Structural Core Inflation

European Economic Association

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This presentation does not necessarily reflect the views of the Bank of Israel

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Motivation

- Monetary policy based on core inflation (Mankiw & Reis, 2003)
  - Better and less noisy than policies based on other price indexes.
- Fed's view on inflation (Hasenzagl et al., 2022)
  - Core inflation $\Longrightarrow$ relevant price index of the economic stance.
- Other CBs' view on inflation:
  - ECB, BoE, BoJ, RBA, etc.
- Research question: What is the core inflation measure that accounts for the
  - whole economic structure?
  - full price structure?

Inflation Measures

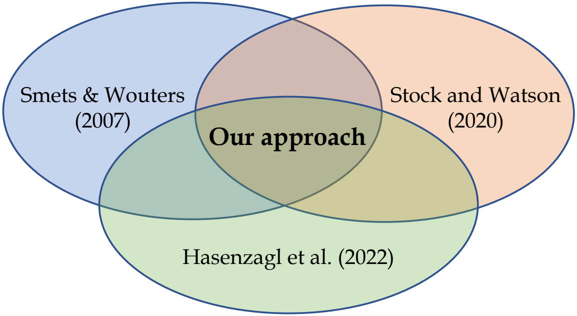
- PCE/CPI Components
  - without energy, food, etc.
- Decreased weight for extreme observations
  - median, trimmed-mean, etc.
- Sticky price indexes.
- Factor model approaches
  - reduced structural form (underlying inflation, Atlanta Fed UI)
  - core, sectoral, trend inflation indexes (Stock and Watson, 2016)
- Without factor
  - cyclical components (Stock and Watson, 2020)

Contribution

- We build an **inflation block** decomposing each inflation component into core, non-core, and trend inflation.
- This inflation block is plugged into the Phillips curve of the Smets and Wouters (2007) model to
  - consider a wide range of macroeconomic variables interlinked in a micro-founded way.
  - capture the complex economic shock interdependencies.
- Our structural core inflation measure aims to capture the common component of inflation relevant to the **business cycle** following the NK-DSGE model filter.
- Our **flexible** approach can be implemented for any other DSGE model.
- The economy is best represented by Fed monetary policy decisions targeting core rather than headline inflation.

Literature

- Smets & Wouters (2007)
  - Shocks and Frictions in US Business Cycles: A Bayesian DSGE approach
- Stock & Watson (2020)
  - Slack and Cyclically Sensitive Inflation
- Hasenzagl, Pellegrino, Reichlin & Ricco (2022)
  - A Model of the Fed's View on Inflation



Model: Smets and Wouters (2007)

- Headline Phillips curve:

$$\pi_t = \frac{\beta\gamma^{1-\sigma_c}}{1+\beta\iota_p\gamma^{1-\sigma_c}} E_t\left[\pi_{t+1}\right] + \frac{\iota_p}{1+\beta\iota_p\gamma^{1-\sigma_c}}\pi_{t-1} - \frac{1}{1+\beta\iota_p\gamma^{1-\sigma_c}} \frac{\left(1-\beta\gamma^{1-\sigma_c}\xi_p\right)\left(1-\xi_p\right)}{\xi_p\left(1+\left(\phi_p-1\right)\varepsilon_p\right)}\mu_t^p + \varepsilon_t^p \quad (1)$$

  - ι_p: degree of indexation to past inflation
  - ξ_p: degree of price stickiness
  - ε_p: curvature of the Kimball (1995) goods market aggregator
  - $\phi_p - 1$: steady-state price markup
  - ε_t^p: price markup shock
  - μ_t^p: price markup
- ARMA process for the price markup shock:

$$\varepsilon_t^p = \rho_p \varepsilon_{t-1}^p + \eta_t^p - \mu_p \eta_{t-1}^p \quad (2)$$

where $\rho_p \in [0,1]$ is the first-order AR parameter, μ_p the moving average coefficient, and η_t^p the innovation term.

