CITADEL

A Discussion on Inflation

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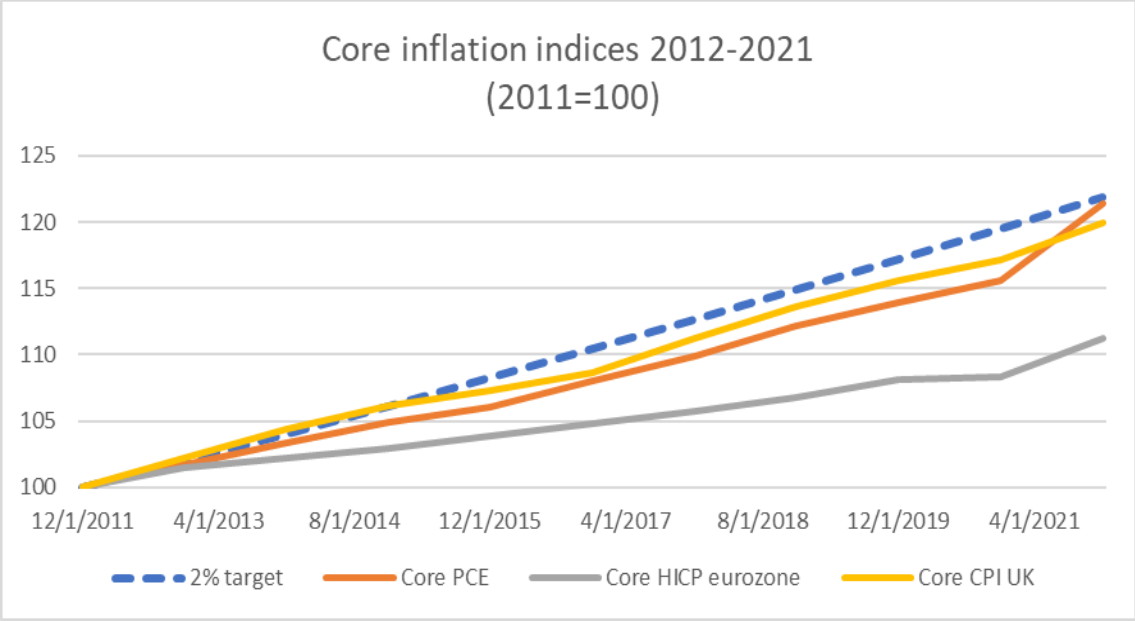
Outline and Summary

- Markets see inflation as a function of expectations, labor market, and pricing power. Have markets overlooked inflation risks?
  - A look at expectations
    - Did they de-anchor? The Failure to Arbitrage faced with Knightian uncertainty about commodities
    - Have they become more adaptive, given the salience, size and breadth of price hikes?
    - Do short term inflation expectations matter?
    - Were expectations driven by commodity prices, or the stance of policy?
  - A look at the labor market
    - Is the Great renegotiation a one-off?
  - A look at pricing power
    - A margin spiral?
  - A domestic macro shock, or many, sequential, micro shocks?
    - What's different about Japan?
- Were central banks behind the curve?
  - The "AND condition" strategy
- What are the risks?

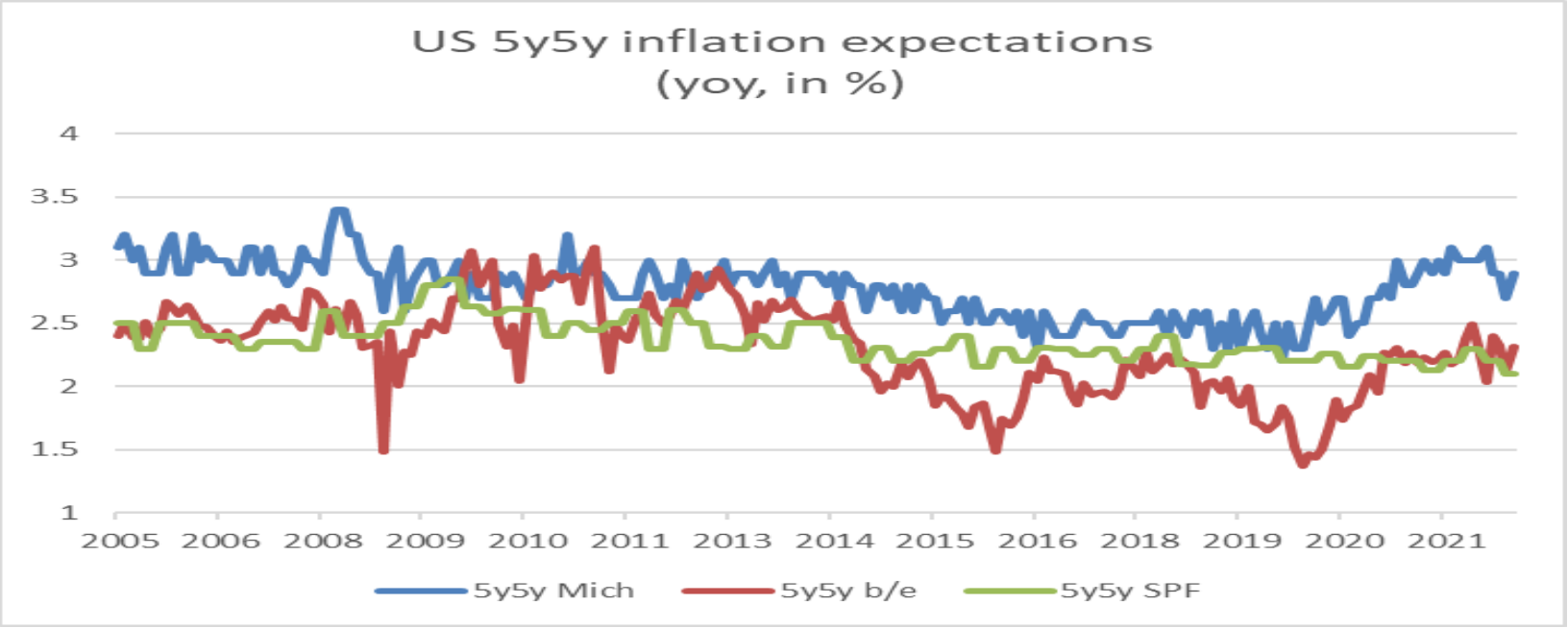
Did inflation expectations de-anchor?

