What are the effects of a monetary policy contraction? Evidence from disaggregated price indices*

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Abstract

How long will it take the Federal Reserve to bring inflation back to target? This paper aims to shed light on this question by studying the responses of many disaggregated prices series to interest rate changes. Using local projections, we examine the dynamics of subcategories of the consumer price index (CPI), subcategories of the personal consumption expenditure (PCE) deflator, as well as geographic price indices in response to identified monetary policy shocks. We document significant heterogeneity in the size and timing of the responses across different price categories. Using our disaggregated responses and weights from 2023, we can reconstruct a synthetic aggregate CPI response to the recent monetary tightening. This provides an estimate of "how far along" the Fed might currently be on the path to price stability.

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1 Overview

How monetary policy affects prices is a classic question in macroeconomics. It has come to the forefront of the public debate in the last few years. Some commentary suggests that the Fed's recent interest rate increases have already fully paid off, with inflation being much below its 9% peak in 2022. However, in most macro models changes in monetary policy result in both a delayed and a less than one-to-one pass-through to prices. Empirical work on the question yields a range of results on the length of this delay and the size of the pass-through. For example, according to Christiano, Eichenbaum, and Evans (1999) it may take over 2 years for the aggregate price level to react, while recent work by Swanson (2023) suggests an almost instant reaction. These estimates leave considerable uncertainty around the question of how long will it take for inflation to come back to target. Indeed, Fed Chair Jerome Powell emphasized in his 2023 Jackson Hole speech that the Fed's "*assessment is further complicated by uncertainty about the duration of the lags with which monetary tightening affects economic activity and especially inflation.*"

This paper aims to shed light on this classic question by studying the responses of many disaggregated prices series to interest rate changes. While the aggregate price level is the subject of most previous analyses, our idea is that a more disaggregated view can help shed new light on the lags of the monetary policy transmission mechanism. If different prices respond to monetary policy with different timing of their peak response, for example, the aggregate series will likely mask this heterogeneity. We do so by employing a large number local projections to different levels and dimensions of disaggregation of the aggregate US price level. Specifically, we examine the dynamics of subcategories of the consumer price index (CPI), subcategories of the personal consumption expenditure (PCE) deflator as well

as geographic prices indices (see Hazell, Herreno, Nakamura, and Steinsson (2022)) in response to identified monetary policy shocks. Specifically, we use the shock series of Aruoba and Drechsel (2022) and Bauer and Swanson (2022) to study the response of disaggregated price series to plausibly exogenous interest rates changes.

As a first "proof of concept", we can already document significant heterogeneity in the size and lag of the responses across one set of different price categories. Our local projections show that it takes almost 4 years for the aggregate CPI to display a significant decline after a monetary policy tightening. This aggregate response masks strong differences across disaggregated categories. For example, nondurable goods prices fall faster (significantly negative after around 3 years), while housing services prices fall much slower (5 years).

The subsequent analysis we plan to undertake will expand our focus to many more price categories and systematically analyse their patterns. There are some specific price categories that have received a lot of debate since the last recession, such as used cars and rent. Furthermore, a regional analysis across different US states will paint a rich spatial picture of the monetary policy transmission mechanism.

From the the disaggregated responses we can always reconstruct an aggregate response using the respective basket weights. The obvious approach would be to use historical weights in the price indices to aggregate. However, given the focus on the present, we aim to reconstruct a synthetic aggregate CPI response using weights from 2023 instead. This will provide an estimate of "how far along" the Fed might currently be on the path to price stability.

2 Methodology

We construct impulse response functions (IRFs) using local projections, following Jordà (2005). Specifically, for each price subcategory i, we run the following regression over horizon $h = 0, ..., H$

$$\log p_{i,t+h} = \alpha_{i,h} + \beta_{i,h} s_t + \gamma X_t + u_{i,t+h}, \tag{1}$$

where s_t is the monetary policy shock. The estimate of $\beta_{i,h}$ will represent the IRF of price category i at horizon h. X_t collects additional controls, such as lags of the left hand side as well as potentially other macroeconomic variables and lags thereof. See also Ramey (2016) for a discussion of the specification of local projections.

We are planning on at least two technical improvements over this standard approach. First, we will use local projections with instruments (LP-IV) where in the first stage, we regress changes in the Federal Funds Rate on two measures of monetary policy shocks

$$\Delta R_t = \delta^{AD} \varepsilon_t^{AD} + \delta^{BS} \varepsilon_t^{BS} + v_t, \tag{2}$$

ε_t^{AD} are the estimated shocks from Aruoba and Drechsel (2022) and ε_t^{BS} the ones from Bauer and Swanson (2022). The idea of having a first stage is to exploit interest changes that are plausibly exogenous. While for finer price categories, the worry about reverse causality between the left hand side to the right hand side in (1) might be less of a concern, it is an identification problem for higher aggregates. The idea of using several instruments is to the best of our knowledge new relative to the monetary policy literature. Our reasoning is that multiple instrument should increase statistical power of the exercise. The fitted values of $\Delta \hat{R}_t$ in equation (2) will

give us our main regressor s_t in equation (1). Another different approach we plan to investigate is to use only contractionary shocks in the first stage, given the explicit interest in the consequences of contractionary shocks we have in this project.

