

Review of price setting theories based on pricing conduct in South Africa 2001-2007

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Review of studies of pricing conduct

- Studies based on CPI and PPI microdata
- Surveys of price-setters
- Supermarket pricing data

Studies based on CPI and PPI microdata

- Israel (Baharad et al, 2003)
- Spain (Alvarez et al (2004))
- France (Baudry et al (2004))
- the Euro Area (Alvarez et al (2005a))
- the United States (Bils and Klenow (2005))
- Portugal (Dias et al (2005))
- Germany (Stahl (2005))
- Luxemburg (Lunnemann (2005))
- Austria (Baumgartner et al (2005))
- Sierra Leone (Kovanen (2006))
- Italy (Sabbatini et al (2006))
- Denmark (Hansen et al (2006))
- Brazil (Gouvea (2007))
- France (Gautier (2007))
- Finland (Kurri (2007))
- Slovakia (Coricelli and Horvath (2008))
- Colombia (Julio et al (2008))
- South Africa (Creamer and Rankin (2008))

Surveys of price-setters

- the United States (Blinder et al 1998)
- France (Loupias and Ricart (2004))
- Sweden (Apel et al ((2005))
- Austria (Kwapil (2005))
- Spain (Alvarez et al (2005a))
- Portugal (Martins (2005))
- Luxemburg (Lunnemann (2006))
- Canada (Amirault et al (2006))
- Holland (Hoebrechts et al (2006))
- Turkey (Sahinoz et al (2008))

Supermarket pricing data

- the United States (Chevalier et al (2000))
- the United Kingdom (Bunn and Ellis (2009))

Objectives of this paper

- firstly, to discuss how pricing conduct in South Africa compares with the theories of pricing conduct prevalent in the macroeconomic literature, and
- secondly, to introduce a basic framework for understanding some of the possible implications of such pricing conduct for monetary policy

Key findings on pricing conduct in South Africa 2001-2007

Source: Creamer and Rankin (2008), Creamer (2009a) and Creamer (2009b)

- Based on a study of the large CPI data set comprising 3 930 977 price records over the period 2001m12 to 2007m12, there is evidence of:
- a **varying frequency of price changes**, and related price durations, over time, with an unweighted average monthly price change frequency of 16,8% over the period
- **asymmetry in pricing** as price increases (10,8%) occur more frequently than price decreases (6%)
- **heterogeneity** in pricing across goods and services and across various product categories, with goods prices increasing with a frequency of 10,8% and decreasing with a frequency of 6,1%, and services prices increasing with a frequency of 11,4% and decreasing with a frequency of 3,5%
- **psychological, or attractive, pricing** with 62,7% of all prices ending in either 99 cents, 95 cents, 50 cents or 00 cents
- **sizeable magnitudes in price changes**, which are larger than the prevailing inflation rate, as for those prices that rose, the average magnitude of price increases was 12,1% and for those prices that declined, the average magnitude of price decreases was -14,9%
- **seasonality in pricing (or time-dependent pricing)** is evidenced in that the frequency of price increases rises during the month of March, where there is some evidence of seasonality of price decreases

• state-dependency in pricing is evidenced by:

- a *positive association between the frequency of price increases and the rate of inflation* both in real time and after a three-month lag
- the fact that a *currency appreciation is associated with a decline in the frequency of price increases* both in real time and after a three-month lag
- the fact that *after a three month lag an increase in the repo rate is associated with an increase in the frequency of price decreases*, although there is no such effect in real-time
- the fact that an *increase in inflation expectations* – measured using bond spreads and surveys of inflation expectations – is associated with a higher frequency of price increases

Comparative findings

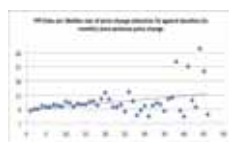
- South Africa's unweighted CPI price change frequencies for 2001-2007 (16,8%)
- this is broadly similar to findings for Spain 1993-2001 (15%), the Euro Area 1996-2001 (15,1%) and France 1994-2003 (18,9%)
- the United States economy would appear to have a significantly greater frequency of price changes 1998-2003 (24,8%) and Brazil has experienced a significantly higher frequency of price changes 1996-2006 (37%).