- Context matters: the current spike in prices happened after a decade of too low inflation



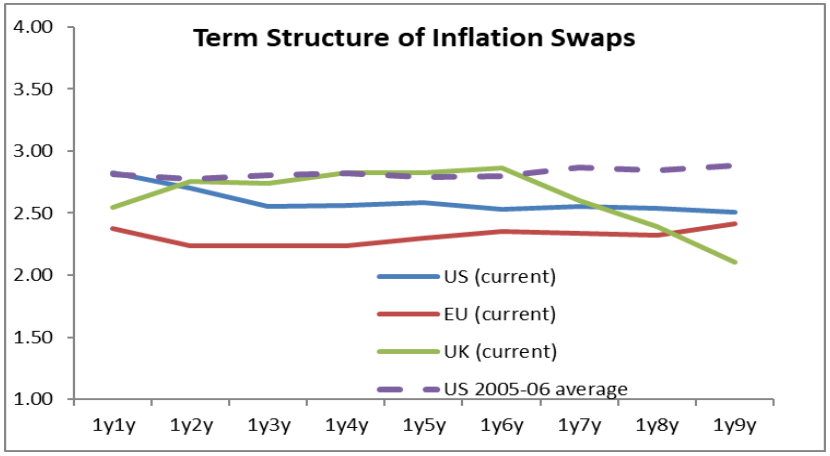
Did inflation expectations de-anchor?

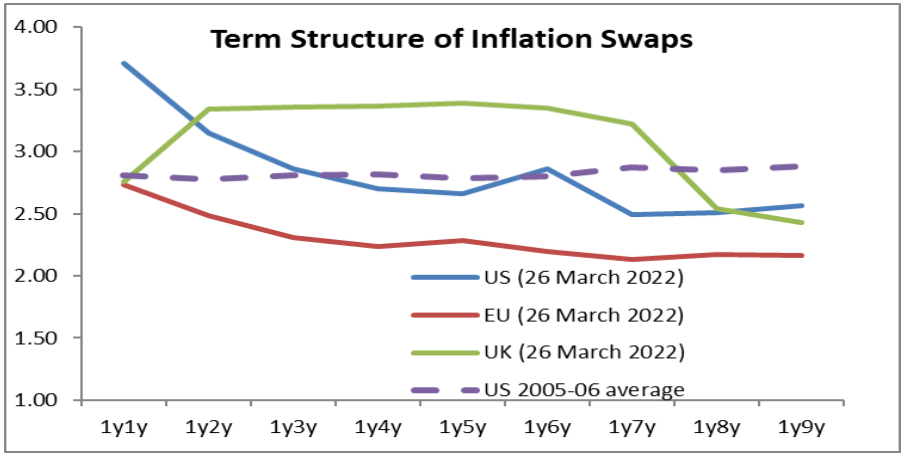
- This may help explain why medium-term inflation expectations have remained well anchored despite the size, breadth, and salience of the price shocks
  - The period 2005-06 provides a benchmark for anchoring.
  - Could you tell from this chart that in 2022 there was the largest increase in inflation in decades?



Did inflation expectations de-anchor?

- Even at the peak inflationary panic – at the peak in US 5y5y b/e, in March 26th 2022, around time of peak in commodity prices – US and Eurozone medium term expectations remained compatible with a ***symmetric*** 2% objective. In the UK this was less clear.
  - In normal times, there is plenty of two-way flow across a wide range of market participants active in inflation linked assets. In the EU and UK, though, there is structural demand for longer-dated linkers to hedge inflation-linked liabilities that bias these measures upwards on some forward measures.
  - In March, **"Failure to arbitrage"** in near term inflation linked assets in the face of Knightian uncertainty on commodity prices – GSCI had increased at over 300% annualized Jan-March 2022, upside risk was unbounded due to the war.





*For UK, swaps refer to RPI minus 100 to make it comparable to CPI

Did inflation expectations de-anchor?

