Trend Inflation and the Role of Food and Energy Inflation: the Peruvian experience

(Preliminar)

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Motivation

- For monetary policy implementation it is important:
  - Identify the nature of the change in inflation environment as quickly as possible
  - But, in real-time, uncertainty and incomplete information is a limitation.
  - Thus, the importance of monitor a large number of trend inflation indicators and the broad of indicators of disaggregated inflation
- Importantly, bbroad inflationary role of food and energy inflation (AE inflation) pose major risks for monetary policy implementation
- Although AE transitory in nature, may affects inflation expectation and the long-trend of inflation.

In this paper

- Centers on estimating the predictive relation of AE inflation and measures of trend inflation

Research questions & Methodology

Questions

- Are AE inflation shocks persistent or temporary?
- In history and recent high inflation period, Are the forces of risen inflation temporary or persistent?
- How are trends on inflation and inflation expectations related ?

Methods

- Dynamic models: Dynamics correlations, VAR, and a Two-Sector UC SV.

Quick answers

- AE affect trend inflation through its spillovers effects on SAE inflation. However, the main source of fluctuations of aggregate trend inflation and inflation expectation is still SAE trend inflation.

Data

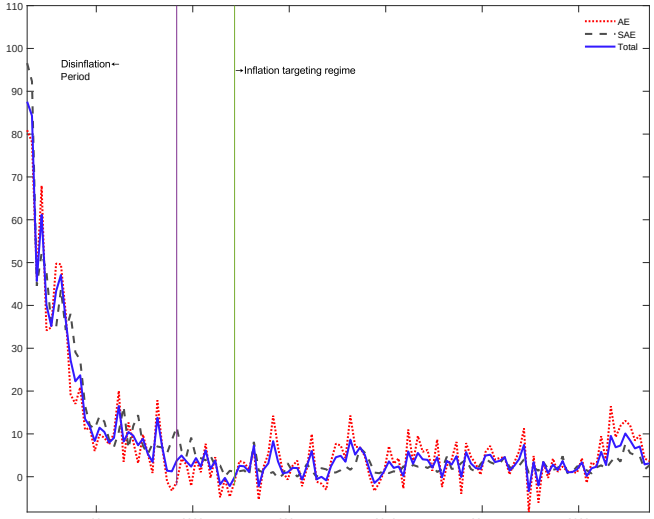
- The price data are monthly consumer price indices from 1992:M1 to 2013:M9
- CPI divided by its 2 major type of group expenditures (Source: BCRPData):
  - Prices are for Non Foods and Energy items (SAE CPI)
  - Prices for Foods and Energy items (AE CPI)
- Inflation is measured in percentage points at an annual rate using the final month of the quarter prices:

$$\pi_{it} = 400 \times ln(P_{it}/P_{it-1}),$$

where P_{it} are prices for March, June, September, and December.

Data: Components of Inflation

Two different regimes of inflation dynamics: Disinflation Periods & IT regime



Data: Statistics (I)

After IT: Inflation is less volatile and not very persistent. SAE Inflation much lower and much more stable $\Rightarrow$ Trend inflation more stable

	N	Mean	Median	SD	$\frac{SD}{SD(\pi)}$	$Cor(., \pi)$	Ser.Cor.
Panel A: All Sample							
π_t	125	5.92	3.57	8.55	1.00	1.00	0.89
π_t^{SAE}	125	6.06	2.69	9.30	1.09	0.93	0.94
π_t^{AE}	125	6.28	4.28	9.59	1.12	0.96	0.74
Panel B: 2002Q1-2023Q2 Sample							
π_t	86	3.14	2.85	2.75	1.00	1.00	0.25
π_t^{SAE}	86	2.37	1.89	1.66	0.60	0.59	0.33
π_t^{AE}	86	4.02	3.74	4.82	1.76	0.96	0.17

Note: π is annualized quarter change of a consumer price index. SD: Standard Deviation. $Cor(., \pi)$: correlation with CPI inflation. Ser. Cor: Serial Correlation.