Reasons for relative price stickiness

- Altissimo et al (2006) suggest that: “[I]n a stable macroeconomic environment, where agents trust in price stability, there is less need to change prices. On the other hand, there might be structural inefficiencies that can prevent firms from changing prices.”
- Structural factors limiting immediate price adjustments include:
 - long term relationships with customers,
 - explicit contracts which are costly to renegotiate,
 - co-ordination problems arising from the fact firms prefer not to change prices unless their competitors do so.

Relationship between price duration and the magnitude of price changes

- For both the CPI and PPI micro data there is a positive relationship between the duration of prices and the magnitude of price changes
- This is evidence of price stickiness as “If prices can be set in each period there is no reason to expect price changes to be larger if more time has passed since the price last changed.” (Bunn and Ellis (2009))



Reasons for heterogeneity in pricing

- prices change less frequently for products with a larger share of labour input (due to persistence in wage developments)
- prices change more frequently with rising shares of raw material input
- sectors with a high degree of competition are likely to have less price stickiness

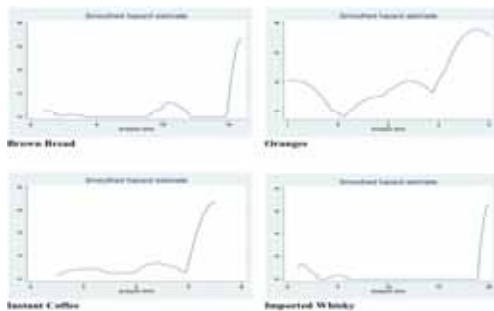
Pricing heterogeneity in South Africa

- For South Africa - services prices are more sticky than goods prices, which may be indicative both of high labour input costs in services, as well as low levels of competition in the services sector.
- Caveat – price stickiness may also be indicative of high levels of competition
 - for example, low price change and price increase frequencies for footwear and clothing may be indicative of increased import competition in those sectors. As prices are fixed at a specific level and price increases are avoided in the context of increased import competition.

Hazard function analysis

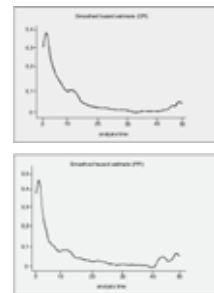
- the hazard rate (h) k is expressed as the probability that a price (p_t) will change after k periods conditional on having remained constant during the previous $k-1$ periods, that is:
- $h(k) = Pr\{p_{t+k} \neq p_{t+k-1} | p_{t+k-1} = p_{t+k-2} = \dots = p_t\}$
- for a variety of specific consumer products at specific stores hazard functions are broadly upward sloping, indicating the expected result that the likelihood of price changes increase with the passing of time

Dissaggregated Hazard functions for specific products at specific stores

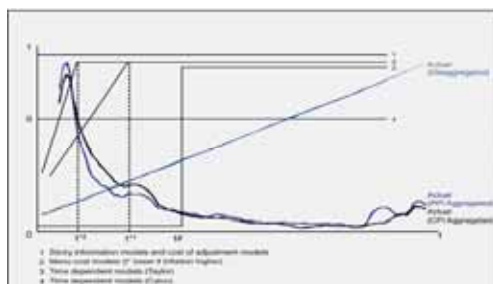


Aggregate level hazard functions

- Downward sloping aggregate hazard function is evidence of pricing **heterogeneity**: "When the aggregate hazard function is obtained, the share of price changes corresponding to firms with more flexible pricing rules decreases as the horizon increase and, consequently, the hazard rate also decreases" (Alvarez et al (2005b))
- Also there is evidence of **time-dependent** pricing as both the CPI and PPI hazard functions show an increase in the probability of price changes after 12 months



Comparison of actual hazard functions to theoretical hazard functions



Disjuncture between theoretical models and evidence of South Africa's microdata

- Firstly, whereas a number of the theoretical models assume continuous price evaluations by price-setters, the relatively low frequency of price changes would indicate that **price-setters do not review their pricing plans on a continuous basis**.
- Secondly, whereas a number of models are based on the assumption of homogeneity of pricing conduct across firms, the **data reveals significant heterogeneity in pricing across various sectors**.
- Thirdly, a number of pricing models do not incorporate **seasonality, or time-dependence**.

