 Yield Curve Slopes

In this section, I study the relationship between yields of different maturities.

6.1 Unconditional Properties

6.1.1 World Yield Curve Slopes

Panel A of Table 8 documents that the world average 10 year - 5 year inflation-linked yield curve slope is positive between January 2001 and June 2016. It is economically and statistically significant at 0.39% annually. The unconditional real yield curve is even more upward-sloping than the inflation-linked yield curve. This is because of the slight negative slope of the liquidity premium: the inflation-linked yield curve slope consists of the 0.50% real yield curve slope and -0.11% liquidity premium slope.

Panel A of Table 9 indicates that the world average 10 year - 5 year nominal yield curve slope is positive at 0.65% annually between January 2001 and June 2016. The vast majority of it (0.51%) is coming from the real yield curve slope. The inflation risk premium and expected inflation slopes contributes 0.10% and 0.04%, respectively.

Appendix J documents that over 90% of the world inflation-linked slope variance is due to the real yield curve slope variance. Appendix K indicates that around 70% of the nominal yield curve variance is coming from the real yield curve slope variance. The rest is mainly from the inflation risk premium slope variance.

6.1.2 Country-specific Yield Curve Slopes

Panel B of Table 8 documents that between September 2005 and June 2016 average 10 year - 5 year inflation-linked yield curves are upward-sloping in all countries. For instance, the French average inflation-linked yield curve slope is 0.51% annually. Average 10 year - 5 year real yield curves are even more upward-sloping. For example, the UK average real yield curve slope is 0.79% annually. The results are statistically and economically significant. Unconditional liquidity premium yield curves are downward-sloping in France and the UK, at -0.28% and -0.34% annually, respectively. Note the large cross-country differences in average real, liquidity premium, and inflation-linked yield curve slopes. For example, the average 10 year - 5 year inflation-linked yield curve slope is 0.29% in Sweden but 0.60% in the US.

Panel B of Table 8 documents that average 15 year - 10 year inflation-linked yield curve slopes are positive in all countries except the UK. However, inflation-linked yield curves are becoming flatter with the maturity. For instance, the French average 15 year - 10 year inflation-linked yield curve slope is 0.23% compared to 0.51% average 10 year - 5 year slope. Average 15 year - 10 year liquidity premium yield curve slopes are usually positive, albeit economically and statistically insignificant. Overall, results suggest that unconditional real yield curves are upward-sloping at medium maturities and become flatter at long maturities. Unconditional liquidity premium yield curves are moderately downward-sloping at medium maturities and become flat or slightly upward-sloping at long maturities.

Panel C of Table 8 confirms the findings in the shorter sample covering more countries. The only country where the average 10 year - 5 year real yield curve is not statistically and economically significantly upward-sloping is Germany (the slope of 0.08%). However, Appendix L shows that the average German 5 year - 2 year real yield curve is statistically and economically significantly upward-sloping. Germany is also the only country where the average 10 year - 5 year liquidity premium yield curve slope is statistically and economically significantly positive. However, Appendix L documents that the average German 5 year - 2 year liquidity premium slope is strongly negative. This is in line with concave liquidity premium yield curves observed in other countries.

Panel B of Table 9 shows that between 2005Q3 and 2016Q2 average 10 year - 5 year nominal yield curve slopes are positive and come largely from positive average real yield curve slopes in all countries. For instance, the UK average nominal yield curve slope is 0.70% consisting of 0.69% real yield curve slope, -0.03% expected inflation slope, and 0.05% inflation risk premium slope.

There is a large heterogeneity in average inflation risk premium and nominal yield curve slopes between countries. For instance, the average 10 year - 5 year inflation risk premium slope is -0.02% in France but 0.22% in the US. The average 10 year - 5 year nominal yield curve slope is 0.44% in Sweden but 0.94% in the US.

Panel B of Table 9 indicates that the contribution of the inflation risk premium to the nominal yield curve slope becomes more important at longer maturities (10-15 years). For example, between 2005Q3 and 20016Q2 the French average 15 year - 10 year nominal yield curve slope is 0.37% with 0.18% coming from the real yield curve slope and 0.19% from the inflation risk premium slope. Panel C of Table 9 confirms the findings.

Appendix L documents that average 5 year - 2 year nominal yield curves are upward-sloping in Germany, Korea, Japan, and the US. Positive slopes are mainly coming from upward-sloping real yield curves. Short maturity real yields are not available for long enough period in other countries.

Theoretically, the results are most consistent with the habit model of Wachter (2006), where the intertemporal smoothing effect is dominant. It generates positive real yield curve slopes which account for most of the positive nominal yield curve slopes. This is in line with Table 9. The long-run risk model of Hasseltoft (2012) implies on average a downward-sloping real term-structure. The positive nominal yield curve slope is coming from the inflation risk premium. The habit model of Verdelhan (2010), where the precautionary savings effect is dominant, has the same predictions. These implications are not in line with my results. The rare disasters model (Gabaix, 2012) implies on average a flat real term structure. The positive nominal yield curve slope is coming from the inflation risk premium. These predictions are only consistent with some of the long maturity slope decompositions.

Appendix J indicates that most of the inflation-linked yield curve slope variance is due to the real yield curve slope variance. The contribution of the liquidity premium slope variance increases at longer maturities. Appendix K documents that the real yield curve slope variance is also usually the most important component of the nominal yield curve slope variance. It generally accounts for around 75% of the unconditional variance. The inflation risk premium slope variance contributes around 20% in most countries.

6.2 Time Series Properties

6.2.1 World Yield Curve Slopes

Figure 6 illustrates that world real and nominal 10 year - 5 year yield curve slopes are unconditionally highly correlated. However, conditional correlations can be low. For instance, negative correlations are observed during and shortly after the Great Recession. This has implications for no-arbitrage term-structure models, because the yield curve slope is one of the main yield curve factors. In particular, the assumption that real and nominal yield curve slopes are perfectly correlated (e.g., Christensen, Lopez and Rudebusch, 2012, or Andreasen et.al., 2016) holds well unconditionally but conditionally might be problematic.

Figure 6 shows that the world nominal yield curve slope increased during the Great Recession. It had stayed high for several years. Most, but not all, of this increase is due to the real yield curve slope increase. Figure 7 illustrates that the inflation risk premium and expected inflation yield curve slopes also increased. The inflation risk premium slope increase is stronger. Panel A of Table 10 documents that the average real yield curve slope increased by 0.51% after 2008Q1. Panel A of Table 11 indicates that the average inflation risk premium yield curve slope increased by 0.38% after 2008Q4. In unreported results, I find that the world expected inflation yield curve slope also increased in the midst of the Great Recession. The increase is statistically significant but its magnitude is economically negligible.

6.2.2 Country-specific Yield Curve Slopes

Figure 8 shows that unconditionally real and nominal yield curve slopes are highly correlated in most countries. The exception is Japan, where the nominal yield curve slope is stagnant around 0 but the real yield curve slope fluctuates. At the same time, conditional correlations between real and nominal yield curve slopes can sometimes be low. For example, during the Great Recession real and nominal yield curve slopes moved in the opposite directions in Canada, Sweden, and the US. The US evidence is consistent with Ang, Bekaert, and Wei (2008), who using a term structure model identify several regimes where the nominal and real term-structure slopes diverge. Also Abrahams et.al. (2016) find that principal components of inflation-linked yields can be different from nominal yields.

Figure 8 illustrates that nominal yield curve slopes increase in most countries following the Great Recession. The increase is mainly coming from real yield curve slopes. The inflation risk premium slopes have also increased in most countries. The magnitude of expected inflation yield curve fluctuations is negligible in all countries except Japan. The small and static slope of the US and the EU expected inflation yield curves is consistent with Chernov and Mueller (2012) and Grishchenko, Mouabbi, and Renne (2016).

Results from break-point models in Panel B of Table 10 indicate that there were an economically small but statistically significant drop in 10 year - 5 year real yield curve slopes before the Great Recession and a strong increase after it. For example, the Swedish average 10 year - 5 year real yield curve slope dropped from 0.17% annually to 0.09% annually in 2006Q3 and then increased to 0.41% annually in 2009Q3. The countries where the data starts after the Great Recession don't exhibit the breaks in real yield curve slopes. The exception is Germany where the average real yield curve slope decreased from 0.33% annually to -0.21% annually in 2014Q3.

Panel B of Table 11 documents that there is an increase in 10 year - 5 year inflation risk premium slopes in most countries where the data starts before the Great Recession. The magnitude of the increase is smaller than the magnitude of the real yield curve slope increase in most countries. However, the magnitudes of the increases are comparable in some countries (e.g., in the US). The countries where the data becomes available only after the Great Recession don't exhibit statistically significant breaks in the inflation risk premium slope. The exception is Germany where the average 10 year - 5 year inflation risk premium slope increased from 0.58% annually to 0.81% annually in 2012Q3.

In unreported results, I find that expected inflation yield curve slopes statistically significantly increased during and shortly after the Great Recession in most countries. However, the magnitude of the increase is economically small. For example, the US average 10 year - 5 year expected inflation yield curve slope increased from 0.02% annually to 0.07% annually in 2011Q1.

7 International Yield Comovement

I study the cross-country comovement of different yields. Panel A of Table 12 documents that 5 year real yields were strongly correlated across countries. The continental European countries (France and Sweden) were more correlated with each other (the correlation of 0.94) while the UK is more correlated with the US (the correlation of 0.93). The results for longer maturities are not reported as they are similar.

Panel B of Table 12 indicates that cross-country correlations between 5 year real yields after the Great Recession were generally high, but not as high as in the full sample. For instance, the correlation between the French and Swedish 5 year real yields was 0.94 between September 2005 and June 2016 but only 0.75 between June 2011 and June 2016. Japan had particularly low real yield correlations with other countries: for example, the correlation between the US and Japanese 5 year real yield was -0.21. Panel C of Table 12 shows that cross-country 10 year real yield correlations were generally higher than 5 year real yield correlations between June 2011 and June 2016.

Theoretically, the strong cross-country real yield correlations support models where the cross-country asset prices comovement is driven by real factors (e.g, through risk-sharing as in Colacito and Croce, 2013, Heyerdahl-Larsen, 2014, or Stathopoulos, 2017, or learning as in Ho, 2014, or Benzoni et.al., 2015). The decrease in real yield correlations from Panel A to Panel B in Table 12 is consistent with the predictions of these models, because, due to the concave utility function, they generate a stronger comovement during negative macroeconomic shocks (for instance, during the Great Recession).

Panel A of Table 13 indicates that 5 year liquidity premia were moderately correlated between countries. For instance, the correlation between the French and US liquidity premium was 0.52. Panel B of Table 13 shows that post-Great Recession cross-country liquidity premium correlations were lower than in the whole sample but still positive. The correlations for longer maturities are not reported as they are similar. The exception is the UK long term liquidity premium, which had weaker correlations with other countries liquidity premia.

Theoretically, moderate cross-country liquidity premium correlations support the models where cross-country asset prices comovement is driven by liquidity factors (e.g., convergence traders operating in several markets, as in Kyle and Xiong, 2011, or institutional investors trading in inflation-linked bonds, as in Basak and Pavlova, 2013). The decrease in liquidity premium correlations from Panel A to Panel B of Table 13 is consistent with the predictions of these models because, due to the binding margin constraints, they primarily generate the comovement when investors suffer losses in at least one of the markets.

Appendix M shows that the inflation risk premium and expected inflation are moderately positively correlated across countries. Unreported covariance decompositions indicate that most of the cross-country nominal yield comovement (e.g., Sutton, 2000, or Jotikasthira, Le, and Lundblad, 2015) is driven by the real yield comovement. This is the outcome of strong cross-country real yield correlations and real yields contributing the most to nominal yield variances (Appendix H).

8 Conclusion

I study inflation-linked yield curves for 9 developed countries. The liquidity premium, which has been ignored in inflation-linked bond studies outside the US, is an important component of the inflation-linked yields. Unconditional real yield curves are upward-sloping and become flatter at longer maturities. Most of the positive nominal yield curve slope is due to the positive real yield curve slope. The direct issuance costs of nominal debt are lower than of inflation-linked debt. Low nominal yields following the Great Recession are mainly due to low real yields.

My sample is relatively short. Thus, results should be taken with a caution. For instance, Ang, Bekaert, and Wei (2008) find that the US term structure exhibited 4 regimes between 1952 and 2004. Consequently, my analysis is most likely based only on some of the regimes. However, my results will still allow to verify conditional predictions of theoretical models for the analyzed period. Furthermore, real yields data allows to identify the real stochastic discount factor even if it is only available for a short period of time (e.g., Ang and Ulrich, 2012). The real stochastic discount factor can then be used to estimate real yields before inflation-linked bonds have became available.

The dataset of inflation-linked zero-coupon yields provides a ground for future research in finance and macroeconomics. In finance, it allows to study topics such as asset allocation or macroeconomic determinants of real yields and the inflation risk premium. In macroeconomics, real yields data can, for instance, help to calibrate dynamic stochastic general equilibrium models.

