

On implications of micro price data for macro models

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Introduction

- **Ten years ago, in his Handbook of Macroeconomics chapter “Staggered price and wage setting in macroeconomics”, John Taylor (1999) took stock of the micro evidence on price and wage setting.**
- **Since then economists have gained access to new, detailed micro data on prices from the consumer and producer price indices as well as from supermarket scanner data.**
- **This paper**
 - **reviews this new literature, revisiting some of Taylor’s conclusions**
 - **and discusses implications for macro models**

Taylor's (1999) conclusions

- **Taylor (1999) highlighted four conclusions on the existing micro and macro evidence on nominal wage and price rigidities at the time:**
 1. **While casual observation may suggest that wage rigidity is greater than price rigidity, the detailed studies do not provide evidence that one form of rigidity is more significant than the other: the studies suggest that price changes and wage changes have about the same average frequency – about one year”**
 2. **There is a great deal of heterogeneity in wage and price setting. ... some degree of heterogeneity will be required to describe reality accurately.**
 3. **Neither price setting, nor wage setting is synchronised.**
 4. **The frequency of wage and price changes depends on the average rate of inflation**

Overview

- **Main findings of the new micro price literature**
 - In many ways, Taylor's conclusions still hold up, but the picture is now much richer and the micro data reveal a lot of heterogeneity.
- **Mapping from the price change frequencies in micro data to impulse responses of prices and quantities to macro shocks.**
 - Price change frequencies are helpful for calibrating standard macro models, but not decisive. And the mapping is not simple. Two examples.
- **Promising lines of research**
 - Real rigidities – Rational inattention – Customer markets

Overview

- **Main findings of the new micro price literature**

In many sectors prices are sticky

- **Prices remain constant for extended periods of time in many sectors of the economy:**
 - **IPN: Dhyne et al (2005): Average duration for the euro area is between 10 (median) and 13 (mean) months.**
 - **Bils and Klenow (2005): 4.3 months for the US, but... Nakamura and Steinsson (2006): 8 to 11 months correcting for sales; Klenow and Kryvtsov (2007): 3.7 – 7.2 – 9.3 months.**
 - **Using weekly scanner data, Eichenbaum, Jaimovich and Rebelo (2008): very high frequencies for raw prices (3 weeks), but about 4 quarters for reference prices.**
- **Similar results for producer prices and from surveys.**

But a lot of heterogeneity...

- **Frequency of price changes:**
 - **E.g. Nakamura and Steinsson (2007a): Legal services: 1.6% - Used cars: 100%; Services excluding travel: 6.6% - Vehicle fuel: 87.6%.**
 - **E.g. Dhyne et al (2005): Services: 5.6% - Oil products: 78%**
- **Also the incidence of sales prices and forced item substitutions differs a lot across categories:**
 - **E.g. Nakamura and Steinsson (2007a): 87% in “Apparel”, close to zero in “Utilities”;**

Heterogeneity and macro calibration

- **Should we take into account the large heterogeneity in price change frequencies or can we live with the mean/median in macro calibration?**
 - Carvalho (2006) shows that it matters in a Calvo set-up;
 - Kara and Dixon (2006) use a Taylor set-up;
 - Nakamura and Steinsson (2007b) develop a menu cost model with different sectors.
- **All papers find that modelling heterogeneity matters:**
 - A model with a representative sector produces less aggregate stickiness than the model with heterogeneous sectors and the same average price rigidity.

Sales prices and macro calibration

- **Should we include price changes due to sales in the price change frequencies used to calibrate macro models?**
 - Sales-related price changes are transient and stochastic (Nakamura and Steinsson, 2007a);
 - They do respond to macro factors such as inflation (Klenow and Willis, 2007);
 - But they should probably not be included in macro calibration (Kehoe and Midrigan, 2007):
 - In a menu cost model with sales nominal shocks have significantly larger real effects compared to the same model without sales calibrated to all posted prices.