Data: Statistics (II)

However, AE inflation inflation is relatively more volatile, with relative higher inflation rates in average, highly correlated with overall inflation but much less persistent.

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Ground of AE inflation

- Because of the high variability and low persistence of AE, they are excluded from observed measures of trend inflation, as they respond to supply forces that are exogenous to monetary policy. $\Rightarrow$ AE inflation is exogenous.

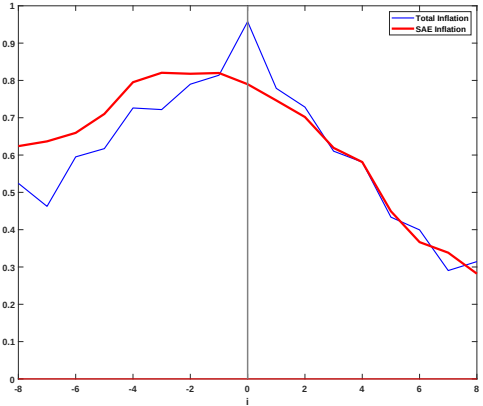
- However, AE inflation may have more important implications for trend inflation.

- In the following, I center in the predictive relation between AE inflation and a observable measures of trend inflation: core inflation or SAE inflation.

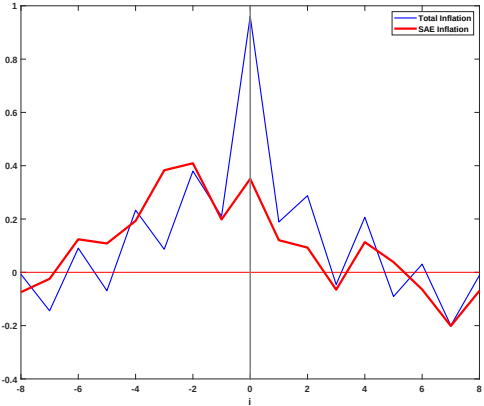
Evidence of Dynamic Correlations: Trend inflation vs AE Inflation π_{t+i}^{AE} (I)

- Total inflation highly correlate with AE inflation contemporaneously.
- But, AE inflation has power to predict future SAE inflation even with one year lag.

A. All Sample: 1992Q1:2023Q2



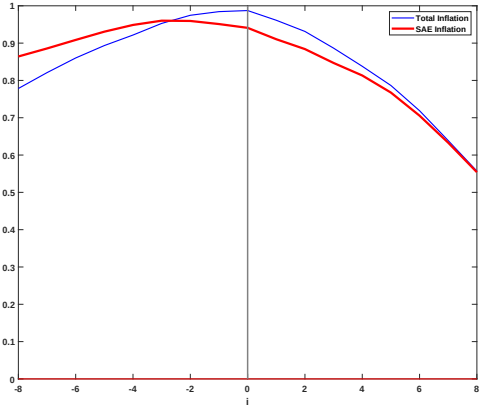
B. IT Sample: 2002Q1:2023Q2



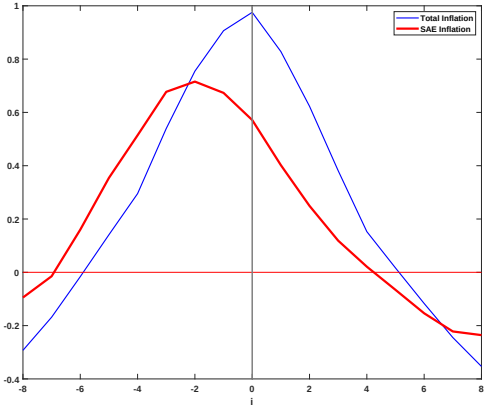
Evidence of Dynamic Correlations: Trend inflation vs AE Inflation π_{t+i}^{AE} (II)

- Q-o-Q changes may hide medium to long run relationships.
- But, Y-o-Y changes show even stronger predictive power of AE inflation.