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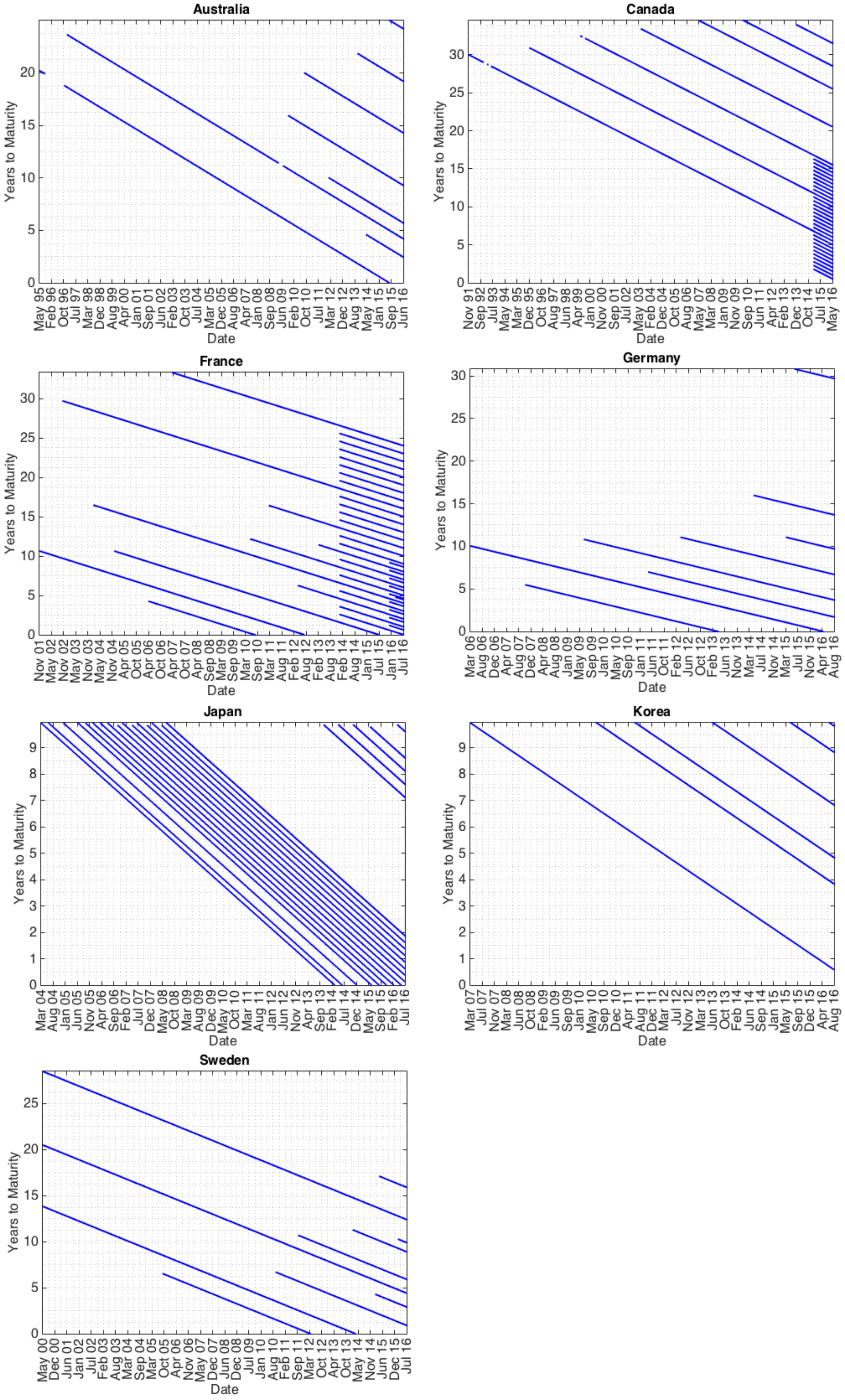

Figure 1 – Inflation-linked Bonds by Country. Each line corresponds to a bond with an available price at the end of the corresponding month on the horizontal axis.

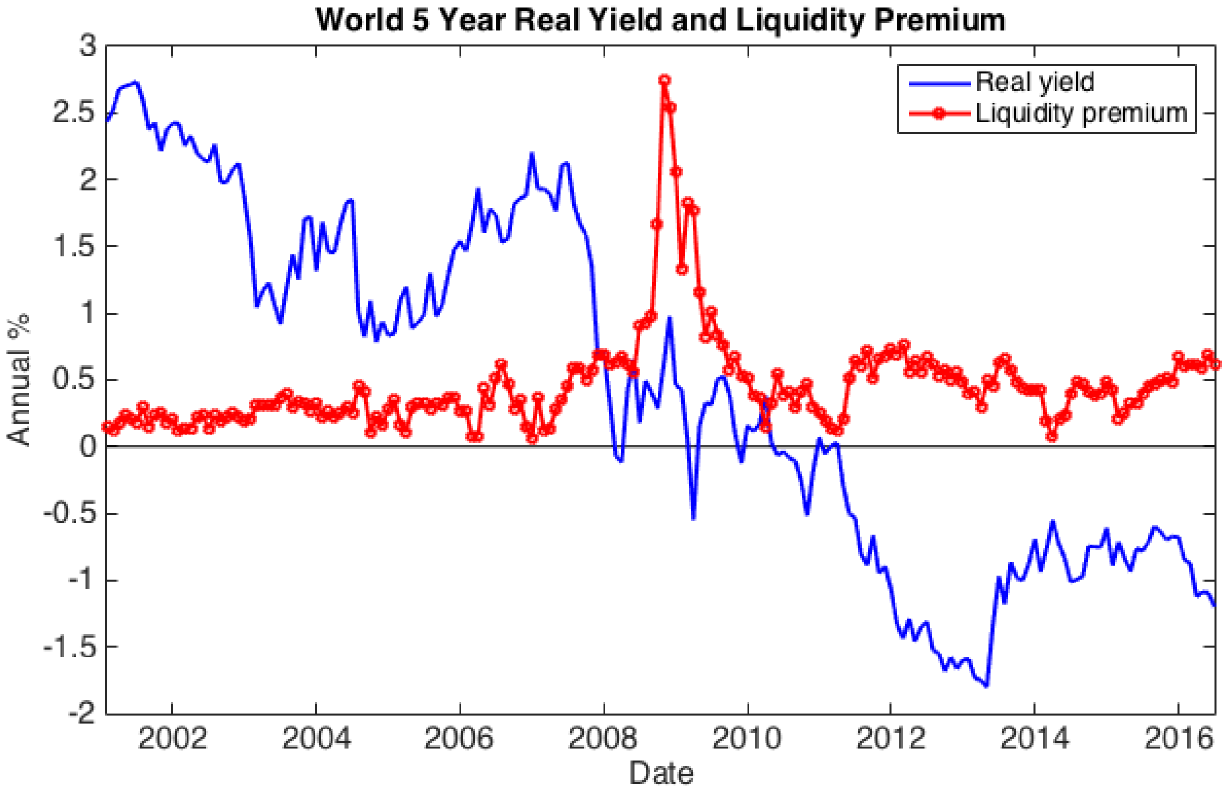

Figure 2 – World Inflation-Linked Yield Components. For each time point the world real rate is computed as the GDP-weighted average of available countries' real rates with GDP weights updated annually. The yields are annual zero-coupon yields. The graph is monthly.

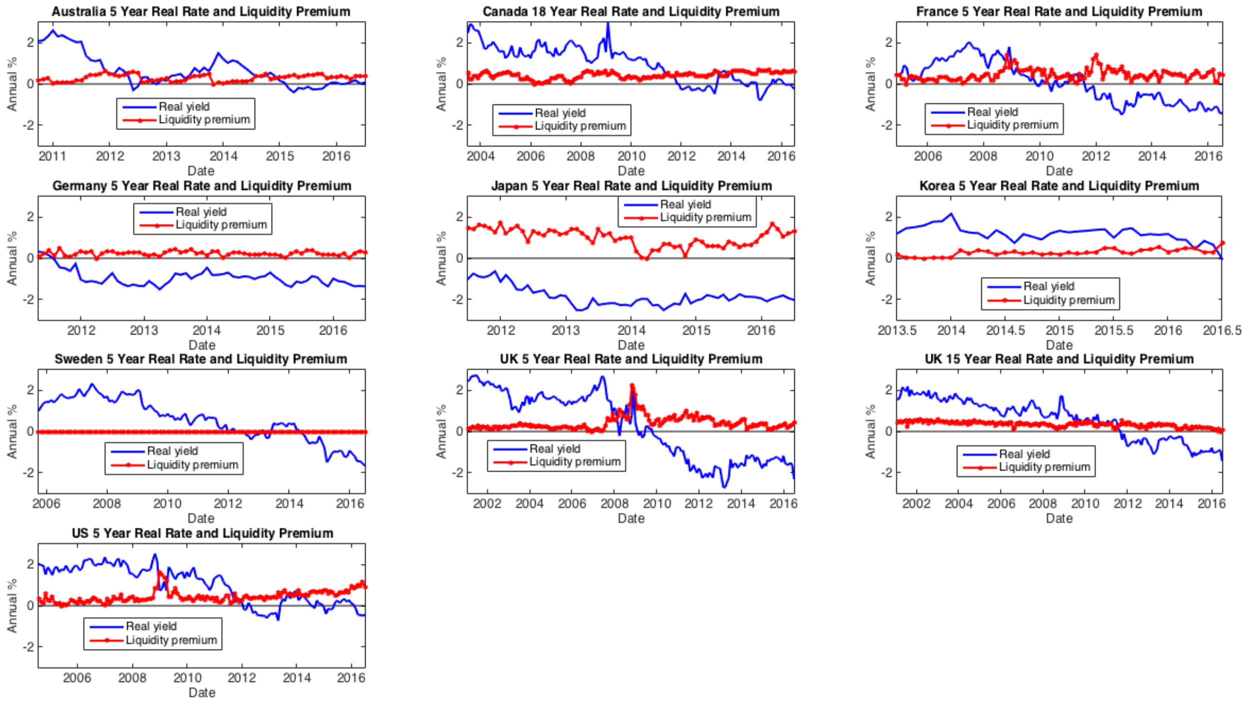

Figure 3 – Country-specific Inflation-linked Yield Components. The yields are annual zero-coupon yields. The graph is monthly.

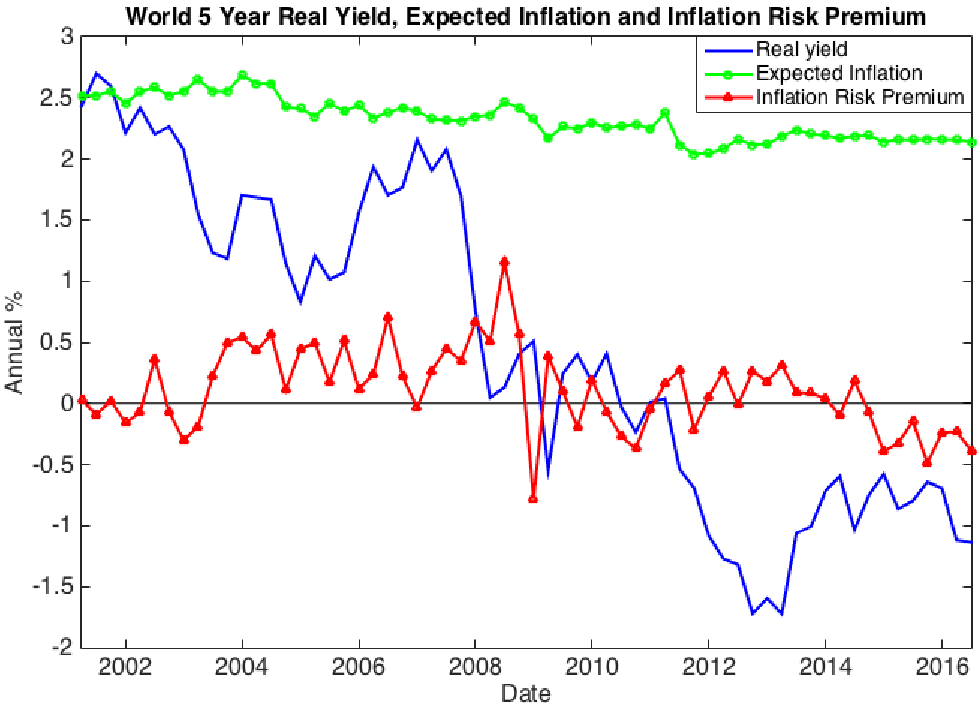

Figure 4 – World Nominal Yield Components. For each time point the world real rate, expected inflation, and inflation risk premium are computed as the GDP-weighted average of available countries' real rates, expected inflations, and inflation risk premia with GDP weights updated annually. The yields are annual zero-coupon yields. The graph is quarterly.

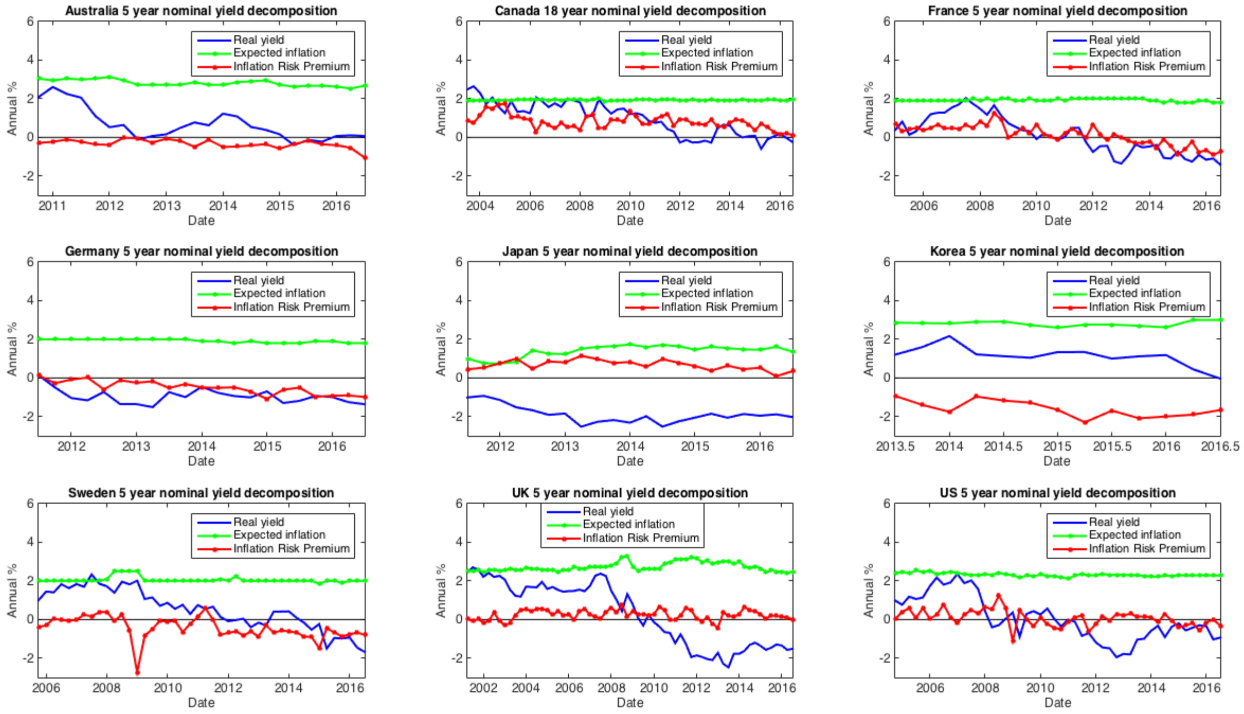

Figure 5 – Country-specific Nominal Yield Components. The yields are annual zero-coupon yields. The graph is quarterly.