Euro area versus United States

- **Prices appear to change less frequently in the euro area than in the United States**

Country	Unpro- cessed food	Processed food	Energy (oil products)	Non-energy industrial goods	Services	Total
Belgium	31.5	19.1	81.6	5.9	3.0	17.6
Germany	25.2	8.9	91.4	5.4	4.3	13.5
Spain	50.9	17.7	n.a.	6.1	4.6	13.3
France	24.7	20.3	76.9	18.0	7.4	20.9
Italy	19.3	9.4	61.6	5.8	4.6	10.0
Luxembourg	54.6	10.5	73.9	14.5	4.8	23.0
The Netherlands	30.8	17.3	72.6	14.2	7.9	16.2
Austria	55.3	24.5	15.9	14.3	13.6	21.1
Portugal	37.5	15.5	72.3	8.4	7.1	15.4
Finland	52.7	12.8	89.3	18.1	11.6	20.3
Euro Area	28.3	13.7	78.0	9.2	5.6	15.1
United States	47.7	27.1	74.1	22.4	15.0	24.8

Average absolute price changes are large

- **When prices change, on average they change by large amounts relative to inflation.**
 - **Klenow and Kryvtsov (2007): 11.5 percent (9.7 percent when sale-related price changes are excluded)**
 - **Nakamura and Steinsson (2007a): 7.7 percent for finished producer goods.**
 - **Dhyne et al (2005): CPI: mean increase 8 percent; mean decrease 10 percent.**
 - **Vermeulen et al (2007): average 4 percent.**
- **Compare to monthly inflation rates of about 0.2 percent. Suggests that idiosyncratic shocks are a much more important cause of variation in prices than aggregate shocks.**

But a lot of heterogeneity

- **Size of price changes:**
 - Klenow and Kryvtsov (2007): Avg: 11.5% - 9.7% (without sales), but 25% of price changes are smaller than 2.5%.
 - Nakamura and Steinsson (2007a): 6% in “Utilities” to 30% in “Apparel”
- **The presence of many relatively small price changes poses a challenge for the basic menu cost model**

Price decreases are very common

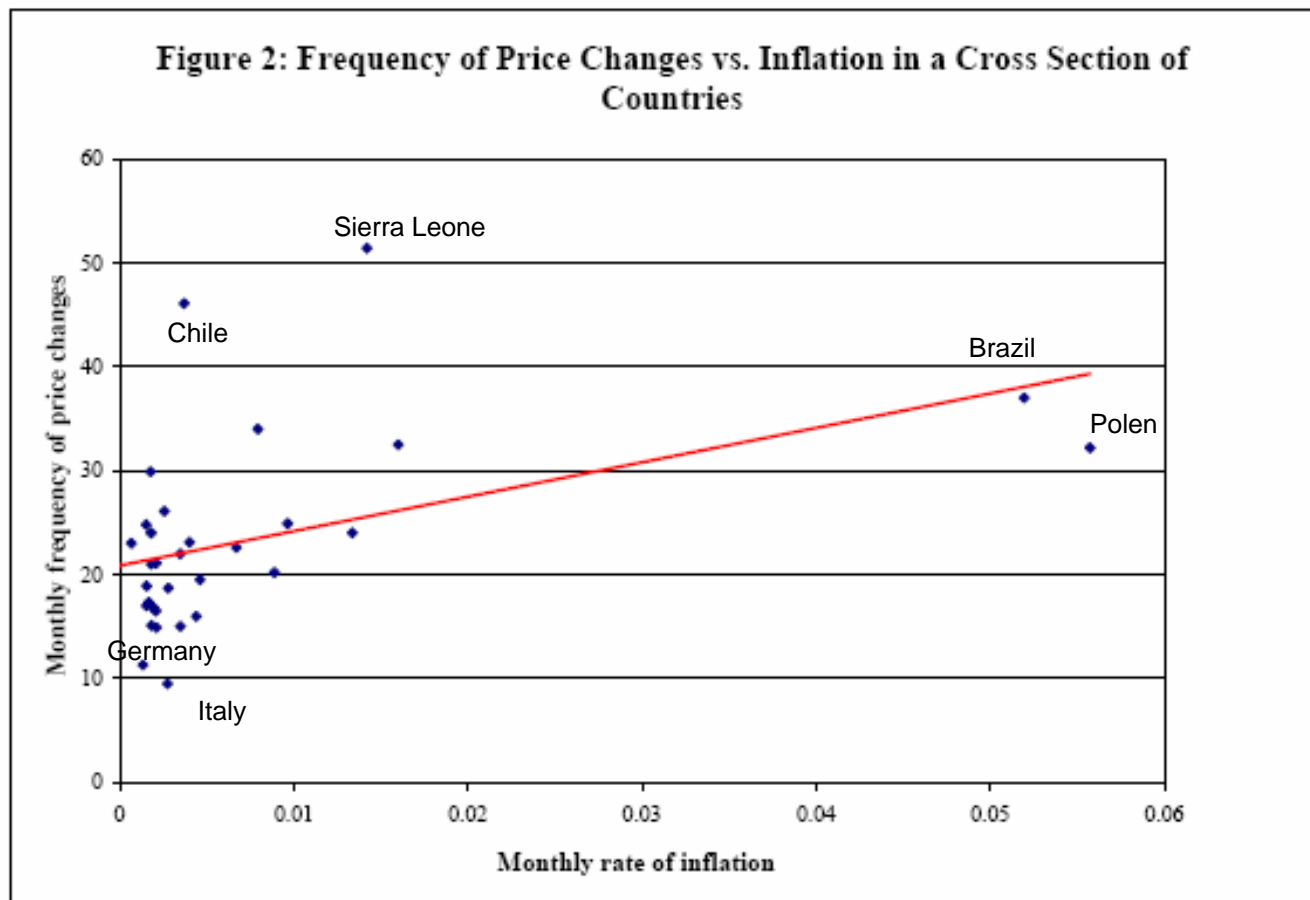
	Unprocessed food	Processed food	Energy (oil products)	Non-energy industrial goods	Services	Total
Share of price increases	54	54	54	57	80	58
Size of price increases	15	7	3	9	7	8
Size of price decreases	16	8	2	11	9	10

