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Prices are sticky after all

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ABSTRACT

Economists have interpreted the evidence that prices change every four months as implying that sticky prices cannot be important for monetary transmission. Theory implies that this interpretation is correct if most price changes are regular, but not if a large fraction are temporary, as in the data. Since regular prices are much stickier than temporary ones, our models predict that the stickiness of the aggregate price level matches that in a standard Calvo model or a standard menu cost model in which micro-level prices change about once a year. In this sense, prices are sticky after all.

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1. Introduction

A widely held view in macroeconomics is that monetary policy can be effective primarily because aggregate prices are sticky; when monetary policy changes, the aggregate price level cannot respond quickly enough to offset the intended real effects. This price stickiness is clearly at the heart of the widely used New Keynesian analysis. In standard New Keynesian models of both the Calvo and the menu cost varieties, the degree of aggregate price stickiness is determined by the frequency of price changes at the micro-level: if individual good prices change rarely, then the aggregate price level is highly sticky and cannot offset monetary shocks, whereas if good prices change often, then the aggregate price level is not sticky and can.

Until recently, micro-level prices have been assumed to be quite sticky—changing relatively infrequently, only about once a year; hence, aggregate prices have been assumed to be highly sticky. Recently, however, researchers (e.g., [Bils and Klenow, 2004](#)) have examined large micro-price data series and determined that individual good prices change much more frequently than previously thought, about once every 4.3 months. According to these studies, prices are quite flexible at the micro-level. Interpreted through the lens of the standard New Keynesian models, this evidence implies that aggregate prices are quite flexible too.

We dispute this interpretation. Although the interpretation follows logically from standard New Keynesian models, those models are grossly inconsistent with the pattern of price changes in the micro-data. Here, simple extensions of both the Calvo model and the standard menu cost model that are consistent with the micro-data are built to show that in these models, aggregate prices are as sticky as those in a standard menu cost model in which micro-level prices change about once a year.

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The major inconsistency between the standard New Keynesian models and the data is the models' inability to simultaneously account for the high- and low-frequency patterns of price variation that are documented by using monthly price data from the U.S. Bureau of Labor Statistics (BLS). At high frequencies, prices often temporarily move away from a slow-moving trend line called the *regular price*, but after a *temporary price* change, the nominal price often returns exactly to its pre-existing level. These distinctive features imply that even though an individual price series has a great deal of *high-frequency price flexibility* (the actual price changes frequently), the series also has a great deal of *low-frequency price stickiness* (the regular price changes infrequently).²

Standard New Keynesian models of both the Calvo and menu cost varieties have only one type of price change and thus have no hope of generating this feature of the data. In particular, these models generate either highly flexible prices at both high and low frequencies or highly sticky prices at both frequencies. What they cannot generate is what is seen in the micro-data: very flexible prices at high frequencies and very sticky prices at low frequencies.

To remedy this deficiency of standard New Keynesian models, a theory of why firms temporarily change their prices is needed. Such theories can be found in the models of sales from industrial organization. Unfortunately, these theories are about real prices and, hence, cannot explain the striking feature of temporary price changes: after a temporary price change, the nominal price often returns exactly to the nominal pre-existing price.³

The models studied here, although simple, overcome the shortcomings of both the standard New Keynesian models as well as the models of sales from industrial organization. We extend the Calvo model and the standard menu cost model by allowing firms to temporarily deviate from a sticky pre-existing price. These models are quantified, and it is shown that they reproduce the empirical micro-pattern of regular and temporary price changes.

It is then shown that these models imply that the aggregate price level responds slowly to monetary shocks. This result is driven by the distinctive features of temporary micro-price changes. In the models prices change frequently, but most of those changes reflect temporary deviations from a much stickier regular price. When a firm changes its price temporarily in a given period because of an idiosyncratic shock, it is also able to react to changes in monetary policy. These responses are, however, short-lived. And whenever the price returns to the old price, it no longer reflects the change in monetary policy. For this reason, even though micro-prices change frequently, the aggregate price level is sticky. Our key insight is that what matters for how the aggregate price level responds to low-frequency changes in monetary policy is the degree of low-frequency micro-price stickiness. Since the micro-data have substantial low-frequency price stickiness, the aggregate price level is sticky as well.

Our result has implications for the debate between [Bils and Klenow \(2004\)](#) and [Nakamura and Steinsson \(2008\)](#) on the stickiness of prices. [Bils and Klenow \(2004\)](#) find that when they leave sales in their data, prices change often—once every 4.3 months—and argue that prices are fairly flexible. Nakamura and Steinsson study the same data and show that once temporary price cuts are removed, prices change infrequently—about every 7–11 months—and argue that prices are fairly sticky.

The rationalization suggested by [Bils and Klenow \(2004, p. 955\)](#) for leaving sales in the data is that “temporary sales represent a true form of price flexibility that should not be filtered out, say because the magnitude and duration of temporary sales respond to shocks.” The argument for removing temporary price cuts is that they are somehow special and, to a rough approximation, can be ignored when determining the amount of price stickiness in the data. For example, [Nakamura and Steinsson \(2008, p. 1417\)](#) suggest that “some types of sales may be orthogonal to macroeconomic conditions.”

Economic theory is used to help advance this debate. A simple extension of the Calvo model is used to make our point because it is simple and is viewed as the workhorse New Keynesian model. It is then shown that our result is robust to explicitly introducing menu costs to changing prices, rather than the more reduced-form Calvo approach.

In both models, the assumptions made about the technologies for changing prices are purposefully engineered to allow the model to reproduce the observed pattern of micro-price changes. In particular, the assumption is that firms set two prices—a list price and an actual transactions (posted) price—and face frictions on either changing the list price or having the posted price differ from the list price. In the Calvo model, these frictions are that the list price can be changed only at certain random dates and that the posted price can differ from the list price at other random dates. In the menu cost model, these frictions are menu costs of either changing the list price or charging a posted price other than the list price.

The resulting models, though simple, are broadly consistent with some aspects of the pricing practices of actual firms. In particular, [Zbaracki et al. \(2004, 2007\)](#) provide evidence that pricing is done at two levels: upper-level managers (at headquarters) set list prices, while lower-level managers (at stores) choose the actual transaction (posted) prices. These researchers find that lower-level managers face constraints on their ability to post a price that departs from the list price set by the upper-level managers. Our models capture this two-level decision-making process in a simple, reduced-form way.

Consider first our extension of the Calvo model. In the standard Calvo model, a fraction of firms is allowed to permanently reset their list price in any given period. This model is extended by also allowing a fraction of firms to temporarily deviate from their list price in any given period. This simple one-parameter extension of the standard Calvo

² For documenting this basic pattern in the data, an important reference is [Nakamura and Steinsson \(2008\)](#), who focus on temporary price decreases (or sales) and show that sales price changes account for the bulk of all price changes in the data. They also show that sales price changes are more transient than regular price changes and tend to return to the original level following a sale. For a survey of this literature, see [Klenow and Malin \(2010\)](#).

³ See, for example, models based on demand uncertainty ([Lazear, 1986](#)), thick-market externalities ([Warner and Barsky, 1995](#)), loss-leader models of advertising ([Chevalier et al., 2003](#)), and intertemporal price discrimination ([Sobel, 1984](#)).

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