- But were expectations at risk of de-anchoring? Reis (2022) argues that growing divergence in expectations could be a leading indicator of de-anchoring.
- We can estimate and monitor the degree of de-anchoring of inflation expectations (see Lyziak, Paloviita (2016))
  - **The adaptive and anchored components of expectations are modelled as follows:**

$$y_t = x_t\beta_{x,t} + w_t\beta_{w,t} + \varepsilon_t \qquad \varepsilon_t \sim N(0, \sigma_\varepsilon^2)$$

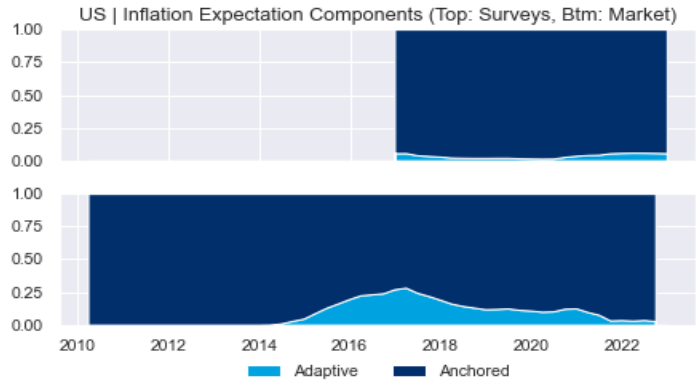
$$\begin{bmatrix}\beta_{x,t}\\ \beta_{w,t}\end{bmatrix} = \begin{bmatrix}\beta_{x,t-1}\\ \beta_{w,t-1}\end{bmatrix} + \begin{bmatrix}\zeta_{x,t}\\ \zeta_{w,t}\end{bmatrix} \qquad \begin{bmatrix}\zeta_{x,t}\\ \zeta_{w,t}\end{bmatrix} \sim N\left(\begin{bmatrix}0\\ 0\end{bmatrix}, \begin{bmatrix}\sigma^2_{\beta,x} & 0\\ 0 & \sigma^2_{\beta,w}\end{bmatrix}\right)$$

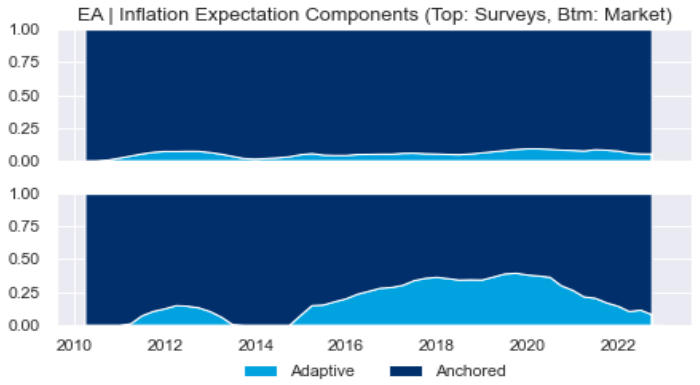
$$\beta_{x,t} + \beta_{w,t} = 1$$

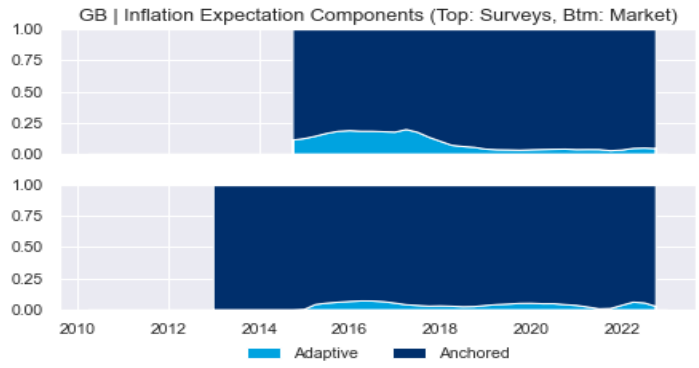
  - **Where y, x and w represent a measure of expectations, the CB target and realized CPI inflation lagged by one quarter, respectively**. All inputs where are transformed to quarterly average. The respective betas represent the anchored and adaptive components, which are time-varying. The anchored and adaptive components are constrained to sum to 1.
  - Before estimation, we adjust each measure for potential bias vs the CB target. This accounts for the fact that some measures are persistently higher than target.
  - **We estimate the model in two ways: via 5yr rolling OLS regressions, and in a state-space representation via ML and the Kalman filter**. In the latter, we allow coefficients to evolve as a random walk, and we do not need to specify an arbitrary estimation window. The model is estimated separately for each measure. All estimates shown are the simple average of the OLS and state-space results. Results from the two approaches tend to be close.

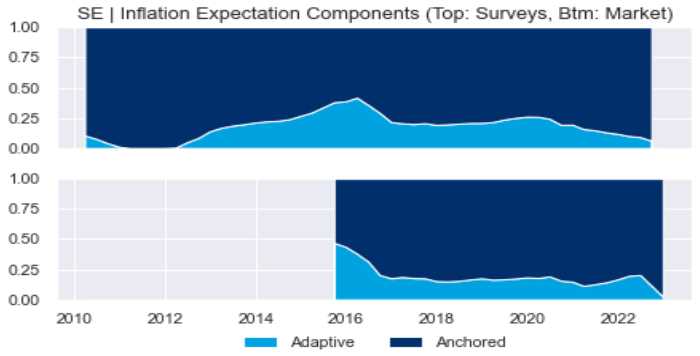
Did inflation expectations de-anchor?