A. All Sample: 1992Q1:2023Q2



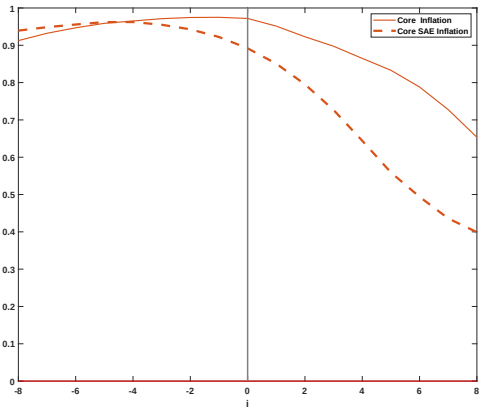
B. IT Sample: 2002Q1:2023Q2



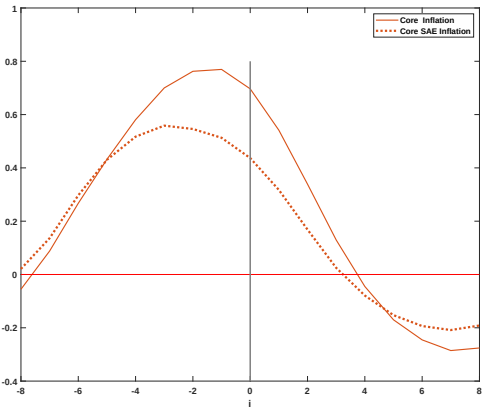
Evidence of Dynamic Correlations: Trend inflation vs AE Inflation π_{t+i}^{AE} (II)

AE inflation has also power to predict future Core inflation

A. All Sample: 1992Q1:2023Q2



B. IT Sample: 2002Q1:2023Q2



Dynamic relationship of AE & SAE inflation

- The full dynamic relation between AE and trend inflations is most easily seen in a recursive VAR specification, using impulse responses.

- The structural VAR in levels (log of CPI AE and CPI SAE) is given by

$$A_0 Y_t = a + \sum_{i=1}^{p} A_i Y_{t-i} + \epsilon_t$$

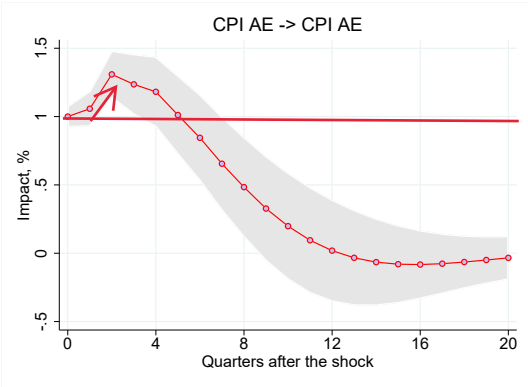
  ϵ_t is the vector of structural shocks with $E(\epsilon_t \epsilon_t') = I$, and I is an identity matrix. $p = 3$ (BIC)

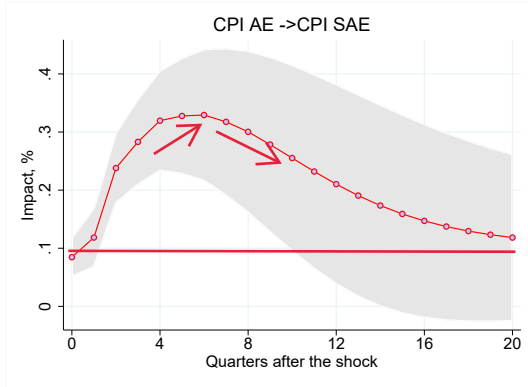
- Cholesky identification: CPI AE ordered first.

- Sample: 2002Q1-2023Q3.

Effects of AE shocks

- Short-lived effects of The AE supply shock on itself. Reversion after 2 quarters.
- SAE CPI continually increases after 2 quarters.





