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Asymmetrical Price Response in Energy Supply: A Review of Ofgem's Analysis

For Energy UK

NERA
Economic Consulting

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Executive Summary

Ofgem published a short paper on 21 March 2011, entitled “Do energy bills respond faster to rising costs than falling costs?”[1] To summarise Ofgem’s conclusions, the paper states that “This analysis found some evidence that energy bills follow an asymmetric trajectory”, but “[b]ecause of the number of plausible reasons for finding asymmetry, the implication for consumer harm is not clear cut.”[2]

Since then, Ofgem and others have focused on the first statement – that prices move asymmetrically – without noting the second statement – that such evidence does not necessarily mean that customers are suffering any harm. Proving that prices respond asymmetrically would not, of itself, provide evidence of competition problems or of any harm to consumers, in retail energy markets. Furthermore, Ofgem has not even proven that prices respond asymmetrically. Ofgem is therefore wrong to state publicly that it has evidence of energy suppliers responding asymmetrically to rising and falling costs.[3]

Several problems undermine Ofgem’s statistical analysis of pricing, as the authors themselves recognise. Ofgem first selected a long run relationship between tariffs and costs, and then used the observed deviations from this long run relationship to explain changes in the tariffs. There are problems in both steps. Ofgem’s long run relationship has implausible coefficients on key cost items, so it does not provide a reliable basis for identifying the long run level of tariffs or deviations from it. Then, when using these deviations to explain tariff changes, Ofgem selects explanatory variables that run the risk of giving spurious evidence of asymmetric price response. For instance, Ofgem focused on responses with a *three month* lag. Ofgem’s own equation shows that the asymmetry is less marked after allowing for responses with *no* lag; allowing for yet other lags might remove the asymmetry altogether.

In any case, the existence of price asymmetry neither proves nor disproves that there is any problem with the state of competition. (The absence of price asymmetry does not prove or disprove that a market is competitive, either.)

A number of authors have found alternative explanations for price asymmetry, according to which it is a rational and efficient (i.e. cost-minimising) response by competing suppliers. If a market does exhibit price asymmetry, it may simply indicate that suppliers face certain costs of changing tariffs, which government intervention is unable to reduce. Ofgem would have to carry out a great deal more analysis to show that any price asymmetry reflected problems with competition in retail energy markets.

Price asymmetry can be a rational and efficient response by suppliers to particular costs, such as “menu costs” (the cost of changing prices) and/or inflation, or costs incurred by customers when they search for a lower priced offer. If these costs arise, interventions that impose alternative pricing rules will be less efficient, and will offer consumers a lower level of welfare. But so far Ofgem has no evidence of asymmetry to back up such interventions.

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1 Ofgem (2011), *Do energy bills respond faster to rising costs than falling costs?*, Discussion paper, 21 March 2011.

2 Ofgem (2011), paragraphs 3.12 and 3.13.

3 See for instance page 4 of Ofgem’s “Factsheet 98”, *Retail markets: review and remedies*, dated 25 March 2011.

1. Introduction

Energy UK has asked NERA Economic Consulting to comment on Ofgem's short paper dated 21 March 2011, entitled "Do energy bills respond faster to rising costs than falling costs?"[4]

To summarise Ofgem's conclusions, the paper states that "This analysis found some evidence that energy bills follow an asymmetric trajectory", but "[b]ecause of the number of plausible reasons for finding asymmetry, the implication for consumer harm is not clear cut."[5] Recent discussion of this topic has sometimes focused on the first statement – that prices move asymmetrically – without noting the second statement – that such evidence may not mean that customers are suffering actual harm. Thus, as I show below, there is some doubt about the results of Ofgem's analysis, but in any case evidence of asymmetrical price responses would not of itself prove the existence of competition problems, or of any harm to consumers, in retail markets for the supply of energy in Britain.

In this report, I comment on the economics of asymmetrical price response, including a number of different interpretations of price asymmetry, and on the econometrics (i.e. statistical analysis of data) that Ofgem used to examine pricing behaviour in British retail energy markets.

