INFLATION EXPECTATIONS: RECENT MOVEMENTS AND THEIR INTERPRETATION

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LSE

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ECB - FBRNY
conference on inflation expectations

Not surprising that inflation rose in 2021

Harder: is it persistent or transitory?

- **In the long run this is about expectations anchor and monetary policy**
  - There are temporary headwinds and tailwinds, but inflation is a monetary phenomenon
  - In a flexible-price world (and so in long run), monetary policy is all about guiding expectations.
- **The two are interconnected**
  - Asking people what they think inflation will. be in 5 years is asking them: do you trust the central bank?
  - Measures of credibility
- **Answer has to be probabilistic**
  - Virtue of central bank independence and inflation targeting is to reduce inflation risk premium
  - Beyond average forecasts upside risk is what you would worry about

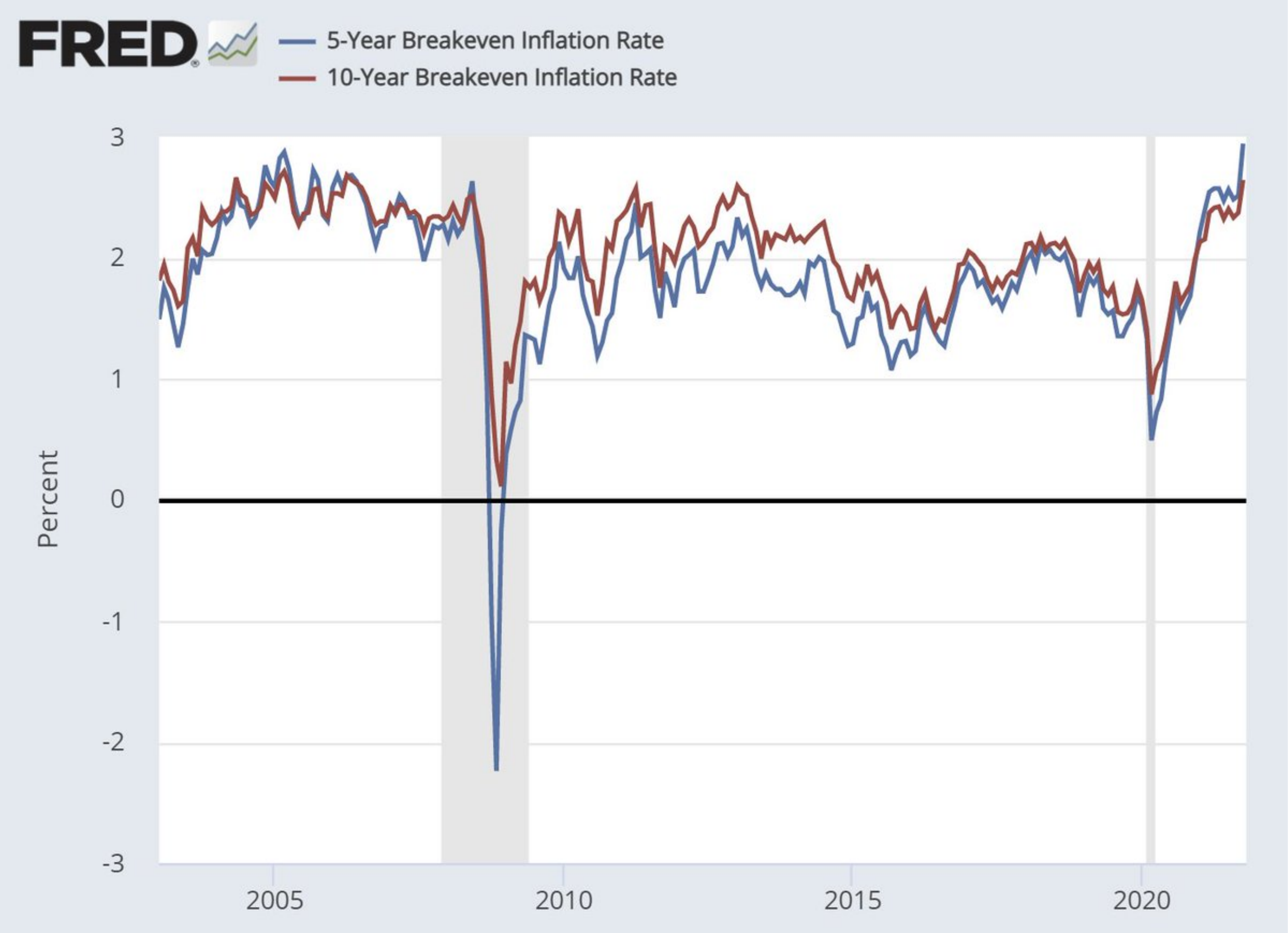
In this talk I will describe 2 (3) papers

- With Jens Hilscher and Alon Raviv
  - "How Likely is an Inflation Disaster?" (2021)

- On surveys of expectations:
  - "Losing the Inflation Anchor" (2021)
  - (and "The People versus the Markets: A Parsimonious Model of Inflation Expectations" (2020)

1. What do the market prices say?

Tail counterparts to this figure



- What is the risk- adjusted probability of an inflation disaster between today and ten years from now?
- What is the risk-adjusted probability of an inflation disaster between 5 years form now and 10 years from now?
- What is the actual probability of an inflation disaster between 5 years form now and 10 years from now?

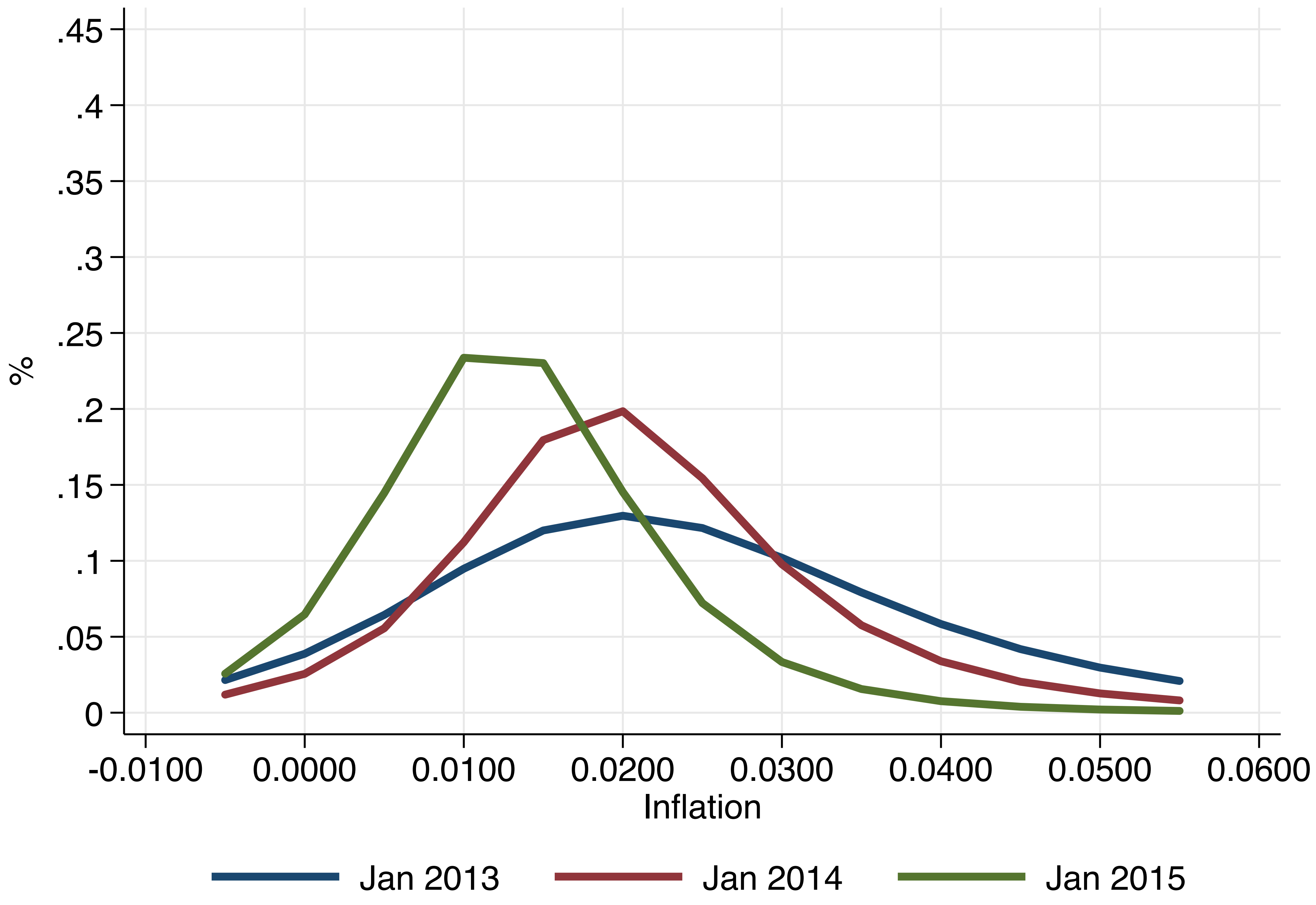
$$\Phi^h = Prob(\pi_{t,T} > (T-t)\bar{\pi})$$

$$\Phi^d = Prob(\pi_{t,T} < (T-t)\underline{\pi})$$

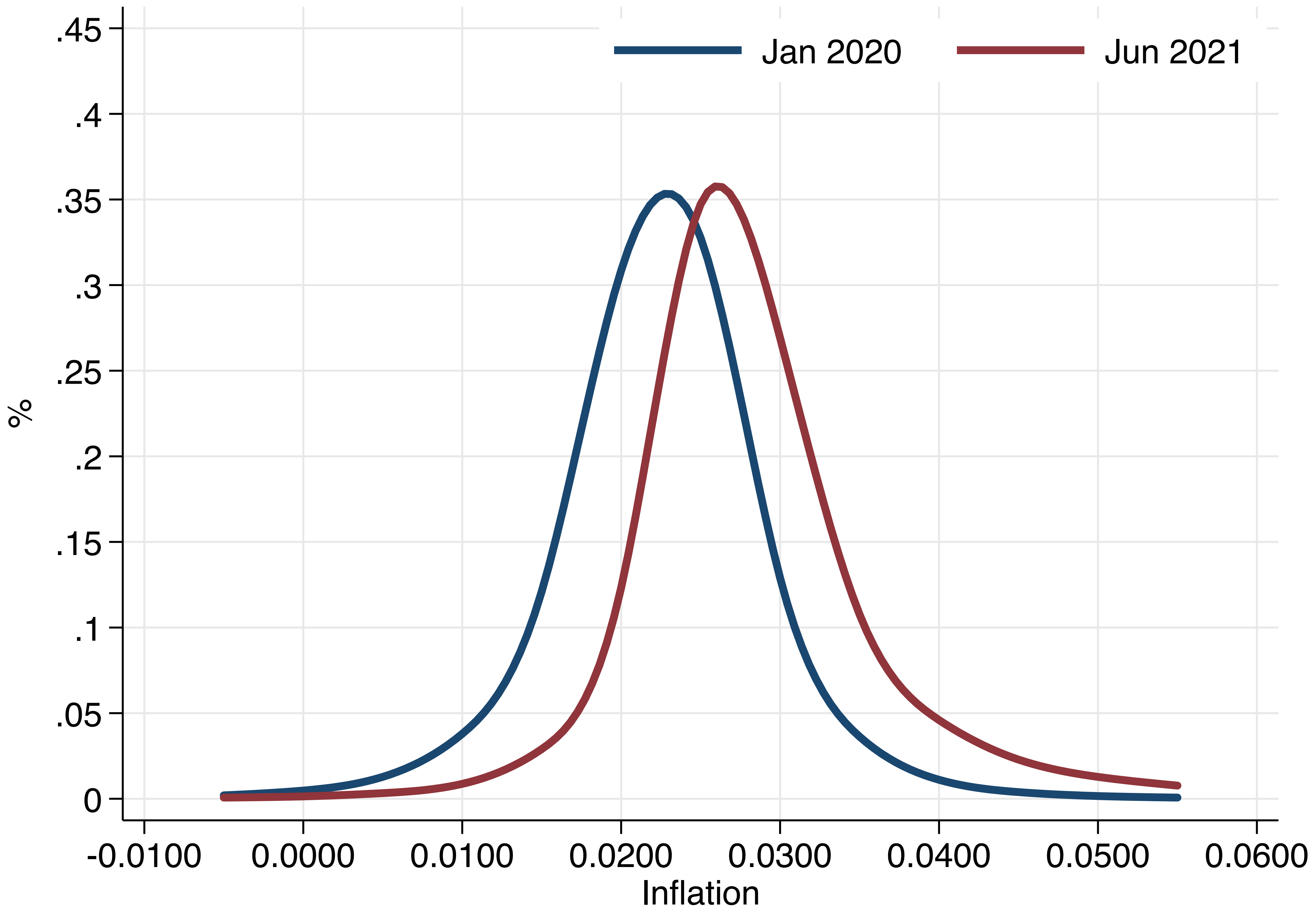
Source: Hilscher, Raviv Reis (2021)

Obvious candidate: inflation options

EZ



US



Disasters definition: >4% on average per year for 5 years, or <0% on average per year for 5 years. 10 log points deviation from target

Source: Hilscher, Raviv Reis (2021)

But data is misleading, does not match

Proposition 1. *The probabilities of disaster high-inflation and deflation are, respectively:*

$$\Phi^h = \sum_{\pi_{t,T} > (T-t)\bar{\pi}} p(\pi_{t,T}) \quad \textit{and} \quad \Phi^d = \sum_{\pi_{t,T} < (T-t)\underline{\pi}} p(\pi_{t,T}) \tag{4}$$

The actual probabilities satisfy:

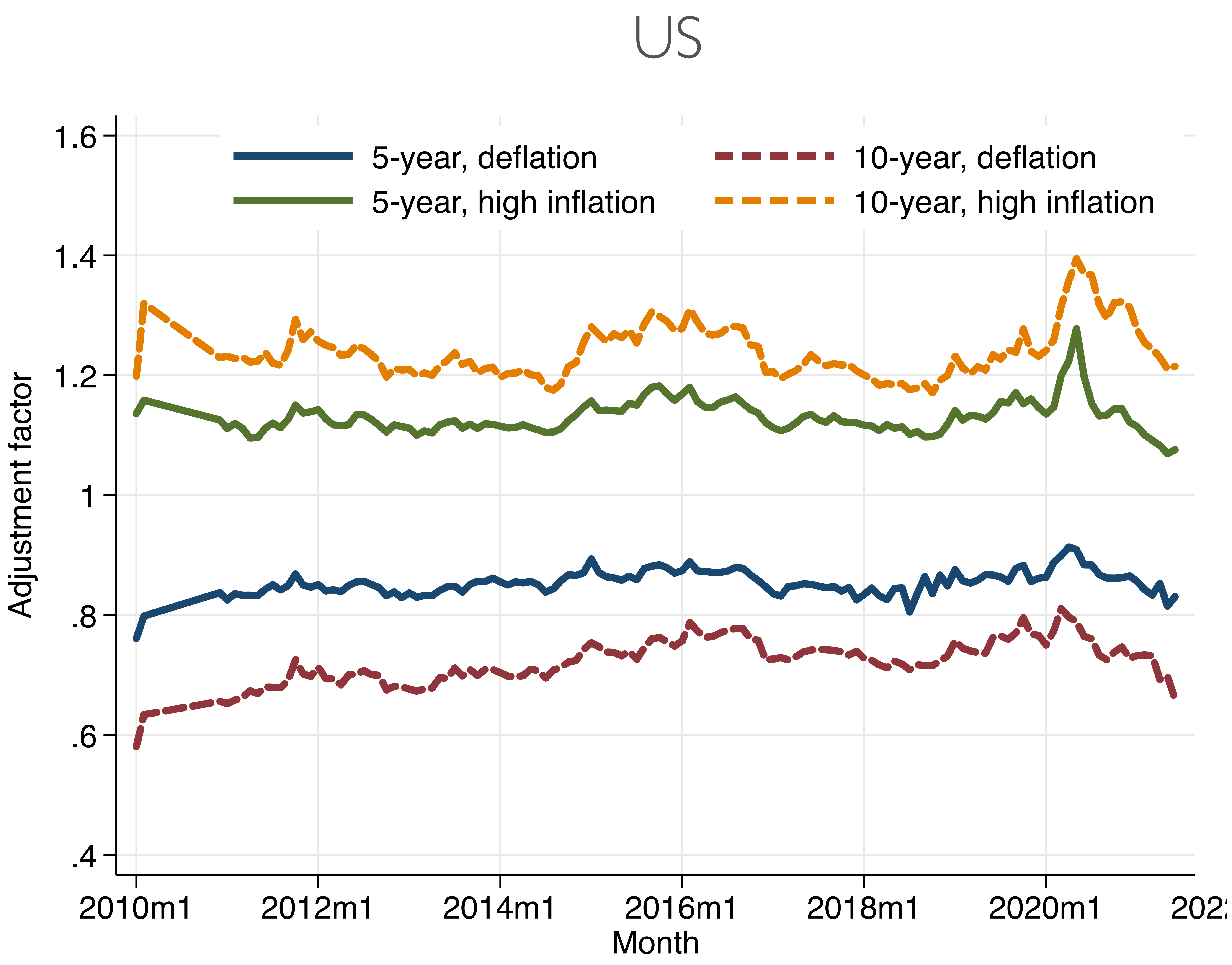
$$p(\pi_{t,T}) = \underbrace{n(\pi_{0,T})}_{Options} \times \underbrace{\left(\frac{e^{\pi_{0,T}} R_{0,t}}{I_{0,T}}\right)}_{Real} \times \underbrace{\left(\frac{\sum_{\pi_{0,t}} p(\pi_{0,T} + \pi_{t,T} | \pi_{0,t}) p(\pi_{0,t})}{p(\pi_{0,T})}\right)}_{Horizon} \times \underbrace{\left(\frac{1}{R_{0,T} m(\pi_{0,T})}\right)}_{Risk}$$

Three adjustments

- Probabilities that mean something
- From 5y or 10y to instead 5y5y
- From risk-neutral (***q***) to actual probabilities (***p***)

Source: Hilscher, Raviv, Reis (2021)