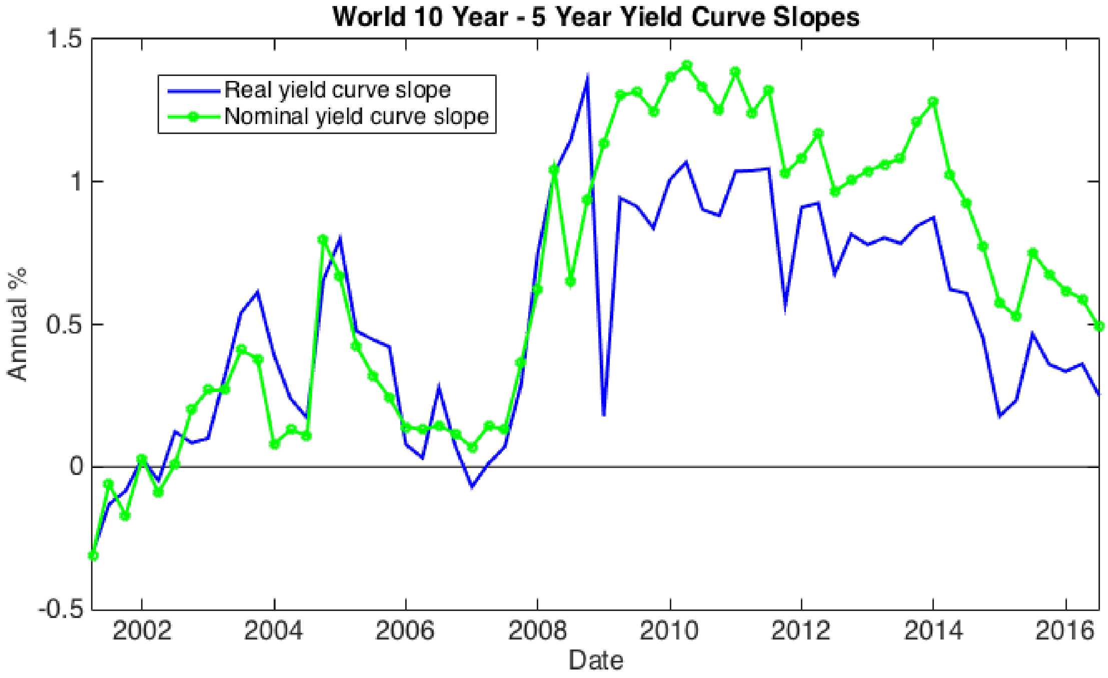

Figure 6 – World Real and Nominal Yield Curve Slopes. For each time point the world real and nominal yield curve slopes are computed as the GDP-weighted average of available countries' real and nominal yield curve slopes with GDP weights updated annually. The yields are annual zero-coupon yields. The graph is quarterly.

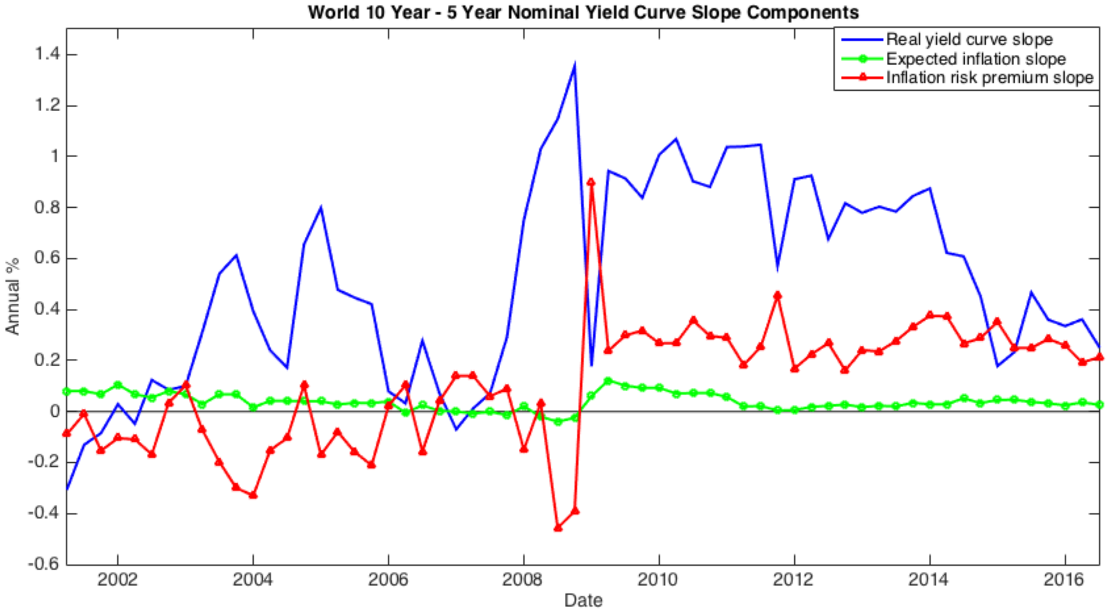

Figure 7 – World Nominal Yield Curve Slope Components. For each time point the world nominal yield curve slope components are computed as the GDP-weighted average of available countries' nominal yield curve slope components with GDP weights updated annually. The yields are annual zero-coupon yields. The graph is quarterly.

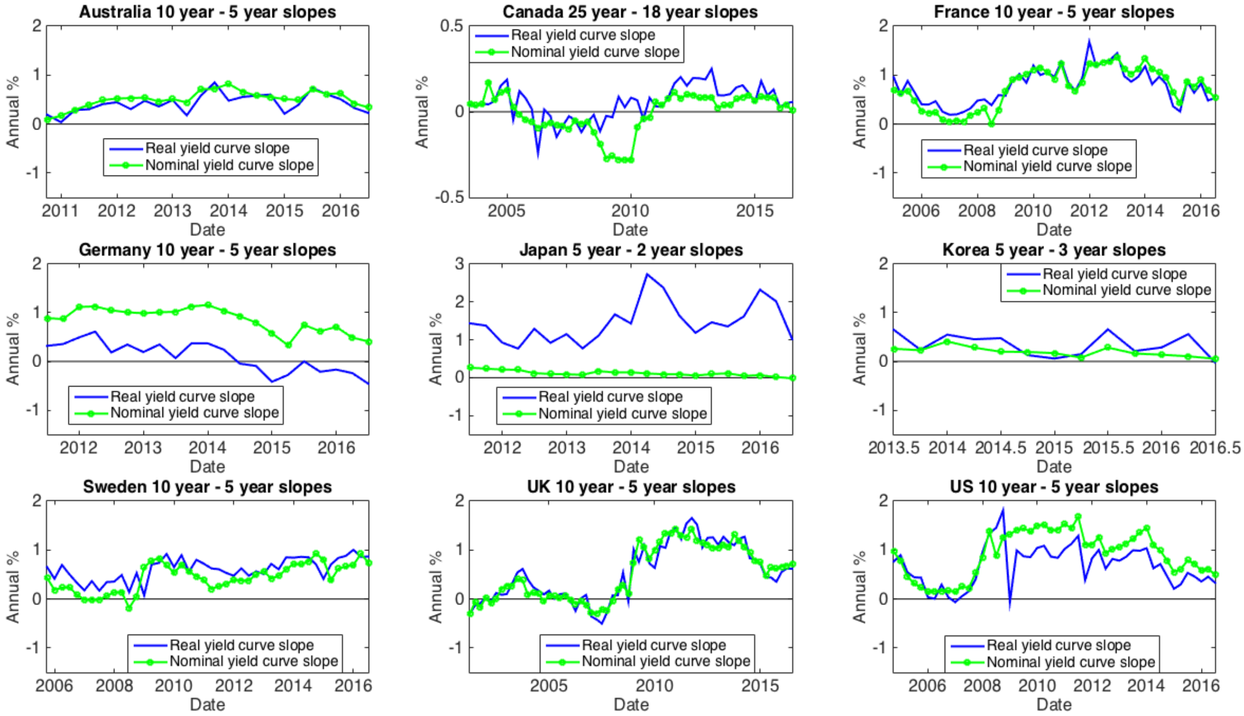

Figure 8 – Country-specific Real and Nominal Yield Curve Slopes. The yields are annual zero-coupon yields. The graph is quarterly.

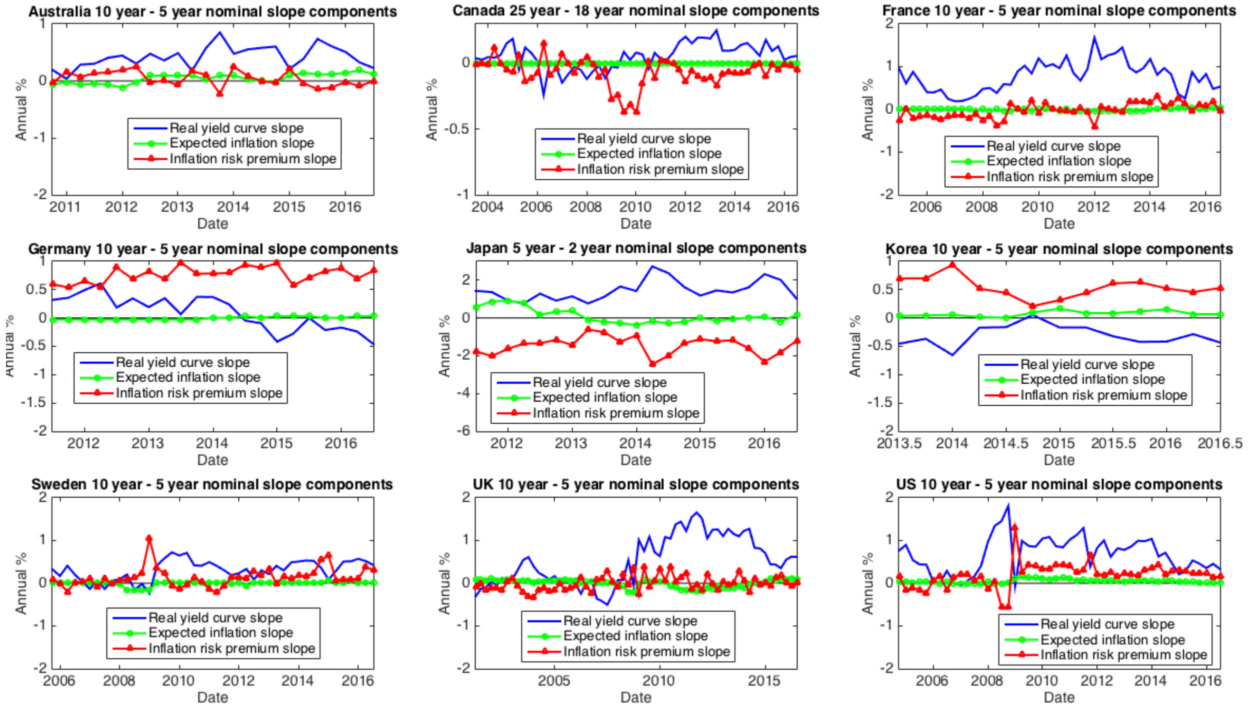

Figure 9 – Country-specific Nominal Yield Curve Slope Components. The yields are annual zero-coupon yields. The graph is quarterly.

Table 1 – International Sovereign Inflation-linked Bond Markets. The market sizes are either from the Bank of International Settlements or country-specific Debt Management agencies (e.g., Treasury in France or Ministry of Finance in Japan). The currencies are converted to USD using end of the day December 31, 2015 exchange rate. Ratio of inflation-linked debt to medium and long-term nominal debt is computed by dividing the inflation-linked bond markets size by the medium- and long-term nominal bond market sizes.

Country	Inception Year	Size of the market in 2015 (USD billions)	Ratio of inflation-linked debt to medium and long-term nominal debt in 2015	Inflation index	Sample	Maturities available for the whole sample
Australia	1985	21	8%	Consumer Price Index	Sep 2010 - June 2016	5-15 years
Canada	1991	30	9%	Not Seasonally Adjusted Consumer Price Index	June 2003 - June 2016	18-30 years
France	1998	175	15%	Eurozone Harmonised Index of Consumer Prices, excluding tobacco	Nov 2004 - June 2016	5-15 years
Germany	2006	83	7%	Eurozone Harmonised Index of Consumer Prices, excluding tobacco	April 2011-June 2016	2-10 years
Japan	2004	72	9%	Consumer Price Index	June 2011 - June 2016	2-5 years
Korea	2007	7	2%	Consumer Price Index	June 2013 - June 2016	3-10 years
Sweden	1994	22	31%	Consumer Price Index	Sep 2005 - June 2016	5-15 years
UK	1981	262	36%	Retail Price Index	Jan 2001- June 2016	5-15 years
US	1997	1168	11%	Not Seasonally Adjusted Consumer Price Index for Urban Customers	July 2004 - June 2016	5-15 years

Table 2 – Explaining Breakeven Inflation Rates with Inflation Expectations and Liquidity Proxies. The reported values are adjusted R^2:s from the end-of-month OLS regressions of the breakeven inflation rates on survey inflation expectations and liquidity proxies. *, **, and *** correspond to statistical significance at the 10%, 5%, and 1% significance level, respectively. The significance on the "Inflation expectations + liquidity proxies"-row is the joint significance of liquidity proxies over inflation expectations computed following Bauer and Hamilton (2015) bootstrap with 10,000 runs. ADF-test is the augmented Dickey-Fuller test statistic for the OLS regression residuals.