I conclude that further work would be required to establish whether or not there is asymmetry in price responses, because Ofgem's work cannot be relied on. Even then the existence of asymmetric price responses would not prove (and their absence would not disprove) that there was any lack of competition in retail energy markets.

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[4] Ofgem (2011), *Do energy bills respond faster to rising costs than falling costs?,* Discussion paper, 21 March 2011.

[5] Ofgem (2011), paragraphs 3.12 and 3.13.

2. The Economics of Price Asymmetry

Asymmetry in the way prices respond to changes in costs does not necessarily indicate any problem with the degree of competition. A number of authors have found alternative explanations for price asymmetry, according to which it is a rational and efficient (i.e. cost-minimising) response by competing suppliers. Ofgem would have to carry out a great deal more analysis to show that any price asymmetry reflected problems with competition in retail energy markets.

Indeed, Ofgem's own paper does not contain any overt accusation of competition problems. Paragraph 1.1 of the paper says specifically,

> "In a competitive market, we may expect cost increases to be passed through to consumers promptly. The same argument would work in reverse, meaning that wholesale cost falls would be passed on just as quickly otherwise suppliers ***may not*** be pricing competitively." (***emphasis added***).

Thus, Ofgem's paper hints that asymmetry in pricing might be caused by a problem with competition, but does not actually claim to have found evidence of a problem with competition. Readers might ***assume*** that asymmetry is caused by competition problems, but in doing so they would be making the mistake identified by Mayer and von Cramon-Taubadel, in their 2004 survey of academic literature on Asymmetric Price Transmission (APT):[6]

> "Most publications on APT refer to non-competitive market structures as an explanation for asymmetry…In most cases, however, the conjecture is presented as essentially self-evident, without rigorous theoretical underpinning. In fact, the case for positive APT is not so clear-cut".[7]

Various authors have studied the reasons for apparent asymmetry in price responses. In the first place, the price asymmetry that Ofgem claims to observe may be a spurious statistical finding due more to the method of analysis, than to any real asymmetry (see section 3). Lack of competition may cause pricing behaviour of the type identified by Ofgem in certain (very specific) conditions. However, some researchers concluded that oligopolistic firms would ***lower*** prices more quickly than they increased them, e.g. to avoid losing market share.[8] Others found reasons why price asymmetry may arise in competitive markets, due to special cost conditions, as discussed below. Ofgem cannot conclude therefore that price asymmetry is evidence of a lack of competition. It may also represent a rational response to unavoidable costs in a competitive market.

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6 Meyer J., and von Cramon-Taubadel, S., (2004), Asymmetric Price Transmission: A Survey, *Journal of Agricultural Economics*, vol. 55 no. 3, November 2004, pp 581-611.

7 Meyer and von Cramon-Taubadel (2004), pp 586-7.

8 Ward, R.W. (1982), Asymmetry in Retail, Wholesale and Shipping Point Pricing for Fresh Vegetables, American Journal of Agricultural Economics, 62, pp 205-212.

2.1. Evidence on Price Asymmetry and Competition

Several authors have proposed game theoretic models in which suppliers raise prices when costs rise, but are less willing to reduce prices when costs fall. Such models depend on very specific conditions – and by defining very specific conditions it is possible to produce any market outcome. The following theories should therefore be regarded as models suitable for testing, not proven explanations of an observed phenomenon.

Several academic papers suggest that oligopolists who are colluding tacitly (that is, without communicating their strategies directly to one another) will respond to rising costs by raising prices immediately, but will hold back from reducing prices when costs fall. One suggested reason for the lack of downward price adjustment is the fear that such action would prompt other suppliers to engage in a price war, as a punishment for trying to capture a higher market share. However, as Meyer and von Cramon-Taubadel point out, it is difficult to observe the effect of market power, when it is difficult to compare degrees of market power between different markets, and when the degree of market power does not change much over time within a single market.[9] Other factors may therefore be responsible for any observed asymmetry in price response.