Model: Core Inflation

- Fed's view on inflation (Hasenzagl et al., 2022)
  - Phillips curve dynamics suitable to explain core inflation.
  - Our Phillips curve thus measures core inflation.
- Core inflation equation:

$$\begin{aligned} \pi_t^C &= \frac{\beta\gamma^{1-\sigma_c}}{1+\beta\iota_c\gamma^{1-\sigma_c}} E_t\left[\pi_{t+1}^C\right] + \frac{\iota_c}{1+\beta\iota_c\gamma^{1-\sigma_c}}\pi_{t-1}^C \\ &\quad - \frac{1}{1+\beta\iota_c\gamma^{1-\sigma_c}} \frac{\left(1-\beta\gamma^{1-\sigma_c}\xi_c\right)\left(1-\xi_c\right)}{\xi_c\left(1+\left(\phi_c-1\right)\varepsilon_c\right)}\mu_t^C + \varepsilon_t^C \end{aligned} \tag{3}$$

- Core price markup shock: $\varepsilon_t^C = \rho_c \varepsilon_{t-1}^C + \eta_t^C - \mu_c \eta_{t-1}^C$.
- Unlike the headline Phillips curve, η_t^C is a weighted sum of correlated inflation component-specific shocks such that
  - $\eta_t^C = \sum_i w_i w_i^C \eta_{i,t}^C \sim \mathcal{N}(0, \Sigma)$
    w_i : component-specific weight at the average of the sample
    w_i^C: component share of shock that is related to core inflation.

Model: Assumptions

- Each inflation component consists of:

$$\pi_{i,t} = \pi_i^T + \pi_{i,t}^C + \pi_{i,t}^N \tag{4}$$

- Trend inflation
  - Parameter (log-linearized model).
- Core inflation
  - Common dynamic factors among inflation components.
  - Phillips curve: SW structural model.
- Non-core inflation
  - AR(1) exogenous process with correlated shocks assumed for each component.
- All the SW model equations consider core inflation, except the interest rate (Taylor rule) that responds to headline inflation.

Model: Dynamic Factor

- Component-specific core inflation depends on the weighted average of the dynamic factor

$$\pi_{i,t}^C = \beta_i^C F_t \left(\pi_t^C\right) \tag{5}$$

  - Similar to other core inflation indexes based on a common factor.

- Aggregate core inflation depends on the weighted average of component-specific core inflations

$$\pi_t^C = \sum_i w_i \pi_{i,t}^C \tag{6}$$

Model: Non-Core Inflation

- Non-core inflation is the part of inflation that reflects factors that deviate from the Phillips curve.
- Aggregate non-core inflation is the weighted sum of component-specific non-core inflation processes.
- The component-specific non-core inflation equation is:

$$\pi_{i,t}^{N} = \rho_i^N \pi_{i,t-1}^{N} + \left(1 - w_i^C\right) \eta_{i,t}^{C} \quad (7)$$

$$\eta_t^C = \sum_i w_i w_i^C \eta_{i,t}^{C} \quad (8)$$

  - ρ_i^N is the component-specific first-order autoregressive parameter of non-core inflation.
  - $\eta_{i,t}^C$ is the component-specific shock entering both core and non-core inflation with different weights (w_i^C and $1 - w_i^C$).

Model: Summary

Main Model (Smets and Wouters, 2007)

ε_t^a, ε_t^b, ε_t^{qs}, ε_t^g, ε_t^m, ε_t^w

Core Inflation

$$\pi_t^C = \frac{\beta\gamma^{1-\sigma_c}}{1+\beta_{l_p}\gamma^{1-\sigma_c}} E_t[\pi_{t+1}^C] + \frac{l_c}{1+\beta_{l_c}\gamma^{1-\sigma_c}} \pi_{t-1}^C + \frac{1}{1+\beta_{l_c}\gamma^{1-\sigma_c}} \frac{(1-\beta\gamma^{1-\sigma_c}\xi_c)(1-\xi_c)}{\xi_c(1+(\phi_c-1)\epsilon_c)} \mu_t^C + \varepsilon_t^C$$

$$\varepsilon_t^C = \rho^C \varepsilon_{t-1}^C - \mu^C \eta_{t-1}^C + \eta_t^C$$

$$\pi_t^C = \sum_i w_i \beta_i F_t$$

$$\eta_t^C = \sum_i w_i w_i^C \eta_{i,t}^C$$

Inflation Components

$$\pi_{1,t} = \pi_1^T + \pi_{1,t}^C + \pi_{1,t}^N$$

$$\pi_{1,t}^C = \beta_1^C F_t$$

$$\pi_{1,t}^N = \rho_1^N \pi_{1,t-1}^N + (1-w_1^C)\eta_{1,t}^C \quad \text{———} \quad \eta_{1,t}^C$$

$$\vdots$$

$$\pi_{i,t} = \pi_i^T + \pi_{i,t}^C + \pi_{i,t}^N$$

$$\pi_{i,t}^C = \beta_i^C F_t$$

$$\pi_{i,t}^N = \rho_i^N \pi_{i,t-1}^N + (1-w_i^C)\eta_{i,t}^C \quad \text{———} \quad \eta_{i,t}^C$$

Notes: Inflation component shocks and factors are in red and blue, respectively. The dashed block represents the new inflation (Phillips curve) and cost-push shock equations replacing the corresponding equations in the Smets and Wouters (2007) model.