- Medium term inflation expectations showed more signals of de-anchoring during the period of low inflation than in the current episode of high inflation.
  - Eurozone and Sweden are good examples. Even in the US during 2014-16



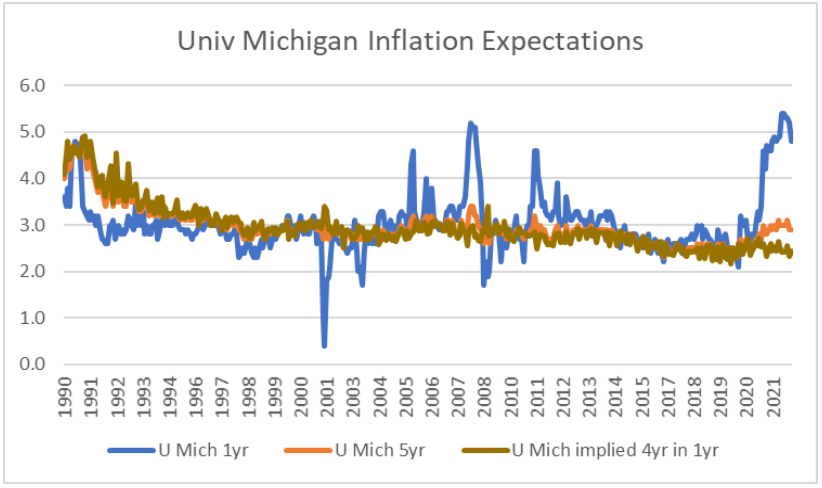


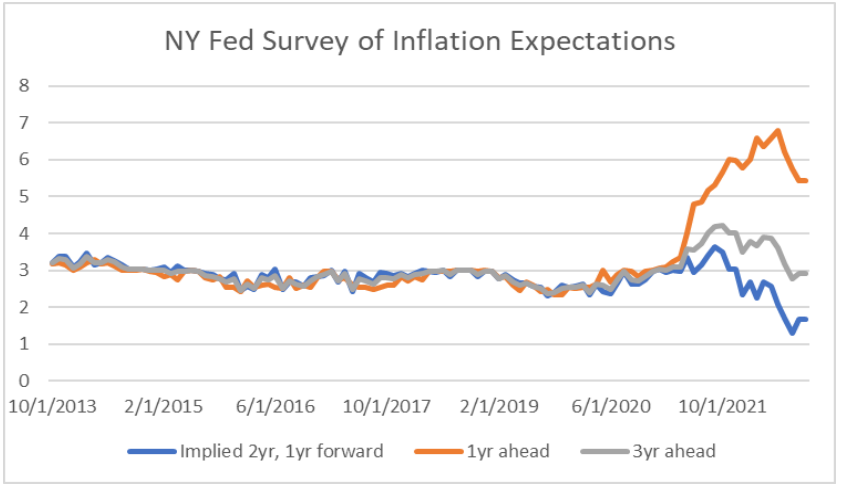




Did inflation expectations de-anchor?

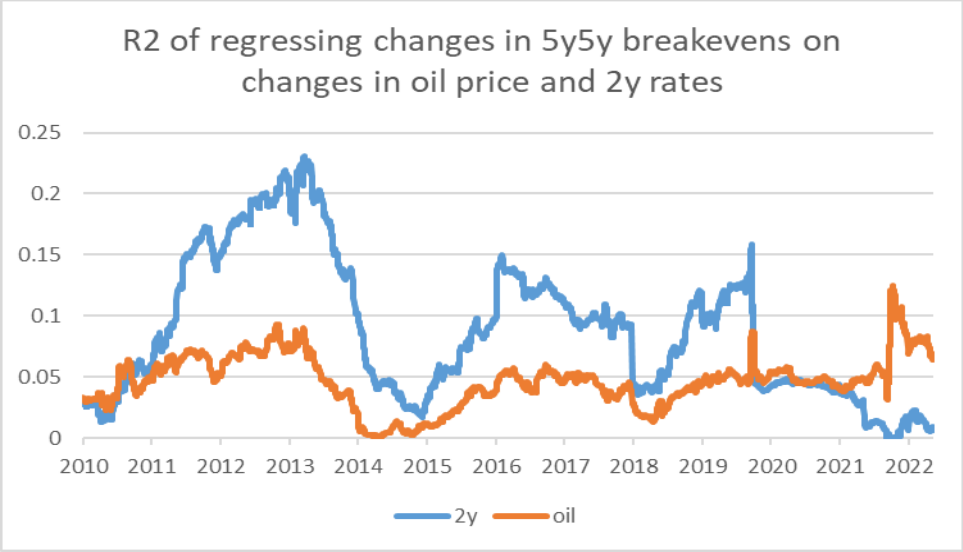
- But what about the elevated near-term consumer inflation expectations?
- Most of the action in near-term inflation expectations is in the year ahead inflation expectation, which reflects mostly current commodity prices
- And 1 year ahead inflation expectations have not contained information for future inflation, even in past periods of high headline inflation
  - For the period 1994-2021, actual core inflation was negatively correlated with 1 year ahead inflation expectations reported in the Michigan Survey a year before (see Wilcox and Reifschneider (2022) and Nalewaik (2016))