First issue: meaningful risk-neutral probabilities



- 2 periods, 3 states case, option price on disaster:

$$a(1) = p_{nd} m_d e^{-\pi_d}$$

- Usually reported (MinnFed)

$$n_d(1) = a(1) I_1$$

- But AD price probability is:

$$q_d(1) = p_{nd} m_d R_1$$

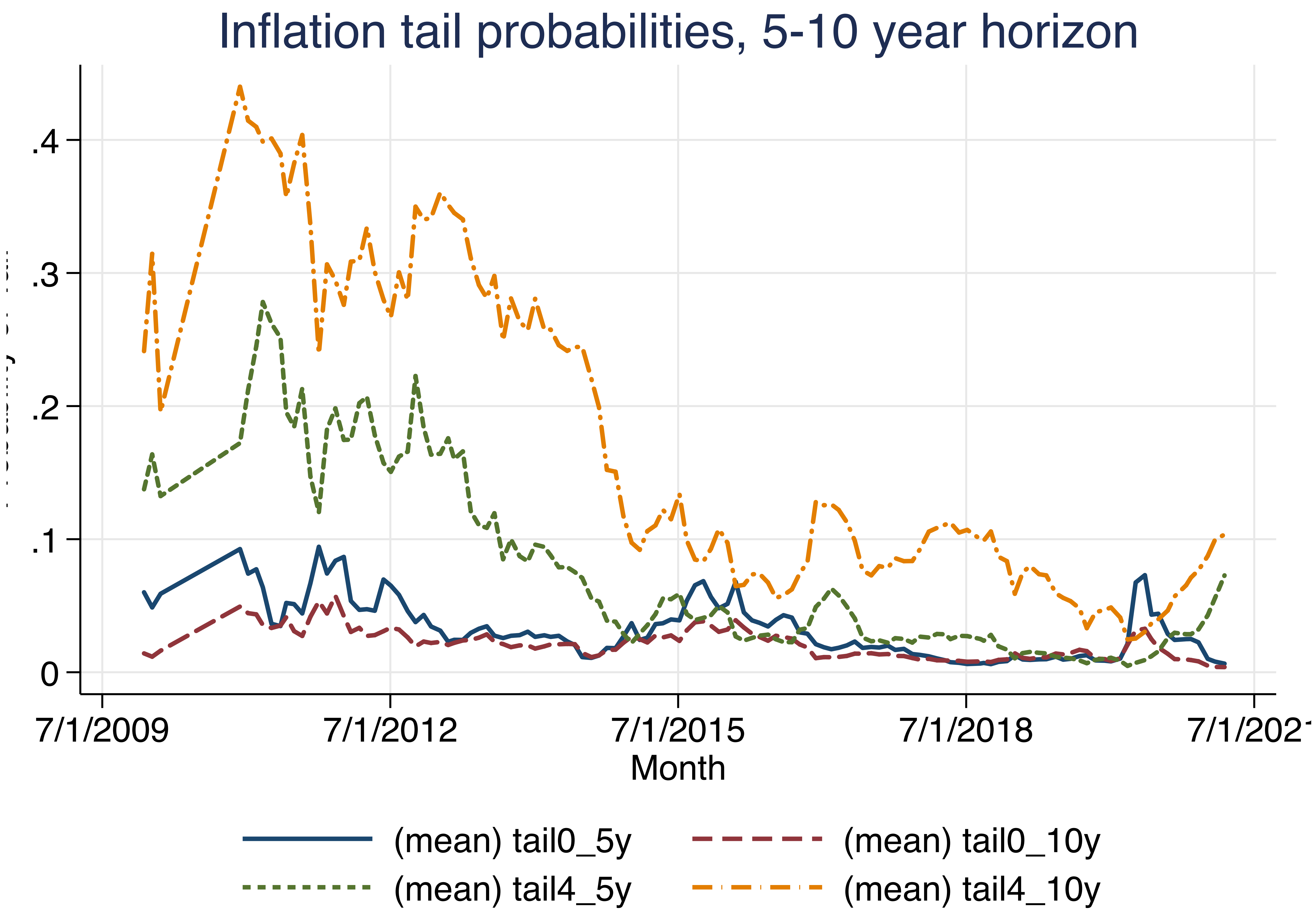
- Adjustment factor

$$q_d(1) = n_d(1)(e^{\pi_d} R_1 / I_1)$$

Source: Hilscher, Raviv, Reis (2021)

First issue: meaningful risk-neutral probabilities

United States



- Pricing condition

$$a(k) = \sum_{\pi} \left(p(\pi) m(\pi) \max\left\{ \frac{e^{\pi} - k}{e^{\pi}}, 0 \right\} \right)$$

- Can measure

$$N(\log(k)) = 1 + Ia'(k)$$

$$n(\pi) = b(\pi) e^{-\pi - i}$$

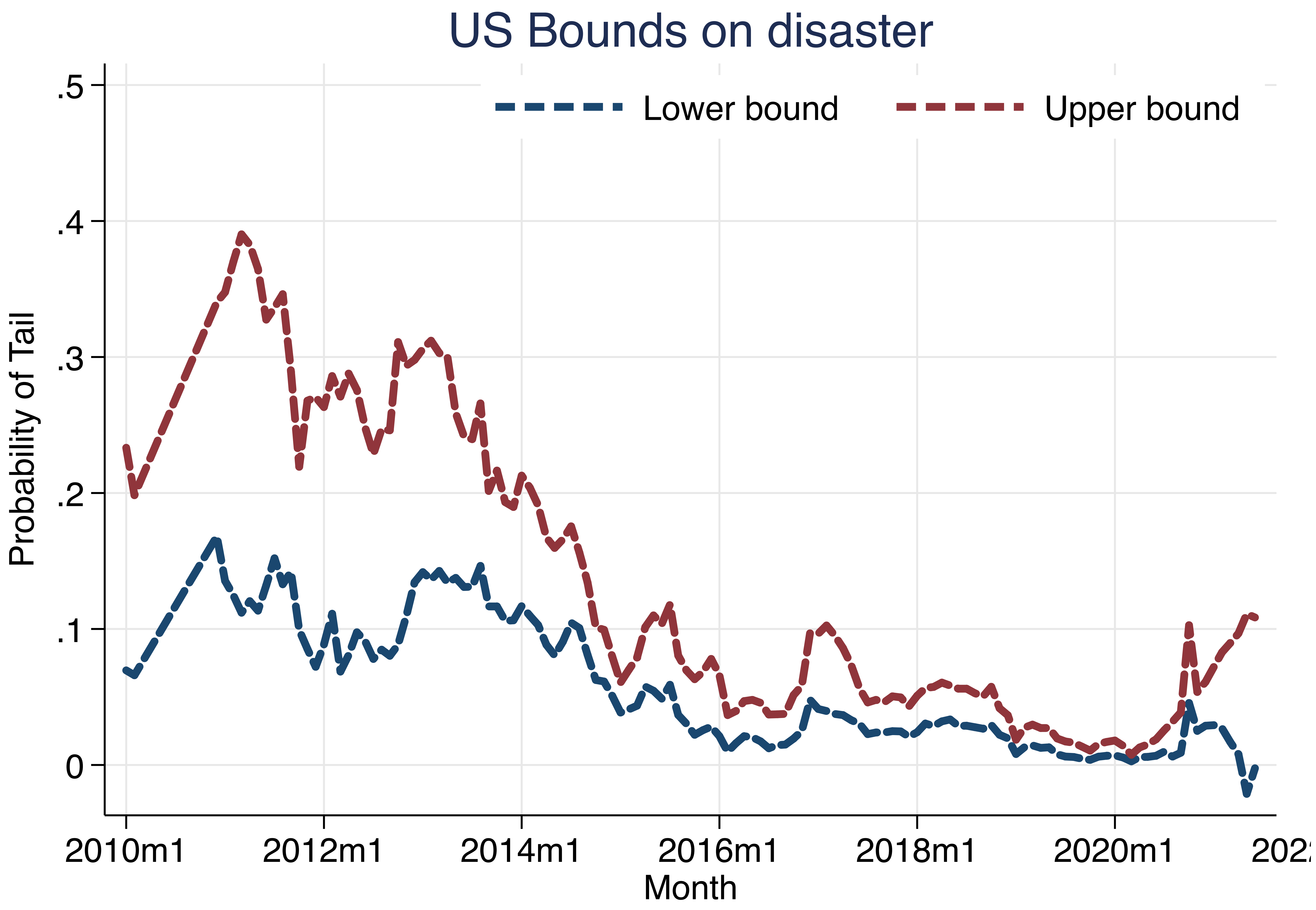
$$q(\pi) = b(\pi) e^{r}$$

- But actually

$$q(\log k) = e^{r} k a''(k)$$

Source: Hilscher, Raviv, Reis (2021)

Second issue: horizon



- 10y probability is almost always above 5y
- Inflation is sluggish, takes time to build up, if 2 periods of 5 years, 5y5y will be higher than 5y and smaller than 10y-5y

Source: Hilscher, Raviv Reis (2021)

Second issue: horizon

The $\mathbf{A}$ matrix looks like:

$$\begin{bmatrix} 1-5\pi_L & \pi_L & \pi_L & \pi_L & \pi_L & \pi_L & 0 & 0 \\ \pi_{nL}+\pi_{nn} & 1-\pi_{nL}-\pi_{nn}-\pi_{mr} & \pi_{mr} & 0 & 0 & 0 & 0 & 0 \\ \pi_{nL} & \pi_{nn} & \pi_m & \pi_{mr} & 0 & 0 & 0 & \pi_{nH} \\ \pi_{nL} & 0 & \pi_{nn} & \pi_n & \pi_{nn} & 0 & 0 & \pi_{nH} \\ \pi_{nL} & 0 & 0 & \pi_{nn} & \pi_n & \pi_{nn} & 0 & \pi_{nH} \\ \pi_{nL} & 0 & 0 & 0 & \pi_{mr} & \pi_m & \pi_{nn} & \pi_{nH} \\ 0 & 0 & 0 & 0 & 0 & \pi_{mr} & 1-\pi_{nH}-\pi_{nn}-\pi_{mr} & \pi_{nH}+\pi_{nn} \\ 0 & 0 & \pi_H & \pi_H & \pi_H & \pi_H & \pi_H & 1-5\pi_H \end{bmatrix}$$

where $\pi_n = 1-2\pi_{nn}-\pi_{nL}-\pi_{nH}$, and $\pi_m = 1-\pi_{nH}-\pi_{nn}-\pi_{mr}-\pi_{nL}$.

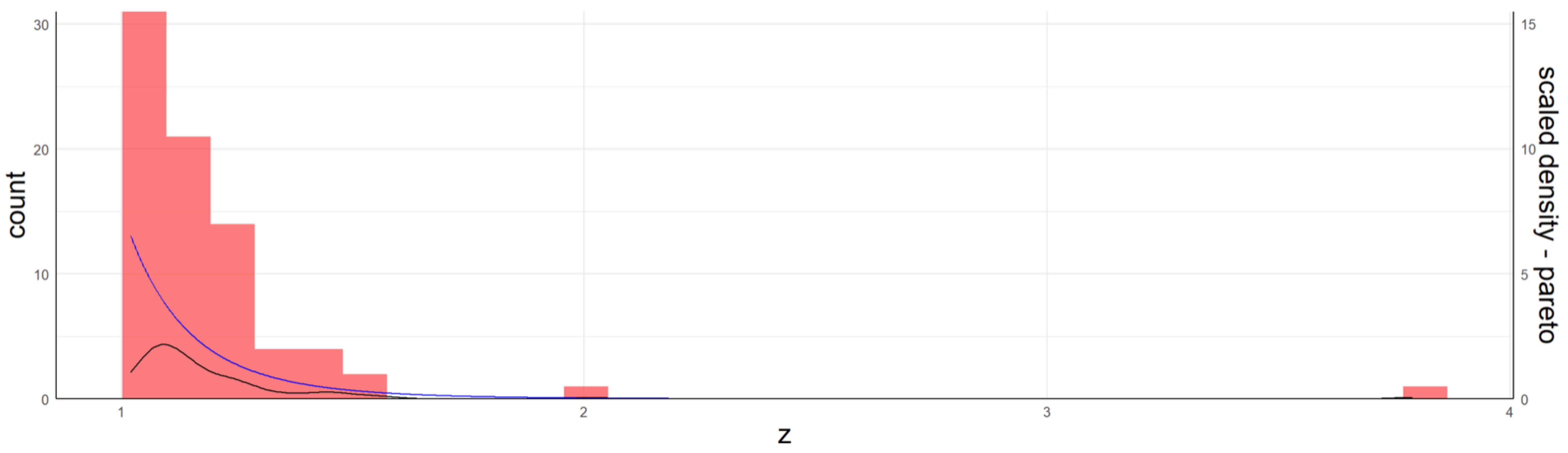
Vector of parameters: $\pi = \begin{bmatrix} \pi_L & \pi_H & \pi_{nL} & \pi_{nH} & \pi_{nn} & \pi_{mr} \end{bmatrix}'$.

- Local model plus disasters in Markov chain form
- Fit to distributions at 5y, 10y, as well as the one-year distributions at 5-9 years.

Source: Hilscher, Raviv Reis (2021)

Third issue: risk aversion

	Method 1.1	Method 1.2	Method 1.3	Method 2.1	Method 2.2	Method 2.3
Unconditional Probability of Inflation Disaster	21.3%	20.7%	13.2%	20.3%	20.9%	12.9%
Probability of at least 1 year joint disaster conditional on inflation disaster (Barro 2006)	16.7%	18%	21.3%	16.9%	18.7%	20.3%
Probability of at least 1 year joint disaster conditional on inflation disaster (Barro & Jin 2011)	27.1%	28.9%	32.4%	25.9%	29.3%	32.2%



- Use Jorda-Schularick-Taylor and Barro datasets
- Within windows of consumption disaster see if inflation disaster as well (relative to target inflation)
- varying window length and size measurement

Source: Hilscher, Raviv Reis (2021)

Third issue: risk aversion

$$log(Y_{t+1}) = \; log(Y_t) + \; g \; + \; u_{t+1} \; + \; v_{t+1}$$

$$f(z) = \alpha z_0^{\alpha} \cdot z^{-(1+\alpha)}, \;\; z \geq z_0 > 1$$

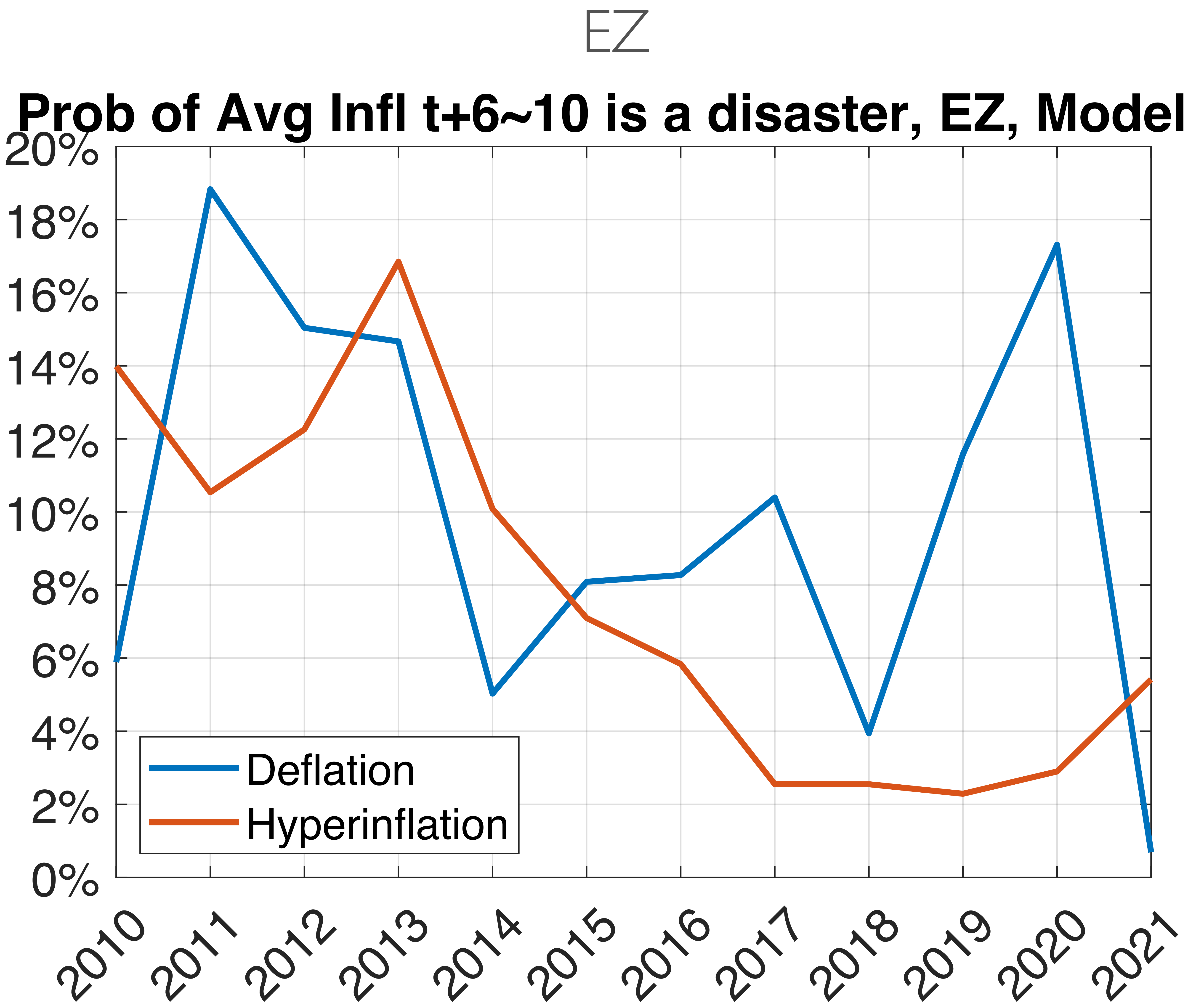
$$1 + \hat{\rho} = (1+g)^{-\gamma} \cdot E_t\left(z^{\gamma} R^{o}_{t+1}\right)$$

Zo	Alpha
1.02	6.68
1.02	6.96
1.02	7.38
1.01	7.63
1.01	8.2
1.01	8.33

- Model of rare disaster, with Pareto distribution in these tails
- Key are the Pareto parameters

Source: Hilscher, Raviv Reis (2021)

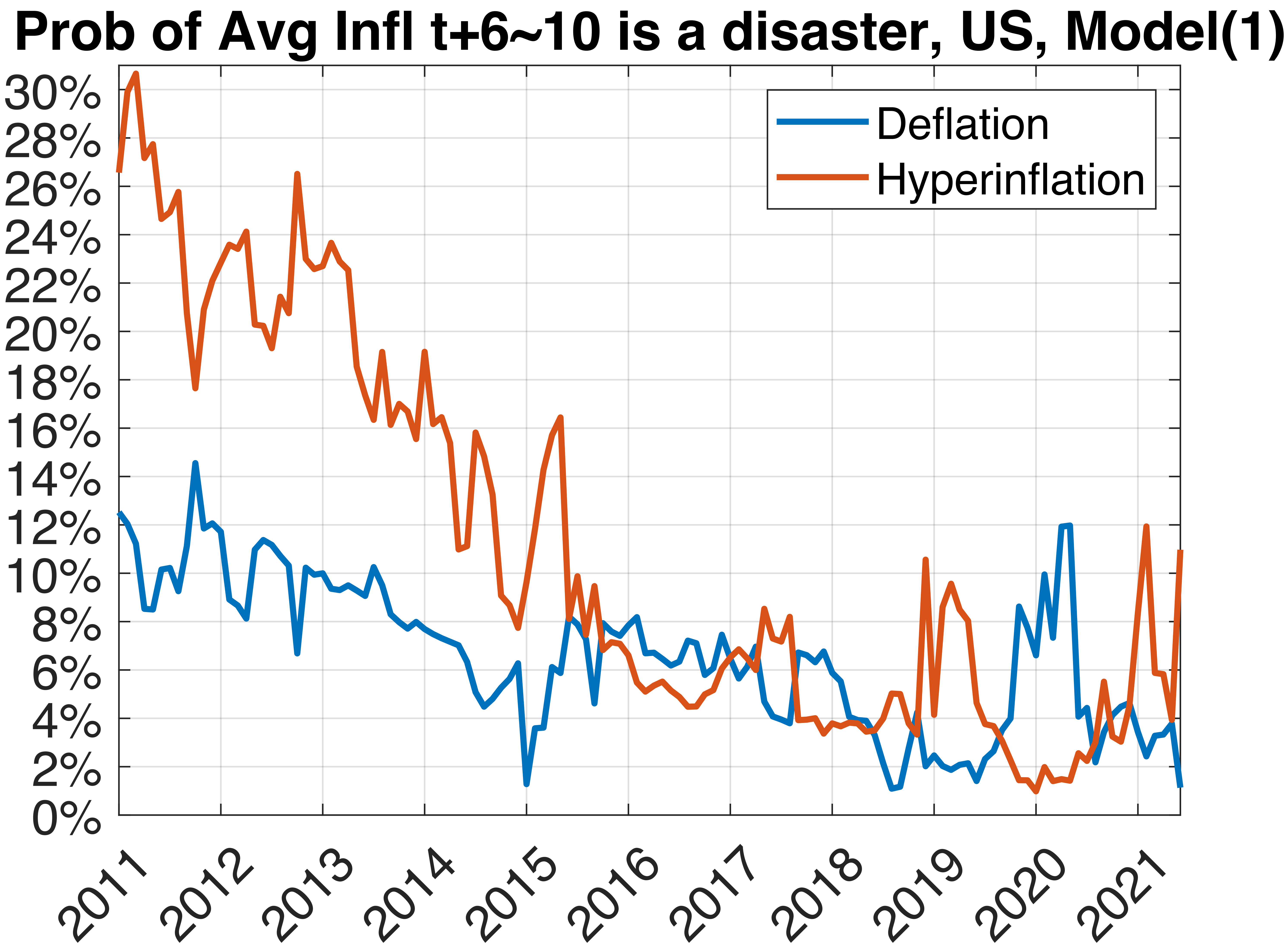
First result: Eurozone and deflation



- First adjustment: lower it, as deflation raises real payofss
- Second adjustment: lower it, as deflation builds up
- Third adjustment lowers it: risk aversion as deflation comes with recession