The second technical innovation will be to use various methods to obtain smooth impulse-responses that have tight uncertainty bands. Two methods that have been proposed recently are the Bayesian local projections (BLP) of Ferreira et al. (2023) and the smooth local projections (SLP) of Barnichon and Brownlees (2019).

3 Data

Price series. We use subcategories of inflation, from the following three sources:

1. Consumer price index (CPI) provided by the BLS
2. Personal consumption expenditure (PCE) deflator provided by the BEA
3. Regional prices indices from Hazell, Herreno, Nakamura, and Steinsson (2022)

Monetary policy shocks. We use identified shocks provided by the following two methodologies:

1. Aruoba and Drechsel (2022): this methodology is based on natural language processing and machine learning techniques, applied to the Fed's Greenbook documents, following Romer and Romer (2004)
2. Bauer and Swanson (2022): this methodology is based on using high-frequency changes in market interest rates around FOMC announcements

Sample. We aim to focus on "traditional" changes in interest rates, and consciously not to focus on non-standard monetary policy. We therefore use

monthly data from the sample 1987-2008. This spans the Chairmanships of Alan Greenspan and Ben Bernanke, up to the period when interest rates were at the zero lower bound (ZLB).

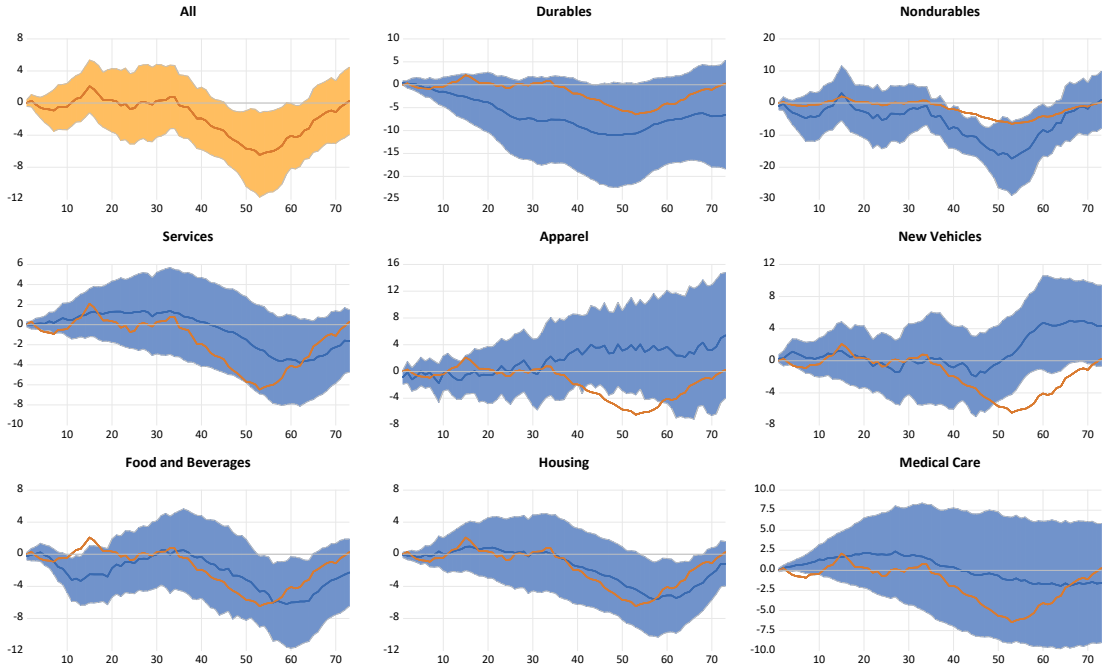
4 Preliminary results

As a preliminary "proof of concept", Figure 1 plots several IRFs to a monetary policy tightening as solid lines, together with 90% confidence bands as shaded areas. What is plotted is the cumulative percentage change in the price in question. The figure shows the aggregate CPI response in the top left panel, in orange. The other panels show the corresponding IRFs of subcategories in blue. We always superimpose the aggregate response in orange. In this case, we focused only on the Aruoba and Drechsel (2022) shock and included 12 lags of the respective log price level on the left hand side as controls.

Comparing the different panels of the figure makes clear that there is large heterogeneity in the size and dynamic profile of price responses. It takes almost 4 years for the aggregate CPI to display a significant decline after a monetary policy tightening. This masks significant differences across disaggregated categories. For example, nondurable goods prices fall faster (significantly negative after around 3 years), while housing service prices fall much slower (5 years). Some categories show responses that are not distinguishable from zero. This is the case for apparel and medical care, for example.

When moving forward with this research project, we intend to expand our analysis by delving into a wider array of price categories and conducting a thorough systematic assessment of their dynamics. Certain price categories, notably used cars and rental expenses, have been the subject of extensive debate since the last

Figure 1: INFLUENCE FUNCTIONS IN DFMS WITHOUT AND WITHOUT FAT TAILS



Notes. The top left panel shows the aggregate CPI response, while the other panels show the IRFs of subcategories. We always superimpose the aggregate response in orange. The sample is 1987-2008.

economic downturn. Regional differences across the US will likely also provide interesting findings. In addition, leveraging our disaggregated data, we aim to reconstruct a synthetic composite CPI response. The idea is to use our disaggregated responses and incorporate weights from the year 2023. This exercise could offer an estimate of the extent to which the Fed has progressed toward achieving price stability at the current juncture.

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