Australia: September 2010 - June 2016				
		5 year	10 year	15 year
Inflation expectations		39.17%	48.60%	55.09%
Inflation expectations + liquidity proxies		68.45%***	62.70%***	70.01%***
ADF-test		-4.74***	-4.12***	-4.11***
Canada: June 2003 - June 2016				
		18 year	25 year	30 year
Inflation expectations		26.63%	33.45%	32.47%
Inflation expectations + liquidity proxies		47.95%***	48.69%***	48.69%***
ADF-test		-4.69***	-4.79***	-5.10***
France: November 2004 - June 2016				
		5 year	10 year	15 year
Inflation expectations		43.28%	45.23%	42.22%
Inflation expectations + liquidity proxies		76.16%***	61.69%***	60.58%***
ADF-test		-4.28***	-3.21***	-3.33***
Germany: April 2011-June 2016				
	2 year	5 year	10 year	
Inflation expectations	54.90%	64.52%	68.09%	
Inflation expectations + liquidity proxies	80.33%***	69.53%	84.62%***	
ADF-test	-3.38***	-4.09***	-3.54***	
Japan: June 2011 - June 2016				
	2 year	5 year		
Inflation expectations	59.70%	58.31%		
Inflation expectations + liquidity proxies	89.37%***	84.60%***		
ADF-test	-3.52***	-3.35***		
Korea: June 2013 - June 2016				
	3 year	5 year	10 year	
Inflation expectations	55.53%	67.74%	63.69%	
Inflation expectations + liquidity proxies	64.46%*	73.40%*	79.20%**	
ADF-test	-5.26***	-4.53***	-4.90***	
Sweden: September 2005 - June 2016				
		5 year	10 year	15 year
Inflation expectations		28.49%	32.88%	31.51%
Inflation expectations + liquidity proxies		26.64%	32.80%	30.89%
ADF-test		-4.14***	-4.38***	-4.39***
UK: January 2001 - June 2016				
		5 year	10 year	15 year
Inflation expectations		16.98%	26.15%	31.39%
Inflation expectations + liquidity proxies		50.43%***	32.96%***	41.37%***
ADF-test		-6.64***	-5.07***	-4.61***
US: July 2004 - June 2016				
	2 year	5 year	10 year	15 year
Inflation expectations	39.92%	37.60%	25.76%	29.90%
Inflation expectations + liquidity proxies	84.24%***	81.55%***	71.57%***	61.55%***
ADF-test	-6.63***	-6.67***	-6.55***	-6.03***

Table 3 – 5 Year Inflation-linked Yield Level Decomposition. The data is monthly. The yields are annual zero-coupon yields. The values are average over the sample. For each time point the world real yield, liquidity premium, and inflation-linked yield are computed as the GDP-weighted average of available countries' real rates, liquidity premia, and inflation-linked yields with GDP weights updated annually. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Panel A: World Inflation-linked Bond Yield January 2001 - June 2016

	Real yield	Liquidity premium	Inflation-linked yield
	0.45%	0.47%	0.92%
	(0.09%)	(0.02%)	(0.09%)

Panel B: Long Country-specific Sample - September 2005 - June 2016

	Real yield	Liquidity premium	Inflation-linked yield
France	0.05%	0.46%	0.51%
	(0.09%)	(0.05%)	(0.10%)
Sweden	0.56%	0.00%	0.56%
	(0.09%)		(0.09%)
United Kingdom	-0.47%	0.50%	0.03%
	(0.13%)	(0.03%)	(0.13%)
United States	-0.10%	0.57%	0.46%
	(0.10%)	(0.04%)	(0.11%)

Panel C: Short Country-specific Sample - June 2011 - June 2016

	Real yield	Liquidity premium	Inflation-linked yield
Australia	0.42%	0.31%	0.74%
	(0.07%)	(0.02%)	(0.07%)
France	-0.85%	0.50%	-0.36%
	(0.05%)	(0.03%)	(0.06%)
Germany	-0.98%	0.24%	-0.74%
	(0.04%)	(0.01%)	(0.05%)
Japan	-1.84%	1.00%	-0.84%
	(0.06%)	(0.05%)	(0.09%)
Sweden	-0.33%	0.00%	-0.33%
	(0.08%)		(0.08%)
UK	-1.70%	0.40%	-1.30%
	(0.05%)	(0.04%)	(0.05%)
US	-1.01%	0.44%	-0.56%
	(0.07%)	(0.03%)	(0.07%)

Table 4 – Break Points in the Level of Real Yields. Real yields are 5 year yields unless mentioned otherwise. Break point models are estimated separately for each country using maximum likelihood estimation. The start of the sample for each country is in parentheses next to it. The end of the sample is June 2016 for all countries. Mean 1 is the average real yield between the start of the sample and Break point date 1. Mean 2 is the average real yield between the Break point date 1 and Break point date 2. Mean 3 is the average real yield between Break point date 2 and the end of the sample. If there is no Break point date 1 for the country, Mean 1 is the average real yield for the whole sample. If there is no Break point date 2 for the country, Mean 2 is the average real yield between Break point date 1 and the end of the sample. The number and timing of break points for each country is chosen by minimizing Bayesian Information Criterion. The data is monthly. The yields are annual zero-coupon yields. For each time point the world real rate is computed as the GDP-weighted average of available countries' real rates with GDP weights updated annually. Standard errors in parentheses are maximum likelihood standard errors computed as the square roots of the diagonal elements of the inverse information matrix.

Panel A: World Real Rate January 2001 - June 2016

	Break point date 1	Break point date 2	Mean 1	Mean 2	Mean 3
	Feb 2008		1.67%	-0.57%	
			(0.07%)	(0.06%)	

Panel B: Country-specific Real Rates

	Break point date 1	Break point date 2	Mean 1	Mean 2	Mean 3
Australia (September 2010-)	Aug 2011	Jan 2012	2.00%	0.70%	0.33%
			(0.13%)	(0.22%)	(0.05%)
Canada 18 year (June 2003-)	Mar 2004	Jun 2011	2.39%	1.48%	-0.01%
			(0.15%)	(0.04%)	(0.05%)
France (November 2004-)	Dec 2009		0.98%	-0.64%	
			(0.08%)	(0.06%)	
Germany (April 2011 -)	Jan 2012		-0.14%	-1.05%	
			(0.09%)	(0.03%)	
Japan (June 2011 -)	Jul 2012		-1.09%	-2.05%	
			(0.07%)	(0.04%)	
Korea (June 2013-)	Mar 2014		1.57%	1.07%	
			(0.13%)	(0.06%)	
Sweden (September 2005-)	Oct 2009	Oct 2014	1.59%	0.24%	-1.08%
			(0.05%)	(0.05%)	(0.07%)
UK (January 2001-)	Mar 2009		1.64%	-1.35%	
			(0.07%)	(0.07%)	
US (July 2004-)	Jan 2008	Jul 2011	1.39%	-0.03%	-1.00%
			(0.07%)	(0.07%)	(0.06%)

Table 5 – 5 Year Nominal Yield Level Decomposition. The data is quarterly. The yields are annual zero-coupon yields. The values are average over the sample. For each time point the world real rate, expected inflation, and inflation risk premium are computed as the GDP-weighted average of available countries' real rates, expected inflations, and inflation risk premia with GDP weights updated annually. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Panel A: World Nominal Interest Rate 2001Q1 - 2016Q2				
	Real yield	Expected Inflation	Inflation risk premium	Nominal yield
	0.47%	2.33%	0.11%	2.91%
	(0.16%)	(0.02%)	(0.04%)	(0.20%)
Panel B: Long Country-specific Sample - 2005Q3 - 2016Q2				
	Real yield	Expected inflation	Inflation risk premium	Nominal yield
France	0.08%	1.93%	0.10%	2.10%
	(0.15%)	(0.01%)	(0.07%)	(0.22%)
Sweden	0.53%	2.05%	-0.44%	2.15%
	(0.16%)	(0.02%)	(0.08%)	(0.21%)
UK	-0.41%	2.80%	0.25%	2.64%
	(0.22%)	(0.04%)	(0.22%)	(0.22%)
US	-0.05%	2.31%	0.05%	2.31%
	(0.17%)	(0.01%)	(0.17%)	(0.20%)
Panel C: Short Country-specific Sample -2011Q2 - 2016Q2				
	Real yield	Expected inflation	Inflation risk premium	Nominal yield
Australia	0.44%	2.79%	-0.35%	2.87%
	(0.12%)	(0.04%)	(0.05%)	(0.16%)
Japan	-1.90%	1.39%	0.66%	0.16%
	(0.09%)	(0.07%)	(0.05%)	(0.04%)
France	-0.79%	1.92%	-0.29%	0.85%
	(0.10%)	(0.02%)	(0.09%)	(0.17%)
Germany	-0.96%	1.92%	-0.49%	0.47%
	(0.08%)	(0.02%)	(0.08%)	(0.13%)
Sweden	-0.34%	2.00%	-0.70%	0.96%
	(0.15%)	(0.02%)	(0.06%)	(0.17%)
UK	-1.69%	2.81%	0.19%	1.32%
	(0.08%)	(0.06%)	(0.06%)	(0.10%)
US	-0.91%	2.29%	-0.05%	1.32%
	(0.11%)	(0.01%)	(0.06%)	(0.11%)

Table 6 – Break Points in the Level of Expected Inflation. Expected inflation is 5 year expected annual inflation unless mentioned otherwise. Break point models are estimated separately for each country using maximum likelihood estimation. The start of the sample for each country is in parentheses next to it. The end of the sample is 2016Q2 for all countries. Mean 1 is the average expected inflation between the start of the sample and Break point date 1. Mean 2 is the average expected inflation between the Break point date 1 and Break point date 2. Mean 3 is the average expected inflation between Break point date 2 and the end of the sample. If there is no Break point date 1 for the country, Mean 1 is the average expected inflation for the whole sample. If there is no Break point date 2 for the country, Mean 2 is the average expected inflation between Break point date 1 and the end of the sample. The number of break points for each country is chosen using Bayesian Information Criterion. The data is quarterly. For each time point the world expected inflation is computed as the GDP-weighted average of available countries' expected inflation with GDP weights updated annually. Standard errors in parentheses are maximum likelihood standard errors computed as the square roots of the diagonal elements of the inverse information matrix.

Panel A: World Expected Inflation 2001Q1 - 2016Q2

	Break point date 1	Break point date 2	Mean 1	Mean 2	Mean 3
	2005Q1	2009Q2	2.54%	2.36%	2.18%
			(0.02%)	(0.01%)	(0.01%)

Panel B: Country-specific Expected Inflation

	Break point date 1	Break point date 2	Mean 1	Mean 2	Mean 3
Australia (2010Q3-)	2012Q3	2015Q2	2.95%	2.77%	2.63%
			(0.03%)	(0.02%)	(0.03%)
Canada 18 year (2003Q2-)	2005Q3		1.94%	1.91%	
			(0.01%)	(0.01%)	
France (2004Q4-)			1.93%		
			(0.01%)		
Germany (2011Q2-)	2013Q4		2.00%	1.85%	
			(0.01%)	(0.01%)	
Japan (2011Q2-)	2012Q3	2013Q2	1.00%	1.49%	1.57%
			(0.05%)	(0.06%)	(0.03%)
Korea (2013Q2-)			2.81%		
			(0.03%)		
Sweden (2005Q3-)	2008Q2	2009Q2	2.09%	2.25%	2.00%
			(0.02%)	(0.02%)	(0.01%)
UK (2001Q1-)	2008Q2	2009Q2	2.64%	2.79%	2.83%
			(0.03%)	(0.03%)	(0.06%)
US (2004Q3-)	2008Q2		2.43%	2.28%	
			(0.02%)	(0.02%)	

Table 7 – Break Points in the Level of Inflation Risk Premium. Inflation risk premium is 5 year annual inflation risk premium unless mentioned otherwise. Break point models are estimated separately for each country using maximum likelihood estimation. The start of the sample for each country is in parentheses next to it. The end of the sample is 2016Q2 for all countries. Mean 1 is the average inflation risk premium between the start of the sample and Break point date 1. Mean 2 is the average inflation risk premium between the Break point date 1 and Break point date 2. Mean 3 is the average inflation risk premium between Break point date 2 and the end of the sample. If there is no Break point date 1 for the country, Mean 1 is the average inflation risk premium for the whole sample. If there is no Break point date 2 for the country, Mean 2 is the average inflation risk premium between Break point date 1 and the end of the sample. The number of break points for each country is chosen using Bayesian Information Criterion. The data is quarterly. For each time point the world inflation risk premium is computed as the GDP-weighted average of available countries' inflation risk premium with GDP weights updated annually. Standard errors in parentheses are maximum likelihood standard errors computed as the square roots of the diagonal elements of the inverse information matrix.