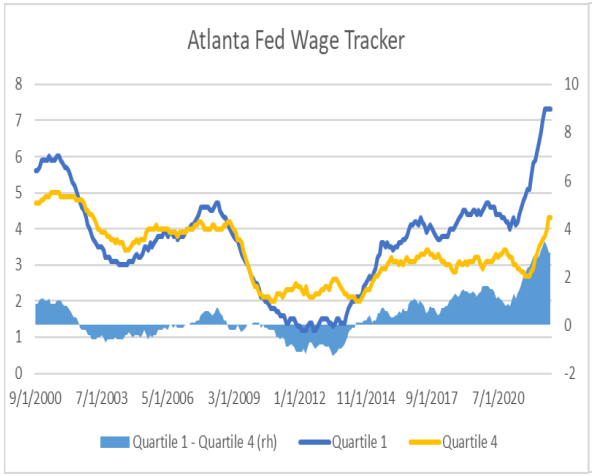
Did inflation expectations de-anchor?

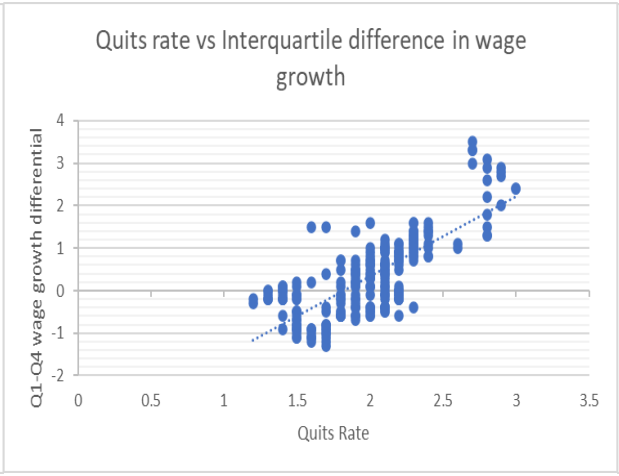
- Were expectations anchored because of the fast rate hikes?
- Or is it possible that expectations were mostly driven by commodity prices?
  - We regress the PC1 of changes in 5y5y breakevens on changes in oil prices and on changes in the PC1 of 2yr interest rates (as a proxy of the monetary policy action). The countries are: US, eurozone, UK, Japan, Australia, Canada, Sweden.
  - The suggests oil prices were the main driver of 5y5y breakevens in the 2021-22 period. The results are similar estimating a joint regression on both oil and 2yr rates.

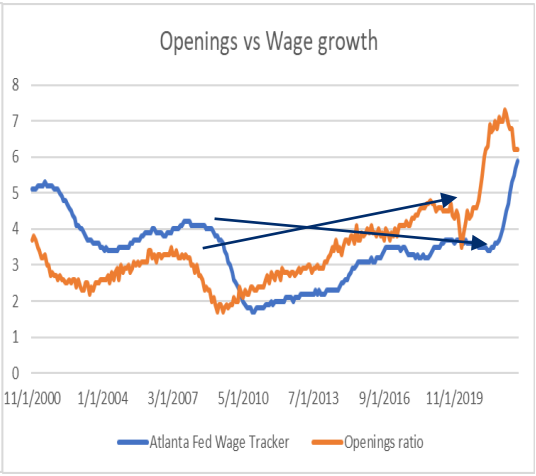


A look at the labor market

- If expectations were anchored, why did prices increase so fast?
  - The decline in unemployment during 2021 was not enough to generate the observed acceleration in wage growth in the US.
  - Is the acceleration in wage growth a one-off, driven by idiosyncratic factors?
- What was different in the US vs eurozone? Furlough vs unemployment
  - The US **Great Renegotiation** + less immigration => spike in labor market churn and increase in "market minimum wage". Likely a level shift, unlikely to generate drift.
  - Vacancies not a robust indicator of slack: it drifted higher during 2007-2019 yet wage growth slowed down. Note labor share back to 2019 levels.