Source: Hilscher, Raviv Reis (2021)

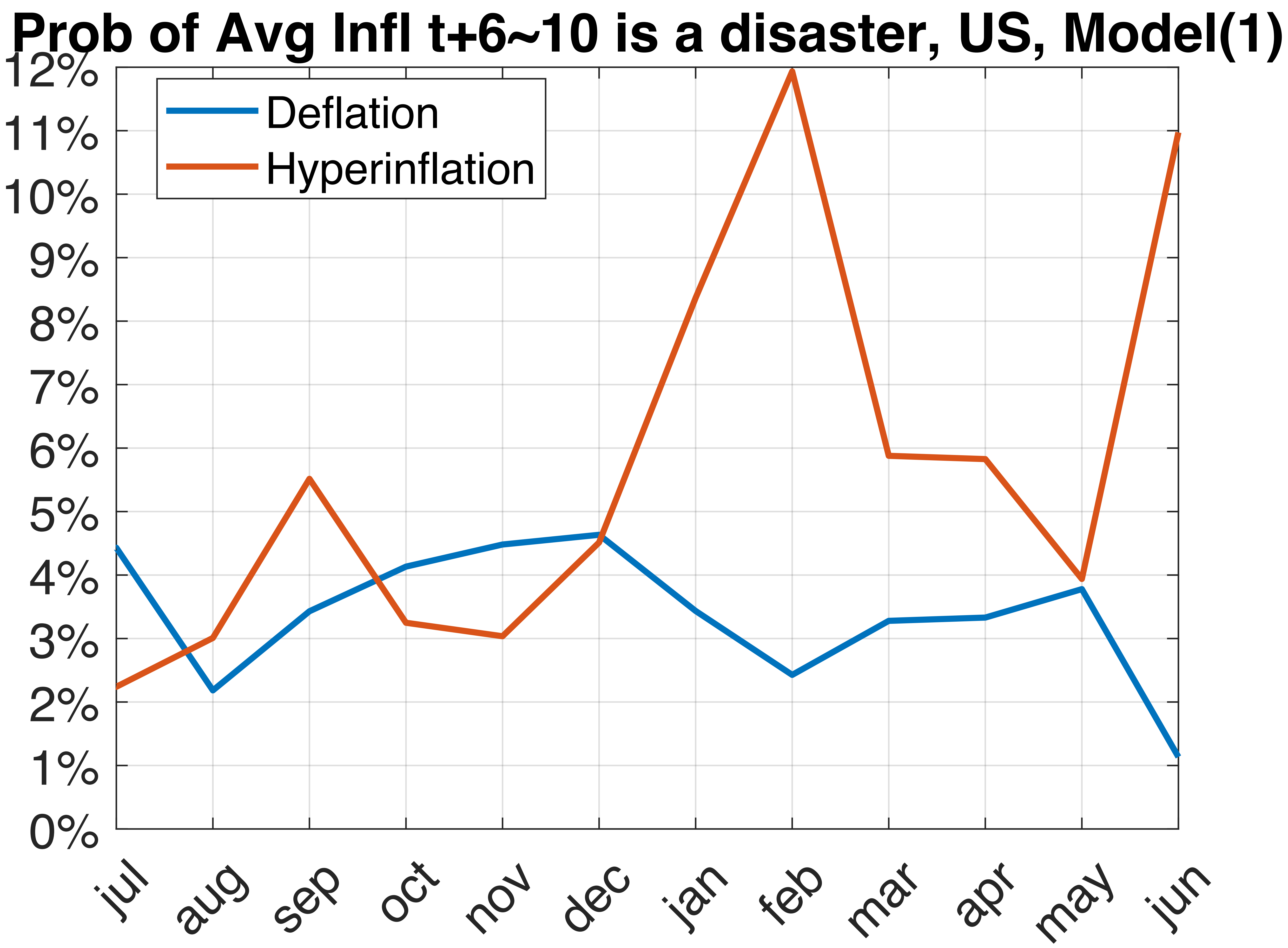
Second result: US high inflation tail rising



- Earlier data clearly problematic
- Also clear trend with pandemic
- Deflation never so high

Source: Hilscher, Raviv, Reis (2021)

Second result: US high inflation tail rising



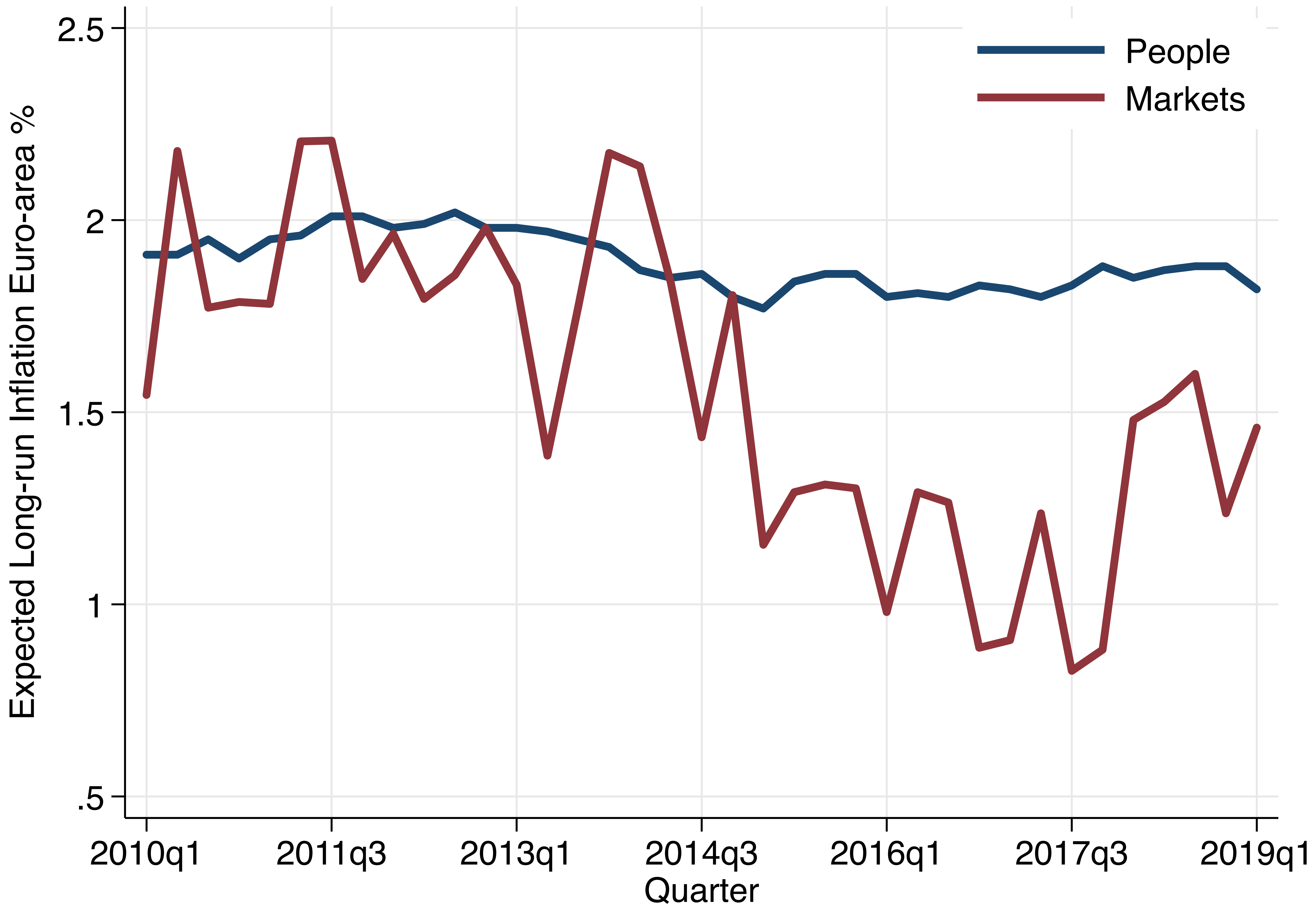
- Twelve months
- Steady increase in hyperinflation
- more recent estimates close to 15%
- May effect

Source: Hilscher, Raviv, Reis (2021)

2. What do surveys say?

Aren't they always behind the curve?

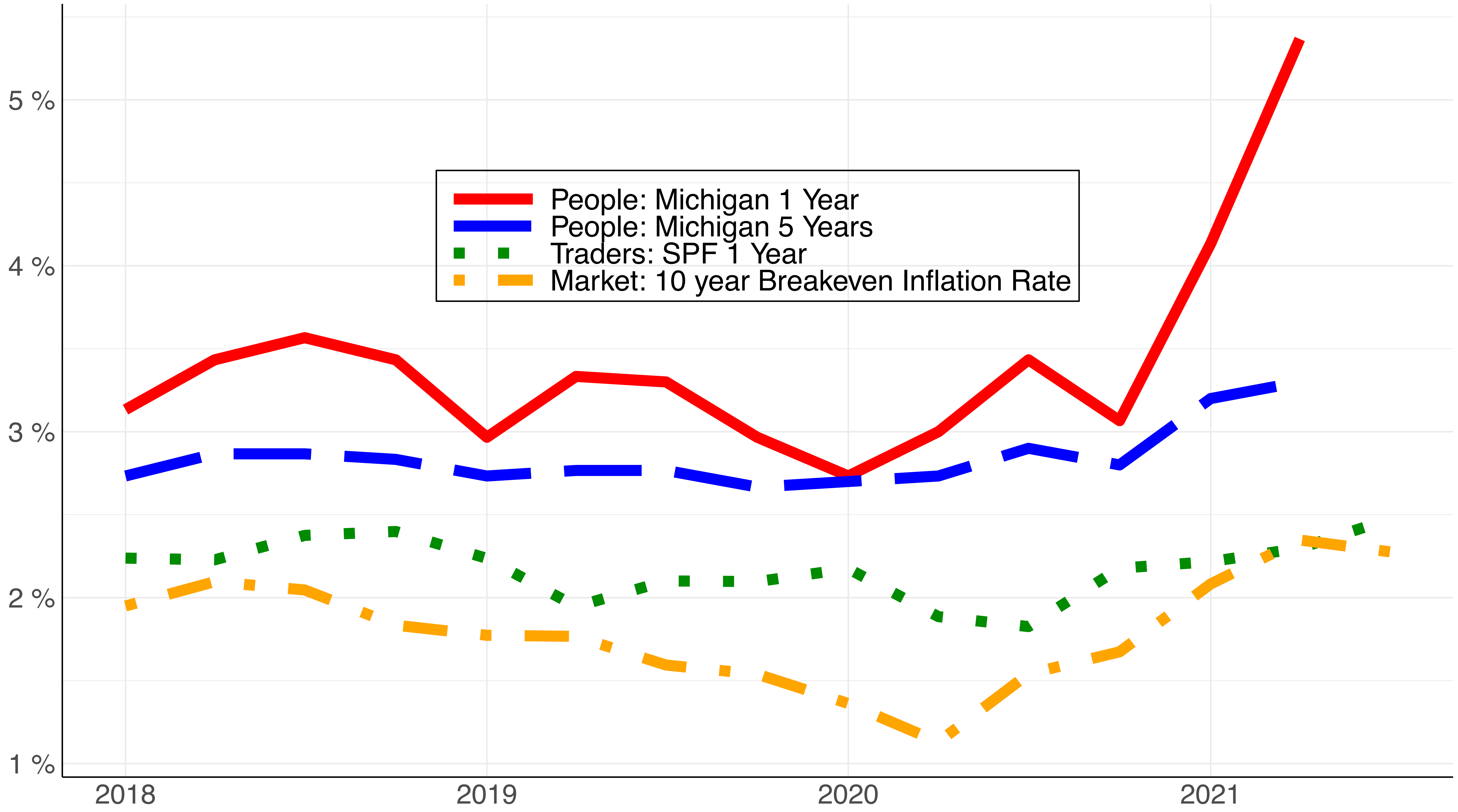
Eurozone 2010s



- More recently, arguably inflation became anchored at 1% rather than 2% in the EZ over last few years
- But surveys show almost no change throughout…

Source: Reis (2020)

Looking at the US anchor



Source: Reis (2021)

Look deeper at surveys: 1980s

Figure 12 THE VOLCKER DISINFLATION: THE EVOLUTION OF INFLATION EXPECTATIONS IN THE MICHIGAN SURVEY

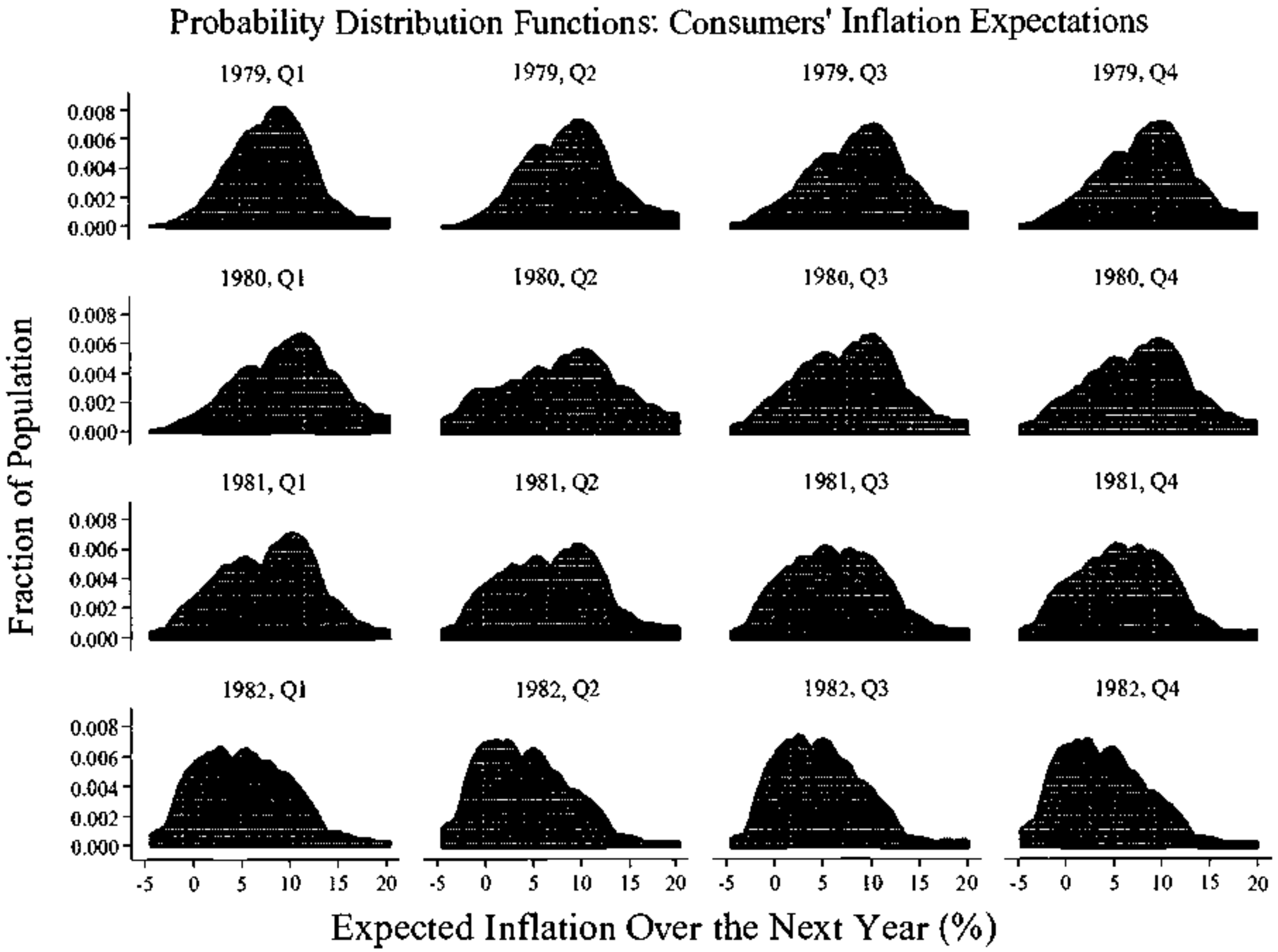
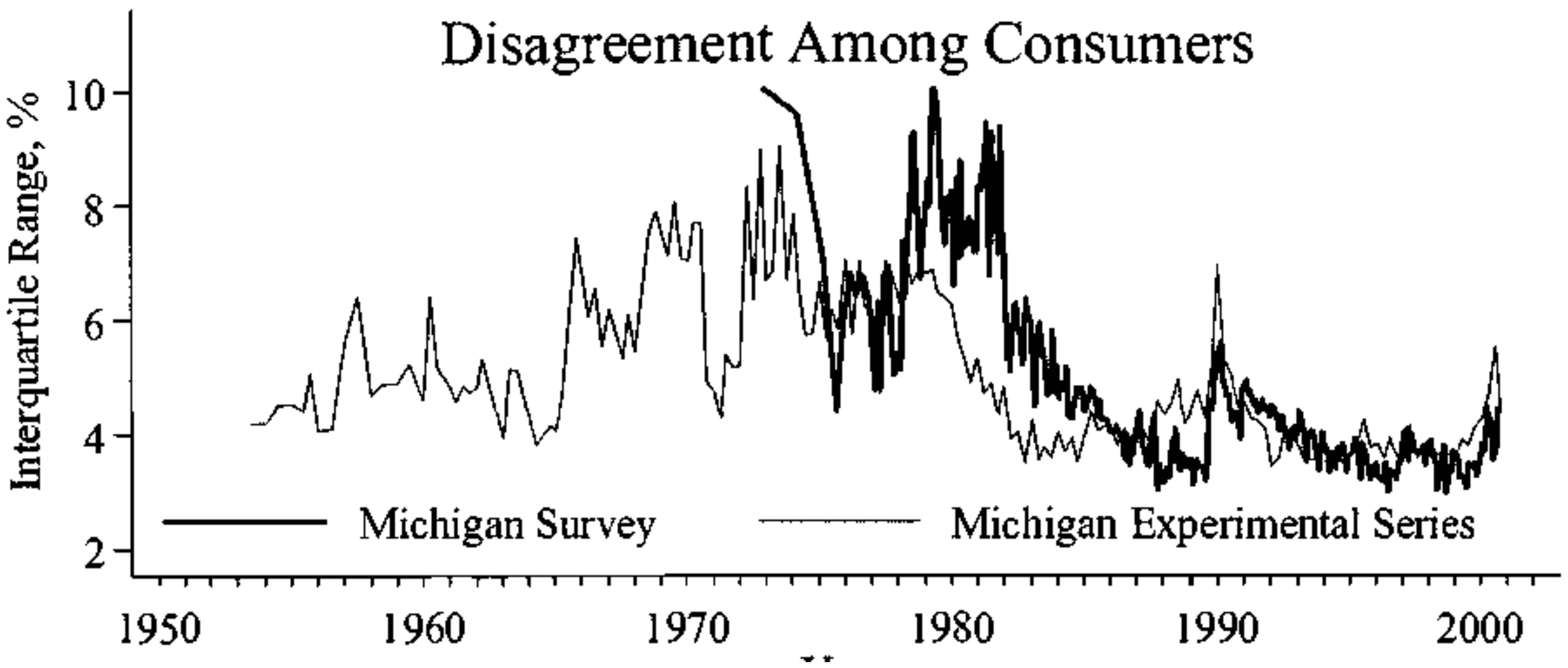