- I call this: The long-run effects of a rise in AE CPI, or supply shocks, on trend inflation

Modelling trends of inflation

- Here I formalize the role of the two components of trend inflation: AE & SAE inflations.
- In particular, recognize that both components are sources of aggregate trend inflation volatility.
- The estimation framework builds on Eo, Uzeda, and Wong (2023): A two sector model of trend inflation.
  It is a flexible model in two empirically important directions:
  - It extends unobserved components with stochastic volatility (UC-SV), and
  - it allows correlation between trends of sectorial inflation

Model of trends of inflation (I)

Each component of inflation,, π^i is decomposed into sector-specific permanent,τ^i, and transitory noise components, where $i =$ AE, SAE.

$$\pi_t^{AE} = \tau_t^{AE} + \zeta_t^{AE},$$
$$\pi_t^{SAE} = \tau_t^{SAE} + \zeta_t^{SAE},$$

where trends are modeled as random walk processes

$$\tau_t^{AE} = \tau_{t-1}^{AE} + u_t^{\tau^{AE}},$$
$$\tau_t^{SAE} = \tau_{t-1}^{SAE} + u_t^{\tau^{SAE}}.$$

To allow for changes in the (conditional) volatility and correlation of the innovations,ζ_t^i and $u_t^{\tau^i}$, the covariance structure follows, where both $\Omega_{\zeta,t}$ and $\Omega_{\tau,t}$ are full matrices

$$\begin{bmatrix} \left(u_t^{\tau^{AE}}, u_t^{\tau^{SAE}}\right)' \\ \left(\zeta_t^{AE}, \zeta_t^{SAE}\right)' \end{bmatrix} \sim \mathcal{N}\left(\begin{bmatrix} 0_{2\times1} \\ 0_{2\times1} \end{bmatrix} \begin{bmatrix} \Omega_{\tau,t} & 0_{2\times2} \\ 0_{2\times2} & \Omega_{\zeta,t} \end{bmatrix} \right),$$

Model of trends of inflation (II)

$\Omega_{\zeta,t}$ and $\Omega_{\tau,t}$ are modeled using a triangular factorization:

$$\Omega_{j,t} = \begin{bmatrix} \sigma^2_{j^{AE},t} & \sigma_{j,t} \\ \sigma_{j,t} & \sigma^2_{j^{SAE},t} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ \gamma_t^j & 1 \end{bmatrix} \begin{bmatrix} \exp\left(h_t^{j^{AE}}\right) & 0 \\ 0 & \exp\left(h_t^{j^{SAE}}\right) \end{bmatrix} \begin{bmatrix} 1 & \gamma_t^j \\ 0 & 1 \end{bmatrix} \text{ for } j \in \{\tau, \zeta\}.$$

$$h_t^{j^i} = h_{t-1}^{j^i} + u_t^{h^{j^i}},\ j \in \{\tau, \zeta\}, i \in \{AE, SAE\},$$

$$\gamma_t^j = \gamma_{t-1}^j + u_t^{\gamma^j},\ j \in \{\tau, \zeta\},$$

$$\begin{bmatrix} \left(u_t^{h^{\tau^G}}, u_t^{h^{\tau^S}}, u_t^{h^{\zeta^G}}, u_t^{h^{\zeta^S}}\right)' \\ \left(u_t^{\gamma^\tau}, u_t^{\gamma^\zeta}\right)' \end{bmatrix} \sim \mathcal{N}\left(\begin{bmatrix} 0_{4\times1} \\ 0_{2\times1} \end{bmatrix}, \begin{bmatrix} \Omega_h & 0_{4\times2} \\ 0_{2\times4} & \Omega_\gamma \end{bmatrix}\right),$$

where

$$\Omega_h = \text{diag}\left(\sigma_{h^\zeta G^2}, \sigma_{h^\zeta S^2}, \sigma_{h^\tau G^2}, \sigma_{h^\tau S^2}\right) \text{ and } \Omega_\gamma = \text{diag}\left(\sigma^2_{\gamma^\zeta}, \sigma^2_{\gamma^\tau}\right).$$

