

# Global and Emerging Market Inflation-Linked Bonds

June 2017

Heathcoat House  
20 Savile Row  
London W1S 3PR  
United Kingdom  
Tel: +44 207 292 6920

885 Third Avenue  
24th Floor  
New York, NY 10022  
United States of America  
Tel: +1 646 472 1800

6 Battery Road #40-02A  
Six Battery Road  
Singapore 049909  
Singapore  
Tel: +65 3158 0222

Level 10  
20 Martin Place  
Sydney NSW 2000  
Australia  
Tel: +61 2859 92132



# Global and Emerging Market Inflation-Linked Bonds

## Contents

|   |    |
|---|----|
| Why Inflation-Linked Bonds – are they an effective hedge against inflation? ..... | 2  |
| Domestic versus Global Inflation-Linked Bond Markets .....                        | 2  |
| The Evolution of Inflation-Linked Bond Markets .....                              | 6  |
| Colchester's Approach to Investing in Inflation-Linked Bonds .....                | 7  |
| Current Valuations of Inflation-Linked Bonds .....                                | 8  |
| Appendix: Market Overview .....   | 10 |



## Why Inflation-Linked Bonds – are they an effective hedge against inflation?

The underlying rationale to hold inflation-linked bonds within a diversified asset portfolio is as a hedge against the erosion of purchasing power and as a protection against unexpected inflation. Experience in high inflation economies, particularly in Latin America, suggests that bonds providing a guaranteed real rate of return over the level of inflation provided better inflation insurance than exposure to a range of nominal financial assets or real assets. Intuitively this makes sense as the source or driver of inflation – cost push, demand pull, institutionalised indexation, unionised wage inflation, etc., - can vary through time. Accordingly, the sensitivity of different asset classes to inflation can also vary.

As inflation-linked bonds provide positive (and potentially negative) real return over inflation they are increasingly being utilised in an array of portfolios with differing investment objectives. Increasingly, inflation-linked bonds are used by pension funds to hedge their pension liabilities, by endowment funds to preserve their purchasing power, by other entities for asset-liability matching purposes or simply as insurance against unexpected inflation. Similarly, defined benefit pension schemes, and others with a need to match future indexed liabilities have an increasing demand for inflation-linked bonds. The asset class provides an effective hedge against future indexed liabilities provided there is no meaningful maturity mismatch.

Given the direct return link with inflation, it is not surprising that there is a high correlation of inflation-linked bond returns with inflation. Indeed, empirical studies of returns in the longer running inflation-linked bond markets like Brazil (and others) point to a strong correlation of returns with inflation. Furthermore, historically this correlation has increased with the investment horizon<sup>1</sup>. As inflation-linked bonds have been issued for a much shorter period of time in most developed markets (see below), it is more difficult to draw similar conclusions in those markets. Nonetheless, the body of evidence suggests that inflation-linked bonds may be expected to provide a consistent hedge against both 'expected' and 'unexpected' inflation through time.

In contrast, the academic and empirical evidence suggests that many other asset classes believed to be good inflation hedges have failed to provide consistent inflation protection through all different economic cycles. Asset classes proven to be a reasonable hedge against inflation in one cycle have not performed as well in others, as the source or type of inflation has varied; starting valuations have differed, etc. Studies show equities have historically been an ineffective hedge against inflation and even act as a perverse hedge<sup>2</sup>. Similarly, the academic evidence suggests that they, along with nominal bonds, have been a poor hedge against unexpected inflation<sup>3</sup>. Historically, real assets have not fared much better either. While the evidence supporting the inflation hedging characteristics of real estate is mixed, recent research suggests that it too has not provided a consistent hedge against unexpected inflation<sup>4</sup>. Here starting valuations and the potentially higher beta or exposure of property to the broader economic environment may have a greater influence. For example, inflation has been higher than the movement in real estate prices for a sustained period in the aftermath of the Global Financial Crisis (GFC) in the 2000's. Furthermore, commercial property prices in the UK and elsewhere have notably lagged domestic inflation in the post GFC period at a time of on-going structural economic weakness.

Lastly, commodities are often considered a good inflation hedge. This may be the case when commodity prices are a dominant driver of inflation, but is less so when other inflation drivers such as domestic wage inflation or persistent indexation are more important. The high volatility of commodities also limits their potential role within a diversified portfolio as a core inflation hedge asset. With a volatility of some 4 times that of inflation-linked bonds, the 'hurdle rate' for commodities to play a significant risk mitigation or hedge role within a diversified portfolio is high<sup>5</sup>.



## Domestic versus Global Inflation-Linked Bonds

A desire to hedge domestic liabilities often constrains asset allocators to consider their inflation hedge purely in domestic market and domestic currency terms. This may be sub-optimal as, like any other asset class allocation decision, improved risk and return characteristics may be achieved by going global. The rationale to invest in global inflation-linked bonds, as opposed to stay domestic, rests on the enhanced real return potential and improved diversification characteristics (i.e. lower volatility) of the asset class. Importantly, this is achieved with only a small 'give up' of the domestic inflation hedge.

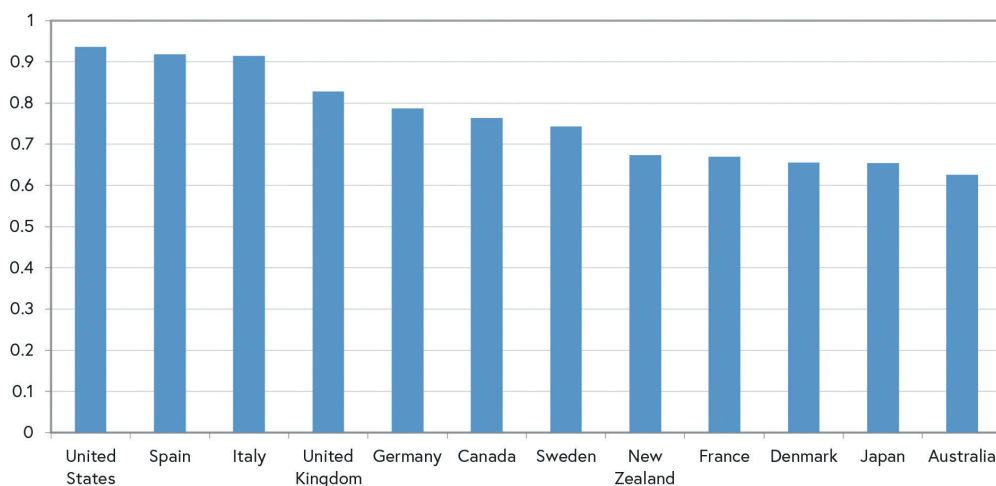
### *Inflation rates are highly correlated around the world*

Often overlooked in the debate about whether to invest in global, as opposed to domestic inflation-linked bonds, is the global beta of inflation. Namely, the drivers of inflation in one country are often highly correlated with those in another. For example, a rise (or fall) in commodity prices feeds through into all inflation rates, a demand driven economic slowdown has a similar impact on global inflation, and so on. While the sensitivity of each country to different inflation shocks is in part a function of the composition of the CPI basket (e.g. more food and necessities in lower per-capita income countries' CPIs results in a greater price sensitivity to these components), this 'common' exposure results in a relatively high correlation of inflation rates across the world.