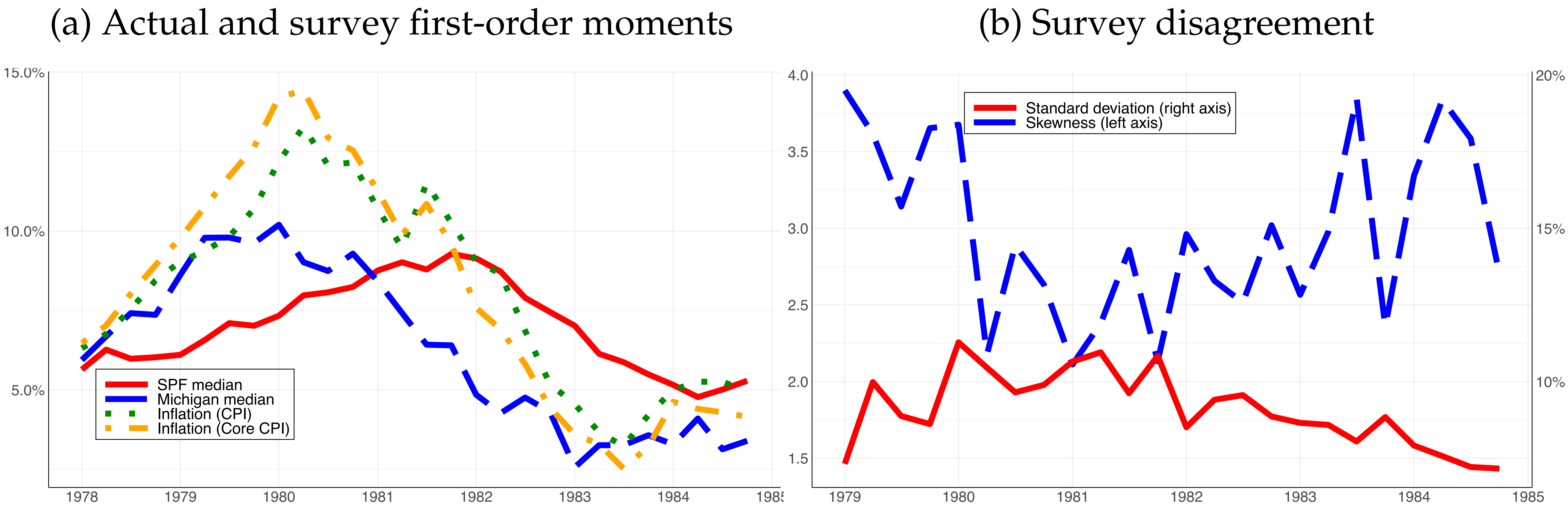
Figure 3 DISAGREEMENT OVER INFLATION EXPECTATIONS THROUGH TIME



In the 1980s, when the policy regime changed, had to look at higher moments to see much in the usually-sluggish surveys data

Source: Mankiw Reis Wolfers (2004)

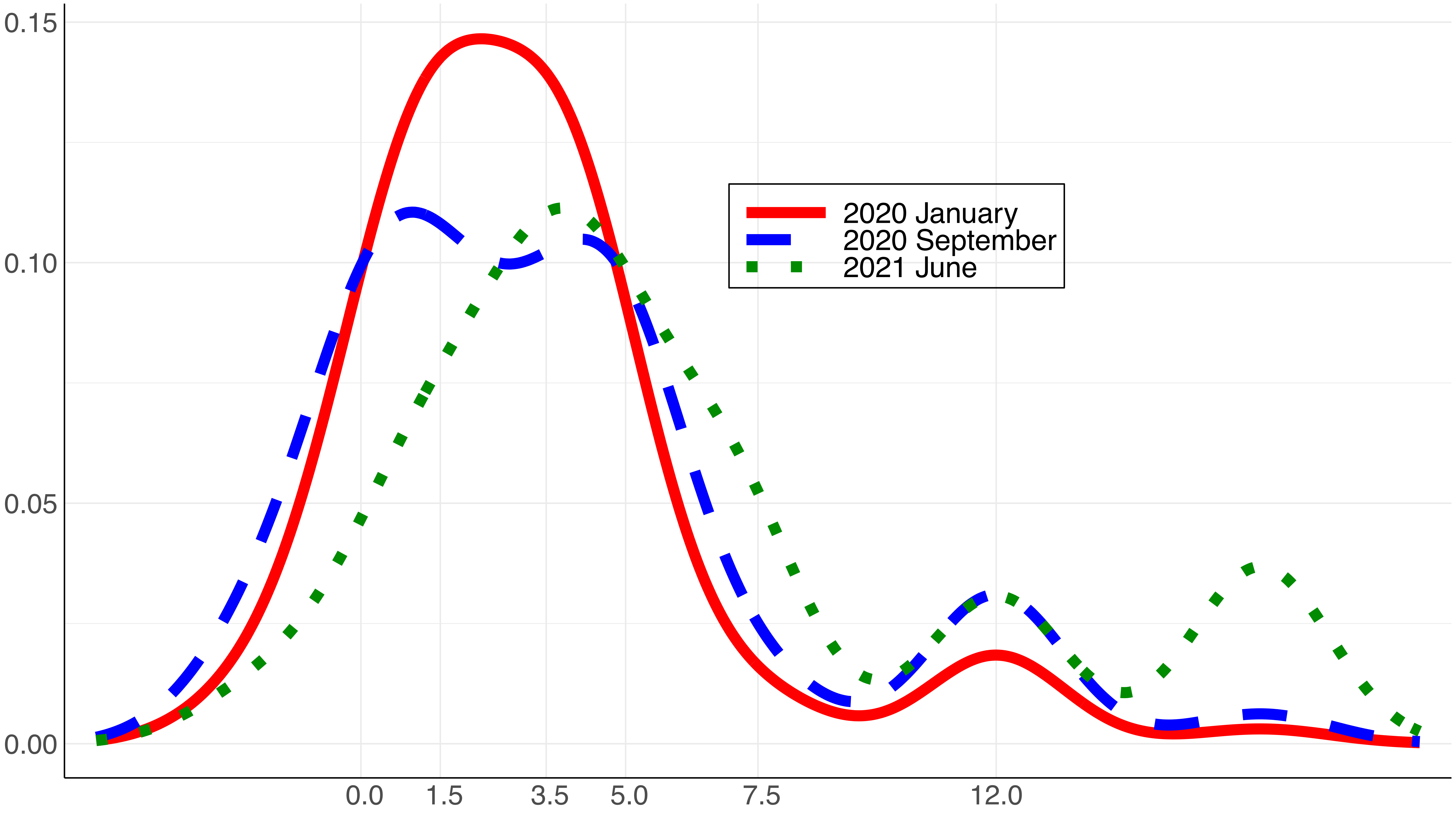
Look deeper at surveys: 1980s



Today.know, not just disagreement, but also skewness can be revealing (higher moments too hard to estimate unless thousands of respondents)

Source: Reis (2021)

What do they look like in recent past?



A little scary

Beyond fundamentals:
- salience of gas prices
- backwardness;
- relatives and absolutes

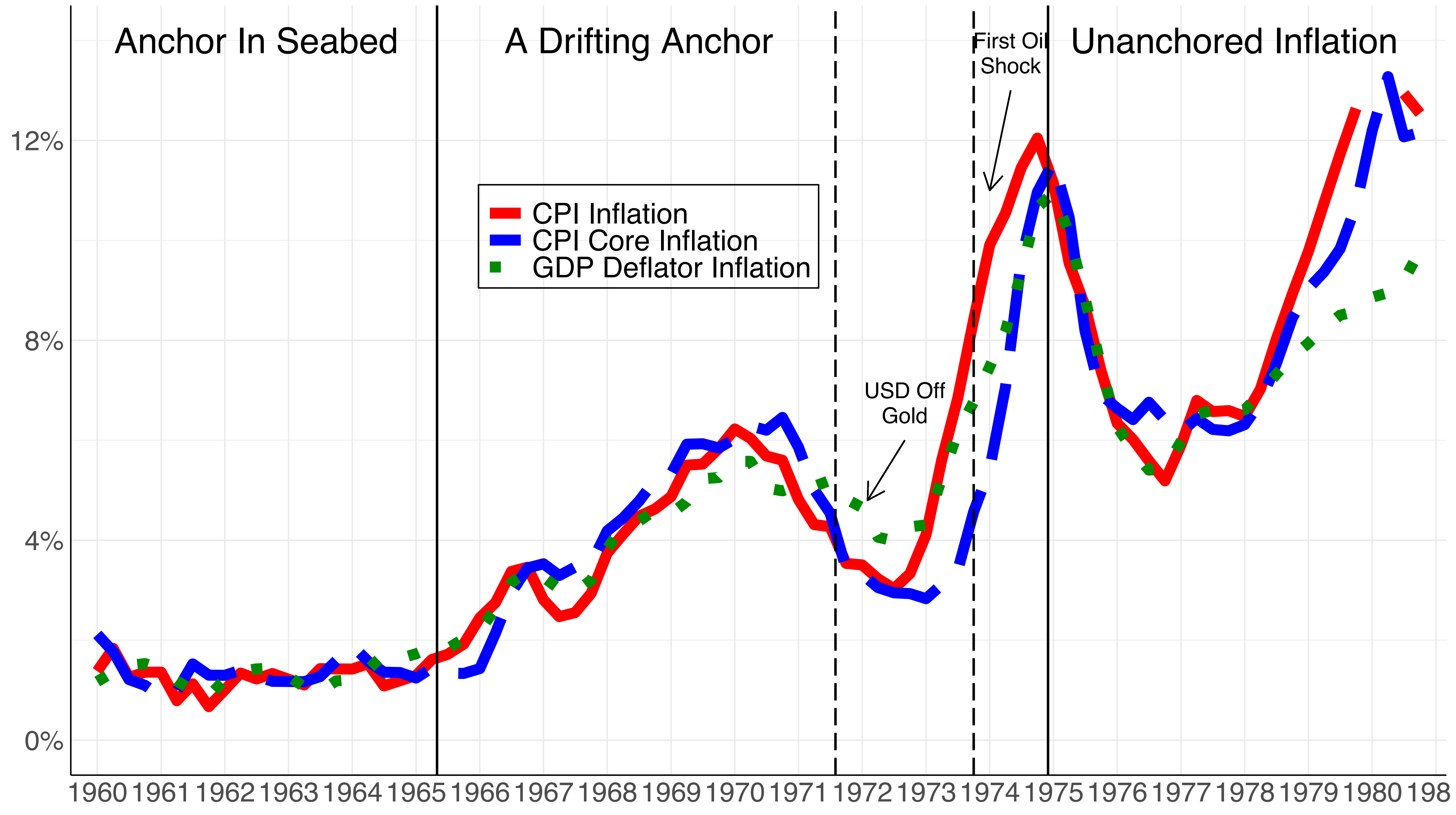
What about wages?
- by then, too late
- recent news are scary

But not too late…

Source: Reis (2021)

3. Lessons from history: how the inflation anchor was lost in the 1960s

Most famous case: the pre Great Inflation



1965-68: signs or no signs?

Martin had no use for models, pressured to prioritize unemployment. Sensitive to investor expectations, measured with bond rates. As inflation kept rising, increasingly relied on "*inflationary psychology*"

1968-71: anchor drifting

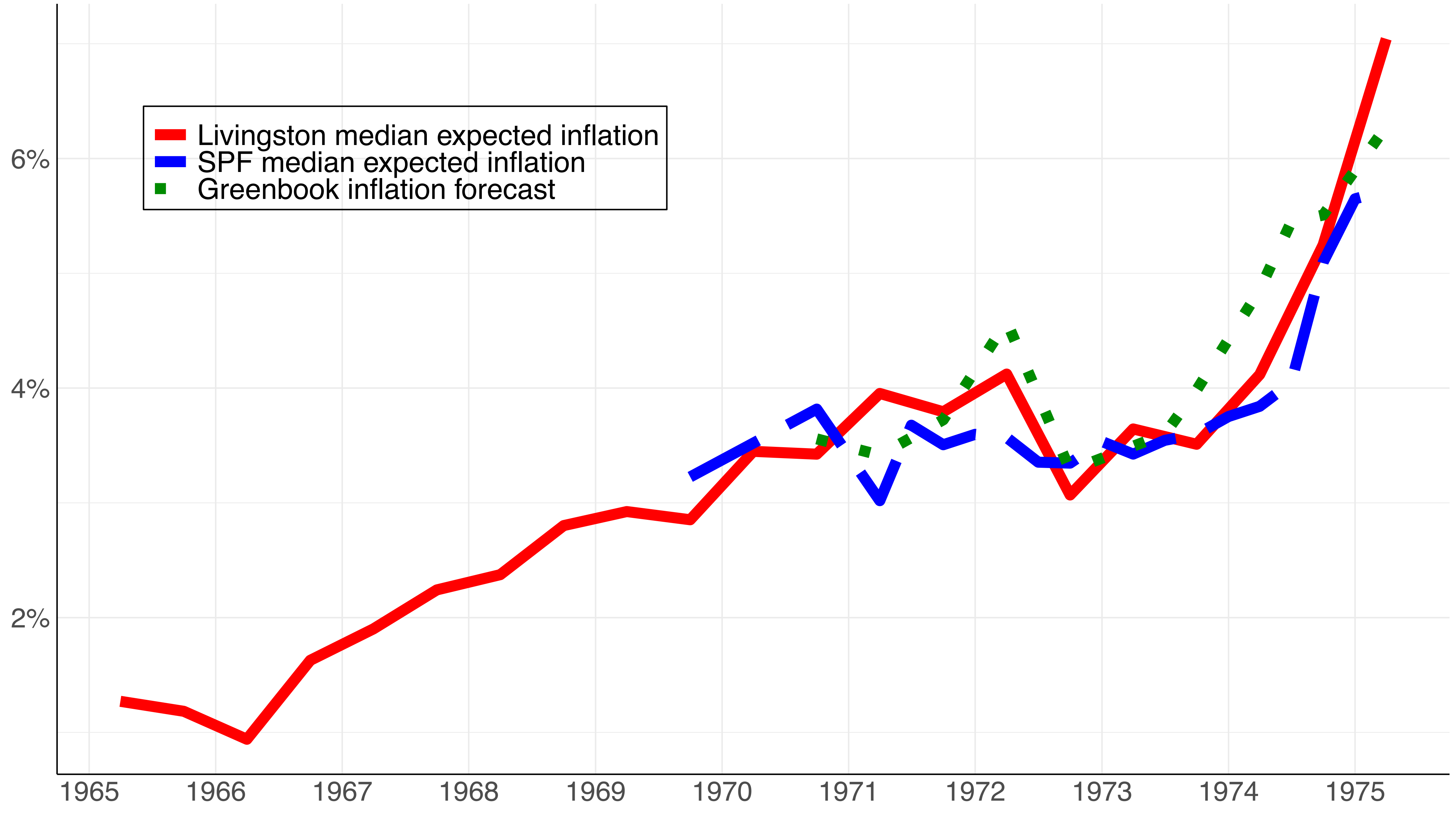
As inflation accelerated, Martin, July 1969, "*inflationary psychology remained the main economic problem*" Shocks temporary because fleeting beliefs. Models of shifts in Phillips curve, inflation bias.

1971-74: anchor adrift

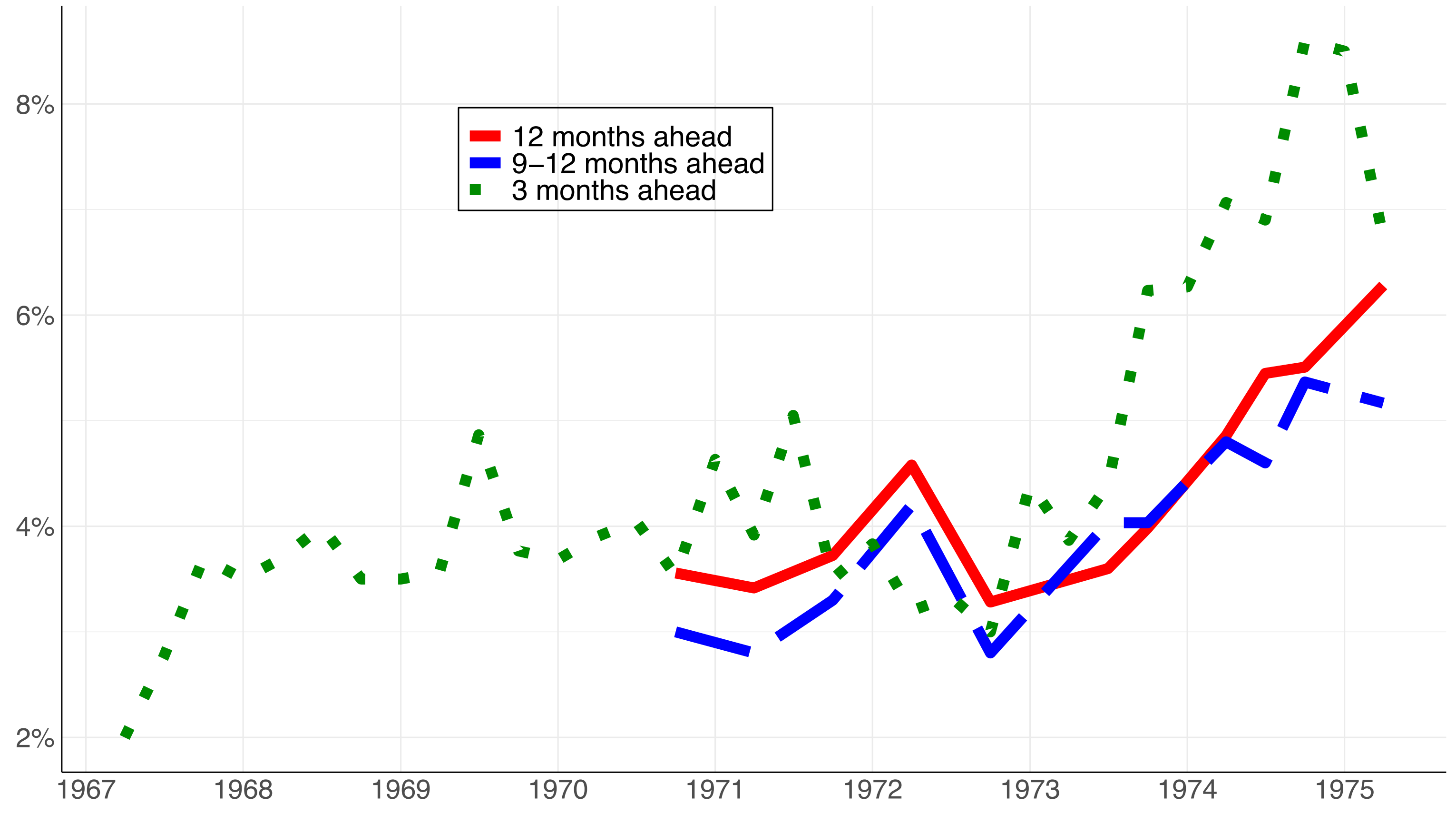
Burns on wage and price controls "*In this new psychological environment, our trade unions may not push quite so hard for a large increase in wage rates, since they would no longer be anticipating a higher inflation rate. And in this new psychological environment, our business people would not agree to large wage increases quite so quickly*"
No measurement, expectations as an add-on factor

Source: Reis (2021)