One of the most surprising aspects of studies into price asymmetry is the large number of markets in which it can (apparently) be found. For example, Pelzman[10] studied prices in hundreds of separate input and output markets in the United States over the period 1978-1996:

§ 165 pairs of manufacturing good markets (and the associated producer price indices), where one market constituted more that 20% of the input costs for the second market;

§ 77 pairs of consumer price indices (CPI) and producer price indices (PPI);

§ 357 specific supermarket prices and the associated input price (PPI).

Pelzman found evidence of price asymmetry in most of these markets – about two-thirds of the manufacturing market pairs (PPI/PPI) and a similar proportion of consumer market pairs (CPI/PPI). It seems unlikely that so many markets should be uncompetitive in the United States. Moreover, he found no significant evidence of asymmetry when looking at supermarket prices for specific goods. That difference should be a matter of concern, as it suggests that the observed asymmetry might be a result of the averaging and other errors present in the production of PPI and CPI, rather than a real feature of individual companies' business decisions.

Meyer and von Cramon-Taubadel present no independent evidence on asymmetry. However, they review several other papers and find 205 other cases, in 48% of which the authors reject the hypothesis that price adjustment is symmetric (i.e. imply that prices move asymmetrically). Of those 205 cases, 31 use a model with an error correction mechanism (like Ofgem's), and in 45% of those cases the authors reject symmetry (i.e. imply

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9 Meyer and von Cramon-Taubadel (2004), pp 589.

10 Pelzman, S., *Prices Rise Faster Than They Fall*, Journal of Political Economy, Vol. 108, No. 3, June 2000, pp 466-502.

asymmetry).[11] When price asymmetry is found so often, in such a wide variety of markets, it is doubtful whether any individual finding of asymmetry provides evidence that competition is lacking in a specific market.

Indeed, there is some evidence that price asymmetry is unrelated to the degree of competition. Pelzman was unable to find any clear relationship between price asymmetry and standard measures of competition, such as the number of suppliers and the Herfindahl-Hirschman Index (HHI) of market concentration. Pelzman was also keen to stress that his article was "unrepentantly descriptive" and stated that "attributing asymmetries to imperfect competition is unlikely to be rewarding". He did find "above-average asymmetry between factory and consumer prices where there were many small intermediaries between the factory and the retailer", [12] but he did not offer any explanation for this finding.

Given the wide range of markets in which price asymmetry has (apparently) been observed, one is forced to conclude either that much of the evidence is spurious, or that price asymmetry is a common feature of competitive behaviour. Certainly, it would be wrong to accuse suppliers in one particular market of non-competitive behaviour, just because it happens to be one of many markets in which price asymmetry can be observed. As explained below, there are several explanations for price asymmetry that depend on the cost structure of the industry, not on the state of competition in its markets.

2.2. Effect of Menu Costs

2.2.1. Menu costs

A common, cost-based explanation for asymmetrical price response lies in "menu costs", the term used to describe any fixed cost incurred when a supplier changes its prices. These costs may include the cost of reprinting price lists (e.g. menus), the cost of relabeling items on the shelves, the cost of informing existing customers (and perhaps relevant government officials), and the cost of gathering information and arranging for management to decide what prices to charge.[13] Stretching the definition slightly, one may also include costs borne by customers, such as inconvenience or annoyance when prices change too frequently. Any supplier who says that it does not wish to upset its relations with its customers is effectively trying not to impose costs on them unnecessarily.

Many of these menu costs arise when suppliers change retail energy tariffs. Even posting a notification to (say) 5 million customers would cost about £2 million in postage, before allowing for the cost of resetting IT systems for billing purposes. One might expect energy supply companies not to incur these costs every time wholesale energy costs change by a small amount. In practice, of course, retail energy tariffs do not change for several months at a time.

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[11] Meyer and von Cramon-Taubadel (2004), pp 589.

[12] Pelzman (2000), p 494.