This high correlation of domestic inflation with global inflation has been widely observed in a number of academic studies. By way of example, recent work by Ciccarelli and Mojon (2010)<sup>6</sup> suggests that the global inflation component among OECD countries may be as high as 70%, with a strong tendency for individual country inflation to follow the long term global trend. Similarly, work by Neely and Rapach (2011)<sup>7</sup> looking at a much broader group of 64 countries, including developing economies, suggests that on average 35% of an individual country's inflation is explained by global inflation and 16% by regional inflation. Both studies covered a long time period spanning the acceleration of inflation in the 1960s and 1970s, and subsequent deceleration thereafter through to the present time.

This phenomenon can also be seen in Chart 1 below. The average correlation of domestic inflation in developed countries (where there is issuance of inflation-linked bonds) with Advanced World Inflation<sup>9</sup> has been in the order of 0.76 since the late 1980s<sup>10</sup>. This suggests that the 'actual' tracking error of substituting global for domestic inflation-linked bonds is significantly lower than generally assumed.

**Chart 1: Correlation of Individual Country with Advanced World Inflation<sup>8</sup>**

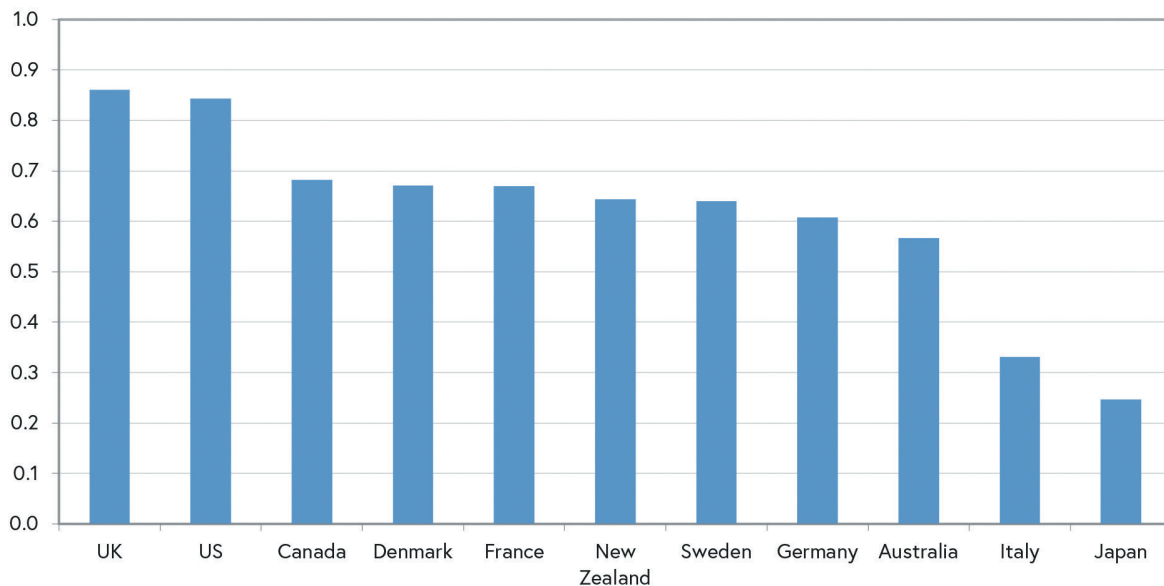




*As a result, global inflation linked bond market returns are reasonably correlated*

This relatively high correlation of domestic with global inflation has historically resulted in a meaningful correlation of individual inflation-linked bond market returns with the global inflation-linked index returns (see Chart 2 below). Notwithstanding the high weight of both the US (approximately 45%) and the UK (27%) in the Bloomberg Barclays Global Inflation-Linked Bond benchmark, their respective return correlations with the global index are relatively high, and are in the order of 0.8 to 0.9 together with Spain and Italy. Similarly, the much smaller weighted countries like Germany, France, Japan and Canada all have return correlations in the order of 0.7. This suggests that an investor in global inflation-linked bonds, particularly a US or UK investor, is getting most of the domestic 'inflation insurance' by investing globally but also has the potential to benefit from the increased diversification and return opportunities afforded by investing globally.

**Chart 2: Correlation of Individual Country Inflation Linked Bond Returns with Global Inflation Linked Bond Returns<sup>11</sup>**