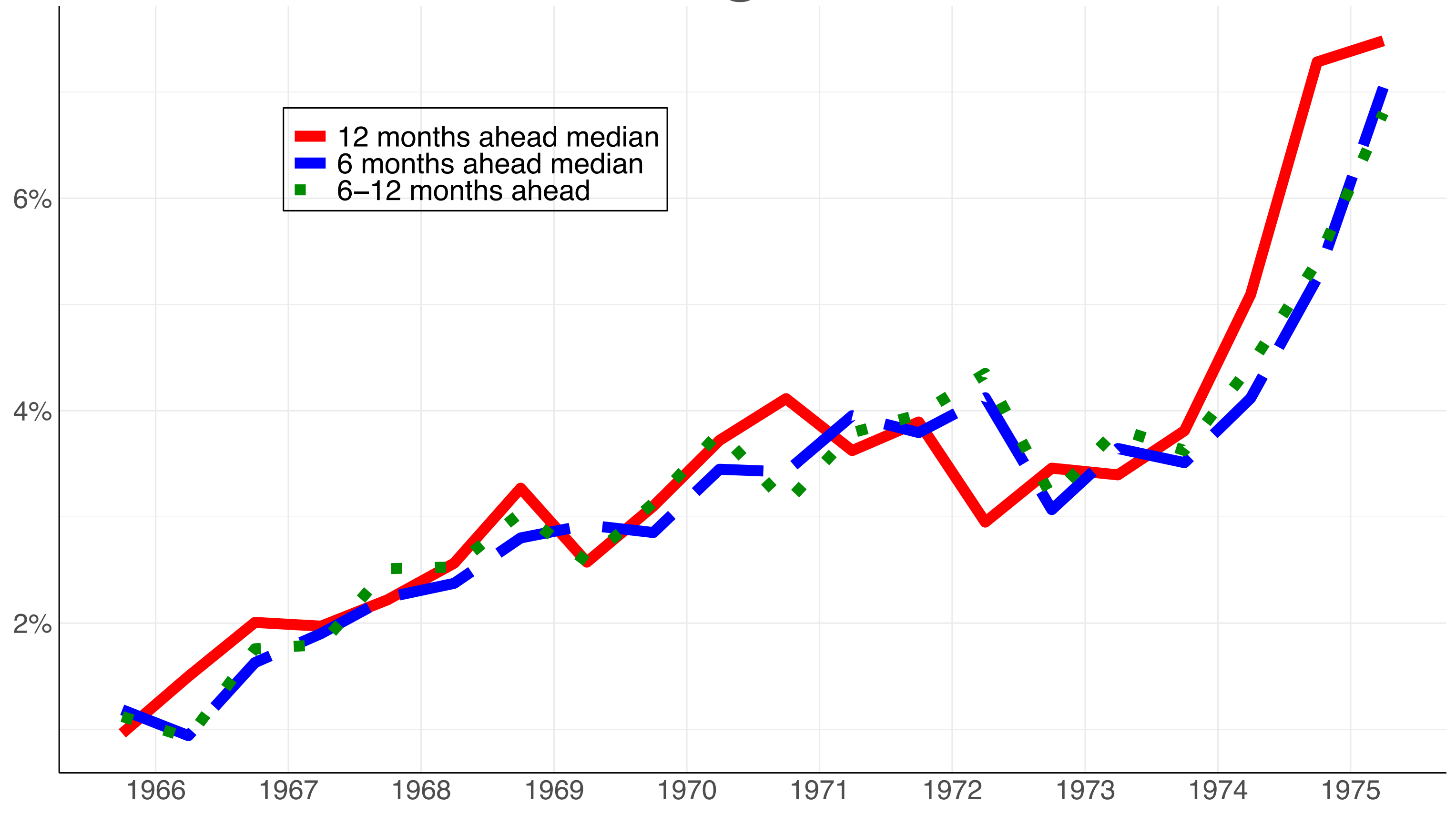
Surveys: professionals



Greenbook



Livingston

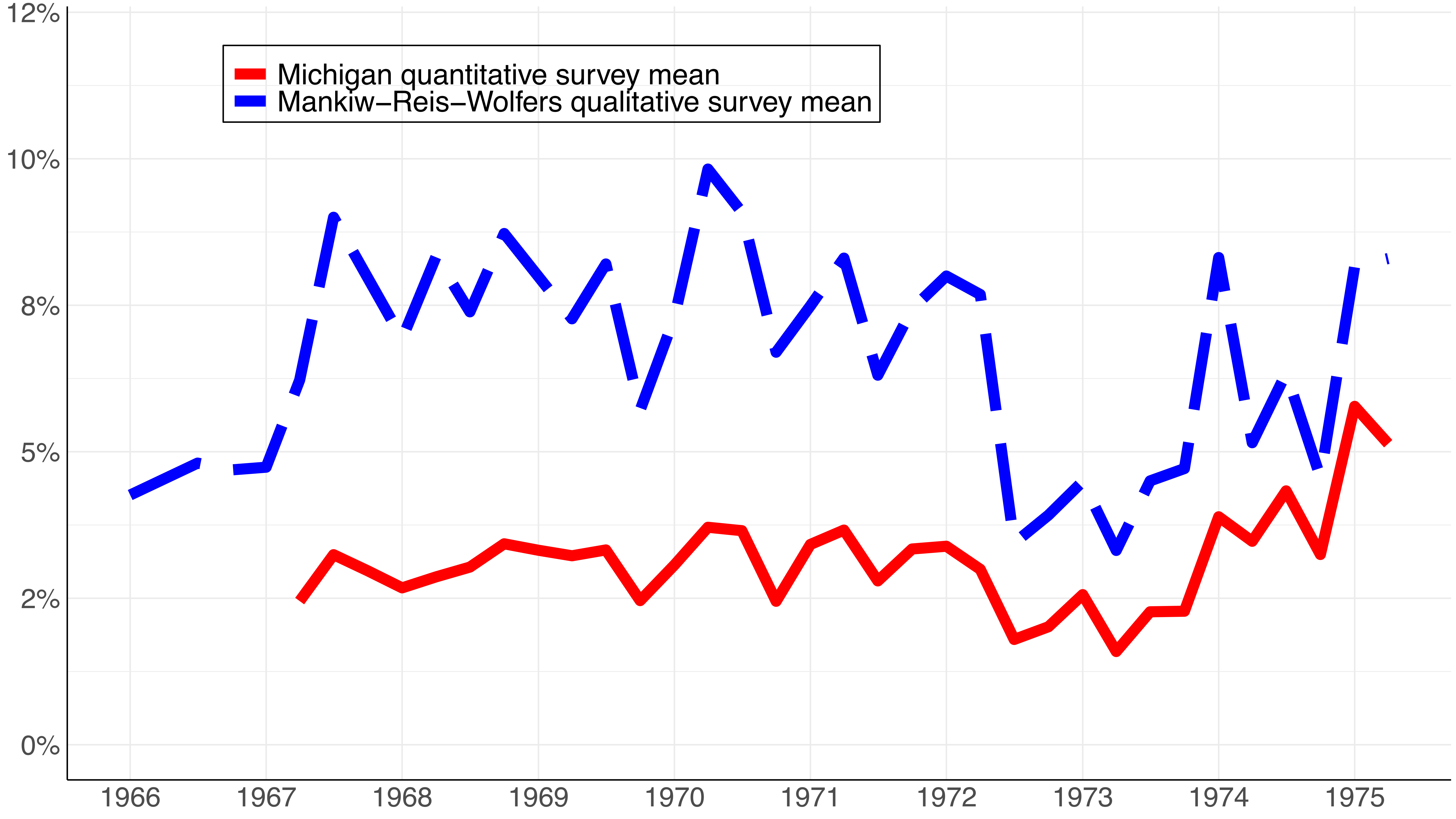


Both Fed's staff and professional forecasters caught up sluggishly

(And the Fed's staff was particularly bullish on view that all was temporary)

Behind the curve

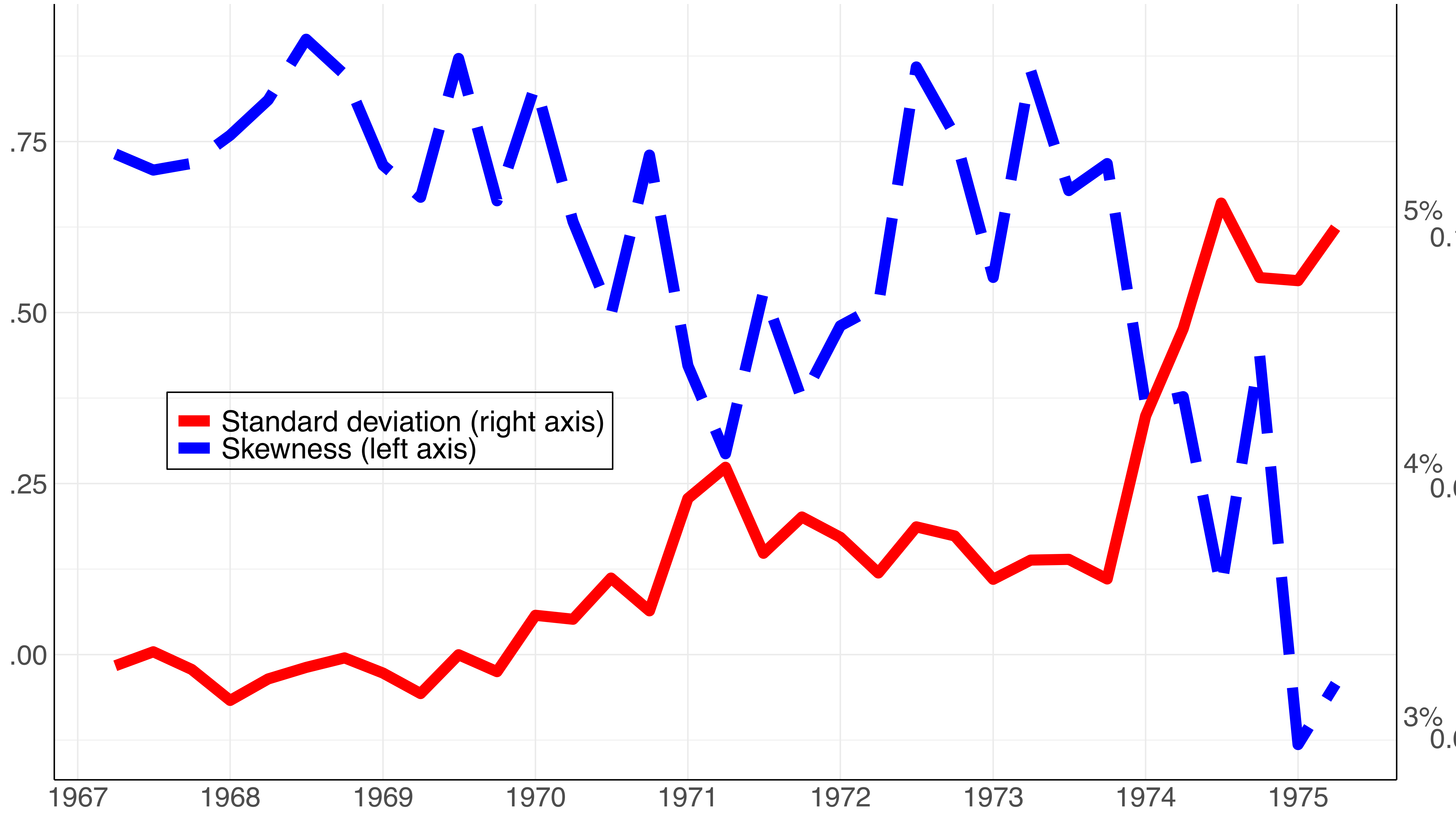
Forgotten data: households

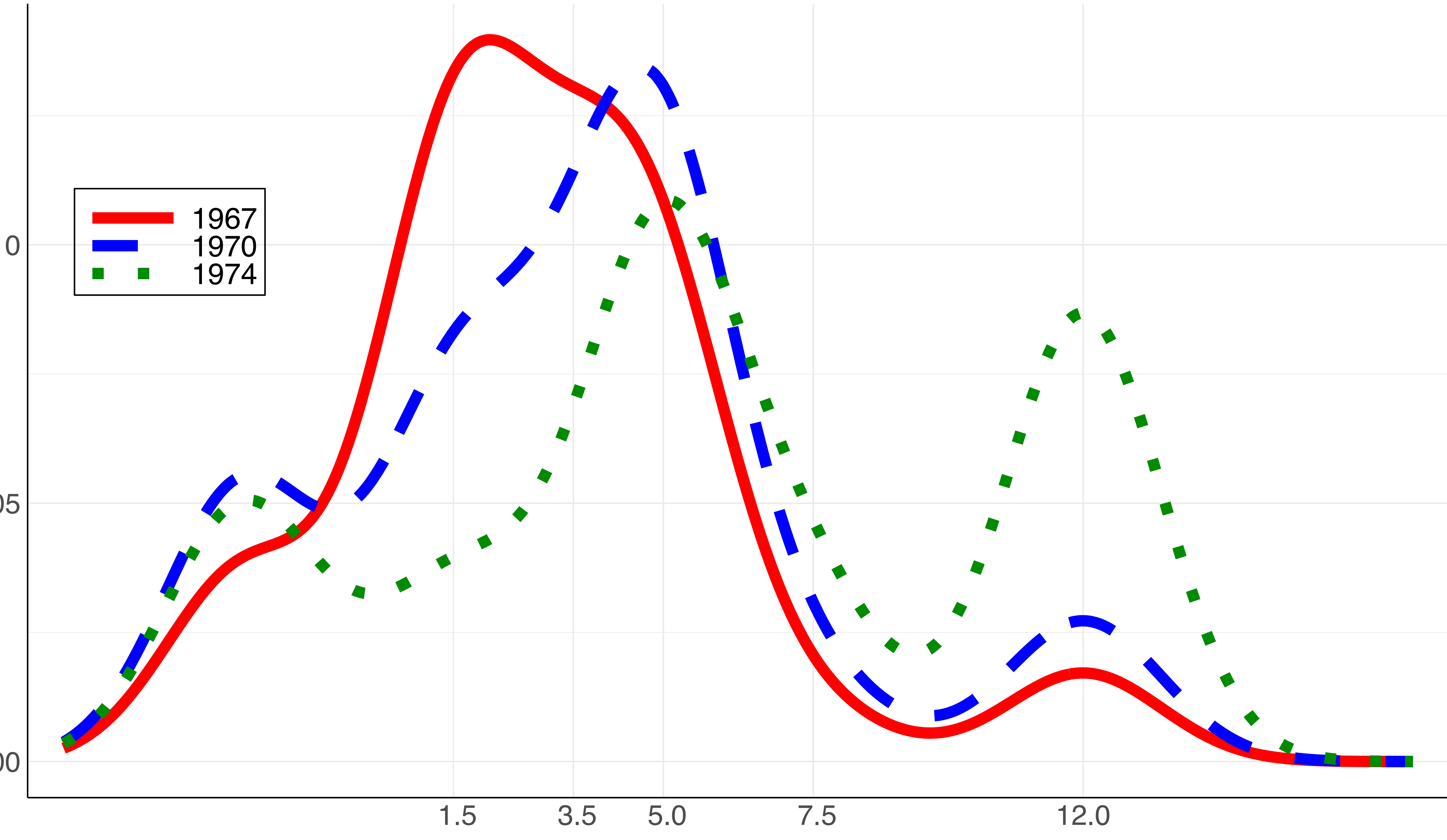


Since 1946, Michigan Survey of Consumer Attitudes asked whether expected prices to rise or fall. MRW (2004) index.

But also, between 1966Q2 and 1976Q4, follow up question: "*How large a price increase do you expect? Of course, nobody can know for sure, but would you say that a year from now prices will be about 1% or 2% higher, or 5% higher, or closer to 10% higher than now or what?*"