Trend inflation definition

Aggregate trend inflation, is approximately calculated as a weighted average of sector-specific trends:

$$\tau_t \approx \omega_{AE,t}\tau_t^{AE} + \omega_{SAE,t}\tau_t^{SAE},$$

where $\omega_{AE,t}$ and $\omega_{SAE,t} = 1 - \omega_{AE,t}$ are expenditure weights of AE and SAE sectors, respectively. These weights are not estimated.

Estimation

- The states are estimated using bayesian and precision sampling techniques as described in Chan and Jeliazkov (2009); Eo, Uzeda, and Wong (2023).
- Sample: 1993Q1-2023Q4.
- Priors
  - Diffuse Inverse Gamma prior distribution for the variance parameters

$$\sigma^2_{h^{\ell i}} \sim \mathcal{IG}\left(\nu_{h^{\ell i}}, S_{h^{\ell i}}\right), \sigma^2_{\gamma^\ell} \sim \mathcal{IG}\left(\nu_{\gamma^\ell}, S_{\gamma^\ell}\right) \text{ for } j \in \{\tau, \zeta\}, i \in \{AE, SAE\},$$

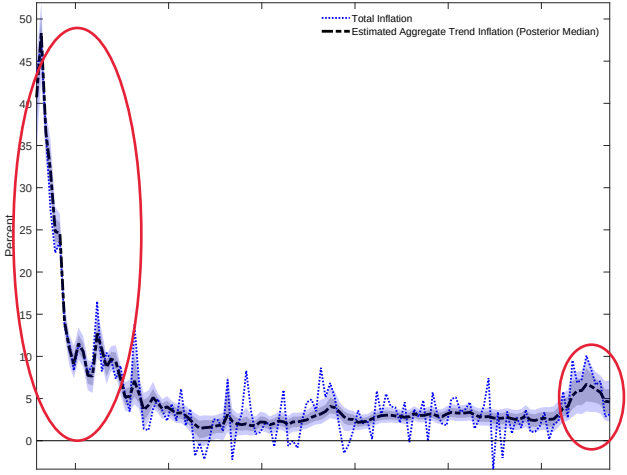
    - With hyperparameters $\nu_{h^{\ell i}} = \nu_{\gamma^\ell} = \frac{T}{10}$ and $S_{h^{\ell i}} = S_{\gamma^\ell} = 0.2^2\left(\nu_{h^{\ell i}} - 1\right)$, as in Chan (2017); Eo, Uzeda, and Wong (2023).
  - Diffuse Gaussian prior for the initial conditions,

$$\left(\tau_0^G \tau_0^S h_0^{\zeta\, G} h_0^{\zeta\, S} h_0^{\tau\, G} h_0^{\tau\, S} \gamma_0^\zeta \gamma_0^\tau\right)' \sim \mathcal{N}\left(\hat{z_0}, \Sigma_{z_0}\right)$$

    - $\hat{z_0} = \left(\pi_1^{AE}, \pi_1^{SAE}, 0, \cdots, 0\right)'$, following Chan (2017); Eo, Uzeda, and Wong (2023)
    - $\Sigma_{z_0} = 1000 \times I_8$ as in Perez (2023)