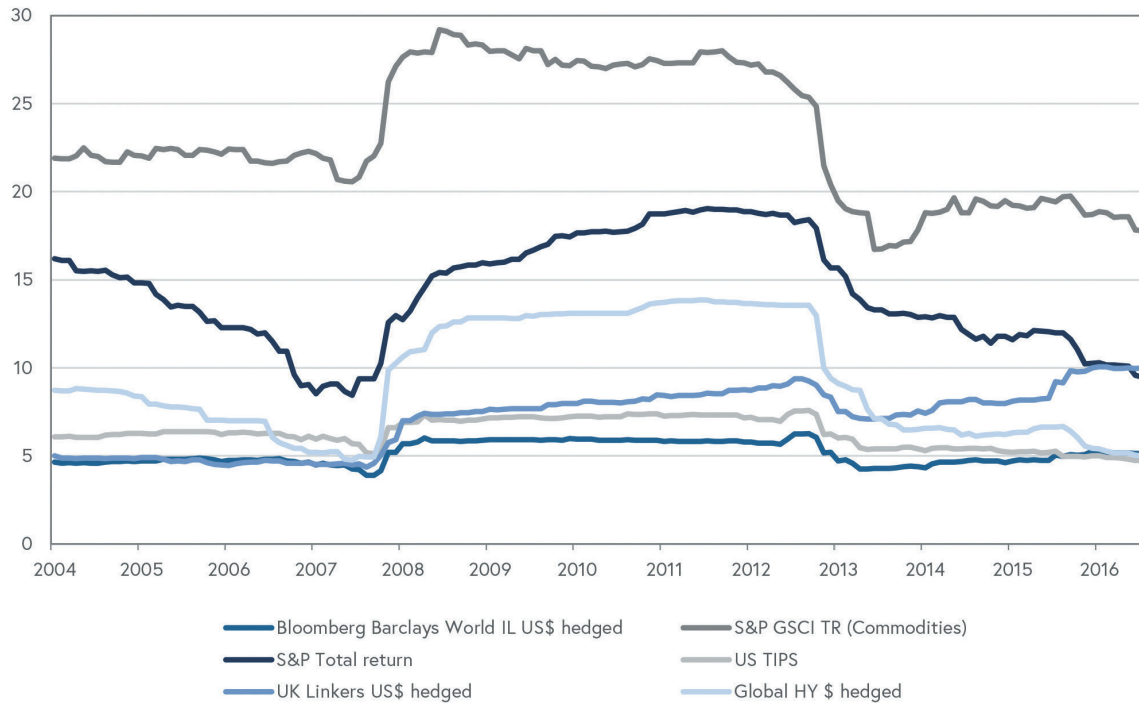


*Global diversification produces lower volatility*

The lower volatility of global inflation-linked bonds relative to both individual domestic inflation-linked bond markets and other alternative asset classes is evident in both Charts 3 and 4 below. While the relatively short time period since inception of most of these inflation-linked bond markets suggests some caution in interpreting this data, it should be apparent that the volatility of the global index has (as expected) been lower than the individual domestic indices over this period. Furthermore, the asset class has lower volatility than a number of other asset classes, including commodities; the latter often touted as an inflation hedge.



**Chart 3: Five Year Rolling Annualised Volatility<sup>12</sup>**

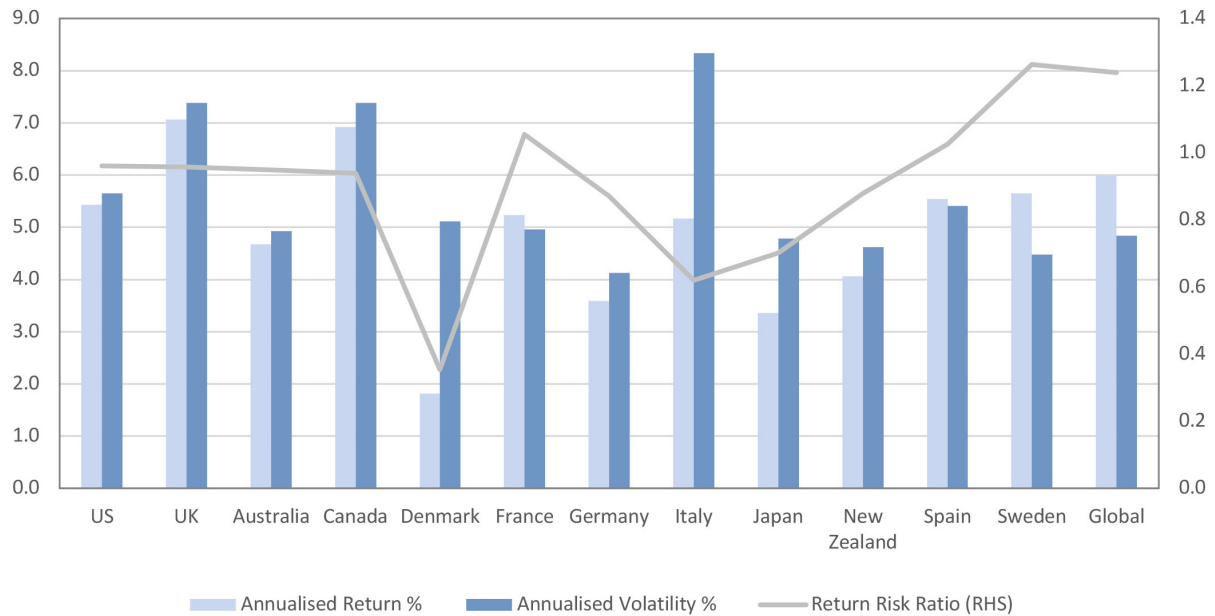


The improved risk-reward characteristics are clearly evident in Chart 4 below, charting annualised returns, volatility and the resulting risk reward ratio in USD hedged terms since inception of the respective countries and the aggregate global inflation-linked index. The global index has better risk-reward characteristics than all individual markets with the exception of Sweden (where it is approximately the same). In summary, global diversification has generally provided better risk-return characteristics than singular country exposure.

Lastly, while the return of the global inflation-linked benchmark is relatively highly correlated with the return of the US and UK domestic inflation bond markets (Chart 2) there is significant diversity within the global opportunity set. Table 1 below highlights the low, and in some instances negative, correlation between the alternative markets in the opportunity set. While the correlation between the US and UK is in the order of 0.48, that between Australia and Italy is 0.38 and Australia and Poland is 0.28. Similarly, the Swedish market has had a correlation of just 0.16 with Japan. Such low or negative correlations provide excellent diversification potential, improving the overall risk and reward characteristics of a potential global portfolio.



### Chart 4: Inflation-Linked Bond Market Risk-Return Characteristics Since Inception<sup>13</sup>



### Table 1: Correlation of 5 Year Monthly Returns in US dollar Hedged<sup>14</sup>

|              | Australia | Canada | France | Germany | Italy | Japan | Sweden | UK   | US   | Brazil | Mexico | Poland | South Africa |
|--------------|-----------|--------|--------|---------|-------|-------|--------|------|------|--------|--------|--------|--------------|
| Australia    | 1.00      |        |        |         |       |       |        |      |      |        |        |        |              |
| Canada       | 0.54      | 1.00   |        |         |       |       |        |      |      |        |        |        |              |
| France       | 0.45      | 0.56   | 1.00   |         |       |       |        |      |      |        |        |        |              |
| Germany      | 0.30      | 0.42   | 0.87   | 1.00    |       |       |        |      |      |        |        |        |              |
| Italy        | 0.38      | 0.36   | 0.46   | 0.31    | 1.00  |       |        |      |      |        |        |        |              |
| Japan        | 0.12      | 0.27   | 0.30   | 0.33    | 0.22  | 1.00  |        |      |      |        |        |        |              |
| Sweden       | 0.45      | 0.48   | 0.65   | 0.60    | 0.32  | 0.16  | 1.00   |      |      |        |        |        |              |
| UK           | 0.37      | 0.38   | 0.37   | 0.37    | 0.19  | 0.05  | 0.47   | 1.00 |      |        |        |        |              |
| US           | 0.57      | 0.75   | 0.63   | 0.55    | 0.26  | 0.35  | 0.53   | 0.48 | 1.00 |        |        |        |              |
| Brazil       | 0.32      | 0.36   | 0.39   | 0.34    | 0.25  | 0.14  | 0.16   | 0.24 | 0.61 | 1.00   |        |        |              |
| Mexico       | 0.51      | 0.45   | 0.50   | 0.41    | 0.14  | 0.26  | 0.29   | 0.37 | 0.75 | 0.52   | 1.00   |        |              |
| Poland       | 0.28      | 0.39   | 0.40   | 0.32    | 0.38  | 0.16  | 0.19   | 0.30 | 0.39 | 0.41   | 0.32   | 1.00   |              |
| South Africa | 0.30      | 0.27   | 0.57   | 0.52    | 0.29  | 0.26  | 0.31   | 0.17 | 0.50 | 0.50   | 0.55   | 0.49   | 1.00         |