Can look deeper: disagreement

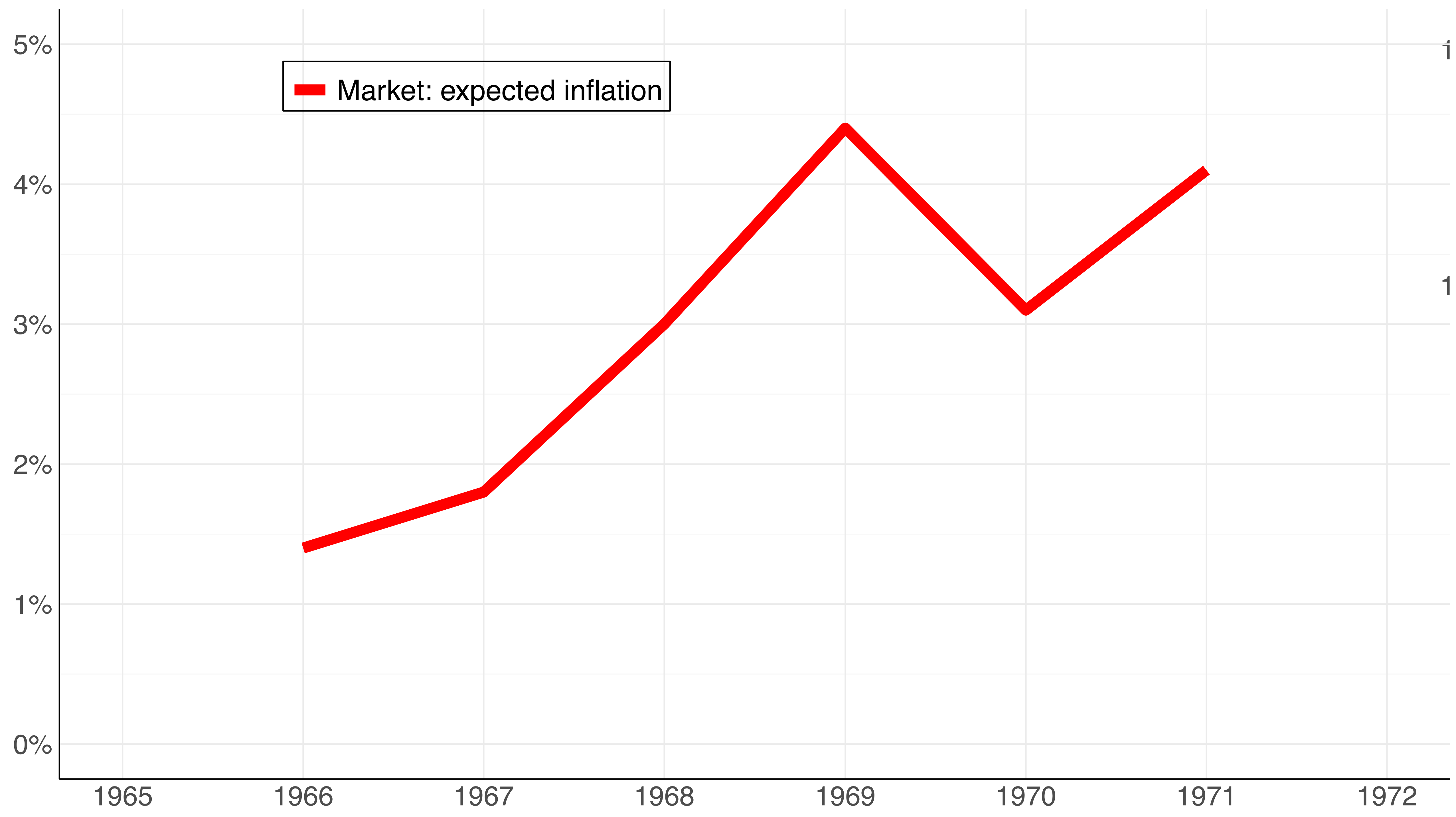


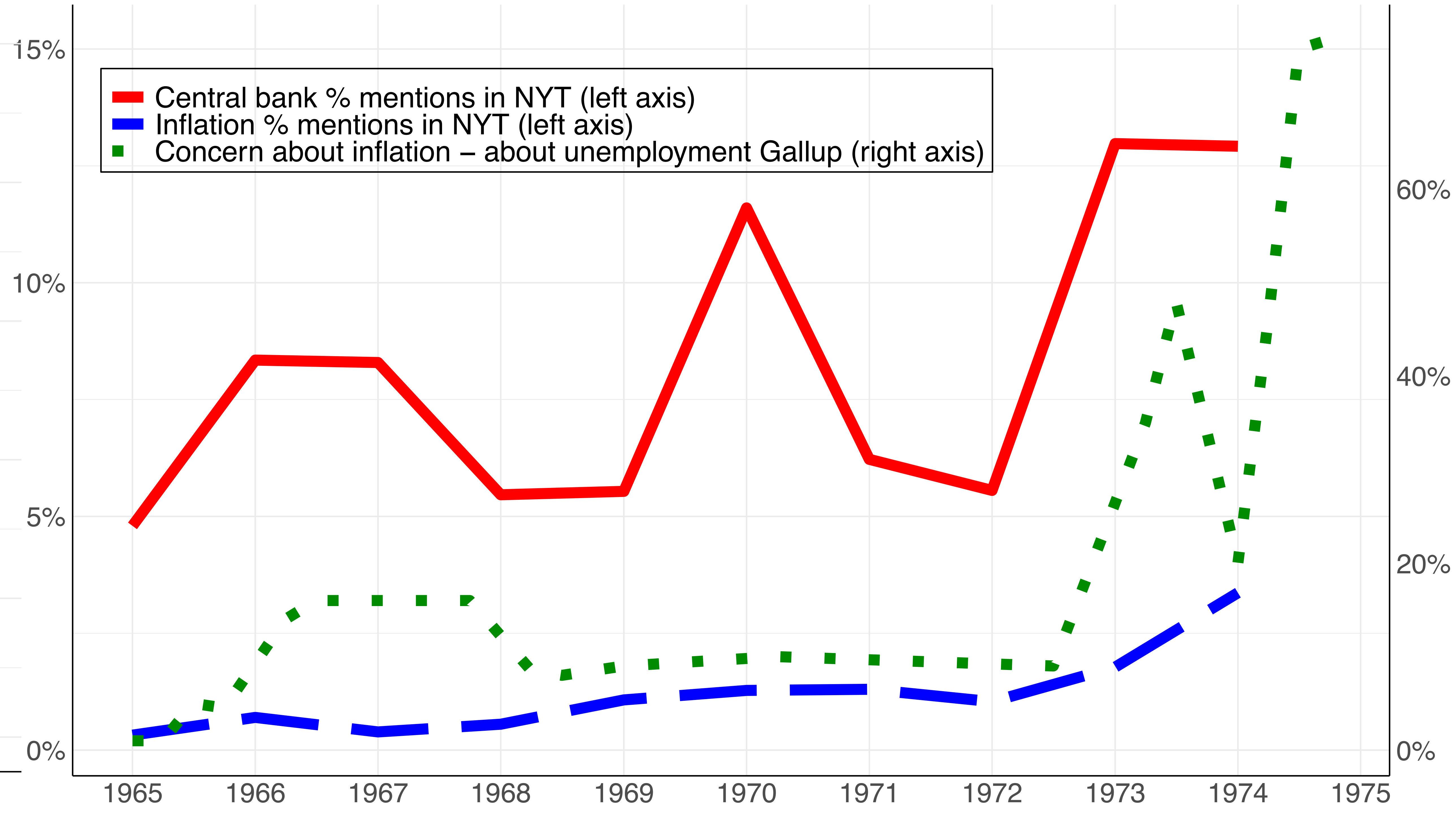


1967-70: Thickening right tail, hollowing of left tail, standard deviation rising, positive skew falling

1970-73: Median shifted slowly, right tail quickly, standard deviation rose, the skew first up then down

Markets and the media





New data from the Zurich market for gold forwards (alternative to London and Gold pool): very responsive, perhaps too much.

In media see some upticks

A model to combine them into fundamental RE

$$v_t^h = \pi_t^* + c_t^h + \theta_t(e_t^h + \pi_t^e - \pi_t^*)$$

$$\text{with} \quad c_t^h \sim E(\lambda_t), \quad e_t^h|\pi_t^e \sim N(0, \sigma_t^2)$$

$$\text{cross-sectional distribution} \quad v_t^h \sim F_t(\pi_t^e)$$

$$q_t = \frac{\int y_t(\pi_t^e) g_t(F_t^{-1}(\omega_t)) f_t(F_t^{-1}(\omega_t)) d\pi_t^e}{\int g_t(F_t^{-1}(\omega_t)) f_t(F_t^{-1}(\omega_t)) d\pi_t^e}$$

$$\text{with:} \quad \omega_t \sim B(\beta), \quad \pi_t^e|q_t \sim G(\pi_t^e)$$

$$E_t^b = \mathbb{E}_t(\pi_t|v_t^{\text{median}}, q_t)$$

Households: biased from experiences, sluggish average, over-react individually

Markets: more information, sensitive to news, filled with noise

Professionals: median is misleading, not marginal traders.

Data inputs: three moments from household survey distribution, one market price, median professional

Model outputs: reaction, dispersion and bias (θ, σ, λ), market noise (ω), fundamental expected inflation (π^e)

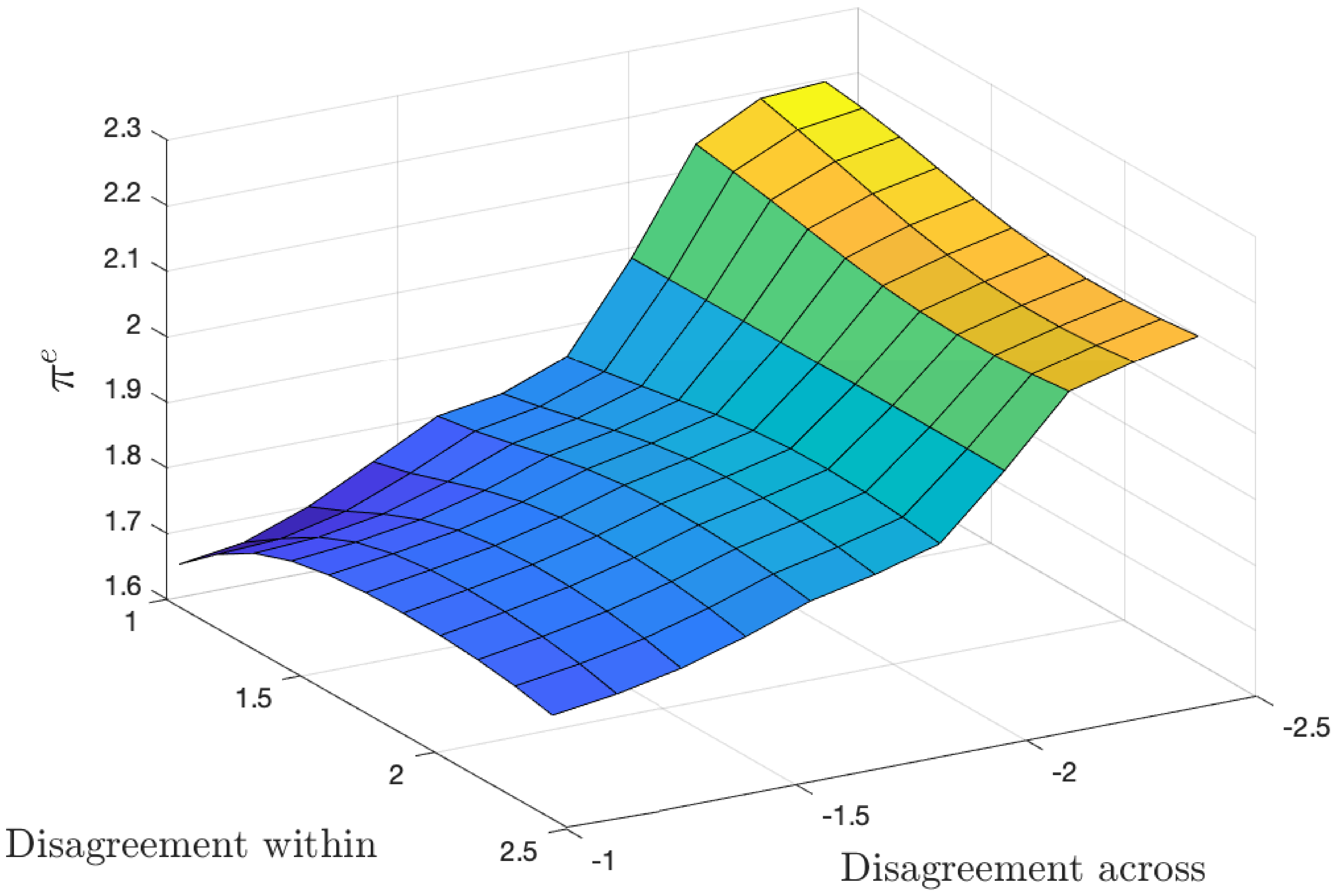
Source: Reis (2020, 2021)

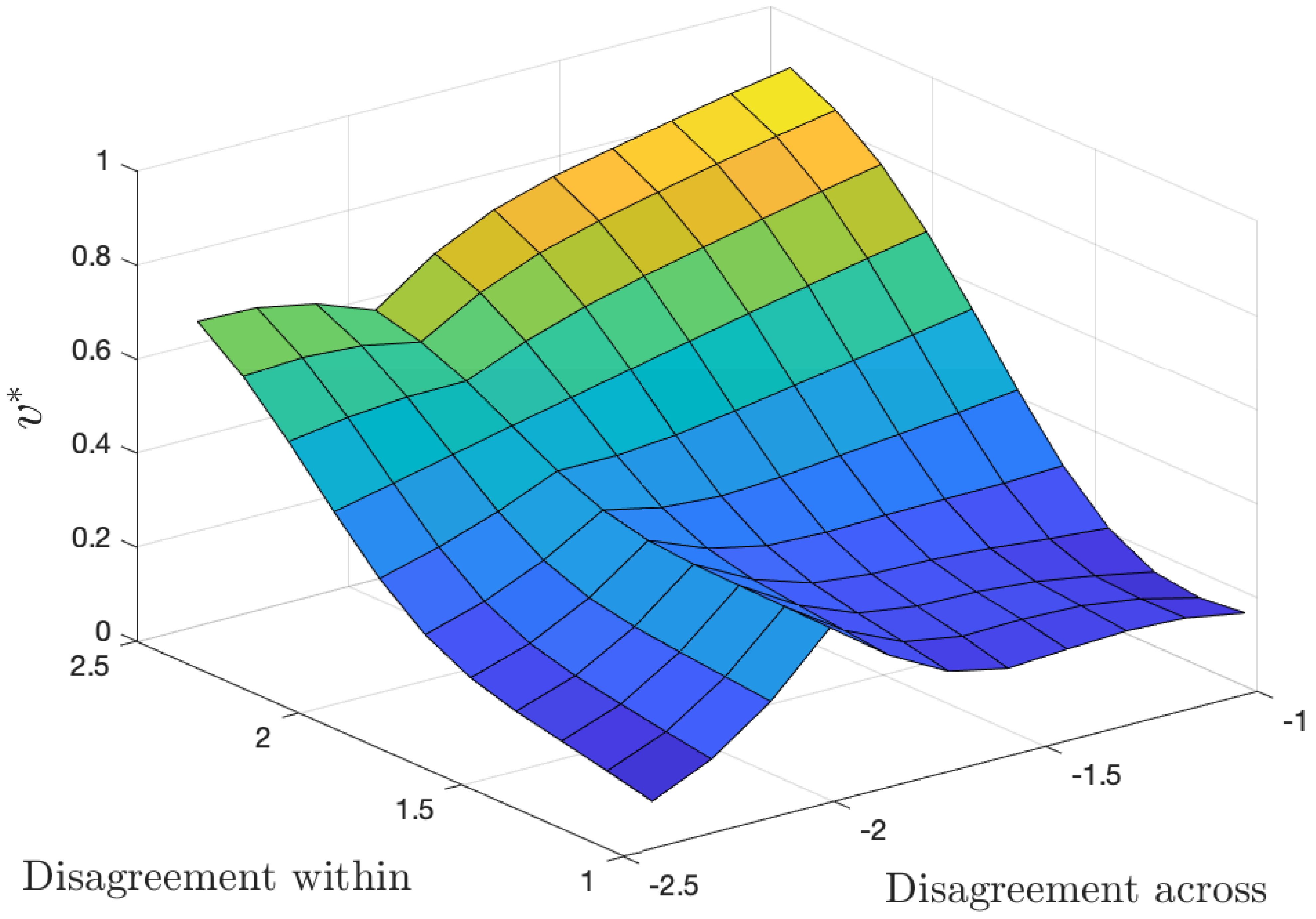
Inference or signal extraction problem

Parameters: only two $\pi^* = 2\%$, and $\beta = 2$

Inputs: First, second and third moment from people, survey traders, market price

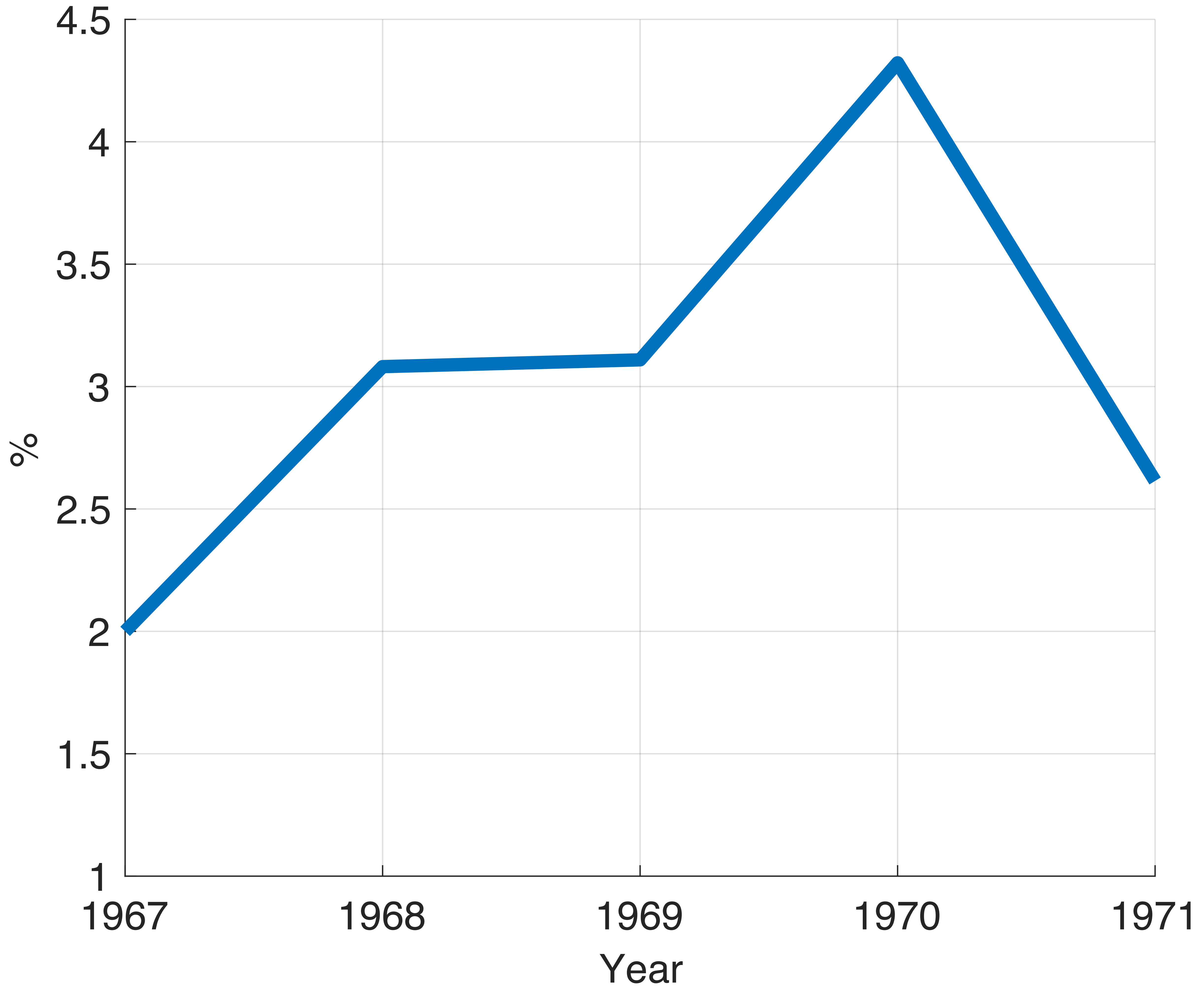
Outputs: fundamental π^e_t, marginal trader v^* , decomposition of discrepancy





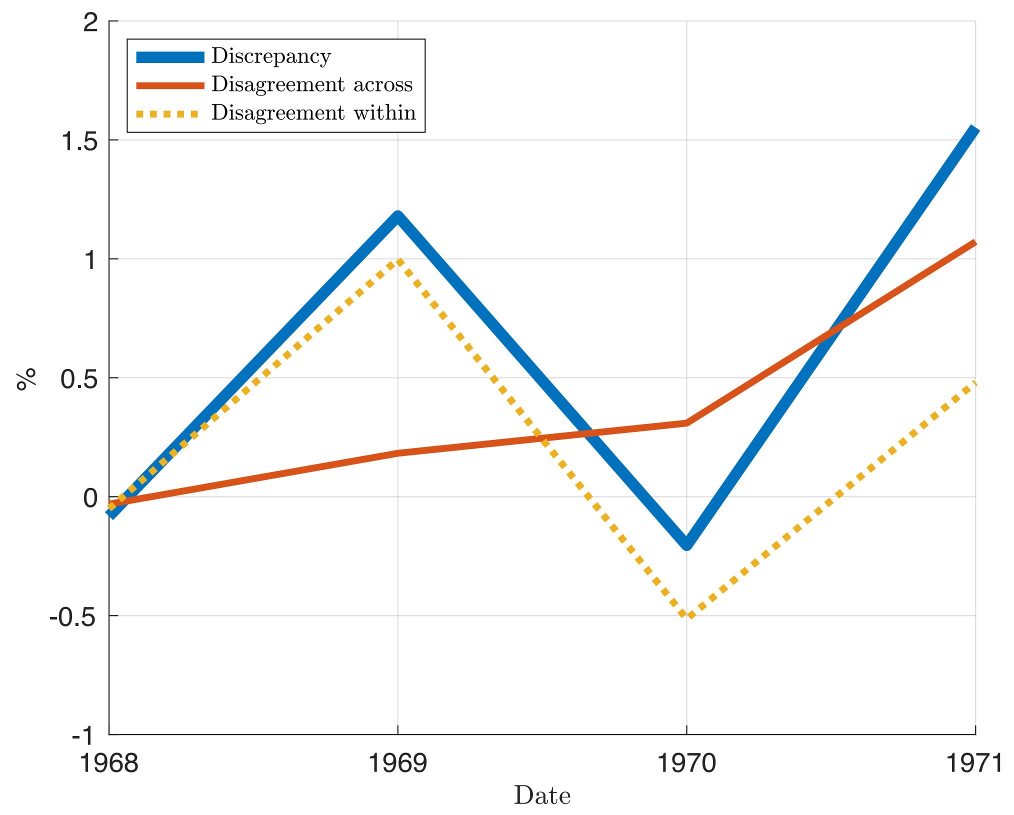
Source: Reis (2020)