Estimation: Data

- Quarterly US data from 1993 to 2019.
- Time series as in Smets and Wouters (2007):
  - Consumption
  - Investment
  - GDP
  - Employment
  - Wages
- Shadow interest rate (Wu and Xia, 2016)
- Inflation is expressed according to PCE components.
- Similar results when considering CPI components (Appendix).
- Data transformations follow Smets and Wouters (2007).

Estimation: Calibration

- Our calibration follows Smets and Wouters (2007) regarding estimated parameters except those related to inflation.

Inflation Processes and Shock Parameters: Priors

	Distribution	**Prior Mean**	**Prior Std.**
π_i^T	Normal	Sample mean	1.0
β_i^C	Generalized Beta*	1.0	0.4
ρ_i^N	Beta	0.5	0.2
w_i^C	Beta	0.5	0.2
$\Sigma_{i,i}$	Inverse Gamma	0.1	2.0
$\Sigma_{i,j}$	Generalized Beta**	0.0	0.2

Notes: * Generalized Beta distribution defined in the interval [0;2]. β_1^C is calibrated to 9 minus the 8 other betas ($\beta_2^C ... \beta_9^C$), such that the sum of β_i^C equals 9. ** Generalized Beta distribution defined in the interval [-1;1].

Estimation: Methodology

- Bayesian estimation of PCE and CPI inflation models, with different inflation measures in monetary policy rules.
- Sequential mode-finding with different algorithms to search for the maximum of the posterior likelihood.
- 2 000 000 draws divided into two parallel chains for the Monte Carlo Markov Chain (MCMC) algorithm.
- All the estimated parameters are identified in the Jacobian of
  - steady-state and reduced-form solution matrices.
  - first two moments (Iskrev, 2010)
  - steady state and minimal system (Komunjer and Ng, 2011)
  - mean and spectrum (Qu and Tkachenko, 2012)

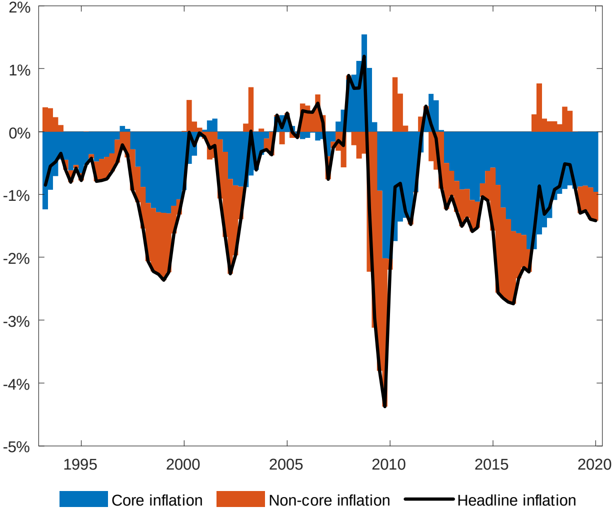
Results: Coreness Index

- Measures the relative importance of core inflation compared to non-core inflation in each component.
- We compute the average ratio of annual core inflation to annual non-core inflation, both in absolute value.

Component	Coreness
Food and Beverages	2.14
Housing	0.87
Health Care	0.50
Energy	0.06
Recreation	0.30
Clothing and Footwear	0.29
Other Durable Goods	0.47
Other Nondurable Goods	1.88
Other Services	0.64

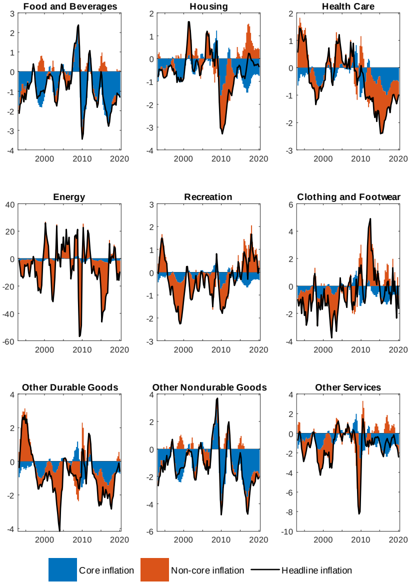
Notes: Values are rounded to two decimal places for clarity.