## The Evolution of Inflation-Linked Bond Markets

An investor looking to invest globally in inflation-linked bonds is confronted by a diverse and growing opportunity set in both developed and developing markets. Their use is more entrenched in a number of developing economies, with most developed economies only beginning issuance from the 1990s onwards. Not surprisingly, the Latin American countries were at the forefront of developing the use of inflation-linked bonds. The persistent and diverse nature of the inflation shocks that frequently rolled across the continent promoted the growth of the asset class. Brazil, for example, issued its first inflation-linked bond in 1964. Even though the threat of hyperinflation has subsequently eased on the continent as many



countries have adopted orthodox macro-economies policies, they have remained an asset of choice in many Latin economies. In addition to Brazil, they are now firmly entrenched in Argentina, Chile, Colombia, Mexico and Peru.

In contrast, the asset class is relatively new in the developed world. While the UK established the 'linker' market in 1981 most other developed countries like Australia, Canada, Sweden, France and the US only started issuing inflation-linked bonds in the 1990s. The largest market – the US TIPS market – only began in 1997. More recently the likes of Germany, Japan, Denmark, Hong Kong, Spain, to name a few, have all started issuing inflation-linked bonds<sup>15</sup>.

While the number and size of issuance varies by market, a number of countries have now developed deep and liquid inflation-linked yield curves extending from 2 through to 30 years. The US and the UK, for example, had some 41 and 58 inflation-linked bonds on issue respectively across the entire maturity spectrum in mid-2017. The UK has even issued a 50-year bond stretching the curve out to 2068. The Australian government restarted its inflation-linked bond program in 2009 and now has a developed inflation-linked curve extending out to 2040. Latin America's historical experience has resulted in many of those countries developing full maturity yield curves, with the likes of Mexico and Brazil having maturities all the way out to 2046 and 2055, respectively. In contrast, more recent issuers offer fewer maturities; Poland has one bond with a maturity of 2023 and South Korea (who begun issuance in 2007) has five bonds of maturities of 2020, 2021, 2023, 2025 and 2026. More recently, New Zealand has re-entered the market and has four bonds with maturities of 2025, 2030, 2035 and 2040. Ireland has also recently issued a private placement bond with a maturity extending to 2040. While the length of maturity and market depth varies across countries, there is a clear commitment across many sovereign debt management offices to develop this market and to continue to improve liquidity in this asset class to meet increasing demand.

## Colchester's Approach to Investing in Inflation-Linked Bonds

Colchester believes its real yield value based approach to managing bond portfolios is particularly well suited to managing inflation-linked bond portfolios. At the heart of Colchester's philosophy is the belief that investments should be valued in terms of the income they will generate in real terms. The approach was developed using key actuarial principles which have at their core inflation-adjusted income and principal present valuing techniques. The investment approach is therefore based on the analysis of inflation, real interest rates and real exchange rates, supplemented by an assessment of sovereign financial balances – fiscal, external and monetary. Portfolios are constructed to benefit from those opportunities with the greatest relative real investment potential for a given level of risk.

Underpinning the investment approach is a forecast of inflation. The forecasts are underpinned by standard monetary theory, commodity and nominal currency movements and capacity utilisation considerations. Armed with these forecasts and supplemented with an assessment of the financial strength of a country, Colchester then makes an assessment of the potential real return on offer in both inflation-linked and nominal bond markets and across various segments of the yield curve. An optimal bond portfolio is then constructed, utilising the highest real yielding global government bonds and segments, subject to a tracking error target, concentration limits and other risk considerations.

Within this framework, Colchester seeks to add value in its inflation-linked bond programs by:

- Investing in the highest real yielding inflation-linked bond markets;
- Investing in the highest value part of a country's inflation-linked yield curve;
- Investing in high real yielding nominal bonds in a limited and constrained fashion when appropriate; and,





- Adding some additional alpha through its currency management.

Colchester invests only in sovereign bonds. For the developed Global Inflation-Linked program, the universe includes markets that are investment grade or higher although different minimum credit ratings may be applied at the discretion of separate account clients. Colchester applies a qualitative screen to all countries to decide upon their inclusion, or otherwise, in the opportunity set. Size of market, liquidity, institutional structure, regulatory environment, capital regulations, political environment, stability issues, etc., are all considered by Colchester in its determination of the suitability of a country to be included in the opportunity set. Colchester considers the current global inflation-linked investment universe to be broken down as follows:

#### Developed World Inflation-Linked Bond Universe (investment grade or higher)

|           |         |              |                |               |
|-----------|---------|--------------|----------------|---------------|
| Australia | France  | Mexico       | South Korea    | United States |
| Brazil    | Germany | New Zealand  | Spain          |               |
| Canada    | Italy   | Poland       | Sweden         |               |
| Denmark   | Japan   | South Africa | United Kingdom |               |

#### Developing World (EM) Inflation-Linked Universe

|           |          |        |              |         |
|-----------|----------|--------|--------------|---------|
| Argentina | Colombia | Mexico | South Africa | Turkey  |
| Brazil    | Poland   | Peru   | South Korea  | Uruguay |
| Chile     | Israel   | Russia | Thailand     |         |