Panel A: World Inflation Risk Premium 2001Q1-2016Q2

	Break point date 1	Break point date 2	Mean 1	Mean 2	Mean 3
	2003Q4	2009Q1	0.07%	0.36%	-0.05%
			(0.08%)	(0.05%)	(0.05%)

Panel B: Country-specific Inflation Risk Premium

	Break point date 1	Break point date 2	Mean 1	Mean 2	Mean 3
Australia (2010Q3-)			-0.33%		
			(0.04%)		
Canada 18 year (2003Q2-)	2004Q1	2015Q4	0.92%	0.82%	0.11%
			(0.09%)	(0.04%)	(0.13%)
France (2004Q3-)	2009Q2	2013Q4	0.54%	0.09%	-0.59%
			(0.07%)	(0.07%)	(0.07%)
Germany (2011Q2 -)	2014Q3		-0.28%	-0.84%	
			(0.07%)	(0.09%)	
Japan (2011Q2 -)			0.67%		
			(0.06%)		
Korea (2013Q2-)	2014Q1		-1.17%	-1.68%	
			(0.11%)	(0.10%)	
Sweden (2005Q3-)	2008Q4		0.01%	-0.62%	
			(0.12%)	(0.08%)	
UK (2001Q1-)	2003Q3		-0.02%	0.28%	
			(0.08%)	(0.04%)	
US (2004Q2-)	2008Q4		0.40%	-0.10%	
			(0.10%)	(0.06%)	

Table 8 – Inflation-linked Yield Curve Slopes Level Decomposition. Real yield refers to the real yield curve slope. Liquidity premium refers to the liquidity premium yield curve slope. The values are average over the sample. The data is monthly. The yields are annual zero-coupon yields. For each time point the world real rate, liquidity premium, and inflation-linked yield curve slope are computed as the GDP-weighted average of available countries' real rates, liquidity premia, and inflation-linked yield curve slopes with GDP weights updated annually. Standard errors in parentheses are autocorrelation adjusted paired t-test standard errors. *, **, and *** correspond to statistical significance at the 10%, 5%, and 1% significance level, respectively.

Panel A: World Inflation-linked Yield Curve Slope Components January 2001-June 2016						
	10 year-5 year					
	Real Yield	Liquidity premium	Inflation-linked slope			
	0.51%***	-0.11%**	0.39%**			
	(0.14%)	(0.05%)	(0.16%)			
Panel B: Country-specific Inflation-linked Yield Curve Slope Components - Long Sample - September 2005 - June 2016						
	10 year - 5 year			15 year - 10 year		
	Real yield	Liquidity premium	Inflation-linked slope	Real yield	Liquidity premium	Inflation-linked slope
France	0.79%***	-0.28%***	0.51%***	0.18%***	0.04%	0.23%***
	(0.12%)	(0.03%)	(0.14%)	(0.03%)	(0.03%)	(0.05%)
Sweden	0.29%***	0.00%	0.29%***	0.15%**	0.00%	0.15%**
	(0.09%)		(0.09%)	(0.07%)		(0.07%)
UK	0.68%**	-0.34%***	0.34%	-0.05%	0.14%***	0.08%
	(0.26%)	(0.08%)	(0.28%)	(0.13%)	(0.04%)	(0.14%)
US	0.70%***	-0.10%	0.60%***	0.32%***	0.01%	0.32%***
	(0.13%)	(0.08%)	(0.18%)	(0.11%)	(0.03%)	(0.11%)
Panel C: Country-specific Inflation-linked Yield Curve Slope Components - Short Sample - June 2011 - June 2016						
	10 year - 5 year			15 year - 10 year		
	Real yield	Liquidity premium	Inflation-linked slope	Real yield	Liquidity premium	Inflation-linked slope
Australia	0.43%***	-0.17%***	0.26%***	0.19%***	0.05%	0.24%***
	(0.04%)	(0.02%)	(0.04%)	(0.03%)	(0.03%)	(0.03%)
France	0.93%***	-0.33%***	0.61%***	0.23%***	0.08%***	0.31%***
	(0.15%)	(0.04%)	(0.15%)	(0.03%)	(0.02%)	(0.04%)
Germany	0.08%	0.38%***	0.45%***			
	(0.16%)	(0.06%)	(0.08%)			
Sweden	0.36%***	0.00%	0.36%***	0.22%***	0.00%	0.22%***
	(0.06%)		(0.06%)	(0.07%)		(0.07%)
UK	0.95%***	-0.29%***	0.65%***	0.13%	0.13%***	0.26%**
	(0.17%)	(0.04%)	(0.21%)	(0.08%)	(0.02%)	(0.13%)
US	0.67%***	0.05%	0.73%***	0.34%**	0.08%	0.42%***
	(0.12%)	(0.04%)	(0.12%)	(0.13%)	(0.05%)	(0.12%)

Table 9 – Nominal Yield Curve Slopes Level Decomposition. Real yield refers to the real yield curve slope. Expected inflation refers to the expected inflation yield curve slope. Inflation risk premium refers to the inflation risk premium yield curve slope. The values are average over the sample. The data is quarterly. The yields are annual zero-coupon yields. For each time point the world real yield, expected inflation, inflation risk premium, and nominal yield curve slopes are computed as the GDP-weighted average of available countries' real yields, expected inflations, inflation risk premia, and nominal yield curve slopes with GDP weights updated annually. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Panel A: World Nominal Yield Curve Slope Components 2001Q1-2016Q2								
	10 year - 5 year							
	Real yield	Expected inflation	Inflation risk premium	Nominal				
	0.51%	0.04%	0.10%	0.65%				
	(0.05%)	(0.01%)	(0.03%)	(0.06%)				
Panel B: Country-specific Nominal Yield Curve Slope Components - Long Sample - 2005Q3-2016Q2								
	10 year - 5 year				15 year - 10 year			
	Real yield	Expected inflation	Inflation risk premium	Nominal	Real yield	Expected inflation	Inflation risk premium	Nominal
France	0.77%	-0.00%	-0.02%	0.74%	0.18%	-0.00%	0.19%	0.37%
	(0.05%)	(0.01%)	(0.02%)	(0.06%)	(0.02%)	(0.01%)	(0.02%)	(0.02%)
Sweden	0.30%	-0.00%	0.14%	0.44%	0.02%	0.15%	0.05%	0.20%
	(0.03%)	(0.01%)	(0.03%)	(0.04%)	(0.02%)	(0.01%)	(0.02%)	(0.02%)
UK	0.69%	-0.03%	0.05%	0.70%	-0.06%	-0.01%	0.42%	0.35%
	(0.09%)	(0.02%)	(0.02%)	(0.08%)	(0.05%)	(0.01%)	(0.02%)	(0.05%)
US	0.67%	0.05%	0.22%	0.94%	0.31%	0.02%	0.13%	0.45%
	(0.07%)	(0.01%)	(0.04%)	(0.07%)	(0.03%)	(0.01%)	(0.01%)	(0.03%)
Panel C: Country-specific Nominal Yield Curve Slope Components - Short Sample - 2011Q2 -2016Q2								
	10 year - 5 year				15 year - 10 year			
	Real yield	Expected inflation	Inflation risk premium	Nominal	Real yield	Expected inflation	Inflation risk premium	Nominal
Australia	0.46%	0.06%	0.04%	0.55%	0.18%	0.02%	0.05%	0.25%
	(0.04%)	(0.02%)	(0.03%)	(0.03%)	(0.02%)	(0.01%)	(0.02%)	(0.02%)
France	0.91%	-0.00%	0.07%	0.97%	0.23%	-0.00%	0.26%	0.49%
	(0.08%)	(0.01%)	(0.04%)	(0.06%)	(0.02%)	(0.01%)	(0.01%)	(0.02%)
Germany	0.10%	-0.00%	0.77%	0.86%				
	(0.07%)	(0.01%)	(0.03%)	(0.05%)				
Sweden	0.37%	0.02%	0.20%	0.58%	0.23%	0.01%	0.10%	0.34%
	(0.04%)	(0.02%)	(0.04%)	(0.04%)	(0.02%)	(0.01%)	(0.02%)	(0.02%)
UK	0.99%	-0.03%	0.01%	0.96%	0.14%	-0.02%	0.41%	0.54%
	(0.08%)	(0.02%)	(0.03%)	(0.06%)	(0.05%)	(0.01%)	(0.02%)	(0.04%)
US	0.67%	0.05%	0.27%	0.98%	0.33%	0.02%	0.17%	0.52%
	(0.06%)	(0.01%)	(0.02%)	(0.07%)	(0.05%)	(0.01%)	(0.02%)	(0.05%)

Table 10 – Break Points in the Level of Real Yield Curve Slopes. Real yield curve slope is 10 year - 5 year annual zero-coupon yield curve slope unless mentioned otherwise. Break point models are estimated separately for each country using maximum likelihood estimation. The start of the sample for each country is in parentheses next to it. The end of the sample is 2016Q2 for all countries. Mean 1 is the average real yield curve slope between the start of the sample and Break point date 1. Mean 2 is the average real yield curve slope between the Break point date 1 and Break point date 2. Mean 3 is the average real yield curve slope between Break point date 2 and the end of the sample. If there is no Break point date 1 for the country, Mean 1 is the average real yield curve slope for the whole sample. If there is no Break point date 2 for the country, Mean 2 is the average real yield curve slope between Break point date 1 and the end of the sample. The number and timing of break points for each country is determined by minimizing by Bayesian Information Criterion. The data is monthly. For each time point the world real yield curve slope is computed as the GDP-weighted average of available countries' real yield curve slopes with GDP weights updated annually. Standard errors in parentheses are maximum likelihood standard errors computed as the square roots of the diagonal elements of the inverse information matrix.

Panel A: World Real Yield Curve Slope January 2001 - June 2016

	Break point date 1	Break point date 2	Mean 1	Mean 2	Mean 3
	2008Q1		0.23%	0.74%	
			(0.08%)	(0.05%)	

Panel B: Country-specific Real Yield Curve Slope

	Break point date 1	Break point date 2	Mean 1	Mean 2	Mean 3
Australia (September 2010-)			0.42%		
			(0.04%)		
Canada 25 year-18 year (June 2003-)	2006Q2	2009Q3	0.04%	-0.04%	0.11%
			(0.02%)	(0.02%)	(0.01%)
France (November 2004-)	2006Q2	2009Q3	0.62%	0.50%	0.94%
			(0.15%)	(0.08%)	(0.05%)
Germany (April 2011 -)	2014Q2		0.33%	-0.21%	
			(0.04%)	(0.05%)	
Japan 5 year - 2 year (June 2011-)			1.46%		
			(0.11%)		
Korea (June 2013-)			-0.31%		
			(0.05%)		
Sweden (September 2005-)	2006Q4	2009Q2	0.17%	0.09%	0.41%
			(0.05%)	(0.03%)	(0.05%)
UK (January 2001-)	2008Q4		0.05%	1.01%	
			(0.06%)	(0.06%)	
US (July 2004-)	2006Q1	2008Q2	0.45%	0.40%	0.79%
			(0.21%)	(0.13%)	(0.06%)

Table 11 – Break Points in the Level of Inflation Risk Premium Yield Curve Slopes. Inflation risk premium yield curve slope is 10 year - 5 year annual zero-coupon yield curve slope unless mentioned otherwise. Break point models are estimated separately for each country using maximum likelihood estimation. The start of the sample for each country is in parentheses next to it. The end of the sample is 2016Q2 for all countries. Mean 1 is the average inflation risk premium yield curve slope between the start of the sample and Break point date 1. Mean 2 is the average inflation risk premium yield curve slope between the Break point date 1 and the end of the sample. If there is no Break point date 1 for the country, Mean 1 is the average inflation risk premium yield curve slope for the whole sample. The number of break points for each country is chosen using Bayesian Information Criterion. The data is quarterly. For each time point the world inflation risk premium is computed as the GDP-weighted average of available countries' inflation risk premia with GDP weights updated annually. Standard errors in parentheses are maximum likelihood standard errors computed as the square roots of the diagonal elements of the inverse information matrix.

Panel A: World Inflation Risk Premium Slope January 2001 - June 2016			
	Break point date 1	Mean 1	Mean 2
	2008Q4	-0.09%	0.29%
		(0.03%)	(0.03%
Panel B: Country-specific Inflation Risk Premium Slopes			
	Break point date 1	Mean 1	Mean 2
Australia (2010Q3-)		0.04%	
		(0.03%)	
Canada (2003Q2-, 25 year - 18 year)		-0.07%	
		(0.03%)	
France (2004Q3-)	2008Q4	-0.19%	0.05%
		(0.03%)	(0.02%)
Germany (2011Q2-)	2012Q2	0.58%	0.81%
		(0.05%)	(0.03%)
Japan (2011Q2-, 5 year - 2 year)		-1.45%	
		(0.11%)	
Korea (2013Q2-)		0.54%	
		(0.05%)	
Sweden (2005Q3-)	2008Q2	0.02%	0.18%
		(0.09%)	(0.04%)
UK (2001Q1-)	2007Q4	-0.07%	0.06%
		(0.04%)	(0.02%)
US (2004Q2-)	2008Q4	-0.05%	0.33%
		(0.05%)	(0.04%)

Table 12 – Cross-country Real Yield Correlations. Real yields are zero-coupon yields. The data is monthly. The bootstrap standard errors in parentheses are computed from 5,000 bootstrap simulations of historical length.