Historical Decomposition: PCE Headline Inflation



Notes: Deviations from aggregate trend inflation (2.96%). Based on Bayesian estimations from 1993 to 2019.

Historical Decomposition: PCE Inflation Components



Notes: Derived from Bayesian estimations from 1993 - 2019.

Components trends

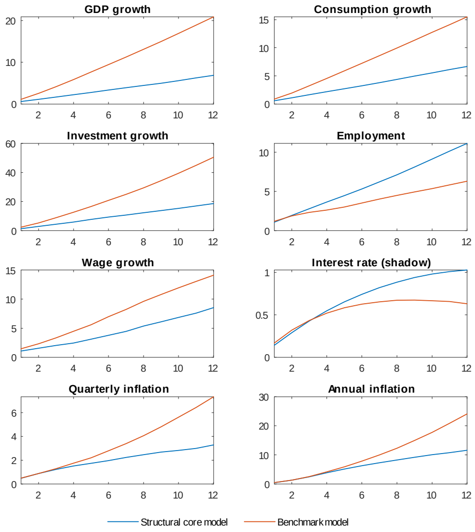
Component	**Trend**
Food and Beverages	2.3%
Housing	2.6%
Apparel	-0.2%
Transportation	3.5%
Medical Care	3.6%
Recreation	1.2%
Education and Communication	1.9%
Other Goods and Services	3.2%

Notes: Based on Bayesian estimations from 1993 to 2019.

Results: In-Sample Fit

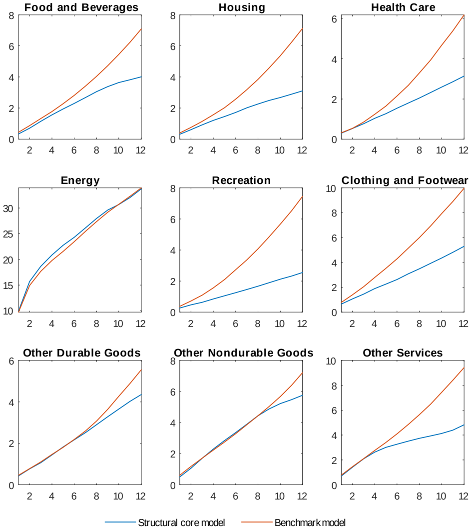
- We compare the fit of our structural core model to the benchmark model (SW).
- The log marginal data density measures how well the model matches the data, considering the number of variables, parameters, and quantity of data.
- Our structural PCE core inflation has a log marginal data density of -**1414**, compared to -**1531** for the benchmark model.
- Minimal adjustments for using PCE components as observables instead of headline PCE in the SW model.

Results: Out-of-Sample Fit for Variables



Notes: Cumulative RMSE of 1-12 quarters horizon. Derived from Bayesian estimations over the sample 1993-1999, and expanding over the testing sample 2000-2019.

Results: Out-of-Sample Fit for Components



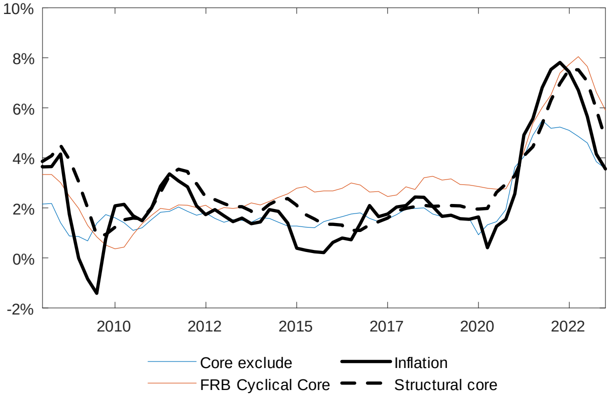
Notes: Cumulative RMSE of 1-12 quarters horizon. Derived from Bayesian estimations over the sample 1993-1999, and expanding over the testing sample 2000-2019.