Implications of pricing conduct for monetary policy

- The development of a basic macroeconomic model facilitates a formal comparative discussion of how the conduct of monetary policy is affected by various degrees of price stickiness and various degrees of backward-looking indexation of prices.
 - prices are relatively sticky where such prices respond in a comparatively muted manner to changes in the output gap.
 - prices are more backward-looking (or indexed) where there is a rising proportion of price-setters who base the current period's prices on the previous period's level of inflation
- The model is not estimated specifically for any particular economy, but rather provides a theoretical framework for understanding the implications of particular forms of pricing conduct for the conduct of monetary policy

Basic Model

$$\pi_t = \gamma\pi_{t-1} + \kappa y_{t-1} + \kappa\mu_t \quad (\text{NKPC})$$

$$y_t = \beta y_{t-1} - \sigma(r_t - \pi_{t-1}) + \varepsilon_t \quad (\text{IS curve})$$

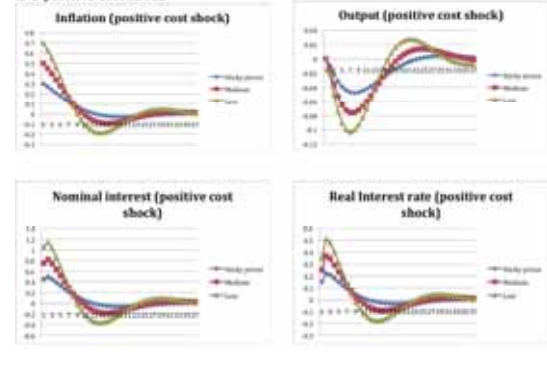
$$r_t = \phi_r r_{t-1} + \phi_\pi (\pi_t - \pi^*) + \phi_y y_t \quad (\text{Taylor rule})$$

- κ = variously calibrated at 0,3, 0,5 and 0,7 to compare degrees of price stickiness with stickier prices being indicated with a smaller κ values
- γ = variously calibrated at 0,9, 0,6 and 0,3 to compare degrees of backward indexation in pricing with higher degrees of indexation being indicated by larger values

Effects of positive cost shock

- The model responds to a positive cost-push shock as follows:
 - an increase in prices due to leads to an increase in inflation π (NKPC)
 - the increase in π lead to an increase in the policy interest rate r (Taylor rule)
 - this leads to a restraining of output growth y (IS curve)
 - which ultimately leads to reduced pricing and containment of inflation (NKPC)
- Stickier prices, i.e. prices of lower change frequency, or longer durations, are associated with smaller κ values
- Inflation is less responsive to changes in proximate determinants such as the output gap, hence the smaller κ values

Fig. 5 Comparing the effect of varying degrees of price stickiness and response to a positive cost shock



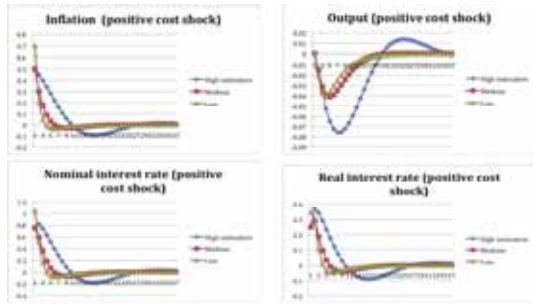
Comparing the effects of a positive cost shock where there are differing degrees of price stickiness

- If prices are relatively sticky (lower κ) then the following time paths are observed for the various key macroeconomic variables:
- Inflation** – For relatively sticky prices, inflation increases, but by less than if prices are more flexible, and above trend inflation persists for a longer period (about 3 to 4 months) than for more flexible prices.
- Output** – For relatively sticky prices, the negative deviation from trend output is lower than for more flexible prices, and this negative deviation from trend output persists for longer (by about 5 to 7 months).
- Nominal and real interest rates** – For relatively sticky prices, there is a lower positive interest rate response than if prices are more flexible, but the above trend interest rate continues for a longer period (by about 2 to 3 months longer).