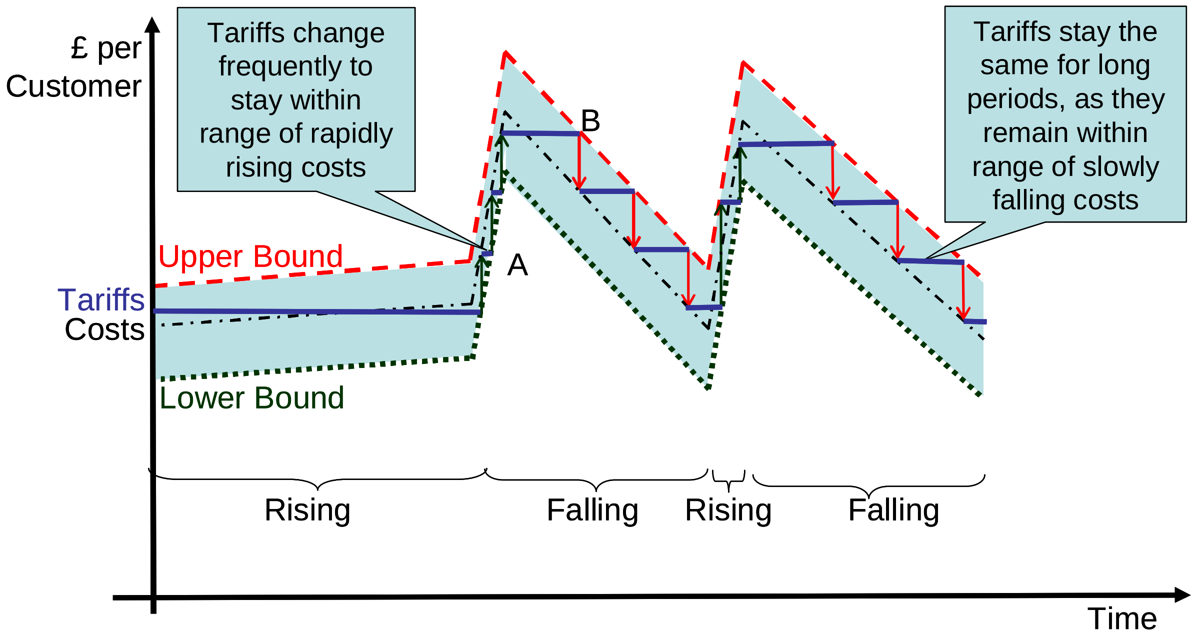
[13] Dias, D.A. et al (2011), *Why Are Some Prices Stickier Than Others? Firm-Data Evidence on Price Adjustment Lags*?, European Central Bank Working Paper Series, No. 1306, March 2011, section 2.

2.2.2. Spurious results due to asymmetrical changes in wholesale costs

Ofgem's model does not accommodate any allowance for the menu cost of changing tariffs, or any other economic reason for changing tariffs infrequently. However, if suppliers allow wholesale costs to vary by some amount before changing tariffs, and if wholesale costs tend to decrease more slowly than they tend to increase, the model presented by Ofgem would *spuriously* find evidence of asymmetric adjustment. This result would arise because quickly rising costs soon justify decisions to incur menu costs by raising retail energy tariffs, whereas slowly falling costs take longer to justify decisions to incur menu costs by lowering retail energy tariffs.

Figure 2.1 explains the effect of menu costs, based on a simple model of retail energy pricing. The black (dash/dot) line shows how wholesale costs vary over a certain period, during which there are phases when they are either rising or falling. Due to menu costs, the supplier does not change its tariff unless costs rise above or fall below the current tariff by a certain margin. In Figure 2.1, the margin that the supplier will tolerate is shown as an upper and lower bound around actual costs, i.e. the dashed red line and the dotted green line, respectively. A tariff is optimal (i.e. there is no reason to change it) if it falls within the shaded area between these upper and lower bounds. If costs rise or fall, so that the tariff now sits outside these bounds, the tariff is no longer optimal and the supplier will incur the menu cost to change it. The solid blue lines show the resulting tariffs. Each time the tariff meets the lower bound, the supplier raises it (green arrow pointing up) to the current level of wholesale costs. Each time the tariff meets the upper bound, the supplier lowers it (red arrow pointing down), similarly to the current level of wholesale costs.