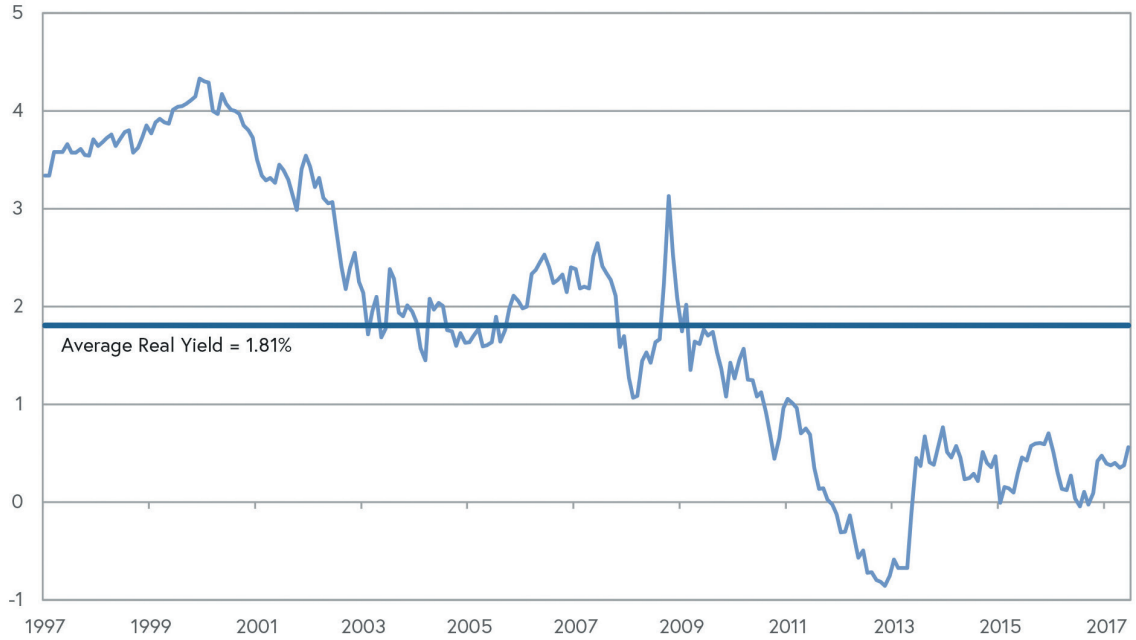
Lastly, Colchester's well-established currency valuation framework uses estimates of real exchange rates, short term real interest rate differentials and external balance factors to determine value. Optimal currency portfolios are built, and as noted above, risk managed within this framework to provide another potential source of lowly correlated alpha. Together, Colchester's independently constructed optimal bond and currency portfolios deliver a well-diversified overall global inflation-linked government bond portfolio.

## Current Valuations of Inflation-Linked Bonds

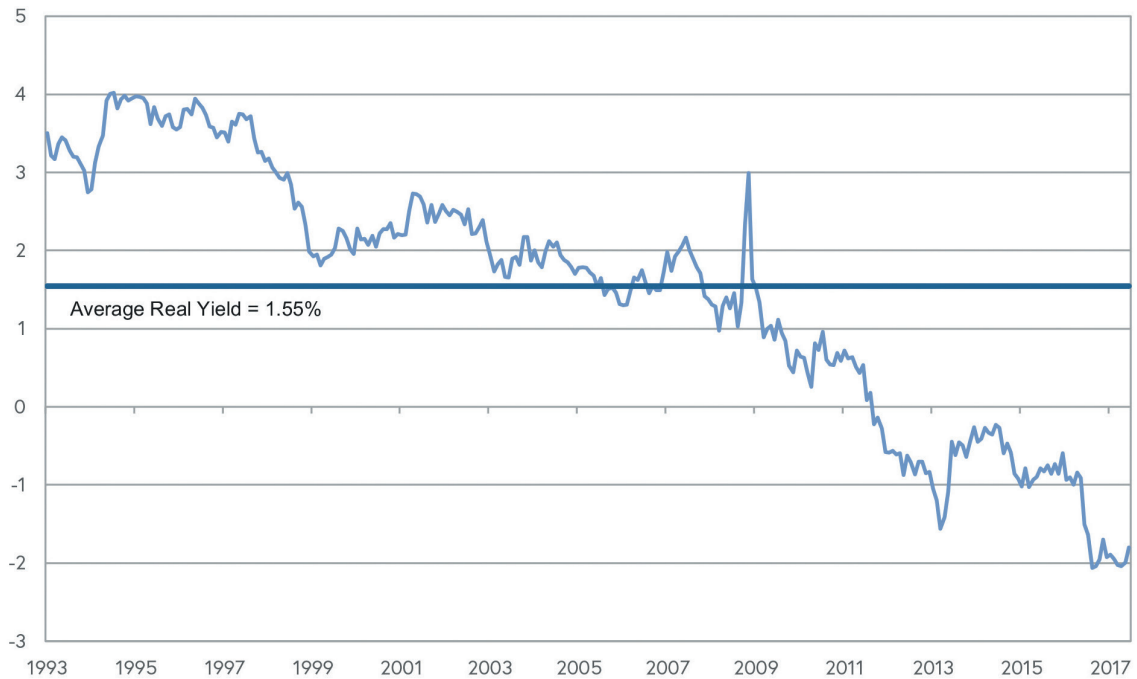
As at the end of June 2017, US TIPS were offering a real yield of 0.6 whilst UK Linkers were offering a negative real yield of minus 1.8% in the 10-year maturity. Not only are these absolute yields near historic lows but they are also low relative to the average real yield on offer since inception of approximately 1.8% and 1.5% in the US and UK respectively (see Charts 5 and 6). This suggests that both US TIPS and UK Linkers are expensive in absolute and relative terms. As illustrated in Chart 7, both markets were offering a lower real yield than that on offer in a number of other global inflation-linked markets. In fact, UK Linkers reached an all-time low of minus 2.25% in April 2017 and are approximately 1% less than that on offer in Germany. This suggests that a diverse portfolio of global inflation-linked bonds could be constructed including the likes of Colombia and Mexico that would offer a substantially higher real yield pick-up over both US and UK domestic inflation-linked bonds. As discussed above such a portfolio would also offer attractive diversification and correlation benefits relative to the aggregate portfolio.