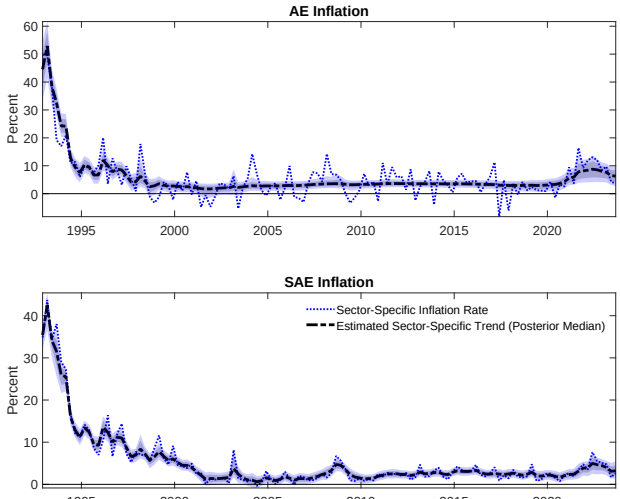
Estimated trend Inflation

- τ_t captures well the long-term movements of inflation: disinflation & stability periods
- Recent Inflationary trends: Pre GFC & After Covid19 periods



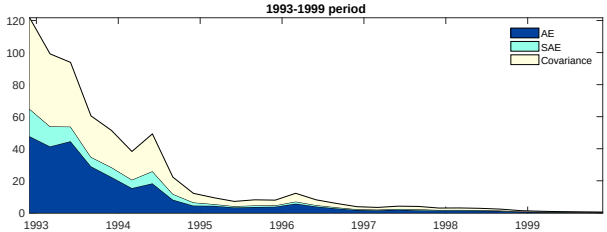
The components of the estimated trend Inflation

- τ_t^{AE} and τ_t^{SAE} show different dynamics after 1996.
- After Covid19 period: τ_t^{AE} leads the start, but lately τ_t^{SAE} still above 3%.



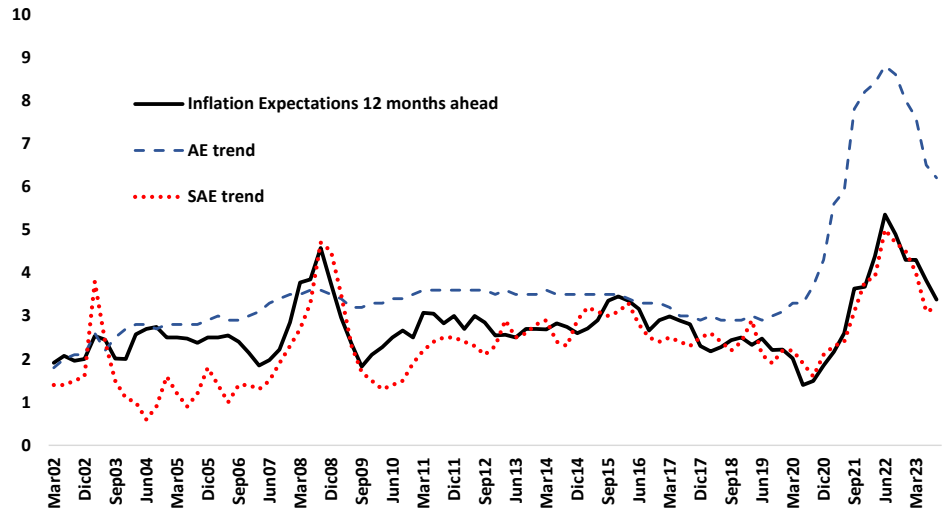
Sources of variation in trend inflation

- 2000 - 2021, the volatility of aggregate trend inflation primarily driven by SAE.
- Disinflation & After Covid19 period: AE sector & covariance component matter



The components of trend Inflation & Inflation Expectations

- SAE trend inflation and inflation expectations show a remarkably strong relationship eve



Conclusions

- AE inflation may have long-run effects on trend inflation, via its relationship with SAE inflation that becomes particurly salient during periods of important upsurge of supply shocks.
- Then, MP may need to be tighter in periods of persistent AE shocks.
- SAE trend inflation during the period of stability has been the main source of aggregate trend inflation fluctuations.
- SAE trend inflation is still mainly related to inflation expectation, which has important implications for anchoring inflation in periods of persistent supply shocks.

Gracias

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