Inflation Expectations Derived from a Portfolio Model

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Outline

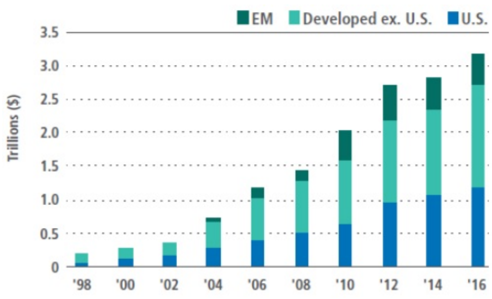
Motivation

Problem

How to extract long-term inflation expectations implicit in financial markets?

Major interest:

- For central bankers and economists: to steer monetary policies. Determine agents' behaviour for investment, consumption, and savings.
- For practitioners: to price **inflation-linked bonds (ILBs)**. As of March 16, more than \$3 trillions (Barclays):



- Because economist surveys are too sticky. Strongly anchored, even backward-looking expectations. Crump et al. (2013), Yellen (2015).

Motivation

Intuition

Inflation Asset

Consider an investor who holds an **inflation-linked bond**, i.e. the principal is indexed to inflation risk.

It's equivalent to holding a nominal bond of same maturity IF:

- Bearing the expected inflation risk is compensated by a rewarded **risk premium**,
- s.t. the **Breakeven Inflation** $BEI_{t,T} = RN_{t,T} - RP_{t,T}$ becomes zero.

Motivation

Intuition cont'd

Therefore, Breakeven Inflation BEI can be disentangled into **inflation expectations**, and an **inflation risk premium**:

- $$\underbrace{BEI_{t,T}}_{\text{Breakeven inflation}} = \underbrace{E\left[\pi_{t,T}\right]}_{\text{Inflation expectations}} + \underbrace{IRP_t}_{\text{Inflation risk premium}}$$
- We could write: $IRP_t = E_P\left[\pi_{t,T}\right] - E_Q\left[\pi_{t,T}\right]$
- where $E_Q\left[\pi_{t,T}\right]$ is the implicit or risk-neutral measure of expected inflations.

A **negative risk premium** $IRP < 0$ is equivalent to $BEI_{t,T} - E\left[\pi_{t,T}\right] < 0$:

- when expected inflation $E\left[\pi_{t,T}\right]$ is high,
- or when nominal yields RN are low,
- e.g. in the current economic environment: expected hiking rates (Fed), but still accomodative monetary policies.

Outline

Contributions

Theoretical Framework

Inflation Expectations $E\left[\pi_{t,T}\right]$ below are smartly inferred from financial instruments:

$$\underbrace{BEI_{t,T}}_{\text{Breakeven inflation}} = \underbrace{E\left[\pi_{t,T}\right]}_{\text{Inflation expectations}} + \underbrace{IRP_t}_{\text{Inflation risk premium}} \quad (1)$$

where:

- Breakeven Inflation $BEI_{t,T}$ is directly observed from nominal bonds yields $RN_{t,T}$ and ILBs yields $RN_{t,T}$;
- Inflation Risk Premium IRP_t is estimated by an Error-Correction Model (ECM).

Contributions

Portfolio Replication

Assume the investor problem allocating between nominal and real bonds. **Replicating Inflation Asset** is equivalent to holding a portfolio composed of riskless asset A and risky asset B, i.e. market portfolio:

$$Y = \alpha A + (1 - \alpha) B \tag{2}$$

where:

- riskless share α increases with inflation risk;
- investment problem is equivalent to: $\max\limits_{\alpha} E[Y]$ s.t.$\mathrm{V}[Y] = K$ *with* Kcst.

Could make an analogy with **Arbitrage Portfolio** in options pricing theory:

$$\mathrm{V} = \mathrm{C} - \frac{\partial C}{\partial S}\mathrm{S} \tag{3}$$

where:

- portfolio value V replicates the risk-free asset;
- call option value C is delta-hedged by a position in the spot S.

Contributions

Inferring Inflation Risk Premium

From the analytical decomposition of the **Inflation Risk Premium** IRP_t:

$$IRP_t = \frac{1}{2\alpha} MPR_t \cdot \sigma^2_{\pi_{t,T}} \tag{4}$$

where:

- $MPR_t = \frac{\bar{R}^t_m - \bar{R}^t_f}{V[R^t_m - \pi_t]}$ denotes Market Price of Risk;
- Inflation Variance $\sigma^2_{\pi_{t,T}}$ is estimated by ECM following cointegration relations with US inflation ΔP^*_t and exchange-rates changes ΔS_t.