Panel A: 5 Year Bond - Long Sample - September 2005-June 2016

	France	Sweden	UK	US
France	1.00	0.94	0.90	0.79
		(0.01)	(0.01)	(0.03)
Sweden	0.94	1.00	0.82	0.70
	(0.01)		(0.02)	(0.03)
United Kingdom	0.90	0.82	1.00	0.93
	(0.01)	(0.02)		(0.02)
United States	0.79	0.70	0.93	1.00
	(0.03)	(0.03)	(0.02)	

Panel B: 5 Year Bond Short Sample - June 2011-June 2016

	Australia	France	Germany	Japan	Sweden	UK	US
Australia	1.00	0.77	0.70	0.22	0.76	-0.04	-0.10
		(0.07)	(0.08)	(0.14)	(0.04)	(0.11)	(0.10)
France	0.77	1.00	0.85	0.46	0.75	-0.05	-0.04
	(0.07)		(0.12)	(0.04)	(0.11)	(0.11)	(0.15)
Germany	0.70	0.85	1.00	0.39	0.62	0.23	0.24
	(0.08)	(0.12)		(0.06)	(0.11)	(0.11)	(0.11)
Japan	0.22	0.46	0.39	1.00	0.22	-0.16	-0.21
	(0.14)	(0.04)	(0.06)		(0.15)	(0.11)	(0.11)
Sweden	0.76	0.75	0.62	0.22	1.00	-0.26	-0.40
	(0.04)	(0.11)	(0.11)	(0.15)		(0.10)	(0.08)
UK	-0.04	-0.05	0.23	-0.16	-0.26	1.00	0.76
	(0.11)	(0.11)	(0.11)	(0.11)	(0.10)		(0.05)
US	-0.10	-0.04	0.24	-0.21	-0.40	0.76	1.00
	(0.10)	(0.15)	(0.11)	(0.11)	(0.08)	(0.05)	

Panel C: 10 Year Bond Short Sample - June 2011-June 2016

	Australia	France	Germany	Sweden	UK	US
Australia	1.00	0.73	0.84	0.83	0.80	0.49
		(0.06)	(0.04)	(0.03)	(0.05)	(0.09)
France	0.73	1.00	0.93	0.84	0.60	0.03
	(0.06)		(0.01)	(0.03)	(0.08)	(0.11)
Germany	0.84	0.93	1.00	0.86	0.75	0.27
	(0.04)	(0.01)		(0.03)	(0.06)	(0.11)
Sweden	0.83	0.84	0.86	1.00	0.67	0.18
	(0.03)	(0.03)	(0.03)		(0.08)	(0.10)
UK	0.80	0.60	0.75	0.67	1.00	0.54
	(0.05)	(0.08)	(0.06)	(0.08)		(0.08)
US	0.49	0.03	0.27	0.18	0.54	1.00
	(0.09)	(0.11)	(0.11)	(0.10)	(0.08)	

Table 13 – Cross-country Liquidity Premium Correlations. Liquidity premia are for 5 year zero-coupon inflation-linked bonds. The data is monthly. The bootstrap standard errors in parentheses are computed from 5,000 bootstrap simulations of historical length.

Panel A: Long Sample - 2005Q3-2016Q2			
	France	UK	US
France	1.00	0.54	0.52
		(0.08)	(0.09)
UK	0.54	1.00	0.75
	(0.08)		(0.08)
US	0.52	0.75	1.00
	(0.09)	(0.08)	

Panel B: Short Sample - 2011Q2-2016Q2						
	Australia	France	Germany	Japan	UK	US
Australia	1.00	0.34	0.17	0.19	0.14	0.37
		(0.12)	(0.12)	(0.12)	(0.14)	(0.09)
France	0.34	1.00	0.37	0.28	0.46	0.11
	(0.12)		(0.11)	(0.12)	(0.12)	(0.12)
Germany	0.17	0.37	1.00	0.04	0.09	0.24
	(0.12)	(0.11)		(0.15)	(0.16)	(0.13)
Japan	0.19	0.28	0.04	1.00	0.47	0.30
	(0.12)	(0.12)	(0.15)		(0.12)	(0.13)
UK	0.14	0.46	0.09	0.47	1.00	0.06
	(0.14)	(0.12)	(0.16)	(0.12)		(0.11)
US	0.37	0.11	0.24	0.30	0.06	1.00
	(0.11)	(0.12)	(0.13)	(0.13)	(0.11)	

Appendix A: Sample and Maturity Choices

A.1 Australia

The sample starts in September 2010 and the main analyzed maturity range is 5-15 years. This is determined by the availability of Australian inflation-linked bonds necessary to construct the yield curve (at least 4 bonds are necessary to construct the yield curve) plotted in Figure 1.

A.2 Canada

The sample starts in June 2003 and the main analyzed maturity range is 18-30 years. The limiting factor for the Canadian sample is that at least four bonds are needed to estimate the inflation-linked yield curve and, as can be seen from Figure 1, when the prices of four bonds become available for the first time the shortest available maturity is around 18 years.

A.3 France

The sample starts in November 2004 and the main analyzed maturity range is 5-15 years. In France, two types of inflation-linked bonds are available: the first type (OATi) is linked to the French Consumer Price Index Excluding Tobacco and the second (OAT€i) to the Euro-zone Consumer Price Index Excluding Tobacco. In terms of their nominal and market values, throughout my sample these two bond types are approximately equal. Also the maturity availability across the dates for these two inflation-linked bond types is very similar. The prices on bonds linked to the French inflation index are available starting from 1998 but there is not enough issues to construct the yield curve before 2004. I use the bonds linked to the Euro-zone inflation index since better liquidity proxies and inflation expectations data are available for it.

A.4 Germany

The sample starts in April 2011 and the main analyzed maturity range is 2-10 years. The upper bound of 10 years is determined by the fact that, as can be seen from Figure 1, until very recently, Germany hasn't issued long maturity inflation-linked bonds.

A.5 Japan

The sample starts in June 2011 and the analyzed maturity range is 2-5 years. The problem with Japan is that, although the country started issuing inflation-linked bonds in 2004 and there had been enough (4) bonds to estimate the longer maturity part of the inflation-linked yield curve already in the second half of 2005, it took a break in issuing inflation-linked bonds between 2008 and 2013 and the maturity spectrum of the bonds was very limited during that period.

A.6 Korea

The sample starts in June 2013 and the main analyzed maturity range is 3-10 years. As it can be seen from Figure 1, the upper bound for the maturity reflects the fact that Korea hasn't issued inflation-linked bonds with the maturity over 10 years. Table 1 summarizes the sample.

A.7 Sweden

The sample starts in September 2005 and the main analyzed maturity range is 5-15 years. This is determined by the availability of Swedish inflation-linked bonds necessary to construct the yield curve.

A.8 United Kingdom

The sample starts in January 2001, because some of the liquidity proxies (trading volume of inflation-indexed bonds) are not available before that. The analyzed maturities are 5-15 years, as the data availability for shorter maturities is limited.

A.9 United States

The sample starts in July 2004. Formally, the US real yield curves are available from 1999, but some of the important liquidity proxies (inflation swap spreads) and shorter maturities (below 5 years) are only available starting in July 2004.

Appendix B: Nominal Zero-Coupon Yields

The Australian nominal yields are from the Reserve Bank of Australia website. The Canadian nominal yields are from the Royal Bank of Canada website. The French nominal yields are from the Banque de France website. The German nominal yields are from the Deutsche Bundesbank website. The Japanese nominal yields are from Japan Ministry of Finance website. The Korean nominal yields are from the Korea Ministry of Strategy and Finance website. The Swedish nominal yields are from the Riksbank website. The UK nominal yields are from the Bank of England website. The US nominal yields are from Gürkaynak, Sack and Wright (2007).

Zero-coupon yields are estimated using one of Nelson-Siegel (1987), Svensson (1994), or spline based techniques (e.g., Anderson and Sleath, 2001, or Li et.al., 2001) depending on the country. The details of the estimation are available from the corresponding sources. For Australia, France, Japan, Korea, and Sweden some annual nominal zero-coupon maturities are missing from the sources above and I input these from Bloomberg. If some maturities are still missing after that, I linearly interpolate them. All missing maturities are in between of the available maturities, so there is no need to extrapolate.

Appendix C: Liquidity Proxies

C.1 Australia

The liquidity proxies for Australia are the nominal off-the-run spread, the relative transaction volume of inflation-linked bonds, and the inflation swap spread. Annual bond transaction volumes were provided by Stephen Kirchner from Australian Financial Markets Association.

C.2 Canada

The liquidity proxies for Canada are the nominal off-the-run spread, the relative transaction volume of inflation-linked bonds, and the relative transaction volume of inflation-linked bonds with the maturity over 10 years (as the vast majority of Canadian inflation-linked bonds has the maturity over 10 years). Quarterly bond transaction volumes were provided by Debra Haggarty from Investment Industry Regulatory Organization of Canada.

C.3 France

The liquidity proxies are the nominal off-the-run spread and the inflation-swap spread.

C.4 Germany

The liquidity proxies are the nominal off-the-run spread, the relative transaction volume of inflation-linked bonds, and the inflation swap spread. Semi-annual bond transaction volumes were provided by Christian Hirschfeld from Bundesrepublik Deutschland - Finanzagentur.

C.5 Japan

The liquidity proxies are the nominal off-the-run spread and the inflation swap spread.

C.6 Korea

The liquidity proxies are the nominal off-the-run spread, the relative transaction volume of inflation-linked bonds, and the relative transaction volume of inflation-linked bonds with the maturity between 3 and 10 years (as the vast majority of Korean inflation-linked bonds has the maturity between 3 and 10 years). The monthly bond transaction volumes are from Korea Ministry of Strategy and Finance website.

C.7 Sweden

The liquidity proxies are the nominal off-the-run spread, the relative transaction volume of inflation-linked bonds, and the 7 day STIBOR (Stockholm interbank Offered Rate) - Riksbank (Swedish Central Bank) repo rate spread. The monthly bond transaction volumes, STIBOR, and Riskbank repo rate are from Riskbank website.

C.8 United Kingdom

The liquidity proxies for the UK are the nominal off-the-run spread, the relative transaction volume of inflation-linked bonds, and the 3 month LIBOR-general collateral repo interest rate spread. Weekly bond transaction volumes were provided by James Knight from UK Debt Management Office. I aggregate them to the monthly frequency. LIBOR is from the Federal Reserve Bank of St. Louis website and the general collateral repo interest rate is from the Bank of England website.

C.9 United States

The inflation-linked bond liquidity proxies for the US are the nominal off-the-run spread, the relative transaction volume of inflation-linked bonds, and the inflation swap spread. The weekly inflation-linked and nominal bonds transaction volumes are available from the Federal Reserve Bank of New York website. I aggregate them to the monthly frequency.

Appendix D: Inflation Expectations

The survey inflation expectations are only available for particular maturities, so I need to interpolate and extrapolate them for nominal yield decompositions. For this purpose, I estimate an AR(1) model, which has been shown to fit the developed countries inflation expectations well (e.g., Mumtaz and Surico, 2012). In the estimation process I small-sample adjust the autocorrelation coefficient as in Kendall (1954). In most cases I use the inflation expectations starting from 2000Q1 to estimate the model.

D.1 Australia

The available inflation expectations are 3 months ahead business inflation expectations, 1 and 2 year ahead union officials' inflation expectations, and 1 and 2 year ahead market economists' inflation expectations from Reserve Bank of Australia website. To extrapolate the inflation expectations, I use 1 and 2 year ahead market economists' inflation expectations. Using one and two year ahead union officials' inflation expectations doesn't change the results. I estimate an AR(1) model of 1 year ahead inflation expectations. To compute inflation expectations for years 3-, I input the inflation expectations for the second year into the estimated AR(1) model and iterate forward.

D.2 Canada

Canadian inflation expectations are 1 and 2 year ahead Bank of Canada Total CPI year-over-year percentage change projections (which are different from Bank of Canada target inflation). I estimate an AR(1) model of 1 year ahead inflation expectations. To compute inflation expectations for years 3-, I input the inflation expectations for the second year into the estimated AR(1) model and iterate forward.

D.3 France and Germany

French and German inflation expectations are Survey of Professional Forecasters mean estimates of 1, 2, and 5 year ahead year on year percentage change of the Eurostat Harmonised Index of Consumer Prices from European Central Bank website. To estimate the inflation expectations for the third, the fourth, an the fifith year, I assume that these three are equal to each other and compute them so that two year ahead and five year ahead inflation expectations are consistent with each other. Using a linear instead of a uniform interpolation doesn't change the results. For years 6-, I compute the inflation expectations in two steps. First, I estimate an AR(1) model of 1 year ahead inflation expectations. Second, I input the inflation expectation for the fifth year computed as above into the estimated AR(1) model and iterate forward.

D.4 Japan

Japanese inflation expectations are 1 and 2 year ahead inflation expectations from Bloomberg. I estimate an AR(1) model of 1 year ahead inflation expectations. To compute inflation expectations for years 3-, I input the inflation expectations for the second year into the estimated AR(1) model and iterate forward.

D.5 Korea

Korean inflation expectations are PricewaterhouseCooper Economics and Policy Team (Global Watch) inflation forecasts for the next calendar year and 5 calendar years after that. To estimate the inflation expectations for the second, third, fourth, fifth, and sixth year, I assume that these are equal to each other and to the average inflation expectation for years 2-6. For years 6-, I compute the inflation expectations in two steps. First, I estimate an AR(1) model of 1 year ahead inflation expectations. Second, I input the inflation expectation for the sixth year computed as above into the estimated AR(1) model and iterate forward.

D.6 Sweden

Swedish inflation expectations are All Interviewees' Median Expectations of 1, 2, and 5 year inflation from TNS Sifo Prospera (an agency which conducts the inflation surveys for Riksbank, the Swedish Central Bank). Using mean instead of the median forecasts doesn't change the results. To estimate the inflation expectations for the third, the fourth, an the fifth year, I assume that these three are equal to each other and compute them so that two year ahead and five year ahead inflation expectations are consistent with each other. Using a linear instead of a uniform interpolation doesn't change the results. For years 6-, I compute the inflation expectations in two steps. First, I estimate an AR(1) model of 1 year ahead inflation expectations. Second, I input the inflation expectation for the fifth year computed as above into the estimated AR(1) model and iterate forward.

D.7 United Kingdom

The UK inflation expectations are 1 year ahead median inflation expectations from Bank of England Public Attitudes Survey. I estimate an AR(1) model of these 1 year ahead inflation expectations. To compute inflation expectations for years 2-, I input one year ahead inflation expectations into the estimated AR(1) model and iterate forward.