Figure 2.1:
The Cost of Changing Tariffs and/or a Non-Linear Form of Adjustment, Would Both Cause Asymmetric Adjustment to Asymmetric Costs



In this example, it so happens that (after an initial period of relative stability) costs rise relatively rapidly during the "Rising" phases. As a result, the lower bound rises sharply and hits the tariff, triggering a tariff increase, after only a short time. On the other hand, during the phases when costs are falling, they fall relatively slowly. As a result, a longer time elapses before tariffs hit the upper bound, triggering a tariff decrease.

Thus, *if the underlying cost movements are asymmetric*, a symmetric rule for adjusting tariffs[14] can together create the *appearance* of asymmetry in tariff adjustments (i.e. different delays in responding to rising or falling costs). Given menu costs, a tariff adjustment rule which responds only to large variations in costs is more efficient than instantaneous tariff changes (i.e. it minimises total costs, including menu costs). Nothing in this explanation relies on, or implies, a lack of competition.

The Ofgem paper shows (in Figure 2) that the overall average rates of increase and decrease in wholesale costs are broadly equal. However, as Figure 2.1 demonstrates, the *overall* average rate of change is not necessarily a useful indicator. In the case above, the *average* rates of change in costs are similar in both the "Rising" and "Falling" phases,[15] but the initial period of slowly rising costs and stable tariffs will be less important for analysis of price changes than the short periods of rapidly rising costs and tariffs. Recent conditions in the wholesale electricity market might therefore have produced the effects shown in Figure 2.1.

However, this analysis is relatively simple. It just assumes that there is a band of costs for which any particular tariff will remain unchanged and that suppliers set tariffs equal to the current level of costs when they fall outside this band. Other academic work has developed a more theoretically rigorous approach to defining the optimal tariff, as explained below.

2.3. Effect of a Rising Trend in Prices

Another dimension to price adjustment was added by a 1994 study by Ball and Mankiw on the effect of a rising trend in prices.[16] Their model was developed for conditions of general inflation but it applies equally to conditions where energy prices are on a rising trend and are expected to rise further. Such conditions applied for much of the period that Ofgem studied. Figure 2 in the Ofgem report shows that periods of rising wholesale energy prices covered almost twice as many months as periods of falling wholesale energy prices.

In such conditions, suppliers who incur menu costs when they change prices have to compromise between the cost-reflectiveness of tariffs and their stability. Rather than resetting prices equal to costs whenever necessary, as in Figure 2.1, suppliers can choose a retail energy tariff that has some chance of remaining useful for several periods, even though the underlying costs are expected to change. Figure 2.2 shows how such decisions work and I explain the mechanism in the following sections.

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14 In this example, I use a "myopic" adjustment rule in which the supplier sets the new tariff equal to the current level of costs and ignores expected costs in the next period. In terms of the discussion set out in section 3.3.3 below, this price adjustment rule is "non-linear", since tariffs do not change for small variations in wholesale costs, but do change for variations above a certain size.