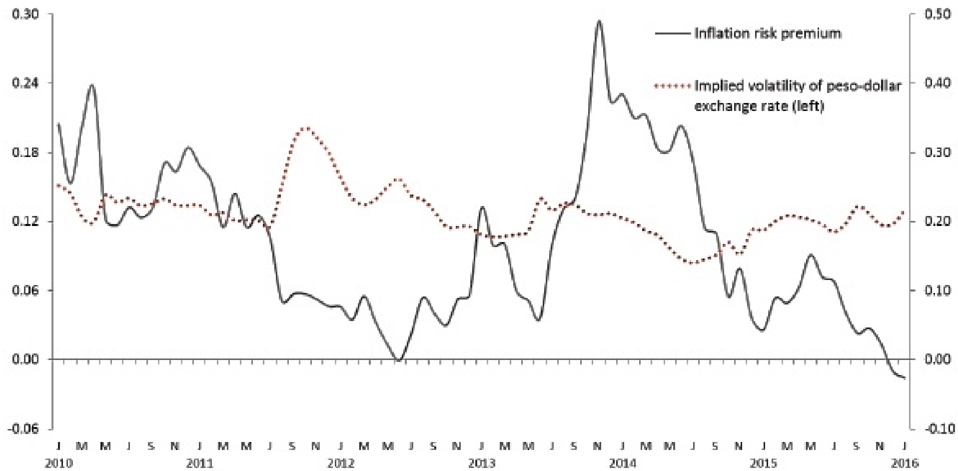
$$\Delta P_t = (\theta_1 \Delta S_t + \theta_2 \Delta P^*_t) + \theta_3 \Delta P_{t-1} + \theta_4 \nu_{t-1} + \chi_t \tag{5}$$

Contributions

Empirical Evidence 1

Inflation asset provides significant diversification benefits in environements of low yields.

Investor bearing inflation risk is rewarded by a high **positive inflation risk premium** when Mexican central bank is accomodative:

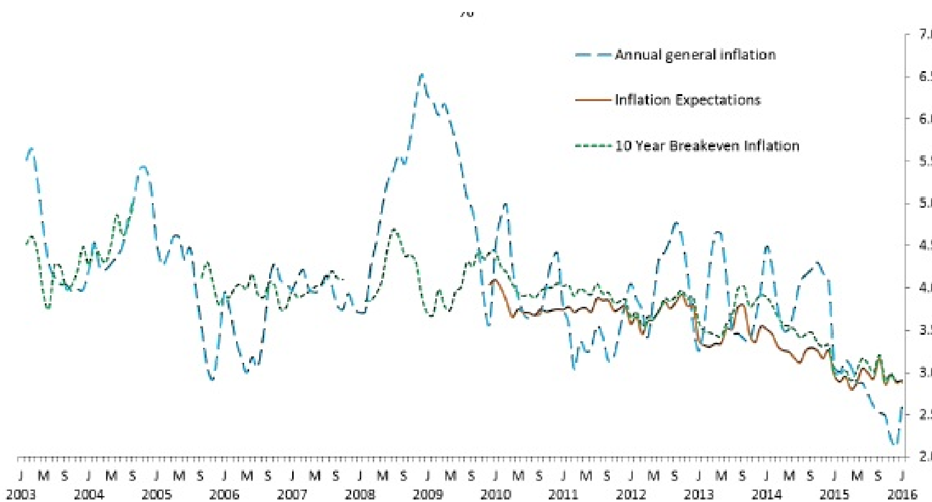


Contributions

Empirical Evidence 2

Long-term inflation expectations are consistently anchored near the inflation target of Banco de Mexico.

Paper provides a **consistent measure** to steer monetary policies even during transitory inflation shocks:



Outline

Remarks

Inflation Variance

- **Extending investment problem (2) with non-constant level of risk**. Inflation variance $\mathrm{V}[Y]$ could reflect market and monetary policy uncertainty, and also heterogenous agents' risk attitudes and beliefs:

$$\begin{aligned} &\max_{\alpha} E[Y] \\ &\text{subject to } \mathrm{V}[Y] = K(.) \end{aligned} \tag{6}$$

where instantaneous inflation variance process could be a CIR or OU process:

$$dV(t) = \kappa(\theta - V(t))\,dt + \eta\sqrt{V(t)}dW_V(t) \tag{7}$$

Remarks

ECM

- **Testing the framework on other economies**. With distinct economic profiles. Investigating other cointegrated variables explaining the Inflation Variance $\sigma^2_{\pi_{t,T}}$ in the ECM.

  Paper explores Mexico: with US inflation ΔP_t^* and peso-dollar exchange-rate changes ΔS_t.

  Could test for specific drivers of the inflation in other economies: imported inflation for EM countries, monetary growth for accomodative central banks (BRICS), etc.

Thanks for your attention