D.8 United States

The US inflation expectations are 1 quarter, 1 year, 5 year, and 10 year ahead Survey of Professional Forecasters median expectations from the Federal Reserve Bank of Philadelphia website. The five year ahead inflation expectations are only available starting from 2005Q3. I estimate the missing values by regressing the 5 year Survey of Professional Forecasters inflation forecasts on 1 quarter, 1 year, and 10 year inflation forecasts. For the second, third, fourth and fifth year inflation forecasts, I assume that these four are equal to each other and compute them so that 1 year ahead and 5 year ahead inflation expectations are consistent with each other. For the sixth, seventh, eighth, ninth, and tenth year inflation forecasts, I assume that these five are equal and compute them so that the 10 year inflation forecast is consistent with the 5 year inflation forecast. Using linear instead of the uniform interpolation doesn't change the results. For years 10- ahead, I compute the inflation expectations in two steps. First, I estimate an AR(1) model of 1 year ahead inflation expectations. Second, I input the inflation expectations for the tenth year from now computed as above into the estimated AR(1) model and iterate forward.

Appendix E: Main Results for Canada and Korea

Inflation-linked Yield Level Decomposition. The data is monthly. The yields are annual zero-coupon yields. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Canada 18 Year Inflation-linked Bond Yield: June 2003-June 2016		
Real yield	Liquidity premium	Inflation-linked
0.97%	0.43%	1.39%
(0.07%)	(0.01%)	(0.06%)
Korea 5 Year Inflation-linked Bond Yield: June 2013-June 2016		
Real yield	Liquidity premium	Inflation-linked
1.19%	0.28%	1.48%
(0.06%)	(0.03%)	(0.05%)

Nominal Yield Level Decomposition. The data is quarterly. The yields are annual zero-coupon yields. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Canada 18 Year Nominal Bond Yield: 2003Q2-2016Q2			
Real yield	Expected inflation	Inflation risk premium	Nominal yield
0.96%	1.93%	0.81%	3.70%
(0.12%)	(0.01%)	(0.05%)	(0.14%)
Korea 5 Year Nominal Bond Yield: 2013Q2-2016Q2			
Real yield	Expected inflation	Inflation risk premium	Nominal yield
1.13%	2.81%	-1.60%	2.34%
(0.14%)	(0.03%)	(0.11%)	(0.18%)

Inflation-linked Yield Curve Slope Level Decomposition. The values are average over the sample. The data is monthly. The yields are annual zero-coupon yields. Standard errors in parentheses are autocorrelation adjusted paired t-test standard errors. *, **, and *** correspond to statistical significance at the 10%, 5%, and 1% significance level, respectively.

Canada Inflation-linked Yield Curve Slope: June 2003 - June 2016					
25 year - 18 year			30 year - 25 year		
Real yield	Liquidity premium	Inflation-linked	Real yield	Liquidity premium	Inflation-linked
0.06%***	0.01%	0.06%***	0.01%	-0.00%	0.01%
(0.02%)	(0.01%)	(0.02%)	(0.01%)	(0.01%)	(0.01%)
Korea Inflation-linked Yield Curve Slope: June 2013 - June 2016					
5 year - 3 year			10 year - 5 year		
Real yield	Liquidity premium	Inflation-linked	Real yield	Liquidity premium	Inflation-linked
0.29%***	-0.17%***	0.12%***	-0.27%***	0.29%***	0.02%
(0.03%)	(0.02%)	(0.03%)	(0.05%)	(0.04%)	(0.06%)

Nominal Yield Curve Slope Level Decomposition. The values are average over the sample. The data is quarterly. The yields are annual zero-coupon yields. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Canada Nominal Yield Curve Slope: 2003Q2-2016Q2							
25 year - 18 year				30 year - 25 year			
Real yield	Expected inflation	Inflation risk premium	Nominal	Real yield	Expected inflation	Inflation risk premium	Nominal
0.05%	0.00%	-0.07%	-0.01%	0.01%	0.00%	-0.11%	-0.10%
(0.01%)	(0.00%)	(0.01%)	(0.02%)	(0.01%)	(0.00%)	(0.01%)	(0.01%)
Korea Nominal Yield Curve Slope: 2013Q2-2016Q2							
5 year - 3 year				10 year - 5 year			
Real yield	Expected inflation	Inflation risk premium	Nominal	Real yield	Expected inflation	Inflation risk premium	Nominal
0.34%	0.10%	-0.24%	0.20%	-0.31%	0.08%	0.54%	0.31%
(0.06%)	(0.02%)	(0.05%)	(0.03%)	(0.05%)	(0.01%)	(0.05%)	(0.02%)

Difference between Inflation Risk Premia of Nominal Bonds and Liquidity Premia of Inflation-linked Bonds. The data is quarterly. The yields are annual zero-coupon yields. Standard errors in parentheses are autocorrelation adjusted paired t-test standard errors. *, **, and *** correspond to statistical significance at the 10%, 5%, and 1% significance level, respectively.

Canada Inflation Risk Premium - Liquidity Premium - 2003Q2 - 2016Q2		
18 year	25 year	30 year
0.38%**	0.31%**	0.20%
(0.15%)	(0.15%)	(0.14%)
Korea Inflation Risk Premium - Liquidity Premium - 2013Q2 - 2016Q2		
3 year	5 year	10 year
-1.86%***	-1.91%***	-1.71%
(0.21%)	(0.39%)	(1.41%)

Appendix F: Inflation-linked Yield Variance Decompositions

5 Year Inflation-linked Yield Variance Decomposition. The real yield variance contribution is computed as Covariance(Real yield, Inflation-linked yield)/Variance(Inflation-linked yield). The liquidity premium variance contribution is computed as Covariance(Liquidity premium, Inflation-linked yield)/Variance(Inflation-linked yield).The data is monthly. For each time point the world real rate, liquidity premium, and inflation-linked yield are computed as the GDP-weighted average of available countries' real rates, liquidity premia, and inflation-linked yields with GDP weights updated annually. The yields are annual zero-coupon yields. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Panel A: World Inflation-linked Bond Yield January 2001 - June 2016

	Real yield	Liquidity premium	Inflation-linked bond yield standard deviation
	99.72%	0.28%	1.23%
	(3.19%)	(3.19%)	(0.10%)

Panel B: Long Country-specific Sample - September 2005 - June 2016

	Real yield	Liquidity premium	Inflation-linked bond yield standard deviation
France	98.24%	1.76%	1.00%
	(2.63%)	(2.63%)	(0.08%)
Sweden	100.00%	0.00%	1.01%
			(0.10%)
UK	94.93%	5.07%	1.47%
	(3.43%)	(3.43%)	(0.19%)
US	82.92%	17.08%	1.26%
	(5.35%)	(5.35%)	(0.15%)

Panel C: Short Country-specific Sample - June 2011 - June 2016

	Real yield	Liquidity premium	Inflation-linked bond yield standard deviation
Australia	102.34%	-2.34%	0.48%
	(4.27%)	(4.27%)	(0.04%)
France	71.90%	28.10%	0.48%
	(8.68%)	(8.68%)	(0.05%)
Germany	88.07%	11.93%	0.36%
	(4.25%)	(4.25%)	(0.03%)
Japan	54.06%	45.94%	0.75%
	(4.53%)	(4.53%)	(0.09%)
Sweden	100.00%	0.00%	0.62%
			(0.05%)
UK	103.34%	-3.34%	0.32%
	(6.93%)	(6.93%)	(0.03%)
US	90.32%	9.68%	0.58%
	(3.35%)	(3.35%)	(0.05%)

Appendix G: Real Yield and Liquidity Premium Comovement

5 Year Real Yield and Liquidity Premium Comovement. The data is monthly. The real and liquidity yields are annual zero-coupon yields. For each time point the world real rate, liquidity premium, and inflation-linked yield are computed as the GDP-weighted average of available countries' real rates, liquidity premia, and inflation-linked yields with GDP weights updated annually. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Panel A: World Inflation-linked Yield January 2001 - June 2016		
	Correlation(real yield, liquidity premium)	2×Covariance(real yield,liquidity premium)/Inflation-linked bond variance
	-0.28	-18.16%
	(0.06)	(2.82%)
Panel B: Long Country-specific Sample - September 2005 - June 2016		
	Correlation(real yield, liquidity premium)	2×Covariance(real yield, liquidity premium)/Inflation-linked bond variance
France	-0.20	-10.86%
	(0.08)	(4.85%)
Sweden	0.00	0.00%
UK	-0.06	-2.76%
	(0.11)	(5.09%)
US	0.03	2.32%
	(0.06)	(4.12%)
Panel C: Short Country-specific Sample - June 2011 - June 2016		
	Correlation(real yield, liquidity premium)	2×Covariance(real yield, liquidity premium)/Inflation linked bond variance
Australia	-0.37	-25.49%
	(0.11)	(10.06%)
France	-0.02	-1.37%
	(0.14)	(13.27%)
Germany	0.11	5.93%
	(0.14)	(7.89%)
Japan	0.40	28.42%
	(0.09)	(4.84%)
Sweden	0.00	0.00%
UK	-0.56	-83.43%
	(0.08)	(34.52%)
US	-0.00	-0.11%
	(0.13)	(8.06%)

Appendix H: Nominal Yield Variance Decompositions

5 Year Nominal Yield Variance Decomposition. The real yield variance contribution is computed as Covariance(Real yield, Nominal yield)/Variance(Nominal yield). The expected inflation contribution is computed as Covariance(Expected inflation, Nominal yield)/Variance(Nominal yield). The inflation risk premium contribution is computed as Covariance(Inflation risk premium, Nominal yield)/Variance(Nominal yield). The data is quarterly. For each time point the world real yield, expected inflation, and inflation risk premium are computed as the GDP-weighted average of available countries' real yields, expected inflations, and inflation risk premia with GDP weights updated annually. The yields are annual zero-coupon yields. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Panel A: World's Nominal Yield 2001Q1-2016Q2

	Real yield	Expected inflation	Inflation risk premium	Nominal yield standard deviation
	81.31%	9.51%	9.17%	1.56%
	(2.42%)	(0.65%)	(2.37%)	(0.21%)

Panel B: Long Country-specific Sample - 2005Q3 - 2016Q2

	Real yield	Expected inflation	Inflation risk premium	Nominal yield standard deviation
France	67.00%	1.38%	31.62%	1.46%
	(2.64%)	(0.72%)	(2.35%)	(0.31%)
Sweden	71.43%	3.84%	24.73%	1.41%
	(3.77%)	(1.74%)	(3.46%)	(0.29%)
UK	94.57%	-0.82%	6.25%	1.52%
	(3.36%)	(2.26%)	(2.35%)	(0.29%)
US	82.17%	3.40%	14.43%	1.32%
	(3.42%)	(1.91%)	(6.17%)	(0.33%)

Panel C: Short Country-specific Sample - 2011Q2 - 2016Q2

	Real yield	Expected inflation	Inflation risk premium	Nominal yield standard deviation
Australia	72.72%	15.75%	11.53%	0.74%
	(8.58%)	(3.36%)	(8.18%)	(0.18%)
France	49.58%	8.48%	41.94%	0.78%
	(8.32%)	(1.62%)	(7.57%)	(0.17%)
Germany	46.67%	9.58%	43.75%	0.61%
	(10.64%)	(3.18%)	(8.34%)	(0.15%)
Japan	104.91%	-76.71%	71.80%	0.18%
	(76.18%)	(53.31%)	(36.88%)	(0.01%)
Sweden	81.59%	3.30%	15.12%	0.80%
	(9.31%)	(2.07%)	(8.90%)	(0.16%)
UK	45.28%	8.44%	46.28%	0.47%
	(13.09%)	(11.52%)	(8.45%)	(0.06%)
US	110.67%	-3.25%	-7.42%	0.41%
	(15.79%)	(1.92%)	(15.28%)	(0.03%)

The results for longer maturities are similar except that the contribution of the real yield variance is slightly smaller and the contribution of the inflation risk premium variance is slightly larger.

Appendix I: Tobin-Mundell Effect

5 Year Real Yield and Expected Inflation Comovement (Tobin-Mundell effect). The data is quarterly. The real and expected inflation are annual zero-coupon yields. For each time point the world real yield and expected inflation are computed as the GDP-weighted average of available countries' real yields and expected inflations with GDP weights updated annually. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Panel A: World 2001Q1 - 2016Q2

	Correlation(real yield, expected inflation)	2×Covariance(real yield, expected inflation)/Nominal yield variance
	0.84	17.61%
	(0.03)	(1.07%)

Panel B: Long Country-specific Sample - 2005Q3- 2016Q2

	Correlation(real yield, expected inflation)	2×Covariance(real yield, expected inflation)/Nominal yield variance
France	0.18	2.42%
	(0.15)	(0.98%)
Sweden	0.37	9.42%
	(0.10)	(2.64%)
UK	-0.22	-7.42%
	(0.13)	(4.10%)
US	0.45	5.73%
	(0.12)	(1.43%)

Panel C: Short Country-specific Sample - 2011Q2 - 2016Q2

	Correlation(real yield, expected inflation)	2×Covariance(real yield, expected inflation)/Nominal yield variance
Australia	0.62	23.83%
	(0.11)	(4.16%)
Japan	-0.87	-438.34%
	(0.06)	(611.93%)
France	0.49	14.98%
	(0.15)	(2.11%)
Germany	0.20	7.87%
	(0.21)	(4.25%)
Sweden	0.18	3.52%
	(0.10)	(2.28%)
UK	-0.59	-125.85%
	(0.13)	(32.23%)
US	-0.45	-6.50%
	(0.13)	(3.93%)

The results for longer maturities are similar except that the evidence of Tobin-Mundell effect is slightly weaker: the correlations between real rates and expected inflation are higher. Interestingly, Barr and Campbell (1997) document a small positive correlation between real yields and expected inflation in the UK, while I find a small but negative correlation. In addition to the non-overlapping samples, the difference in the results might be attributed to the fact that Barr and Campbell (1997) do not adjust the inflation-linked yields for liquidity, which, as suggested by Appendix G, might be negatively correlated with real yields.