Estimates of the expected inflation anchor

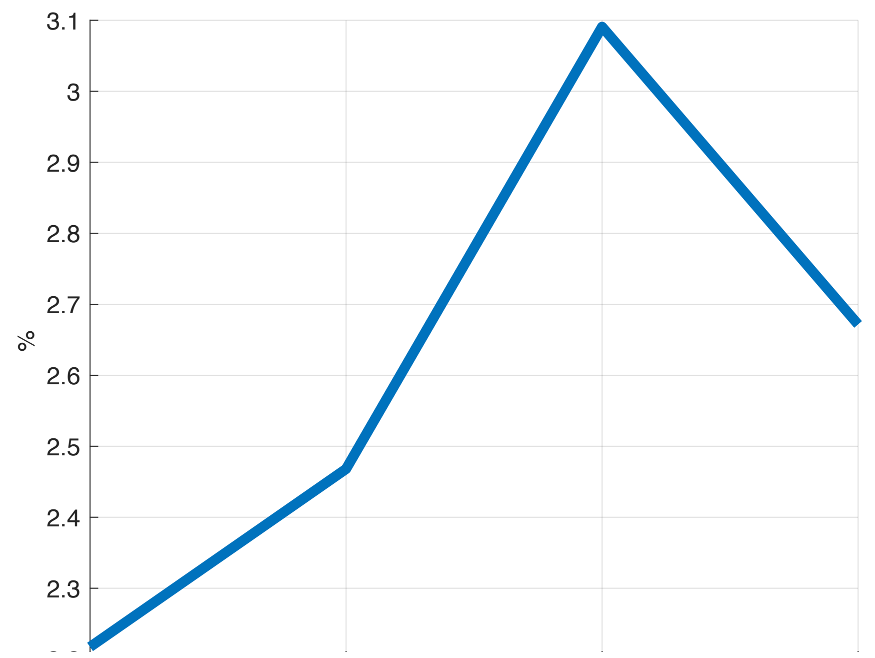


The drifting anchor

At first, markets seen as maybe reflecting noise

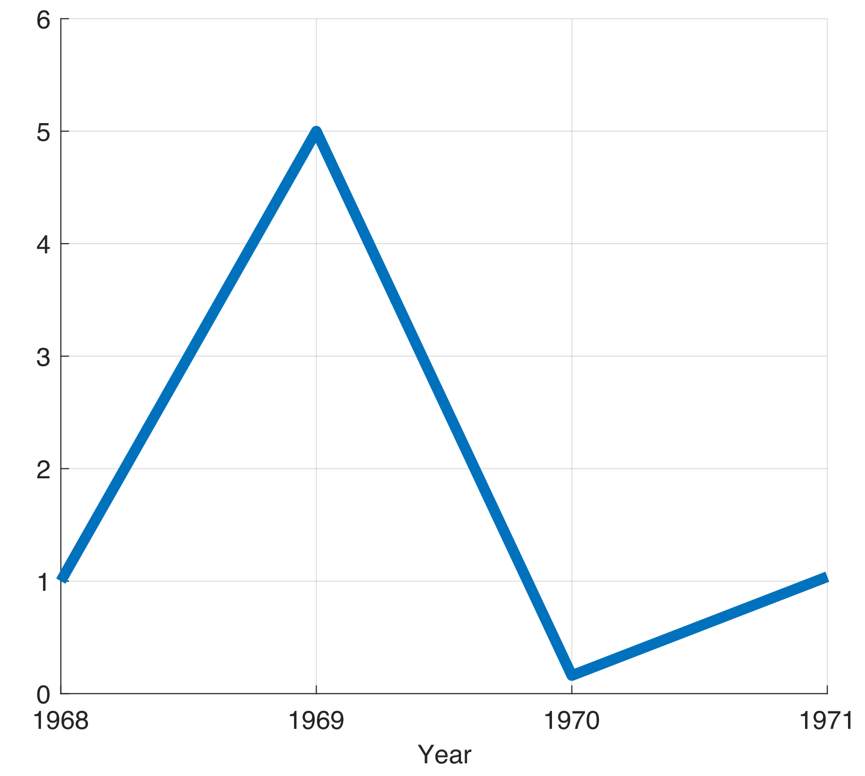


But, disagreement across households showed the fund. expectation shifting



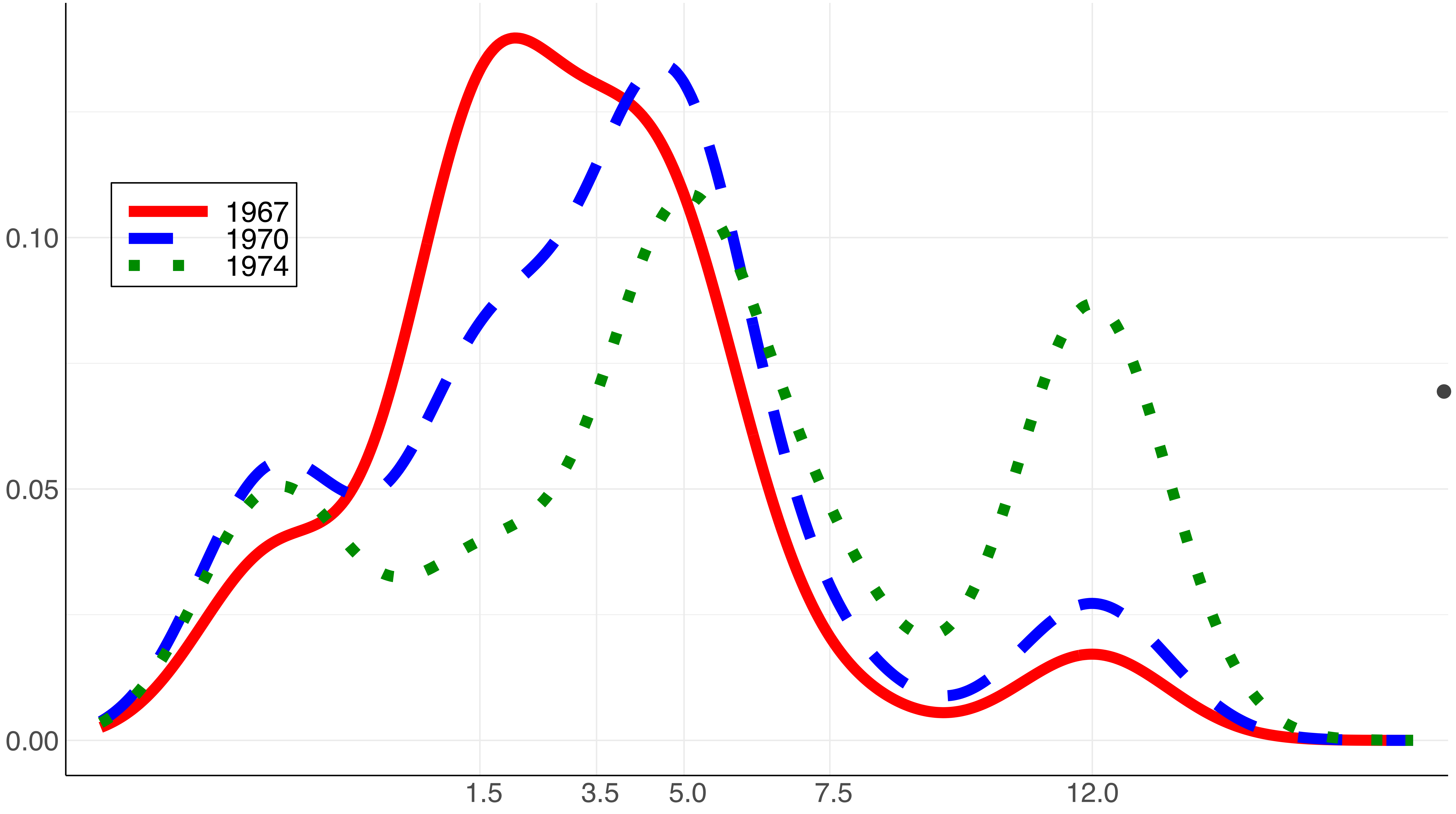
σ

Later, sluggish response of medians of professionals confirms it



θ

Simpler: distributions, ignored at time

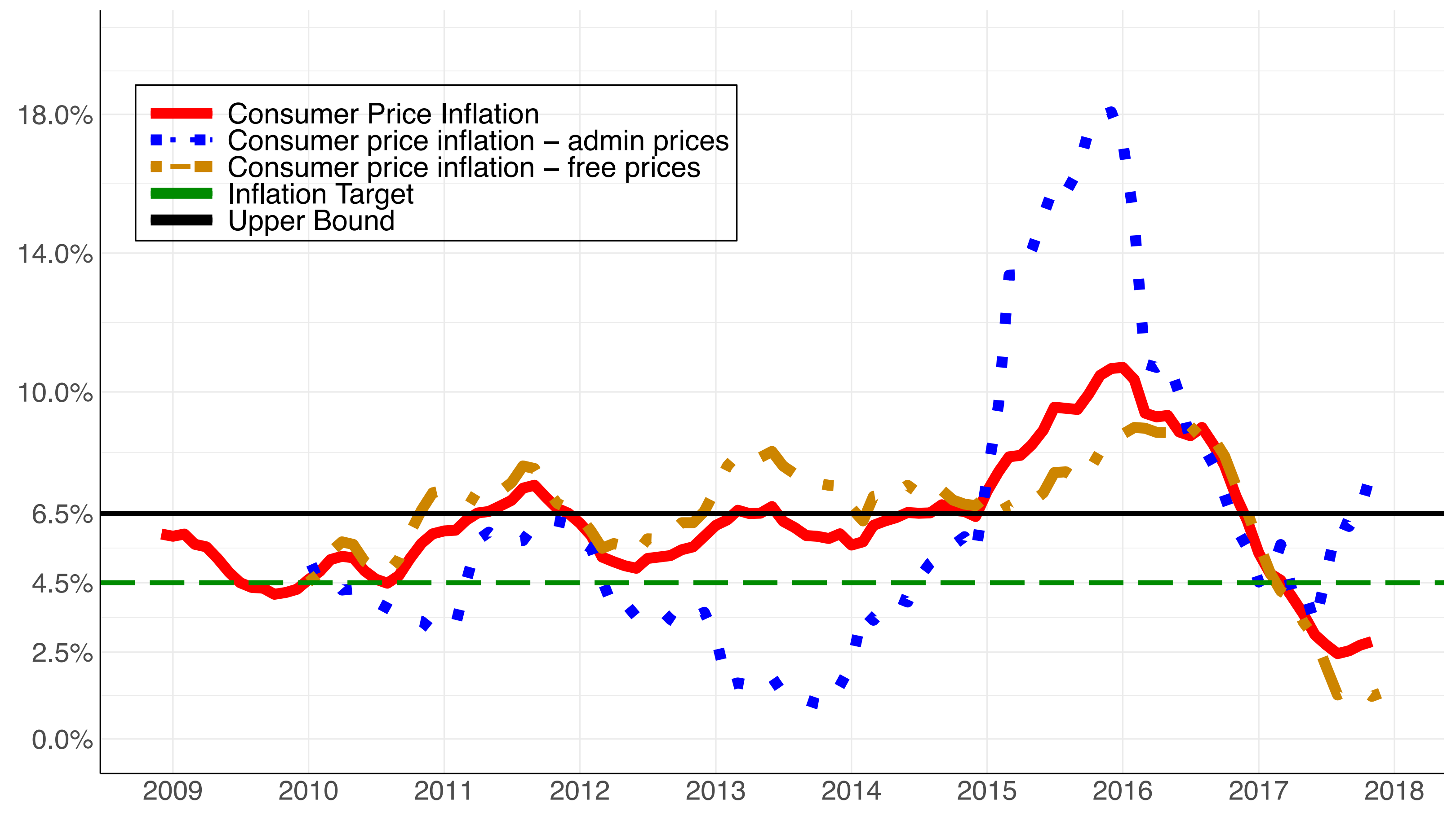


- Treating expected inflation as an exogenous driver…
  - …stories of psychology, animal spirits, bias towards thinking transitory noise. Bad theory.
- Not measuring expectations or ignoring data that had
  - …disregard surveys as too sluggish and biased, markets as noise. Persistent refusal to acknowledge increase in inflation first 6 months. Still saying it is waiting to see uptick in inflation expectations. Bad measurement.

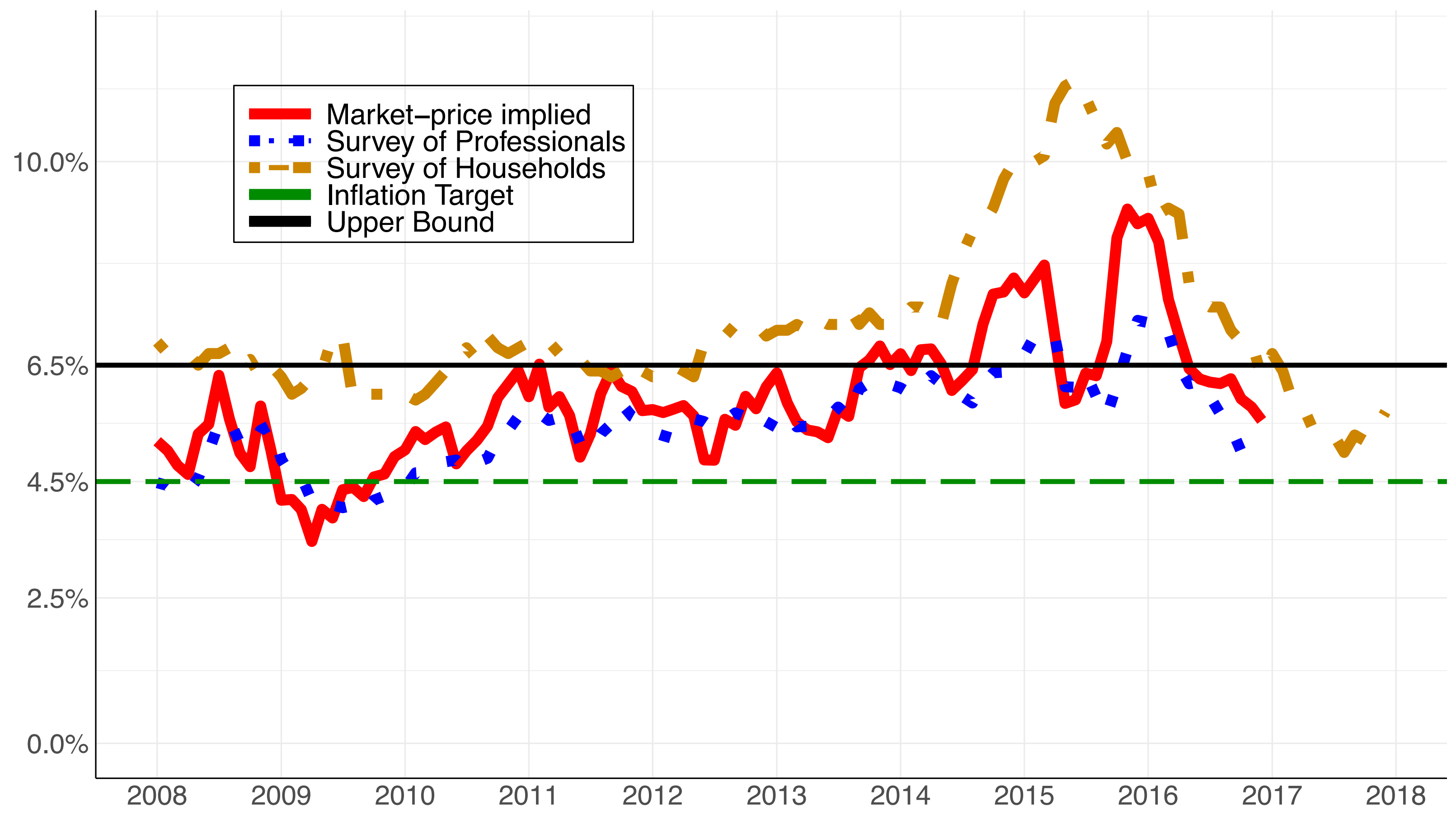
Source: Reis (2021)

Beyond one episode: Brazil 2011-16?