Source: Dhyne et al (2006)

Not much evidence of synchronisation

- **Dhyne et al (2005):**
 - **Low degree of synchronisation (with exception of energy);**
 - **Fisher and Konieczny (2000) index ranges from 0.12 for Germany to 0.50 for Luxembourg; FK index can be interpreted as the share of firms that are perfectly synchronised.**
- **There is some evidence in disaggregate sectors:**
 - **Local markets in Italy do exhibit more evidence of synchronisation;**
 - **German manufacturers change prices when wages are changed;**
 - **Within stores price changes appear to be synchronised.**
- **But this probably does not matter for the macro picture**
- **Some evidence of seasonality in a number of sectors**

Price change frequencies rise with



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Mapping micro into macro

- **One reason why macro modellers are interested in micro price data is that in familiar and tractable macro models the frequency of price changes maps easily into impulse responses of prices and quantities to macro shocks.**
- **The new micro data are helpful, but not decisive; there is no simple mapping.**
- **Two examples:**
 - **Impulse responses of sectoral price indices**
 - **The New Keynesian Phillips Curve in the euro area and the United States**

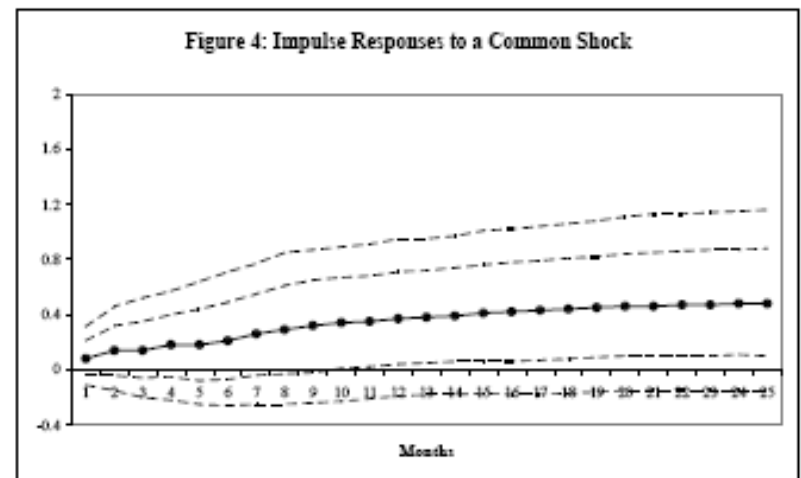
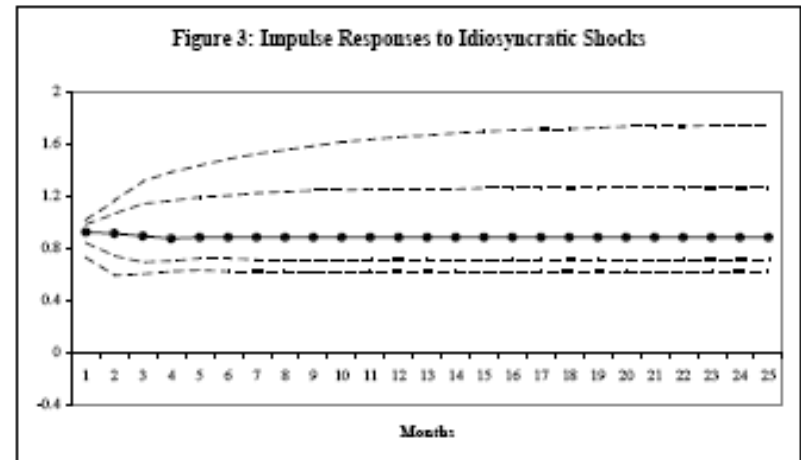
Impulse responses of sectoral prices