Appendix J: Inflation-linked Yield Curve Slopes Variance Decompositions

Variance Decomposition of Inflation-linked Bond Yield Curve Slopes. The real yield variance contribution is computed as Covariance(Real yield curve slope, Inflation-linked yield curve slope)/Variance(Inflation-linked yield curve slope). The liquidity premium variance contribution is computed as Covariance(Liquidity premium yield curve slope, Inflation-linked yield curve slope)/Variance(Inflation-linked yield curve slope). The data is monthly. For each time point the world nominal, real, and liquidity premium yield curve slopes are computed as the GDP-weighted average of available countries' nominal, real, and liquidity premium yield curve slopes with GDP weights updated annually. The yields are annual zero-coupon yields. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Panel A: World Real Yield Curve Slope January 2001 - June 2016						
	10 year -5 year					
	Real yield	Liquidity premium	Inflation-linked slope standard deviation			
	92.29%	7.71%	0.35%			
	(6.15%)	(6.15%)	(0.01%)			
Panel B: Country-specific Inflation-linked Yield Curve Slopes - Long Sample - September 2005 - June 2016						
	10 year - 5 year			15 year - 10 year		
	Real yield	Liquidity premium	Inflation-linked slope standard deviation	Real yield	Liquidity premium	Inflation-linked slope standard deviation
France	106.20%	-6.20%	0.30%	75.73%	24.27%	0.12%
	(5.13%)	(5.13%)	(0.01%)	(4.31%)	(4.31%)	(0.01%)
Sweden	100.00%	0.00%	0.22%	100.00%	0.00%	0.13%
			(0.01%)			(0.01%)
UK	97.70%	2.30%	0.52%	94.70%	5.30%	0.27%
	(7.82%)	(7.82%)	(0.03%)	(7.54%)	(7.54%)	(0.01%)
US	78.27%	21.73%	0.37%	67.42%	32.58%	0.21%
	(10.71%)	(10.71%)	(0.01%)	(6.72%)	(6.72%)	(0.01%)
Panel C: Country-specific Inflation-linked Yield Curve Slopes - Short Sample - June 2011 - June 2016						
	10 year - 5 year			15 year - 10 year		
	Real yield	Liquidity premium	Inflation-linked slope standard deviation	Real yield	Liquidity premium	Inflation-linked slope standard deviation
Australia	102.19%	-2.19%	0.13%	142.92%	-42.92%	0.05%
	(11.51%)	(11.51%)	(0.01%)	(11.43%)	(11.43%)	(<0.01%)
France	99.79%	0.21%	0.27%	79.43%	20.57%	0.09%
	(9.61%)	(9.61%)	(0.01%)	(8.51%)	(8.51%)	(<0.01%)
Germany	92.70%	7.30%	0.24%			
	(8.19%)	(8.19%)	(0.01%)			
Sweden	100.00%	0.00%	0.15%	100.00%	0.00%	0.11%
			(0.01%)			(<0.01%)
UK	121.08%	-21.08%	0.28%	88.71%	11.29%	0.17%
	(5.60%)	(5.60%)	(0.01%)	(4.34%)	(4.34%)	(0.01%)
US	111.90%	-11.90%	0.23%	130.60%	-30.60%	0.15%
	(7.81%)	(7.81%)	(0.01%)	(6.63%)	(6.63%)	(<0.01%)

Appendix K: Nominal Yield Curve Slope Variance Decompositions

10 Year - 5 Year Nominal Yield Curve Slopes Variance Decomposition. The real yield variance contribution is computed as Covariance(Real slope, Nominal slope)/Variance(Nominal slope). The expected inflation contribution is computed as Covariance(Expected inflation slope, Nominal slope)/Variance(Nominal slope). The inflation risk premium contribution is computed as Covariance(Inflation risk premium slope, Nominal yield slope)/Variance(Nominal yield slope). The data is quarterly. For each time point the world nominal, real, expected inflation, and inflation risk premium yield curve slopes are computed as the GDP-weighted average of available countries' nominal, real, expected inflation, and inflation risk premium yield curve slopes with GDP weights updated annually. The yields are annual zero-coupon yields. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Panel A: World's Nominal Yield Curve Slope 2001Q1-2016Q2

	Real yield	Expected inflation	Inflation risk premium	Nominal slope standard deviation
	69.22%	0.39%	30.40%	0.49%
	(3.85%)	(0.98%)	(3.68%)	(0.03%)

Panel B: Country-specific Nominal Yield Curve Slopes - Long Sample -2005Q3-2016Q2

	Real yield	Expected inflation	Inflation risk premium	Nominal slope standard deviation
France	79.78%	-1.13%	21.35%	0.42%
	(5.45%)	(0.57%)	(5.24%)	(0.02%)
Sweden	55.61%	7.02%	37.37%	0.28%
	(8.79%)	(3.34%)	(9.53%)	(0.01%)
United Kingdom	103.53%	-5.91%	2.37%	0.55%
	(4.83%)	(2.12%)	(4.75%)	(0.04%)
United States	71.79%	6.95%	21.27%	0.47%
	(6.84%)	(0.99%)	(6.63%)	(0.04%)

Panel C: Country-specific Inflation-linked Yield Curve Slopes - Short Sample - 2011Q2 -2016Q2

	Real yield	Expected inflation	Inflation risk premium	Nominal slope standard deviation
Australia	105.89%	3.66%	-9.55%	0.12%
	(29.80%)	(13.25%)	(32.18%)	(<0.01%)
France	117.21%	-5.97%	-11.23%	0.27%
	(12.58%)	(1.51%)	(11.97%)	(0.02%)
Germany	109.33%	-7.75%	-1.58%	0.25%
	(13.18%)	(1.16%)	(12.83%)	(0.02%)
Sweden	44.13%	5.37%	50.50%	0.20%
	(16.93%)	(3.03%)	(16.58%)	(0.01%)
United Kingdom	137.69%	-35.02%	-2.66%	0.26%
	(13.41%)	(3.53%)	(11.05%)	(0.01%)
United States	84.87%	5.57%	9.56%	0.32%
	(5.78%)	(1.01%)	(5.43%)	(0.03%)

The 15 year - 10 year nominal slope variance decompositions are similar except the contribution of the real yield variance is slightly smaller and the contribution of the inflation risk premium variance is slightly larger.

Appendix L: Shorter Maturities Yield Curve Slopes

Shorter Maturities Inflation-linked Yield Curve Slopes Level Decomposition. The values are average over the sample. The data is monthly. The yields are annual zero-coupon yields. Standard errors in parentheses are autocorrelation adjusted paired t-test standard errors. *, **, and *** refer to the statistical significance at the 10%, 5%, and 1% significance level, respectively.

Japan Inflation-linked Yield Curve Slope: June 2011-June 2016					
5 year - 2 year					
Real yield	Liquidity premium	Inflation-linked			
1.50%***	-0.69%**	0.81%			
(0.15%)	(0.28%)	(0.74%)			
Germany Inflation-linked Yield Curve Slope: April 2011 - June 2016					
5 year - 2 year			10 year - 5 year		
Real yield	Liquidity premium	Inflation-linked	Real yield	Liquidity premium	Inflation-linked
1.02%***	-0.80%***	0.22%	0.08%	0.37%***	0.45%***
(0.17%)	(0.06%)	(0.17%)	(0.16%)	(0.06%)	(0.08%)
Korea Inflation-linked Yield Curve Slope: June 2013 - June 2016					
5 year - 3 year			10 year - 5 year		
Real yield	Liquidity premium	Inflation-linked	Real yield	Liquidity premium	Inflation-linked
0.29%***	-0.17%***	0.12%***	-0.27%***	0.29%***	0.02%
(0.03%)	(0.02%)	(0.03%)	(0.05%)	(0.04%)	(0.06%)
US Inflation-linked Yield Curve Slope: July 2004 - June 2016					
5 year - 2 year			10 year - 5 year		
Real yield	Liquidity premium	Inflation-linked	Real yield	Liquidity premium	Inflation-linked
0.83%***	-0.40%***	0.43%***	0.69%***	-0.10%	0.59%***
(0.12%)	(0.08%)	(0.15%)	(0.12%)	(0.07%)	(0.17%)

Shorter Maturities Nominal Yield Curve Slopes Level Decomposition. The values are average over the sample. The data is quarterly. The yields are annual zero-coupon yields. Standard errors in parentheses are bootstrap standard errors obtained by re-sampling the historical time-series 5,000 times.

Japan Nominal Yield Curve Slope: 2011Q2-2016Q2							
5 year - 2 year							
Real yield	Expected inflation	Inflation risk premium	Nominal				
1.46%	0.11%	-1.45%	0.11%				
(0.12%)	(0.08%)	(0.10%)	(0.02%)				
Germany Nominal Yield Curve Slope: 2011Q2-2016Q2							
5 year - 2 year				10 year - 5 year			
Real yield	Expected inflation	Inflation risk premium	Nominal	Real yield	Expected inflation	Inflation risk premium	Nominal
1.03%	0.29%	-0.89%	0.43%	0.10%	-0.00%	0.77%	0.86%
(0.07%)	(0.03%)	(0.03%)	(0.04%)	(0.07%)	(0.01%)	(0.03%)	(0.07%)
Korea Nominal Yield Curve Slope: 2013Q2-2016Q2							
5 year - 3 year				10 year - 5 year			
Real yield	Expected inflation	Inflation risk premium	Nominal	Real yield	Expected inflation	Inflation risk premium	Nominal
0.34%	0.10%	-0.24%	0.20%	-0.31%	0.08%	0.54%	0.31%
(0.06%)	(0.02%)	(0.05%)	(0.03%)	(0.05%)	(0.01%)	(0.05%)	(0.02%)
US Nominal Yield Curve Slope: 2004Q3-2016Q2							
5 year - 2 year				10 year - 5 year			
Real yield	Expected inflation	Inflation risk premium	Nominal	Real yield	Expected inflation	Inflation risk premium	Nominal
0.84%	0.12%	-0.23%	0.73%	0.67%	0.05%	0.19%	0.91%
(0.07%)	(0.02%)	(0.04%)	(0.08%)	(0.06%)	(0.01%)	(0.04%)	(0.07%)

Appendix M: Cross-Country Inflation Risk Premium and Expected Inflation Correlations

Cross-country 5 Year Inflation Risk Premium Correlations. Inflation risk premia are for zero-coupon nominal bonds. The data is quarterly. The bootstrap standard errors in parentheses are computed from 5,000 bootstrap simulations of historical length.

Panel A: Long Sample - 2015Q3-2016Q2

	France	Sweden	UK	US
France	1.00	0.51	0.21	0.59
		(0.11)	(0.14)	(0.10)
Sweden	0.51	1.00	0.10	0.59
	(0.11)		(0.15)	(0.13)
United Kingdom	0.21	0.10	1.00	0.13
	(0.14)	(0.15)		(0.17)
United States	0.59	0.59	0.13	1.00
	(0.10)	(0.13)	(0.17)	

Panel B: Short Sample -2011Q2-2016Q2

	Australia	France	Germany	Japan	Sweden	UK	US
Australia	1.00	0.52	0.61	0.38	0.24	-0.17	0.39
		(0.13)	(0.11)	(0.19)	(0.17)	(0.24)	(0.14)
France	0.52	1.00	0.90	0.51	0.28	-0.11	0.40
	(0.13)		(0.03)	(0.15)	(0.24)	(0.21)	(0.22)
Germany	0.61	0.90	1.00	0.51	0.51	-0.04	0.54
	(0.11)	(0.03)		(0.17)	(0.20)	(0.23)	(0.18)
Japan	0.38	0.51	0.51	1.00	-0.05	-0.04	0.57
	(0.19)	(0.15)	(0.17)		(0.21)	(0.20)	(0.15)
Sweden	0.24	0.28	0.51	-0.05	1.00	0.16	0.37
	(0.17)	(0.24)	(0.20)	(0.21)		(0.23)	(0.19)
UK	-0.17	-0.11	-0.04	-0.04	0.16	1.00	-0.14
	(0.24)	(0.21)	(0.23)	(0.20)	(0.23)		(0.23)
US	0.39	0.40	0.54	0.57	0.37	-0.14	1.00
	(0.14)	(0.22)	(0.18)	(0.15)	(0.19)	(0.23)	

Cross-country 5 Year Expected Inflation Correlations. The data is quarterly 2011Q2-2016Q2. The bootstrap standard errors in parentheses are computed from 5,000 bootstrap simulations of historical length.

	Australia	France	Germany	Japan	Sweden	UK	US
Australia	1.00	0.47	0.47	-0.63	0.39	0.69	0.21
		(0.16)	(0.16)	(0.20)	(0.15)	(0.12)	(0.20)
France	0.47	1.00	1.00	-0.53	0.38	0.84	0.41
	(0.16)			(0.12)	(0.16)	(0.05)	(0.16)
Germany	0.47	1.00	1.00	-0.53	0.38	0.84	0.41
	(0.16)			(0.12)	(0.16)	(0.05)	(0.16)
Japan	-0.63	-0.53	-0.53	1.00	-0.49	-0.56	-0.62
	(0.20)	(0.12)	(0.12)		(0.16)	(0.15)	(0.15)
Sweden	0.39	0.38	0.38	-0.49	1.00	0.37	0.29
	(0.15)	(0.16)	(0.16)	(0.16)		(0.15)	(0.16)
UK	0.69	0.84	0.84	-0.56	0.37	1.00	0.27
	(0.12)	(0.05)	(0.05)	(0.15)	(0.15)		(0.17)
US	0.21	0.41	0.41	-0.62	0.29	0.27	1.00
	(0.20)	(0.16)	(0.16)	(0.15)	(0.16)	(0.17)	