Results: Out-of-Sample Predictive Ability Tests

	1	2	3	4	5	6	7	8	9	10	11	12
GDP	10.8 (0)	15.3 (0)	11.6 (0)	13.4 (0)	13.2 (0)	16.5 (0)	22.8 (0)	17.3 (0)	20 (0)	15.7 (0)	33.6 (0)	20.5 (0)
Consumption	6.9 (0.03)	11 (0)	10.4 (0.01)	9.2 (0.01)	14.7 (0)	12.7 (0)	24 (0)	19.8 (0)	19.7 (0)	16.8 (0)	27.1 (0)	23.1 (0)
Investment	5.3 (0.07)	5.6 (0.06)	5 (0.08)	4.9 (0.09)	5.6 (0.06)	6.1 (0.05)	5.6 (0.06)	7.3 (0.03)	7.3 (0.03)	8.3 (0.02)	11.2 (0)	14.1 (0)
Employment	1.6 (0.46)	1.8 (0.41)	-1.1 (0.58)	-4.7 (0.1)	-5.1 (0.08)	-11 (0)	-8.7 (0.01)	-7.1 (0.03)	-7.1 (0.03)	-7.7 (0.02)	-8.6 (0.01)	-11 (0)
Wage	9.9 (0.01)	16 (0)	23.3 (0)	27.2 (0)	34.8 (0)	23.8 (0)	21.6 (0)	17 (0)	14.7 (0)	12.4 (0)	11.1 (0)	9.7 (0.01)
Interest rate	1.3 (0.52)	1.5 (0.48)	1.7 (0.42)	0.6 (0.73)	-0.2 (0.89)	-1.6 (0.46)	-0.9 (0.62)	-3.4 (0.18)	-3.6 (0.17)	-9.3 (0.01)	-11.3 (0)	-12.5 (0)
Inflation	0.4 (0.8)	1.8 (0.41)	0.3 (0.86)	0.3 (0.87)	0.7 (0.7)	1.9 (0.39)	1.5 (0.47)	1.7 (0.43)	1.9 (0.39)	2 (0.37)	2.1 (0.36)	2.2 (0.33)
Food and Beverages	3.4 (0.18)	7.8 (0.02)	6.5 (0.04)	4.2 (0.12)	8.9 (0.01)	11.5 (0)	3.7 (0.16)	3.5 (0.17)	6.7 (0.04)	3.7 (0.16)	3.9 (0.14)	3.6 (0.17)
Housing	5.2 (0.07)	2.8 (0.25)	6.3 (0.04)	3.7 (0.16)	5.2 (0.08)	5.3 (0.07)	5.7 (0.06)	6.2 (0.05)	6.3 (0.04)	6.1 (0.05)	7.9 (0.02)	8 (0.02)
Health Care	2.1 (0.35)	3 (0.23)	0.7 (0.7)	0.9 (0.63)	4.7 (0.09)	2.1 (0.36)	3.3 (0.19)	1.2 (0.56)	1.5 (0.48)	0.8 (0.66)	1.5 (0.47)	1.8 (0.41)
Energy	-2.3 (0.32)	-2.5 (0.28)	-2 (0.36)	-2.1 (0.35)	-1.1 (0.57)	-2 (0.36)	-0.6 (0.73)	-1.9 (0.39)	-1 (0.61)	-0.5 (0.78)	-0.3 (0.85)	-0.3 (0.86)
Recreation	7.7 (0.02)	10.3 (0.01)	12.7 (0)	14.9 (0)	15.3 (0)	14.7 (0)	15.4 (0)	13.4 (0)	12.9 (0)	12.8 (0)	12.3 (0)	13.4 (0)
Clothing and Footwear	6.5 (0.04)	5.9 (0.05)	5.5 (0.06)	5.8 (0.05)	6 (0.05)	6.3 (0.04)	6.4 (0.04)	6.8 (0.03)	6.5 (0.04)	7.4 (0.02)	7.4 (0.02)	7.8 (0.02)
Other Durable Goods	2.7 (0.26)	0.6 (0.75)	0.9 (0.64)	0.6 (0.75)	1.1 (0.56)	0.1 (0.93)	0.2 (0.93)	1.2 (0.54)	4.2 (0.13)	6 (0.05)	7.3 (0.03)	5.6 (0.06)
Other Nondurable Goods	2.4 (0.29)	4.1 (0.13)	3.3 (0.19)	1.6 (0.45)	5.9 (0.05)	-5.7 (0.06)	-7.8 (0.02)	-1.7 (0.42)	-0.5 (0.76)	0.2 (0.92)	4.4 (0.11)	3.9 (0.14)
Other Services	3.2 (0.21)	0.5 (0.76)	2.8 (0.25)	3.4 (0.18)	0.5 (0.76)	1.2 (0.56)	1.2 (0.56)	1.3 (0.52)	1.4 (0.49)	1.8 (0.41)	1.8 (0.41)	1.8 (0.41)