- **Mackowiak et al (2008):**
 - Find that 85 percent of the variation in sectoral price indices is caused by sector-specific shocks
 - Moreover, the degree of stickiness or speed of adjustment is conditional on the source of the disturbance.
- **Similar findings by Boivin et al (2007)**

Impulse responses of sectoral prices

- Sectoral price indices respond very quickly to sector-specific shocks (basically within one month)
- But slowly to an aggregate shock: About 15 percent of the long-run response occurs within one month.

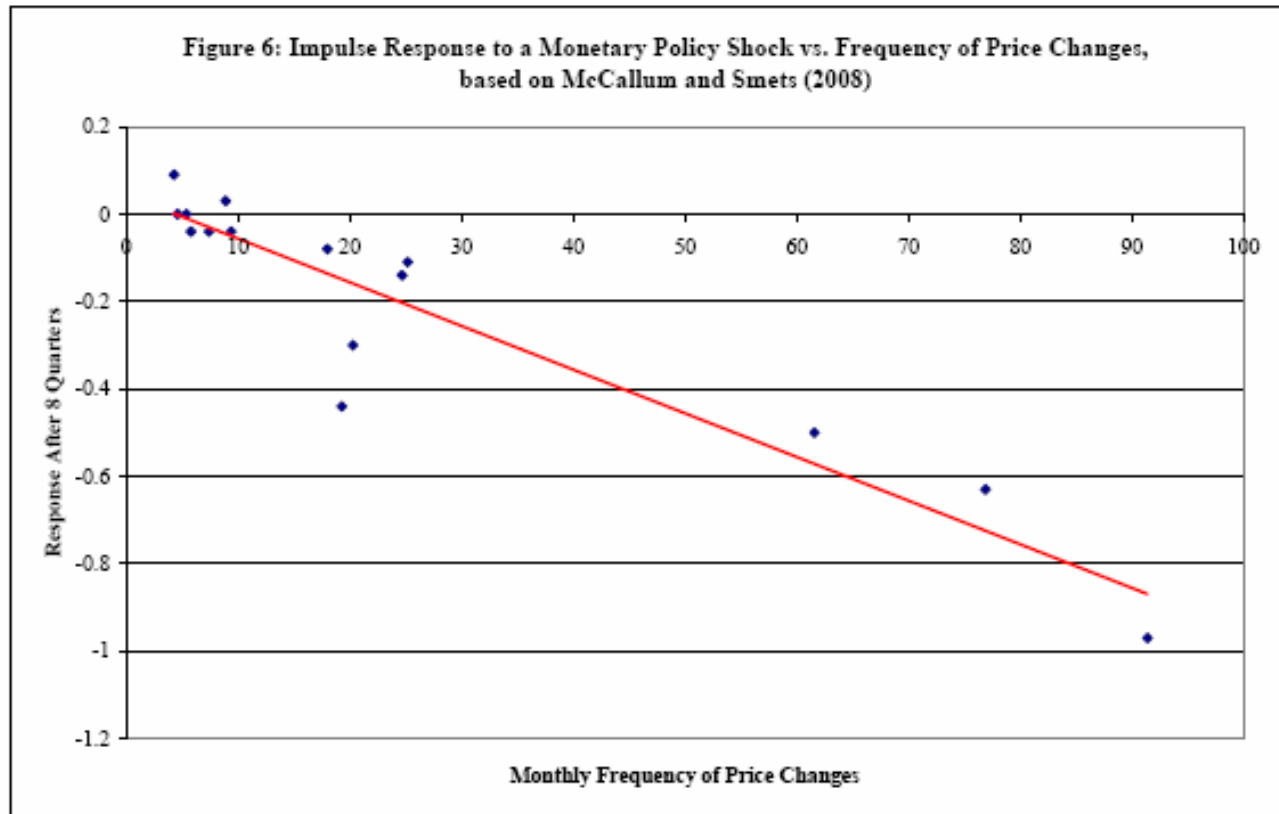
Impulse Responses of Sectoral Price Indices, with 68% and 90% Bands, from Maćkowiak, Moench, and Wiederholt (2008)