**Chart 5: 10 Year US TIP Real Yield Since Inception**

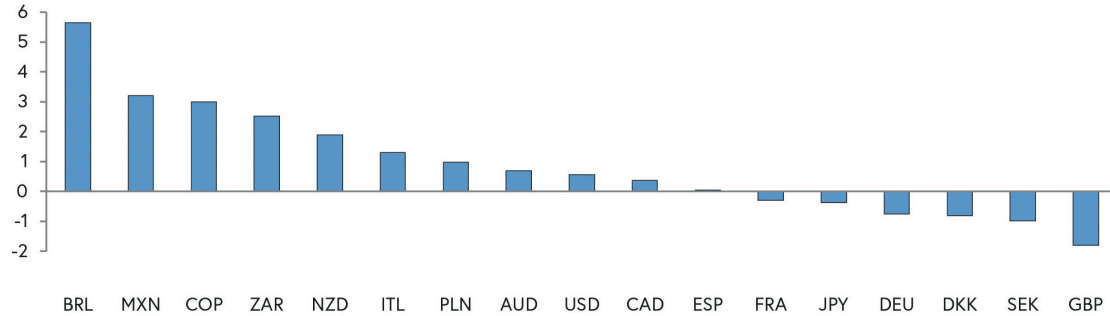


**Chart 6: 10 Year UK Linker Real Yield Since Inception**



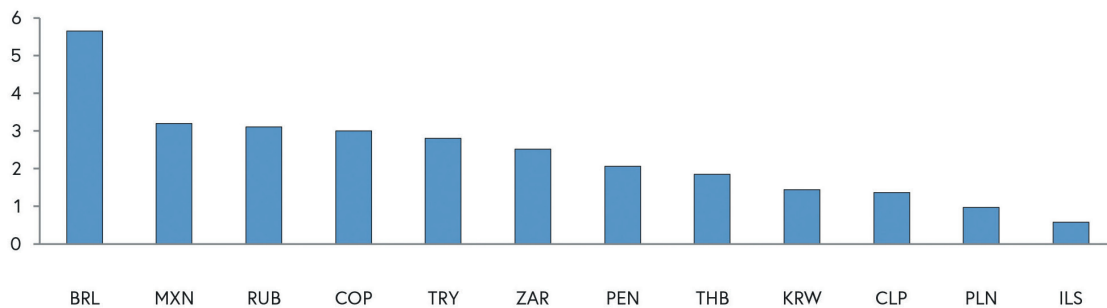


**Chart 7: Market Real Yield on 10 Year Inflation-Linked Bonds as end June 2017**



|     |           |     |         |     |                |     |               |     |              |
|-----|-----------|-----|---------|-----|----------------|-----|---------------|-----|--------------|
| AUD | Australia | DEU | Germany | GBP | United Kingdom | NZD | New Zealand   | ZAR | South Africa |
| BRL | Brazil    | DKK | Denmark | ITL | Italy          | PLN | Poland        |     |              |
| CAD | Canada    | ESP | Spain   | JPY | Japan          | SEK | Sweden        |     |              |
| COP | Colombia  | FRA | France  | MXN | Mexico         | USD | United States |     |              |

**Chart 8: Emerging Market Real Yield on 10 Year Inflation-Linked Bonds as end June 2017**



|     |           |     |        |     |          |     |              |
|-----|-----------|-----|--------|-----|----------|-----|--------------|
| ARS | Argentina | ILS | Israel | PLN | Poland   | UYU | Uruguay      |
| BRL | Brazil    | KRW | Korea  | RUB | Russia   | ZAR | South Africa |
| CLP | Chile     | MXN | Mexico | THB | Thailand |     |              |
| COP | Colombia  | PEN | Peru   | TRY | Turkey   |     |              |

## Appendix: Market Overview

Information on each market can be found in the table below. Specifically, as noted above, today's global government inflation-linked bond markets in the developed world originated in their current form in the UK in 1981. Issuance subsequently followed chronologically in Australia, Canada, Sweden, New Zealand, the US, France, Italy, Japan and Germany.

Inflation-linked bonds were issued in the (former) emerging markets well before the developed markets, although not in their



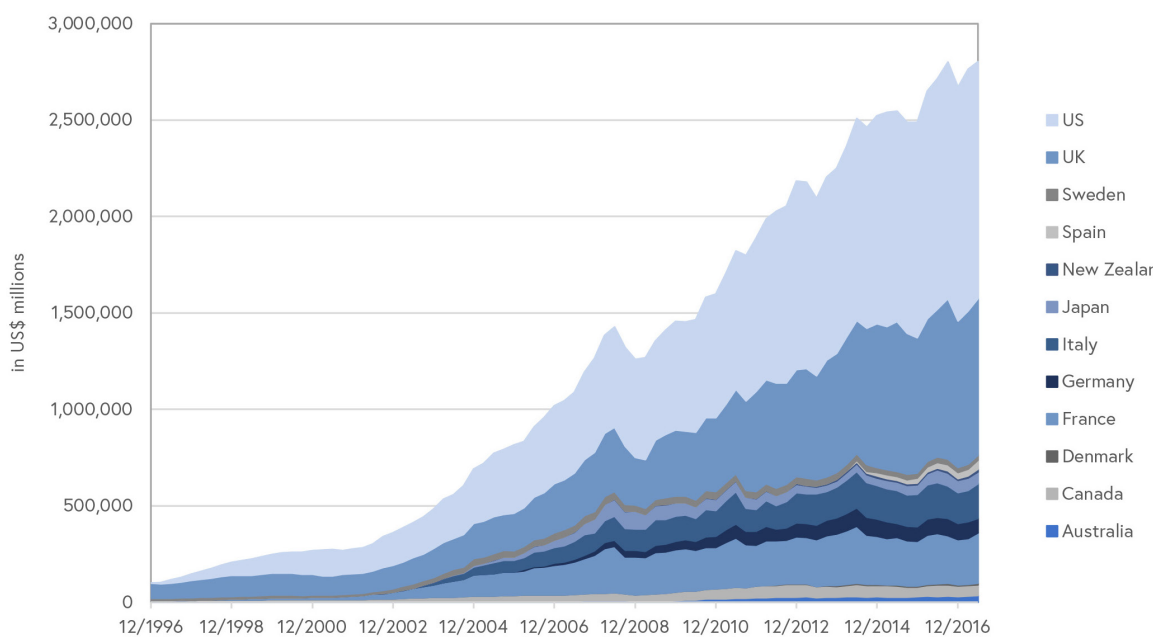
current form. Amongst the largest and oldest local inflation-linked bond markets are Israel (first issued in 1948), Brazil (1964) and Mexico (1996 in their current form). The popularity of inflation-linked bonds in the latter two markets and elsewhere in Latin America increased significantly as those countries went through crises during the 1980s and 1990s. Other smaller markets followed suit throughout the 1990s and in the 2000s like Poland (2003), South Korea (2007) and Turkey (2007). More recently the likes of Denmark and Spain have all issued inflation-linked bonds.

Colchester assesses the depth and limitations of each inflation-linked market rigorously. Each new market Colchester identifies for inclusion within the inflation-linked investment opportunity set is subject to an assessment before investment commences. The review includes:

- Institutional arrangements and market operations, including settlement, restrictions on local currency, registration and certification requirements etc.
- The range and nature of active market counterparties.
- The key features of acceptable securities within the market.
- Market liquidity.
- Withholding tax framework, including the income and capital gains tax consequences of investment in the market and the potential impact of those costs (broad implications based on jurisdiction and entity type).

The charts below show the growth of the developed or advanced country and developing government inflation-linked bond markets.