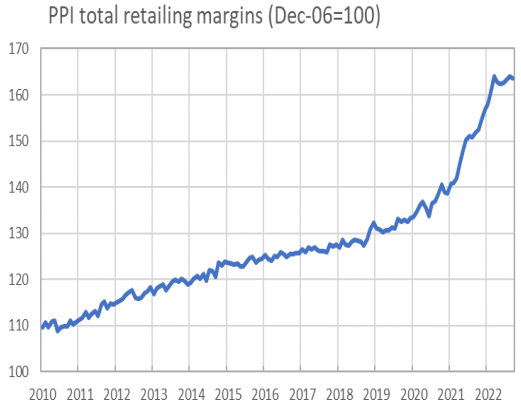


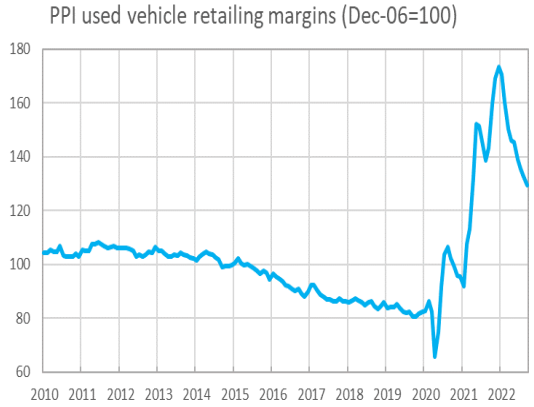


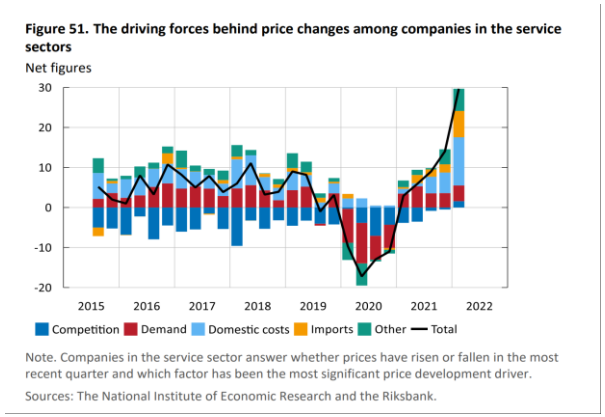


A look at pricing power

- Inflation is a pricing phenomenon. Firms hiked prices "because they could"
  - Pre Covid, firms felt they couldn't hike prices much because of global competition for market share (see. i.e., Lowe (2018) and Riksbank (2022))
  - Covid, then supply bottlenecks, and commodity price shock, segmented competition and gave "moral reason" to hike prices: **non-linear scarcity shocks passed onto prices**
    - A "margin spiral": margins in the US increased rapidly during 2020-21 (see also Brainard 2022)
    - Of course, strong demand growth facilitated it.
- Will companies return to compete on market share once the "moral reasons" are over?

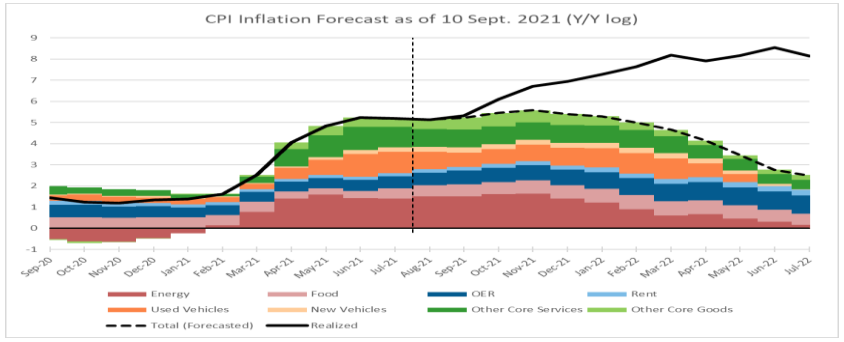


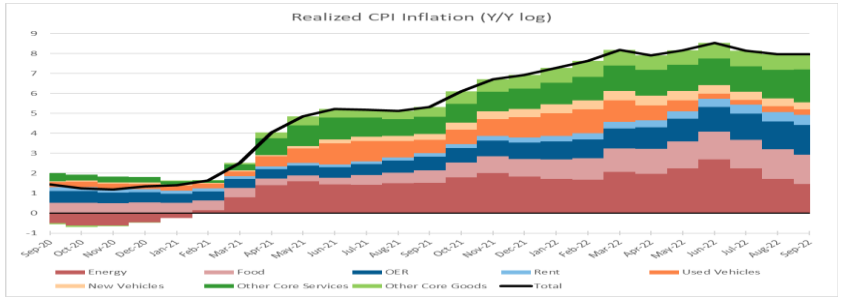


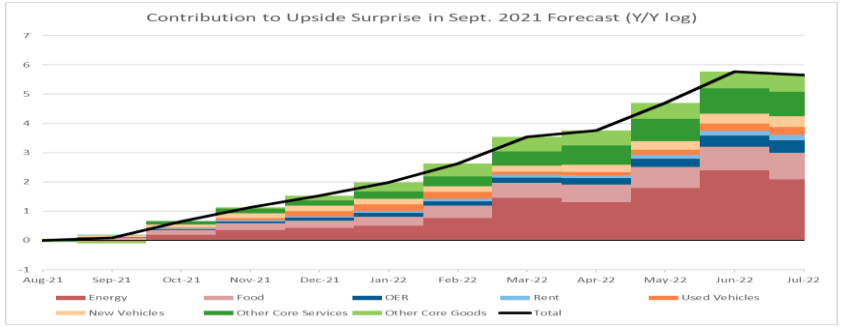


A domestic macro shock, or many, sequential, micro shocks?