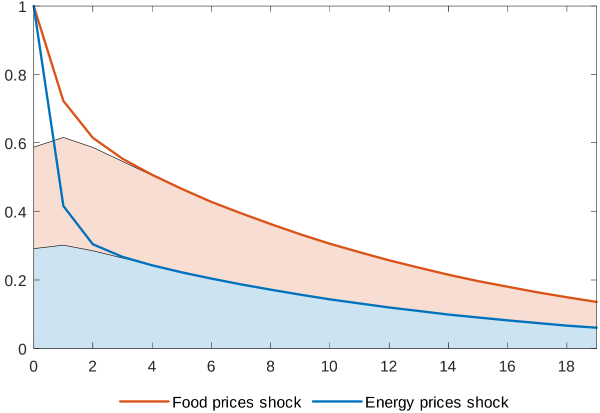
Notes: The darker the cell, the better our structural core inflation forecast is over the benchmark model regarding p-values. Derived from Bayesian estimations over the sample 1993-1999, and expanding over the testing sample 2000-2019.

Covid-19: Structural vs. Alternative PCE Core Measures



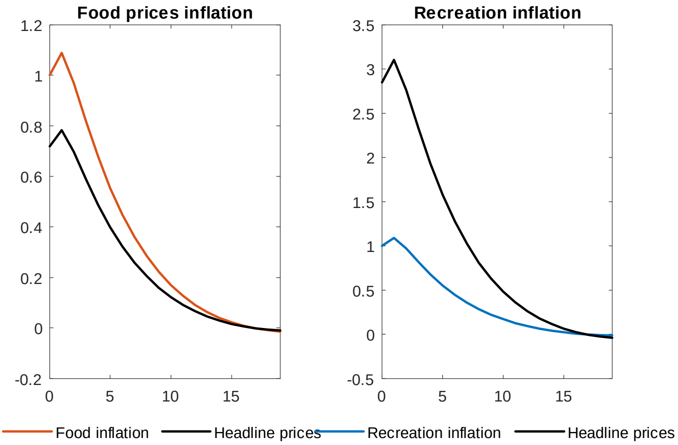
Notes: All indexes are for annual inflation. Structural core is our estimated model core inflation. The estimation sample is 1993-2019, and the model is used to filter the 2021-2022 data with the same parameters.

Sensitivity Analysis: Food and Energy Price Shocks



Notes: impulse response functions of headline inflation (solid lines) and core inflation (shaded areas) to 1% shocks in food (orange) and energy prices (blue). The x-axis shows time in quarters, and the y-axis represents the percentage change in inflation.

Sensitivity Analysis: Productivity Shocks



Notes: impulse response functions of headline inflation (black lines) and component inflation to productivity shocks. The first panel shows the response to a 1% shock on food prices (orange line), and the second panel shows the response to a 1% shock on recreation prices (blue line). The x-axis represents time in quarters, and the y-axis indicates the percentage change in inflation.

PCE Core Inflation: Alternative Measures

- Bayesian estimation of the SW model using different measures of PCE core inflation from the Atlanta Fed's dashboard (UI).
- Estimated log marginal data density to compare model in-sample fits.
- Structural core inflation has the highest marginal data density, indicating the best fit and reliability.

Log Marginal Data Densities: Alternative Measures of Core Inflation

Inflation	Excl. Food & Energy	Cyclical	Structural
-730.98	-631.02	-635.73	-610.36

Notes: A higher log marginal data density implies a better fit compared to models presenting a lower one.

Core Inflation: Monetary Policy Rule

- We compare and estimate 2 models considering:
  - Core inflation in the Taylor rule, our best estimation of the core inflation measure used by the Fed's policymakers.

$$i_t = (1 - \rho_r)\left(\rho_\pi \widehat{\pi_t^C} + \rho_y \widehat{y} \rho_{\Delta y} \Delta \widehat{y}\right) + \rho_r i_{t-1} + \varepsilon_t^i \quad (9)$$

  - Total inflation in the Taylor rule, as usually done in most DSGE (policy) models.

$$i_t = (1 - \rho_r)\left(\rho_\pi \widehat{\pi_t} + \rho_y \widehat{y} \rho_{\Delta y} \Delta \widehat{y}\right) + \rho_r i_{t-1} + \varepsilon_t^i \quad (10)$$

- Comparison of estimated log marginal data densities:
  - Structural core PCE inflation in the Taylor rule likely matches better historical data than headline PCE inflation: log marginal data density of -**1400.4** vs. -**1414.4**, respectively.
  - Same result when considering core CPI inflation in the monetary policy rule (-1432.4) compared to headline CPI inflation (-1439.3), which confirms the Fed likely targets core inflation rather than headline inflation.
- Structural core inflation better aligns with the model's structure and Fed monetary policy decisions.

