



# Price stickiness in $Ss$ models: New interpretations of old results<sup>☆</sup>

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## Abstract

What is the relation between infrequent price adjustment and the dynamic response of the aggregate price level to monetary shocks? The answer to this question ranges from a one-to-one link [Calvo, G., 1983. Prices in a utility maximizing framework. *Journal of Monetary Economics* 12, 383–398] to no connection whatsoever [Caplin, A., Spulber, D., 1987. Menu costs and the neutrality of money. *Quarterly Journal of Economics* 102, 703–726]. The purpose of this paper is to provide a unified framework to understand the mechanisms behind this wide range of results. In doing so, we propose new interpretations of key results in this area, which in turn suggest the kind of  $Ss$  model that is likely to generate substantial price rigidity. Among these new interpretations, we revisit Caplin and Spulber's monetary neutrality result. We show that when price stickiness is measured in terms of the impulse response function, this result is not a consequence of aggregation, as is often assumed, but is due instead to the absence of price stickiness at the microeconomic level. We also show that the “selection effect,” according to which units that adjust their prices are those that benefit the most, is neither necessary nor sufficient to account for the higher aggregate flexibility of  $Ss$ -type models

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compared to Calvo models. Instead, the key concept is the contribution of the *extensive margin* of adjustment to the aggregate price response. The aggregate price level is more flexible than suggested by the microeconomic frequency of adjustment if and only if this term is positive.

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## 1. Introduction

What is behind the slow response of aggregate prices to monetary shocks? The availability of new and detailed microeconomic data sets, documenting the frequency of microeconomic price adjustment for a wide variety of goods and countries, has rekindled economists' interest in answering this important question.<sup>1</sup>

For these studies to be useful for macroeconomics, we need to understand the mapping from the microeconomic price adjustment frequency to aggregate price stickiness. We already know that this mapping can be surprising: [Caplin and Spulber \(1987\)](#), henceforth CS, construct an insightful example where there is no relation between these two measures. They combine a one-sided  $S_s$  model of microeconomic price adjustment with a specific form of asynchronous adjustment of individual prices (the assumption of a uniform cross-section), and obtain an aggregate price level that responds one-for-one to monetary shocks. Thus there is no aggregate price stickiness in their model—the impulse response is one upon impact and zero thereafter—despite the fact that the frequency of microeconomic price adjustments can take any value.

In a related recent result, [Golosov and Lucas \(2007\)](#) show that the sluggishness of the aggregate price response to monetary shocks is overestimated when approximating a standard menu-cost model with a Calvo model, where adjustment is infrequent but uncorrelated with the size of price imbalances. That is, the frequency of microeconomic price adjustments underestimates the flexibility of the aggregate price level in standard  $S_s$  models.

Aside from these illustrative examples, is there anything more general that can be said about the connection between the frequency of microeconomic adjustment and the degree of flexibility of the aggregate price level? What are the precise channels through which microeconomic inaction and aggregate price stickiness are connected in  $S_s$  models? The purpose of this paper is to answer these questions and, along the way, offer new interpretations for some old results.

Two new interpretations and mechanisms we discuss in this paper stand out. First, the main result in CS is that in their context a small monetary expansion has no effect on aggregate output, despite the fact that at any given instant most microeconomic units do

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<sup>1</sup>See [Bils and Klenow \(2004\)](#), [Nakamura and Steinsson \(2006a\)](#) for the US, and [Dhyne et al. \(2006\)](#) and [Fabiani et al. \(2006\)](#) for a summary of the findings of the impressive set of country studies sponsored by the ECB's Inflation Persistence Network.

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