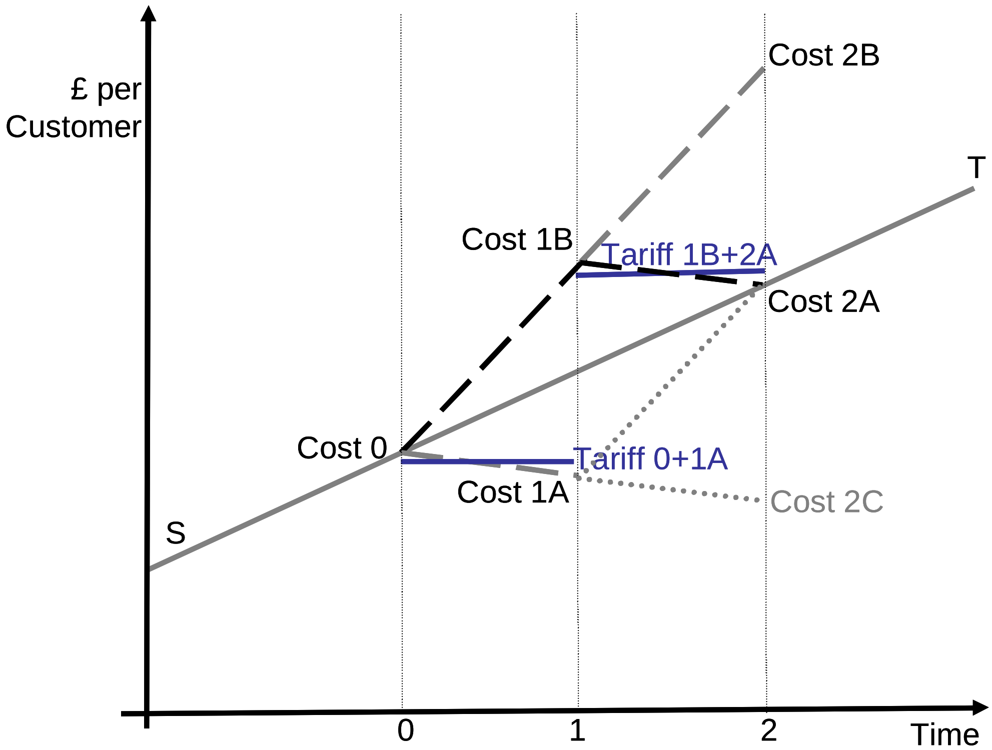
15 The rises and falls net out to zero net change overall, and the total durations of the Rising and Falling phases are about the same.

16 Ball L., and Mankiw, N.G., Asymmetric Price Adjustment and Economic Fluctuations, *The Economic Journal*, no. 104 (March), pp 247-261.

2.3.1. Future costs are expected to rise, but the change is uncertain

Over a certain time period, costs are expected to rise steadily, as shown by the trend line, ST, but future costs are subject to uncertainty around that trend. The current level of costs is Cost 0, but possible costs in the next time period (Time 1) are represented by outcome A (low costs 1A) and outcome B (high costs 1B).[17]

Figure 2.2:
Effect of a Rising Trend on Efficient Price Setting



2.3.2. Optimal tariffs compromise between current and future costs

At Time 0, a company would like to set a tariff that stays close to actual costs for as long as possible, so as to avoid having to incur menu costs. The supplier knows that future costs are uncertain, but that the uncertainty is symmetric around the rising trend, meaning that costs at Time 1 will be either Cost 1A or Cost 1B. In these conditions, the optimal policy for the supplier is to set a tariff somewhere between Cost 0 and Cost 1A (the lower forecast cost for Time 1), as indicated by the blue line "Tariff 0+1A". This tariff is optimal because it will be (approximately) equal to costs in both the current period (Cost 0) and at Time 1, if costs turn out low (Cost 1A). If outcome A occurs at Time 1, the company can avoid any menu cost, because it would not need to change its tariffs.

If costs at Time 1 turn out to be at the high end of the range, i.e. Cost 1B, the company would have to incur the menu cost and change its tariffs. The new optimal level of tariffs (assuming

[17] The paper by Ball and Mankiw actually allows for a range of possible future costs, but two possible future cost levels are sufficient to explain the model.

the same distribution of possible changes between Time 1 and Time 2, as represented by the movement to Cost 2A and Cost 2B) would be Tariff 1B+2A, a compromise between actual costs at Time 1 and the lower cost estimate for Time 2.

By following this strategy, the supplier only has to incur the menu cost if prices rise to the upper end of the range. The supplier can avoid menu costs, at least for one period, if prices turn out to be at the lower end of the range. If costs continue to drift downwards, as shown by Cost 2C, a new lower tariff may become necessary at some time, but only after a delay.

2.3.3. Implications for price asymmetry

This model has two important consequences. First, because of the rising trend, the underlying costs either rise rapidly or fall slowly, as in Figure 2.1. Second, as shown in Figure 2.2, the optimal tariffs (Tariff 0+1A, Tariff 1B+2A) apply for two periods or more if costs fall, but must be revised immediately if costs rise. Thus, to minimise the level of menu costs, suppliers raise tariffs when costs rise, but do not change tariffs when costs are falling (unless and until a wide difference opens up between costs and tariffs).