Conclusion

- Our **flexible inflation block** for DSGE models incorporates component-specific core, non-core, trend, and dynamic factors determining headline inflation.
- Our approach uses the component inflation data, having stronger theoretical foundations than alternative methodologies.
- Our findings are consistent with other methods of measuring core inflation.
- Our **structural core inflation**:
  - is consistent with the economic structure (relevant to the business cycle, not necessarily more correlated to it)
  - presents better forecasting performance than alternative core inflation measures.
- The Fed likely targets structural core inflation and not headline.

Thanks

Thank you for your attention

- Comments
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- Social
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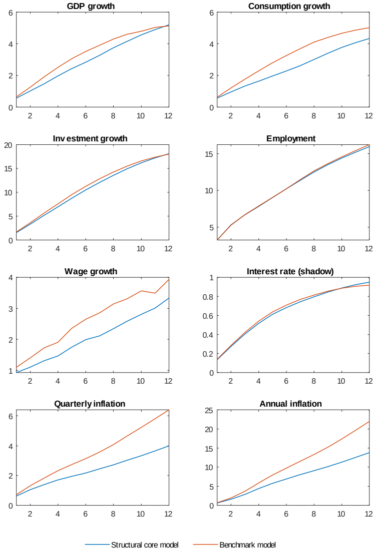
  - LinkedIn: **Linkedin.com/in/Benchimol/**

CPI Results: In-Sample Fit

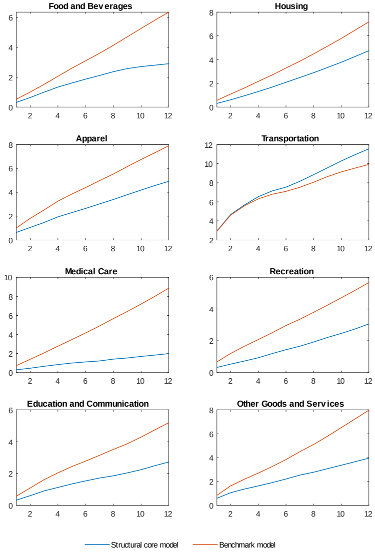
- We compare the fit of our structural core model to the benchmark model (SW).
- Our structural core CPI inflation has a log marginal data density of -1417, compared to -1656 for the benchmark model.
- Minimal adjustments for using CPI components as observables instead of headline PCE in the SW model.

CPI Results: Variables Out-of-Sample Fit



Notes: Cumulative RMSE of 1-12 quarters horizon. Derived from Bayesian estimations over the sample 1993-1999, and expanding over the testing sample 2000-2019.

CPI Results: Components Out-of-Sample Fit



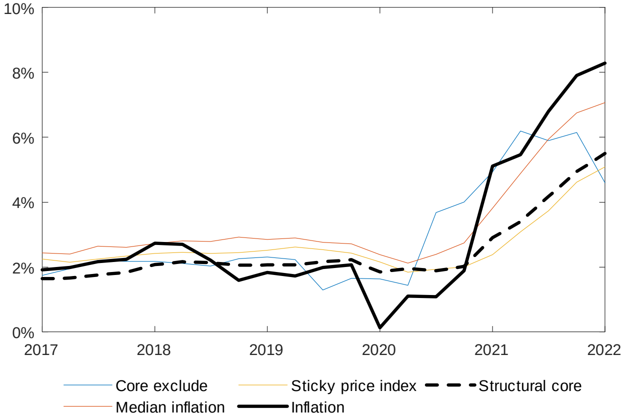
Notes: Cumulative RMSE of 1-12 quarters horizon. Derived from Bayesian estimations over the sample 1993-1999, and expanding over the testing sample 2000-2019.