Impulse responses of sectoral prices

- **There is, however, a positive relationship between the speed of impulse responses of prices to macro shocks and the volatility of sector-specific shocks (Boivin et al, 2007).**
- **This is consistent with the menu cost model: Prices in sectors facing greater sector-specific uncertainty tend to respond faster to macro shocks.**
- **Additional evidence from the euro area:**
 - **McCallum and Smets (2008) estimate the effect of monetary policy shocks using a large data set for the period 1987 to 2005.**

Impulse responses of sectoral prices



Sectors in which prices change frequently tend to respond more strongly

Price change frequencies and the

- **Estimates of the NKPC for the euro area and the United States are consistent with the frequency of price changes being higher in the United States than in the euro area:**
 - **Gali and Gertler (1999) and Gali, Gertler and Lopez-Salido (2001)**
 - **Sahuc and Smets (2007)**
- **But over the recent two decades estimates of the slope are very low and not very different:
US:0.012 – EA: 0.08**
- **Without real rigidity, they imply a very high Calvo parameter (or very low frequency of price changes): US: 0.89 – EA: 0.91**

Price change frequencies and the

- **Sahuc and Smets (2007) show that once these real rigidities are taken into account, changing the Calvo parameter to be consistent with either the euro area or US price change frequencies has only a small impact on the impulse response functions to a policy shock.**

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Modelling the “right” kind of real rigidity

- **Real rigidities are usually introduced at the level of individual firms or sectors:**
 - **Kimball aggregator: price elasticity of demand faced by a firm is increasing in the firm’s output;**
 - **Firm-specific factors: a firm’s marginal cost is increasing in the firm’s output**
- **These real rigidities imply that when firms change prices they change prices by small amounts;**
- **However, the micro evidence suggests large price changes and immediate effects of firm-specific shocks and little evidence of real rigidity at firm level.**

Real rigidities

- **Burstein and Hellwig (2007), Dotsey and King (2005) and Klenow and Willis (2006): in order to match the large price changes, the menu cost model needs a combination of very large idiosyncratic shocks and very large menu costs.**
- **Instead, model real rigidity conditionally on macro shocks:**
 - **E.g. Nakamura and Steinsson (2007b) introduce real rigidity via intermediate inputs. Interaction between heterogeneity and aggregate level of real rigidity is important.**
 - **Wage stickiness may be another source of aggregate-level real rigidity. See Wage Dynamics Network.**

Rational inattention and sticky

- **Mackowiak and Wiederholt (2008):**
 - develop a model in which firms face a trade-off between paying attention to aggregate conditions and to idiosyncratic conditions.
 - When idiosyncratic conditions are more variable, firms pay more attention to idiosyncratic conditions than to aggregate conditions. There is also a feedback effect.
 - Calibration suggests that idiosyncratic volatility has to be one order of magnitude larger than aggregate volatility
 - The key feature is that identity of shocks matter.

Customer markets

- **Repeated interactions and long-term relationships are omnipresent in particular in firm-to-firm transactions. Customer markets are important.**
 - **Fabiani et al (2005): Firms refrain from changing prices mainly because of explicit and implicit contracts with customers.**
 - **Blinder et al (1998) report that managers of US manufacturing firms feared they would “antagonize” their customers.**
 - **Zbaracki et al (2004) analyse the pricing behaviour of a large manufacturing US company and find that the most important cost of changing prices are “customer costs”, that is, costs of communication and negotiations with customers.**

Rigid prices without menu costs

- **Nakamura and Steinsson (2007c):**
 - In a model with customer markets, firms face a time-inconsistency problem if consumers form habits in individual goods.
 - Implicit contracts involving price rigidity can be sustained as equilibria in the infinitely repeated game played by a firm and its customers.
- **Rotemberg (2005):**
 - Develops a model in which firms wishing to avoid customers' anger keep prices rigid under some circumstances.

Impulse responses of sectoral prices