- A domestic macro shock, or a series of micro shocks, possibly global, are observationally equivalent, but have different implications.
  - What was the source of such large forecast errors in inflation?
  - As of Sept 2021, the forecast with a bottom-up inflation model trained on the pre Covid period suggested inflation around 2.5% y/y by July 2022
  - Realized CPI inflation in July 2022 was 8.1% y/y, a surprise of 5.6pp
    - About half of the surprise is food and energy – exogenous micro shock
    - Cars contribute 0.6pp – mostly micro scarcity shock
    - Other core goods 0.6pp – mostly pass through from energy and bottlenecks
    - OER/rent contribute 0.6pp – domestic demand shock
    - Other core services contribute 0.8pp – mostly domestic demand shock, but some pass through from energy and bottlenecks.

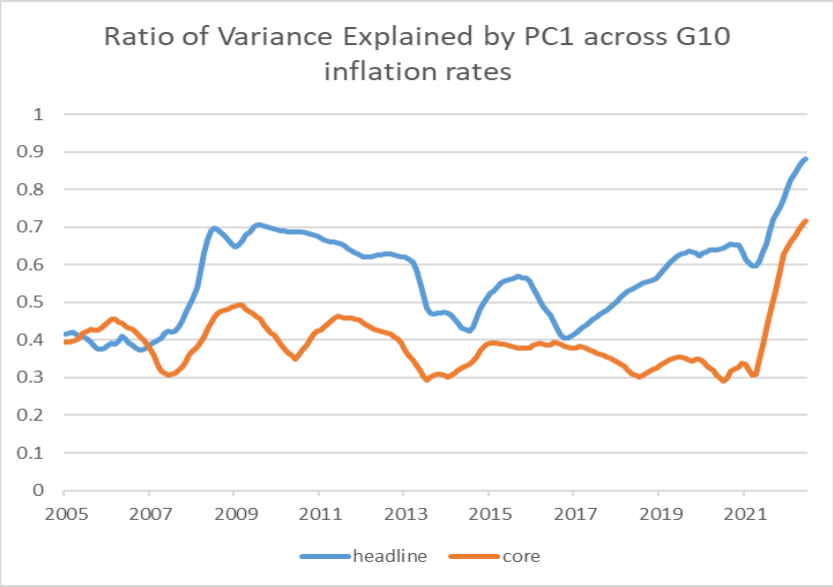


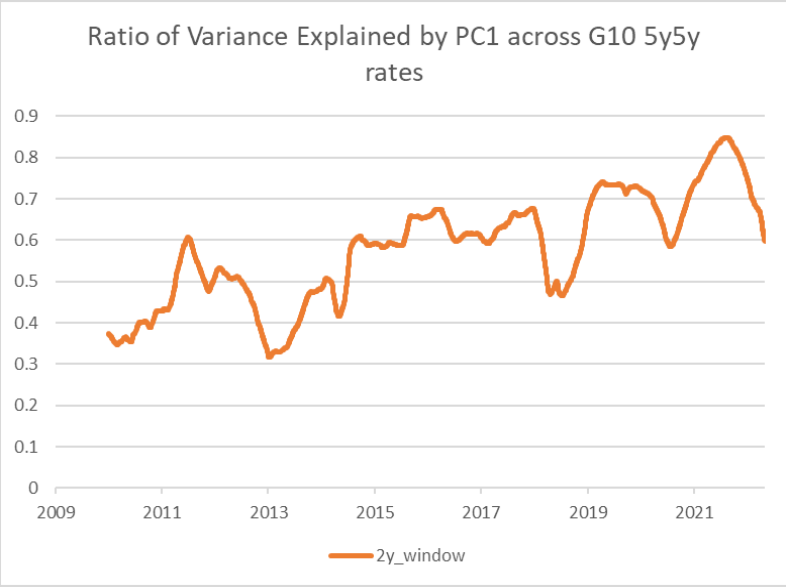




A domestic macro shock, or many, sequential, micro shocks?

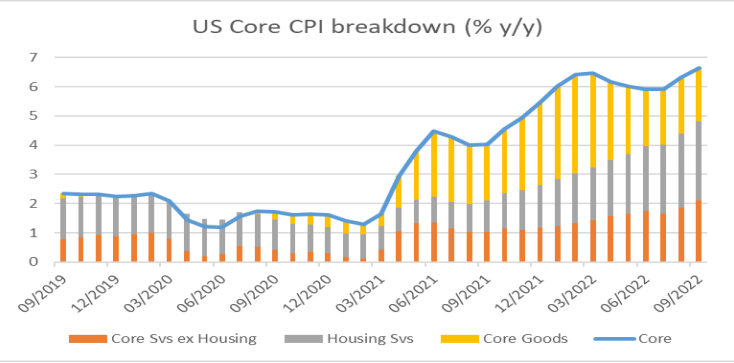
- Another way to look at domestic macro shock vs global micro shocks
  - Both inflation measures (headline and core) and 5y5y breakevens, increasingly driven by global factors, suggesting global micro shocks.
  - If so, is core inflation still “core”? What is the informational content of current core inflation for future inflation?