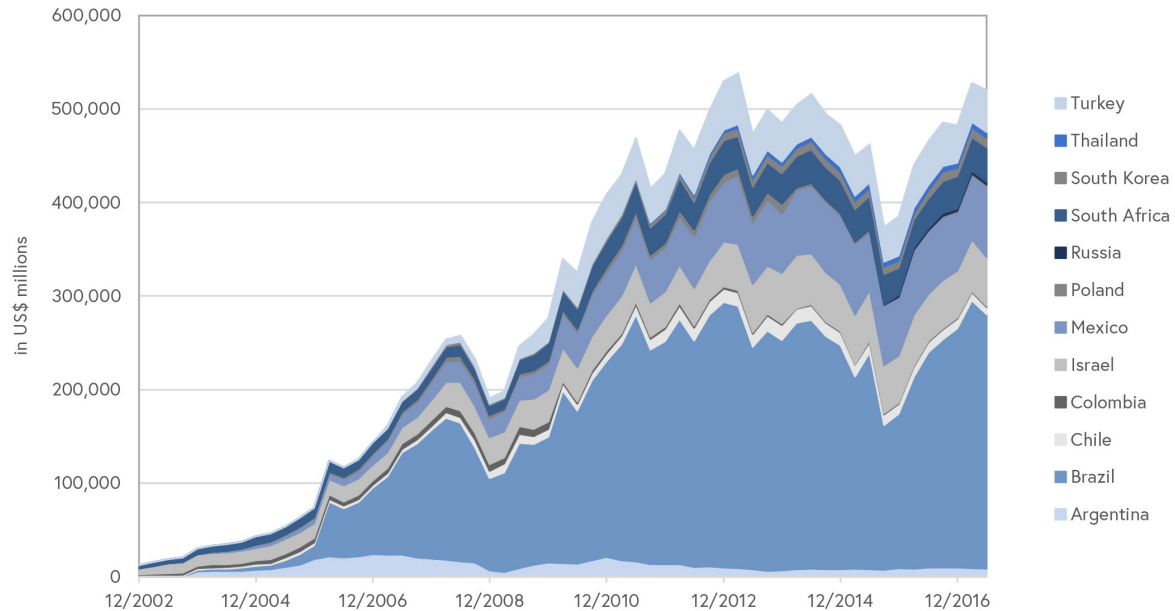
**Chart 9: Growth of Inflation-Linked Issuance in Developed Market Opportunity Set**



Source: Bloomberg Barclays



### Chart 10: Growth of Inflation-Linked Issuance in Developing Market Opportunity Set



Source: Bloomberg Barclays

### Table 2: Inflation-Linked Bond Information by Country of Issuance

|  | UK                                | Australia                        | Canada                     | Sweden                                 | New Zealand                              | Mexico                    | US  | France                                      | South Africa                   | Brazil                            | Chile                   | Colombia                 |
|--|-----------------------------------|----------------------------------|----------------------------|--|--|---------------------------|---|---|--------------------------------|-----------------------------------|-------------------------|--------------------------|
| Generic Name                             | United Kingdom Index-Linked Gilts | Australian Capital Indexed Bonds | Canadian Real Return Bonds | Swedish Government Index-Linked        | New Zealand Inflation-Indexed Bond (IIB) | Udibonos                  | Treasury Inflation Indexed Securities, TIPS, TIPS | OATi, OAT€i, BTAN€i                         | South Africa Index-Linked bond | NTN-Bs, NTN-Cs                    | BCU                     | TES                      |
| First Issue Date at their current format | Mar-81                            | Jul-85                           | Dec-91                     | Apr-94                                 | Nov-95**                                 | May-96                    | Jan-97  | Sep-98                                      | Mar-00                         | May-00                            | Sep-02                  | Oct-02                   |
| Linking Index                            | RPI                               | All Groups CPI                   | CPI All Items nsa          | CPI nsa                                | New Zealand All Groups CPI               | Unidas de Inversion (UDI) | CPI All Urban nsa                                 | French CPI ex-tobacco; Euro HICP ex-tobacco | South Africa CPI NSA           | IPCA, IGPM                        | UF CPI                  | UVR CPI                  |
| Linking Index Bloomberg Ticker           | UKRPI Index                       | AUCPI Index                      | CACPI Index                | SWCPI Index                            | NZCPCPI Index                            | MXUDI Index               | CPURNSA Index                                     | FRCPXTOB Index, CPTFEMU Index               | SACPI Index                    | BZPIIPCA Index                    | CLUFUF Index            | COCPI Index              |
| Indexation Lag                           | 8 months or 2-3 months            | 6 months                         | 2-3 months                 | 2-3 months                             | 6 months                                 | up to 2 weeks             | 2-3 months  | 2-3 months                                  | 3-4 months                     | Up to 4 weeks, includes forecasts | 1 month to 9th of month | 1 month to 15th of month |
| Par Floor?                               | No floor                          | Coupon and principal par floor   | No floor                   | Par floor for new issuances since 1999 | Coupon and principal par floor           | Par floor                 | Par floor   | Par floor                                   | Par floor                      | No floor                          | No floor                | No floor                 |
| Coupon frequency                         | Semi-annual                       | Quarterly                        | Semi-annual                | Annual                                 | Quarterly                                | Semi-annual               | Semi-annual                                       | Annual                                      | Semi-annual                    | Semi-annual                       | Semi-annual             | Monthly                  |
| Market value outstanding US\$m*          | 811,051                           | 34,267                           | 57,500                     | 28,007                                 | 12,717                                   | 76,399                    | 1,227,187   | 261,984                                     | 36,991                         | 272,118                           | 7,829                   | 1,229                    |



|  | Peru                            | Poland         | Italy                | Argentina                               | Japan                                  | Germany              | Israel   | South Korea | Turkey      | Uruguay                                | Thailand     | Denmark        | Spain                | Russia       |
|--|---------------------------------|----------------|----------------------|---|--|----------------------|--|-------------|-------------|--|--------------|----------------|----------------------|--------------|
| Generic Name                             | VAC                             | POLGB          | BTP€i                | Argentinean Government Inflation-linked | JGBi                                   | OBL€i, DBR€i         | Galil, ILCPI   | KTBi        | TURKGB      | UI                                     | THAIGB       | DGBi           | SPGB€i               | RFLBi        |
| First Issue Date at their current format | Jun-03                          | Sep-03         | Sep-03               | Dec-03                                  | Mar-04                                 | Mar-06               | Jun-06   | Feb-07      | Feb-07      | Jun-07                                 | Jul-11       | May-12         | May-14               | Jul-15       |
| Linking Index                            | VAC Index linked to monthly CPI | Polish CPI     | Euro HICP ex-tobacco | CER Consumer Price Index                | Nationwide CPI General ex-Fresh Food   | Euro HICP ex-tobacco | Israel CPI   | Korean CPI  | Turkish CPI | Uruguay Indexed Unit (Unidad Indexada) | Thailand CPI | Denmark CPI    | Euro HICP ex-tobacco | Russia CPI   |
| Linking Index Bloomberg Ticker           | PRVAC Index                     | POCPIYOY Index | CPTFEMU Index        | ARCPI Index                             | JCPNGENF Index                         | CPTFEMU Index        | ISCPINM Index  | KOCPI Index | TUCPI Index | URUIRUI Index                          | THCPI Index  | DNCPINEW Index | CPTFEMU Index        | RUCPNL Index |
| Indexation Lag                           | 1 month                         | 2-3 months     | 2-3 months           | T-5, T-10 to ACERER Index               | 2-3 months to 10th of month            | 2-3 months           | Up to 1.5 months adjusted on inflation reslease          | 2-3 months  | 2-3 months  | 1 month                                | 2-3 months   | 2-3 months     | 2-3 months           | 3-4 months   |
| Floor?                                   | No floor                        | Par floor      | Par floor            | No floor                                | Par floor for new issuances since 2013 | Par floor            | Coupon and principal par floor (Galil), No floor (ILCPI) | No floor    | Par floor   | No Floor                               | Par floor    | Par floor      | Par floor            | Par floor    |
| Coupon frequency                         | Semi-annual                     | Annual         | Semi-annual          | Monthly or semi-annual                  | Semi-annual                            | Annual               | Annual   | Semi-annual | Semi-annual | Semi-annual                            | Semi-annual  | Annual         | Annual               | Semi-annual  |
| Market value outstanding US\$mn*         | 1,130                           | 1,371          | 178,778              | 8,586                                   | 62,982                                 | 75,269               | 51,643   | 10,026      | 44,979      | 3,000                                  | 6,198        | 6,272          | 46,555               | 9,455        |