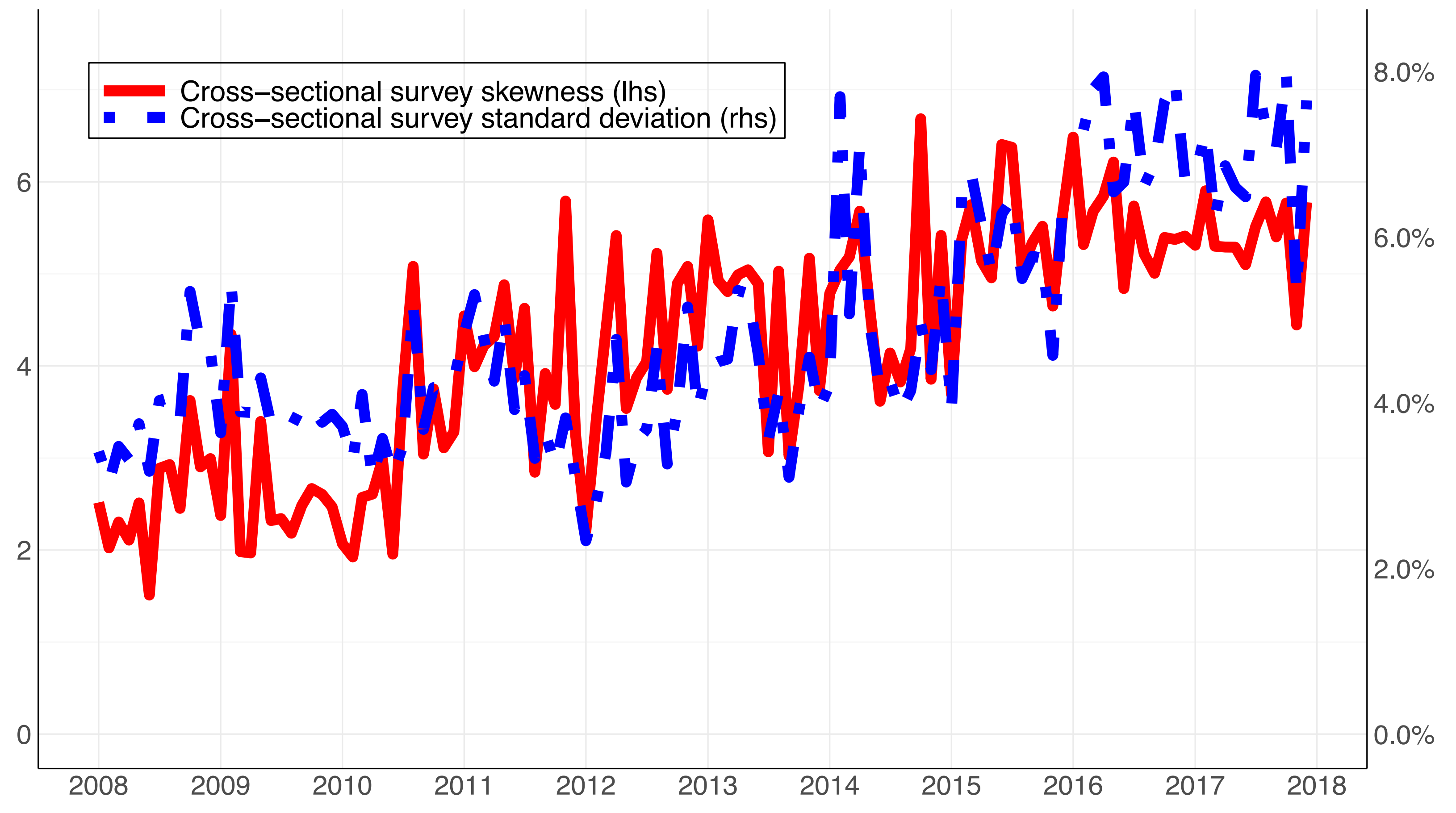
(a) Actual inflation and its target



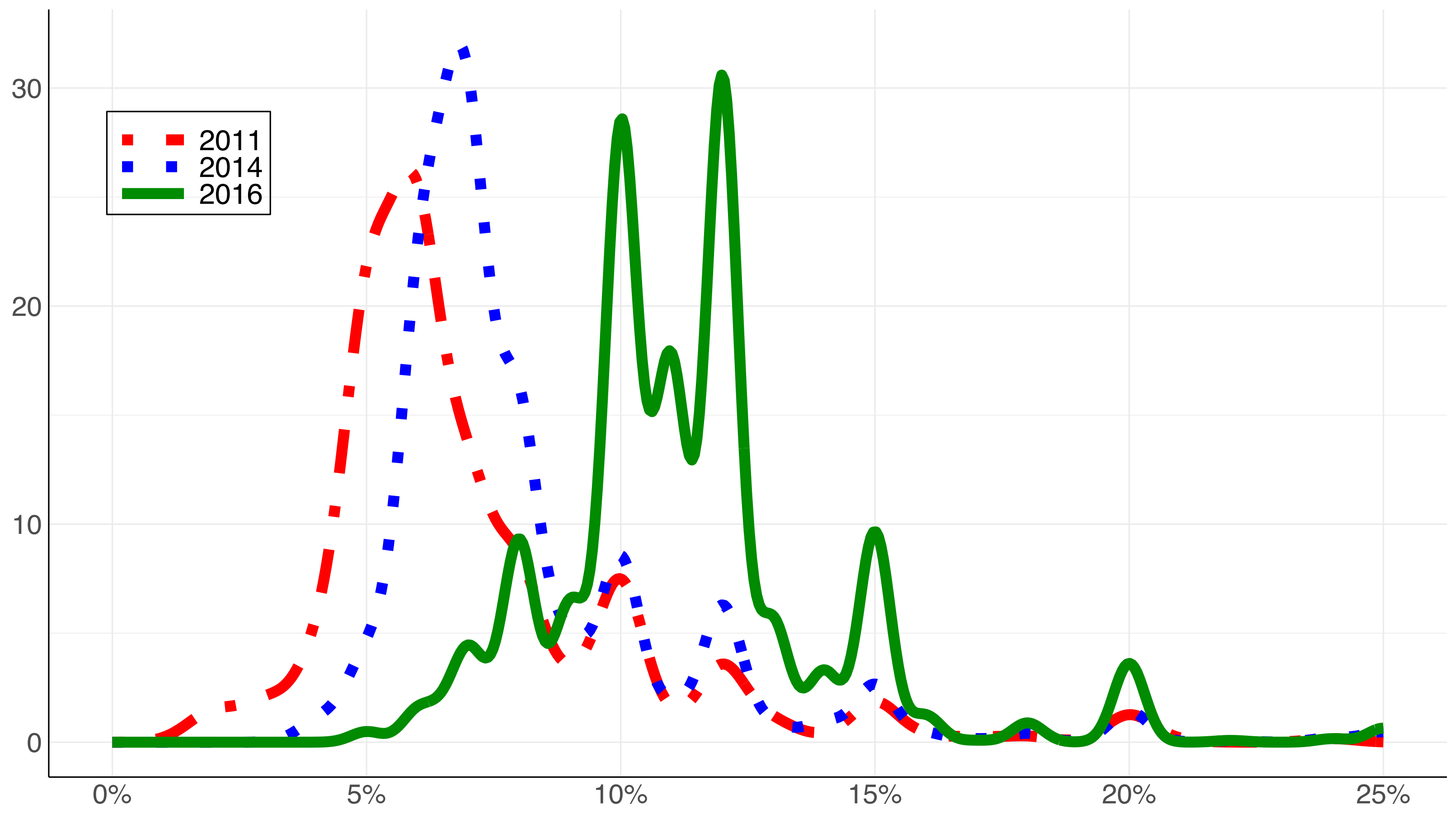
(b) Markets and survey first-order moments



(c) Cross-sectional disagreement of households



(d) Cross-sectional distribution of households



Loose monetary, fiscal dominance, belief all transitory, rising inflation.

Price controls over administrative prices kept it pent-up 2011-15.

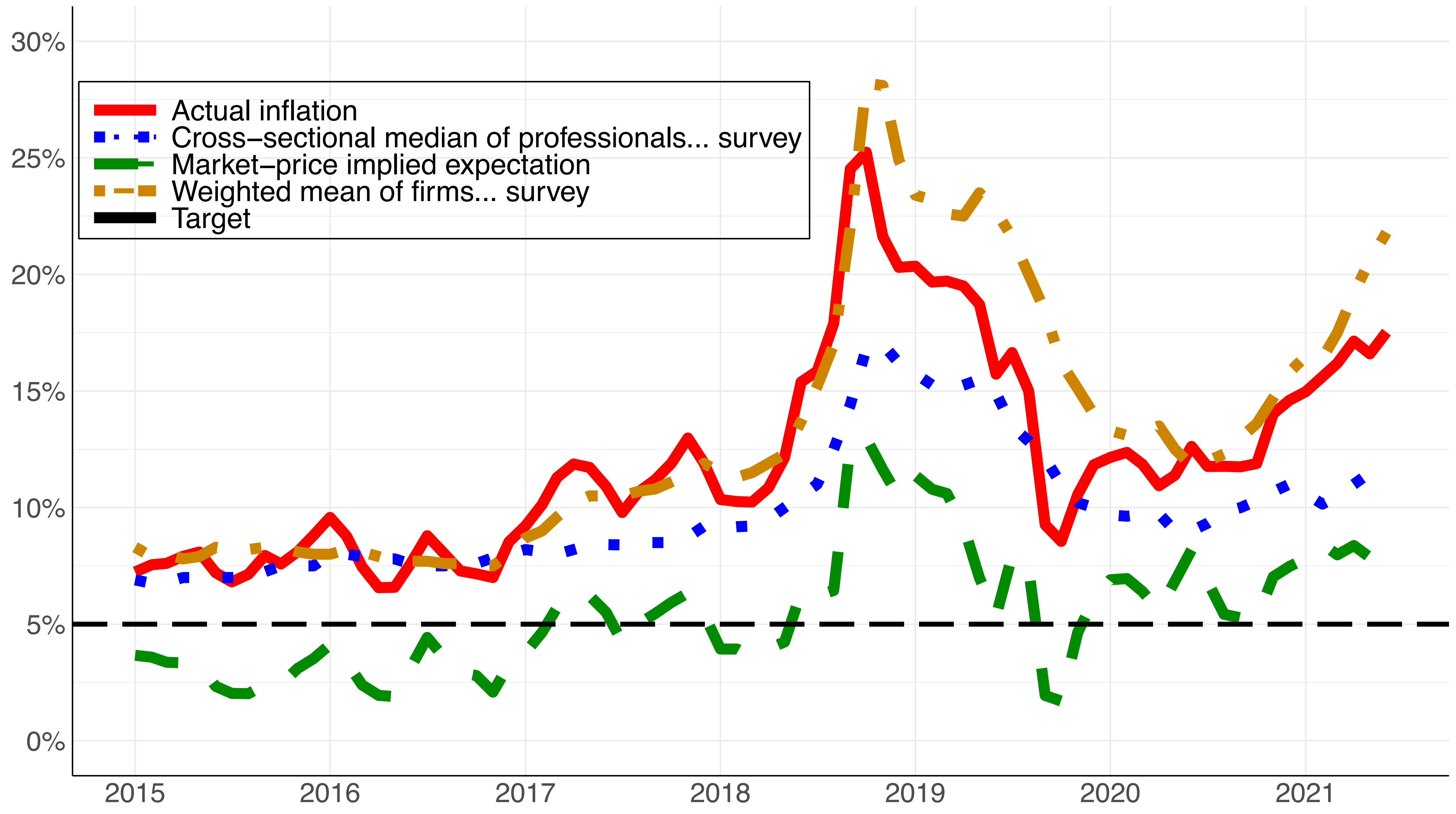
Markets, professionals weak signals

But again household disagreement revealed it

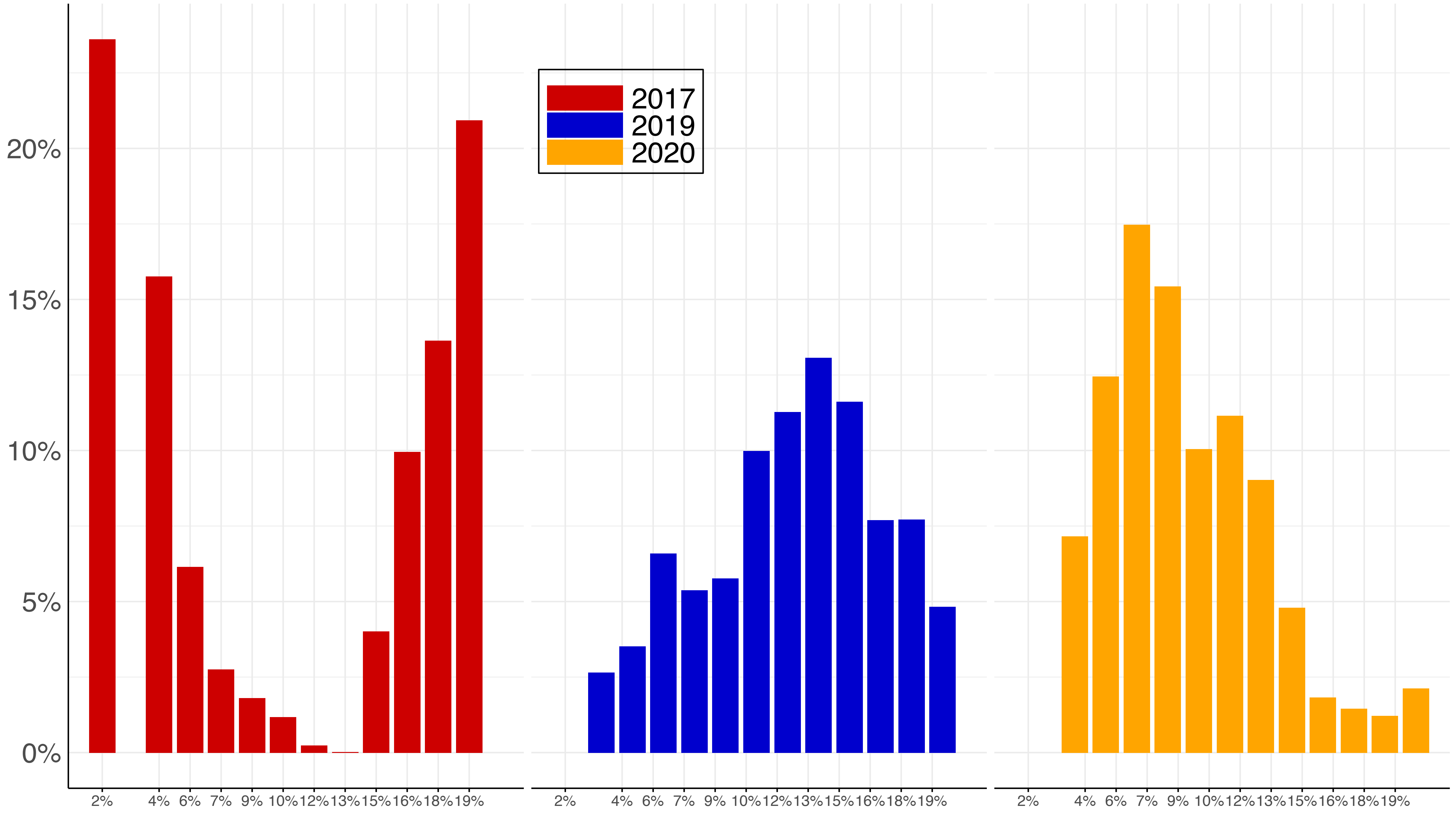
Source: Reis (2021)

And another episode: Turkey 2018-…

(a) Actual inflation, markets and survey first-order moments



(b) Cross-sectional survey distribution



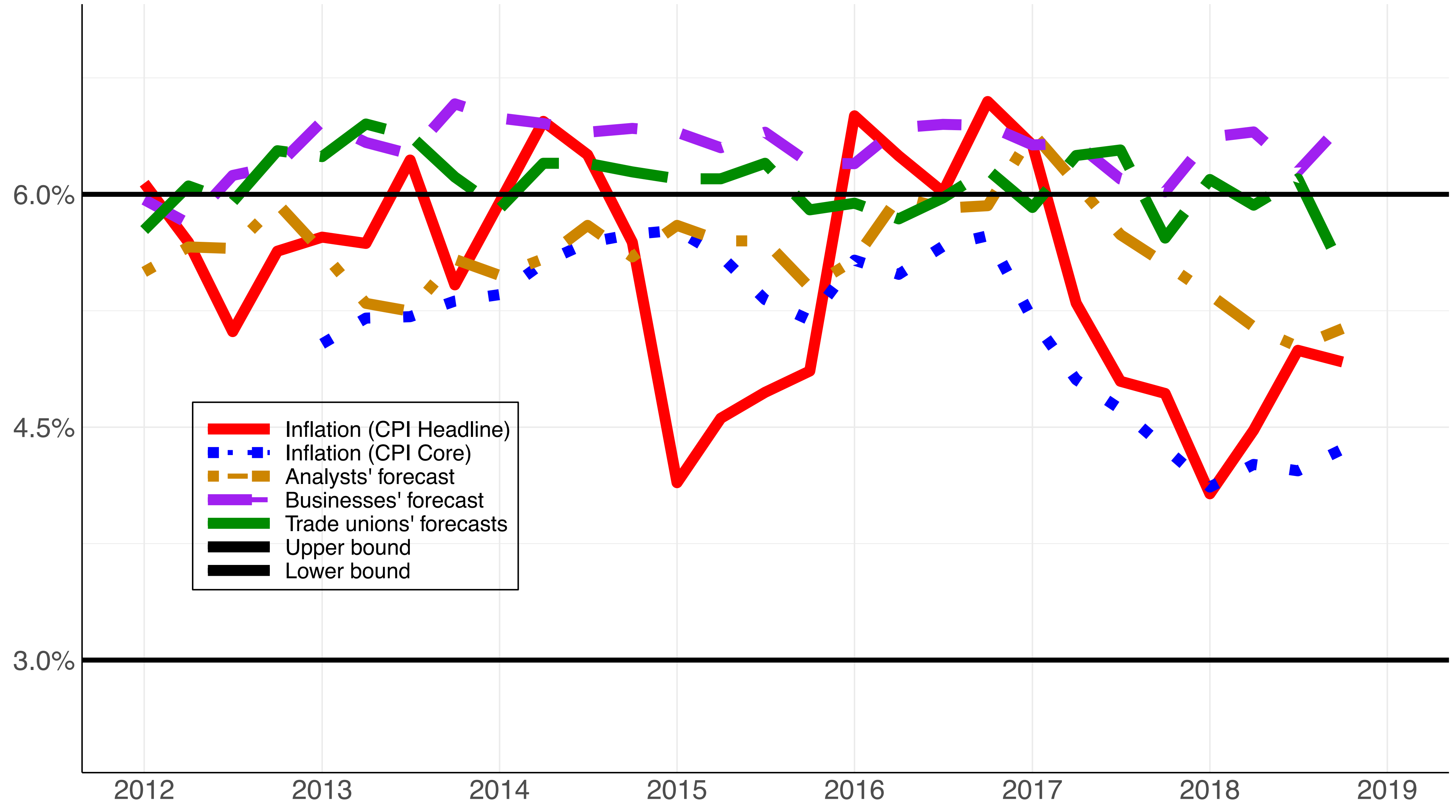
Even in real time, cross-sectional survey expectations distributions give signal

If anchor is not firm in the seabed, shifts are large and fast

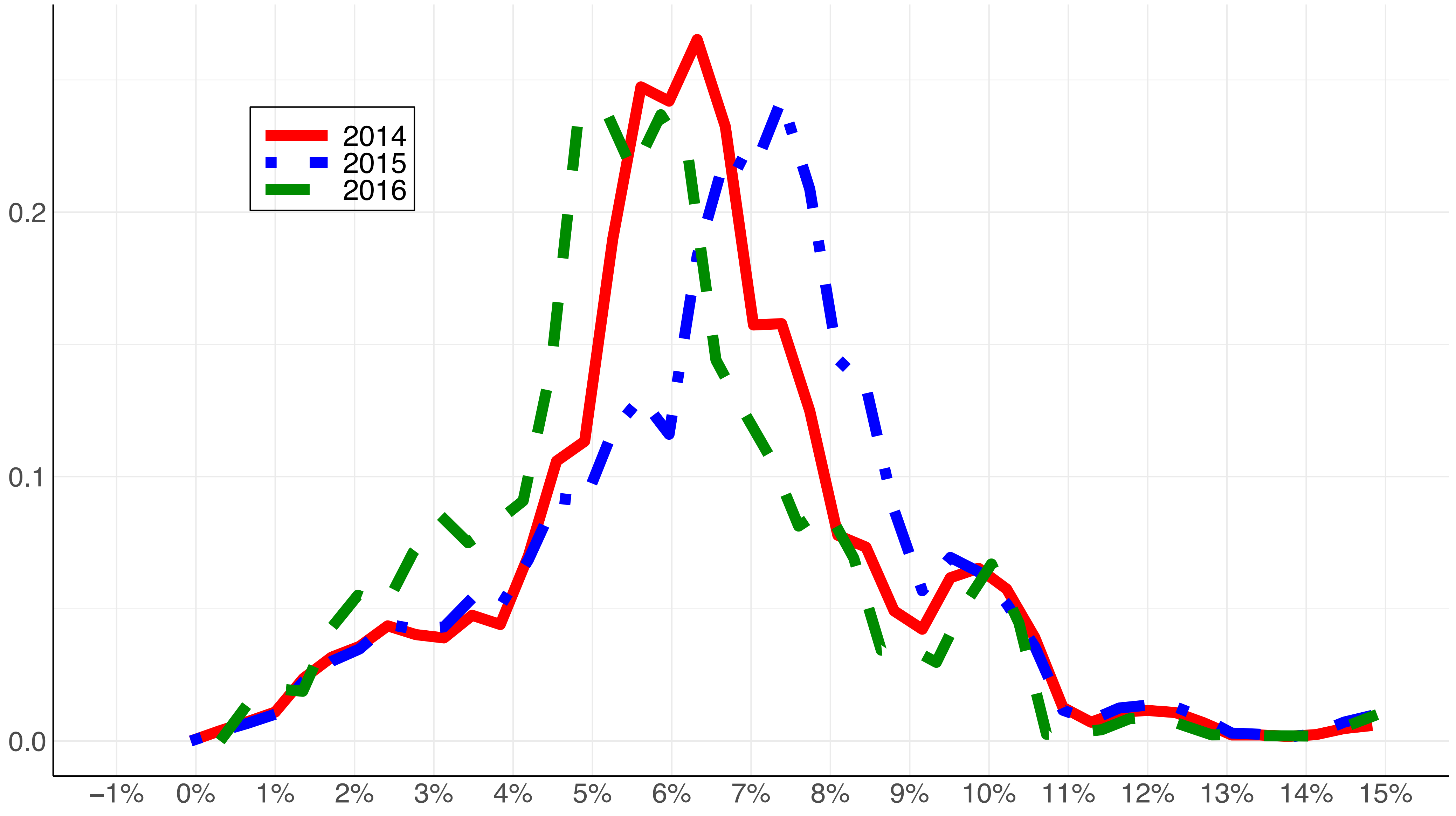
Source: Reis (2021)

False positives: South Africa 2010-16?

(a) Actual inflation, markets and survey first-order moments



(b) Cross-sectional survey distributions



Survey data stayed steady in light of unlucky run of shocks, price controls temporary effect

No drifting anchor, no false positive

Source: Reis (2021)

6. Conclusion

On inflation disasters and economic science

- **Is an inflation disaster around the corner?**
  - More likely no, but in the US the tail probability is growing, anchor is moving
- **The roots of the Great Inflation were in 1967-73, before oil shocks**
  - Bad theory (of expectations), bad measurement (expectations), bad luck (salience)
- **Measurement of expectations**
  - This conference is a good example of how far we have come, relative to 20 years ago when this field was almost theory), and policy treating it as an add-on factor.