Policy Implication

- A higher degrees of price stickiness implies a *less aggressive*, but *more persistent*, monetary policy reaction
- The required increase in the policy interest rate is *smaller*, but *lasts for longer*, if prices are *relatively sticky* or there is backward indexation
- The **smaller size** of the interest rate response is due to the fact that with small κ values the impact of the positive cost shock μ will result in *lower levels of inflation*.
- The **longer period** over which the interest rate response must operate is due to the *higher inflation persistence* associated with relatively sticky prices.

Comparing degrees of backward indexation



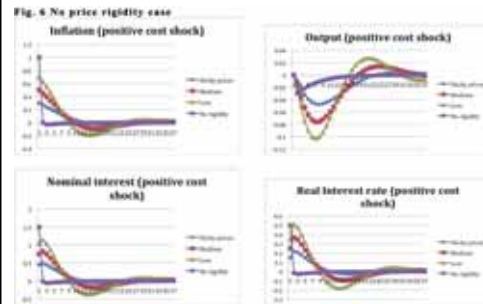
Comparing the effects of a positive cost shock where there are differing degrees of backward indexation

- If price indexation in the economy is relatively *high* (high values) then the following time paths are observed for the various key macroeconomic variables:
- *Inflation* – For relatively high backward indexation, inflation increases, but by less than if backward indexation is less prevalent.
- *Output* – For relatively high backward indexation, the negative deviation from trend output is larger than if backward indexation is less prevalent.
- *Nominal and real interest rates* – both nominal and real interest rates increases persist for a longer period where there is relatively high degree of backward indexation, but there is no significant reduction in the magnitude of the interest rate response for lower degrees of backward indexation

Policy implication

- A higher degrees of backward indexation implies a *more persistent, but no less aggressive*, monetary policy reaction
- A higher degree of backward indexation implies a monetary policy reaction which is more persistent, than it would be for low levels of backward indexation
- The reason is that with a higher degree of backward indexation, inflation is more persistent in response to a positive cost push shock and therefore there is a need to respond to positive cost push shocks over a longer period
- Unlike the high price stickiness case, the case of backward indexation does not imply a lower increase in nominal and real interest rates (due to the high persistent inflation rate)
- For low degrees of backward indexation, the impact of a positive cost shock will be dampened and inflation will be less persistent. As a result the policy nominal interest rate and the real interest rate responses will be less persistent

Case of no price rigidity (k=1, gamma =0)



Case of no price rigidity (k=1, gamma =0)

- in the 'no price rigidity case' a positive cost shock results in a perfect inflationary response in the first period and then inflation returns rapidly and sharply to its long run trend level
- This strong inflation response (not mediated by any price stickiness or backward indexation) results in strong response in the policy interest rate (via the Taylor rule).
- This leads to a rapid decline in inflation which means in turn that the policy interest rate and real interest rates decrease more rapidly than in the 'sticky price case'.
- As a result of this lack of persistence in inflation and elevated interest rates the negative deviation in output is also minimised

Conclusion

- This paper has highlighted two key issues.
 - Firstly, research, which makes use of pricing microdata to better understand pricing conduct, provides a rich, but somewhat complex, set of stylised facts against which to **assess the micro foundations of macroeconomic models**
 - Secondly, variations in pricing behaviour has implications for the **conduct of monetary policy**, for example:
 - a relatively high degree of price stickiness can be shown to require *less aggressive, but more persistent*, interest rates responses to cost shocks
 - a relatively high degree of backward indexation of prices, can be shown to require a *more persistent, but no less aggressive* interest rate response as compared to situations of relatively low backward indexation