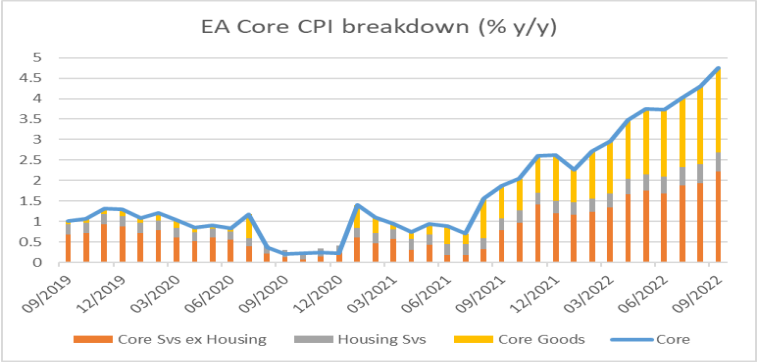


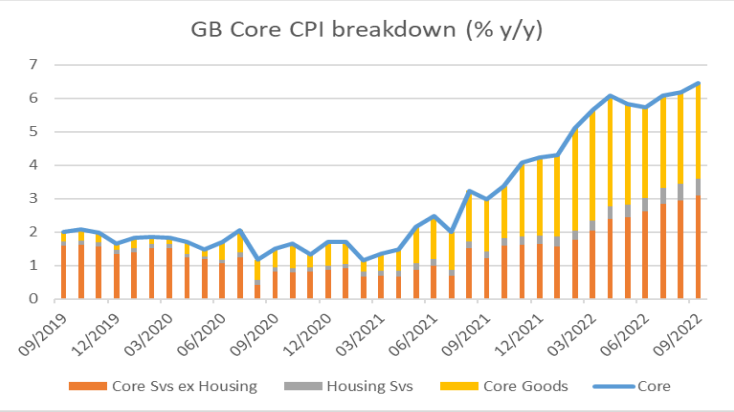


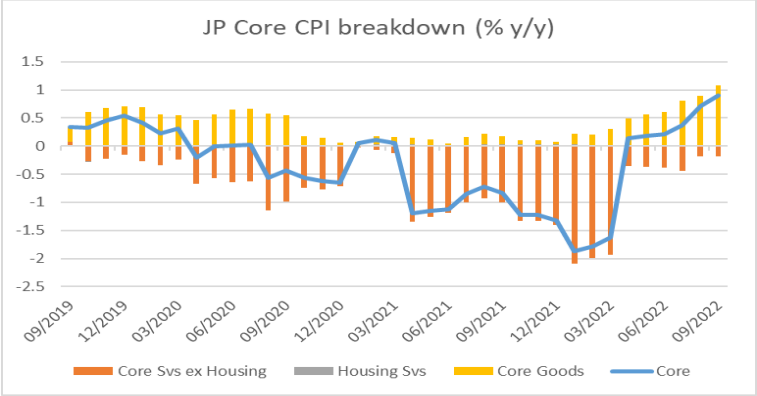
A domestic macro shock, or many, sequential, micro shocks?

- But if it is a global micro shock, why is Japan's inflation so low?
  - Japan isolated from micro shocks because no lockdowns and different energy sources, and it has lagged the reopening to international travel
    - As it welcomes foreign tourism, it may become vulnerable to a sudden increase in churn in the labor market that lifts wage growth and services inflation.









Were central banks behind the curve?

- Based on inflation expectations, not too much. But then, why raising rates so fast?
- **A different strategy – the "AND condition" strategy**
  - Liftoff when inflation at target AND full employment
    - Compare with 2014 liftoff with core PCE at 1.2%
  - The "AND condition" strategy implies that, when fulfilled, rates must be hiked fast to at least neutral
  - If inflation target is a **symmetric** midpoint, not a ceiling, upside inflation risk will be higher than in the past. Central banks not well suited to manage this risk
- **The "AND condition" strategy has three phases**
  - **Phase 1:** Fast to at least neutral (depending on expectations)
    - Look through supply shock only ***after*** reaching neutral
    - If r* higher (stronger balance sheets), then higher rates for right reason.
  - **Phase 2:** Slow to restrictive resting point
  - **Phase 3:** Hold at restrictive resting point to achieve opportunistic disinflation as needed

Were central banks behind the curve?

- **Then optional Phase 4: Opportunistic reflation** (Ubide 2017)
  - If 2% inflation objective was right for Great Moderation and high r*, it must be too low for Great Volatility and low r*
  - Increase inflation objective, de facto or de iure
    - Inflation close but ***above*** 2% during expansions
      - Better policy mix, higher expected growth because of shallower recessions.

What are the risks?

- **Risk from high interest rate volatility**
  - Ubide (2017): cyclically adjusted forward guidance to ease/tighten via volatility of rates and VaR
    - "Measured pace" stance was too easy because of low interest rate volatility.
  - This cycle: uncertainty about pace of hikes added to tightening via higher volatility of interest rates
  - Initially right policy, but trade off pace of hikes vs level becoming unfavorable, creates financial stability risks
    - Two decades of low rates and low volatility of rates have created a financial system that thrived on low volatility of interest rates
- **Risk from current inflation spike**
  - The dominant narrative is typically the most permanent impact of any shock
  - The narrative may imply not enough easing the next downturn and not enough fiscal and monetary policy coordination
    - Gagnon and Sarsenbayev (2022): "25 years of excess unemployment"