CPI Results: Out-of-Sample Predictive Ability Tests

	1	2	3	4	5	6	7	8	9	10	11	12
GDP	8 (0.02)	8.6 (0.01)	8.1 (0.02)	9.9 (0.01)	8.9 (0.01)	10.6 (0.01)	8.3 (0.02)	7.8 (0.02)	13.1 (0)	7.5 (0.02)	9.4 (0.01)	8.8 (0.01)
Consumption	10.8 (0)	10.5 (0.01)	9.8 (0.01)	11 (0)	10.6 (0.01)	12.3 (0)	10.3 (0.01)	10.3 (0.01)	15.3 (0)	10.9 (0)	9.8 (0.01)	11.3 (0)
Investment	-0.6 (0.76)	-0.1 (0.93)	3.5 (0.17)	0.9 (0.62)	4.4 (0.11)	1.4 (0.5)	4.5 (0.11)	1.4 (0.49)	0.8 (0.65)	0.8 (0.67)	1.3 (0.53)	1 (0.6)
Employment	-5.5 (0.06)	-3.7 (0.16)	-2.2 (0.33)	-0.5 (0.79)	-4.3 (0.12)	0 (0.99)	-0.6 (0.74)	-0.1 (0.96)	-0.8 (0.67)	0.5 (0.77)	0.9 (0.63)	2.6 (0.27)
Wage	-0.3 (0.86)	4.9 (0.09)	5.4 (0.07)	8 (0.02)	7.8 (0.02)	11.5 (0)	7.6 (0.02)	6.7 (0.04)	14.4 (0)	5.7 (0.06)	5.8 (0.05)	5.3 (0.07)
Interest rate	-3.3 (0.19)	-3 (0.23)	-1.6 (0.45)	-3.7 (0.16)	-2.5 (0.28)	-2 (0.37)	-7.6 (0.02)	-1.2 (0.55)	-0.5 (0.78)	-0.3 (0.85)	-0.9 (0.62)	4 (0.13)
Inflation	1.5 (0.47)	3.3 (0.19)	5.2 (0.07)	6.7 (0.04)	11.1 (0)	14.8 (0)	18.2 (0)	21.4 (0)	25.6 (0)	32.4 (0)	42.5 (0)	58.2 (0)
Food & Beverages	2.8 (0.25)	4.5 (0.11)	8.3 (0.02)	13.9 (0)	16.3 (0)	20.7 (0)	19.7 (0)	22.4 (0)	26 (0)	30.3 (0)	36.7 (0)	46.5 (0)
Housing	4.9 (0.09)	7.6 (0.02)	11.4 (0)	15.3 (0)	18 (0)	20.7 (0)	21.5 (0)	24.2 (0)	27.7 (0)	33.6 (0)	41.2 (0)	60.9 (0)
Apparel	-40.7 (0)	-96.9 (0)	-64.9 (0)	-38.8 (0)	-25.5 (0)	-14.2 (0)	-8 (0.02)	-4.9 (0.09)	-3.2 (0.2)	-2.5 (0.28)	-1.7 (0.43)	-3.5 (0.17)
Transportation	-15.1 (0)	-9.4 (0.01)	-5 (0.08)	-3 (0.22)	-7.6 (0.02)	-7.7 (0.02)	10.5 (0.01)	3.6 (0.16)	1.5 (0.48)	1.3 (0.51)	1.7 (0.43)	2.2 (0.33)
Medical Care	30.1 (0)	101.4 (0)	118.4 (0)	146.6 (0)	154 (0)	151.1 (0)	125.8 (0)	125.7 (0)	116.4 (0)	115.1 (0)	126.2 (0)	140.4 (0)
Recreation	-14.2 (0)	-15 (0)	-3.1 (0.21)	-0.7 (0.72)	5 (0.08)	1.8 (0.42)	9 (0.01)	6.2 (0.05)	8.7 (0.01)	9.7 (0.01)	12.1 (0)	16.7 (0)
Educ & Comms	2.6 (0.28)	9 (0.01)	20.3 (0)	30.4 (0)	33.4 (0)	34.7 (0)	34.4 (0)	36.8 (0)	37.7 (0)	41.4 (0)	46.8 (0)	53.7 (0)
Other	20.9 (0)	70.2 (0)	124.4 (0)	154.8 (0)	182.8 (0)	187.6 (0)	169.1 (0)	167.7 (0)	151.3 (0)	155.7 (0)	172.1 (0)	205.2 (0)

Notes: The darker the cell, the better our structural core inflation forecast is over the benchmark model regarding p-values. Derived from Bayesian estimations over the sample 1993-1999, and expanding over the testing sample 2000-2019.

Covid-19: Structural vs. Alternative CPI Core Measures



Notes: All indexes are for annual inflation. Structural core is our estimated model core inflation. The estimation sample is 1993-2019, and the model is used to filter the 2021-2022 data with the same parameters.

CPI Core Inflation: Alternative Measures

Headline Inflation	Excl. Food & Energy	Median
-743.66	-709.00	-675.98

Sticky	Trimmed	Structural
-686.59	-692.29	-664.75

Notes: A higher log marginal data density implies a better fit compared to models presenting a lower one.