\*as of 30/06/2017

\*\*relaunch of the New Zealand's government indexed bond market

Sources: Barclays, Colchester, National Treasury Departments

Note: Table 2 includes only those Inflation-linked government bond markets within Colchester's universe.



<sup>1</sup> See Brière, M. and Signori, O., (2011) "Hedging inflation risk in a Developing Economy" Available at SSRN: <http://ssrn.com/abstract=1805512>

<sup>2</sup> See for example Fama, E. F. and Schwert, G. W., (1977) "Asset returns and inflation", *Journal of Financial Economics*, 5(2), p.115-146. And Fama, E.F., (1981). *Stock Returns, Real Activity, Inflation, and Money*, *American Economic Review*, 74 (4), p. 545-565.

<sup>3</sup> See Bekaert G. and Wang X., (2010) "Inflation Risk and the Inflation Risk Premium", *Economic Policy*, 25(64), October, p. 755-806.

<sup>4</sup> See Hoesli M., Lizieri C. and MacGregor B., (2008) *The Inflation Hedging Characteristics of US and UK Investments: A Multi-Factor Error Correction Approach*, *Journal of Real Estate Finance and Economics*, 36(2), p.183-206.

<sup>5</sup> For example, for the US TIPS market in January 1997 to June 2017 the annualized volatility of monthly returns of US TIPS (Bloomberg Barclays Index) has been 5.7%, compared with 22.6% for the Goldman Sachs Commodities Index (GSCI).

<sup>6</sup> Ciccarelli M. and Mojon B., (2010). *Global Inflation*, *The Review of Economics and Statistics*, 92(3), p.524-535.

<sup>7</sup> Neely C. and Rapach D., 2011. *International co-movements in Inflation rates and Country Characteristics*, *Journal of International Money and Finance*, 30, p.1471-1490.

<sup>8</sup> Source IMF. 'Advanced Economies' as defined by the IMF to include the following 39 countries: Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong SAR, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Malta, Macao SAR, Netherlands, New Zealand, Norway, Puerto Rico, Portugal, San Marino, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan Province of China, United Kingdom, and United States.

<sup>9</sup> A time period chosen to coincide with the period most of these countries have been issuing inflation linked bonds.

<sup>10</sup> See footnote 8 above for definition of 'Advanced World'. Correlations calculated from 1989 to 2016.

<sup>11</sup> Source: Bloomberg Barclays Index return data in USD hedged terms. Correlation estimates use monthly data for the 5 years to end June 2017.

<sup>12</sup> Source: Bloomberg and Bloomberg Barclays Index return data in USD hedged terms. Five years rolling to end June 2017.

<sup>13</sup> Source: Bloomberg Barclays Index return data in USD hedged terms since inception.

<sup>15</sup> Source: Bloomberg Barclays Index return data in USD hedged terms. Correlation estimates use monthly data for the 5 years to end June 2017.

<sup>16</sup> A full list of countries currently issuing inflation-linked bonds can be found in the appendix.

---

Investment professional only. Not for public distribution. This commentary reflects Colchester's views and opinions as of end June 2017 and are subject to change without notice. The opinions do not take into account individual investor circumstances, objectives or needs and are not intended as recommendations of particular strategies to particular investors. Nothing in this paper should be construed as providing any type of investment or other advice, nor should anything in this note be considered a solicitation, recommendation, endorsement or offer to purchase or sell any financial security or other financial instrument. Colchester makes no representation or warranty as to the accuracy or completeness of the information contained herein. Past performance is not necessarily a guide or guarantee of future results. The value of investments may fall as well as rise.

Prospective investors should be aware that any investment involves a high degree of risk.

Colchester Global Investors Limited is authorised and regulated by the Financial Conduct Authority in the United Kingdom and registered with the Securities and Exchange Commission in the United States. Colchester Global Investors Limited is also registered as a Commodity Trading Advisor and Commodity Pool Operator with the Commodity Futures Trading Commission. Colchester Global Investors (Singapore) Pte. Ltd is authorised and regulated by the Monetary Authority of Singapore, and holds an offshore discretionary investment management services licence issued by the Financial Services Commission of Korea.

Please note the following in respect of Colchester's regulatory status in Australia: (i) neither Colchester Global Investors Limited nor Colchester Global Investors (Singapore) Pte. Ltd holds an Australian financial services licence for the provision of financial services, and both entities are exempt from the requirement to hold an Australian financial services licence under the Corporations Act 2001 (Cwlth) in respect of the financial services Colchester provides to wholesale clients in Australia; (ii) Colchester Global Investors Limited is authorised and regulated by the Financial Conduct Authority under the laws of England and Wales, which differ from Australian laws; (iii) Colchester Global Investors (Singapore) Pte. Ltd is regulated by the Monetary Authority of Singapore under Singapore laws, which differ from Australian laws. Therefore, Australian wholesale clients are not necessarily subject to the same types of legal protections or remedies that they would enjoy if Colchester was directly subject to the Corporations Act. Colchester is entitled to offer its financial services in Australia pursuant to an exemption from the requirement to hold an Australian Financial Services Licence under the Corporations Act, on the basis, among other things, that the clients are "wholesale clients" within the meaning of the Corporations Act.

Colchester Global Investors Limited is licenced as a financial services provider by the Financial Services Board (licence number 43012) in South Africa.

THIS MATERIAL IS INTENDED FOR PROFESSIONAL USE ONLY AND IS NOT FOR PUBLIC DISTRIBUTION.