Pelzman was unable to confirm the role of menu costs using his data. However, given the contradictory results he produced by using different methods, and the lack of any strong relationships to explanatory variables, these findings do not disprove the theory.

In any case, this type of behaviour would not indicate a lack of competition, merely a special kind of adjustment cost. The proposed tariff strategy minimises total costs and allows suppliers to serve their customers most efficiently. Forcing more frequent tariff changes would raise costs overall and make customers worse off.

2.4. Other Explanations

2.4.1. Firm and sectoral characteristics

In March 2011, the European Central Bank (ECB) issued a working paper entitled "*Why Are Some Prices Stickier Than Others? Firm-Data Evidence on Price Adjustment Lags*".[18] Although the focus of the paper is on inflation (and the effects of monetary stimulus on prices in general), it discusses recent academic papers on the subject of price stickiness, and asymmetric price adjustment. The paper quotes from a number of articles that offer reasons why price adjustment might be slow (such as a desire to hold prices constant to keep customers happy, and a failure of coordination among competing companies), but also examined price asymmetry. The paper reports the results of a survey of Portuguese firms in a wide range of sectors, which asked how quickly they changed prices in response to a rise or fall in costs, or a rise of fall in demand. The ECB found that the firms reacted more quickly to a rise in costs than to a fall in costs, but that they reacted more slowly to a rise in demand than to a fall in demand.[19] One might have expected the two effects to evoke similar price

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[18] Dias, D.A. et al (2011), *Why Are Some Prices Stickier Than Others? Firm-Data Evidence on Price Adjustment Lags*?, European Central Bank Working Paper Series, No. 1306, March 2011.

[19] Dias, D.A. et al (2011), section 4.2.

responses. This contrary result suggests that firms do not exploit all opportunities to raise prices in the same way or to the same extent.

In their subsequent analysis of pricing behaviour, the authors considered four different types of "shock" (rising/falling costs, rising/falling demand) and various characteristics of the firms. They separated the firms according to their survey responses, by different types of contract (whether they offer long or short contracts, explicitly or implicitly), different types of pricing policy (whether or not they engage in price discrimination, offer quantity discounts, etc) and other factors. They found that the type of contract had little effect on price adjustment lags, but that a flexible or case-by-case pricing policy was associated with significantly earlier responses to cost and demand shocks. This factor would be important for the retail energy suppliers, to the extent that online tariffs allow them to adjust their offers more quickly and cheaply than changing standard tariffs.

2.4.2. Search behaviour by customers

Lewis (2004) constructs a model based on the hypothesis that the asymmetry derives from the behaviour of consumers, rather than from the costs of suppliers (in this case, petrol stations in the San Diego area in the US).[20] He suggests that consumers "will search less when prices are falling and more when prices are rising."[21] Such behaviour is rational for consumers, since they use the fact that their price is rising as an indication that lower prices are available from other suppliers, making it worthwhile to incur the costs (time and effort) to seek out the lower price.

One implication of such a hypothesis is that suppliers have little to gain from lowering prices when costs are falling, because they will give up revenues on existing customers without gaining many additional customers. It also means that suppliers will be reluctant to raise prices, and will delay doing so, in case they set off a round of customer defections. However, if all suppliers raise prices around the same time, they will gain as many customers from other suppliers as they lose to other suppliers. Thus, suppliers may have an incentive to follow price rises by others, but not to pursue reductions in price so vigorously, because of the way in which customers decide when to shop around.

Lewis found that actual pricing behaviour was ***not*** consistent with the view that price reductions only took effect when tacit collusion broke down, since he found that both the highest prices and the lowest prices in the city drifted down at the same rate. (The breakdown of collusion would be associated with a steep fall in maximum prices.)

Lewis's findings tend to mean that responsibility for the pricing behaviour of the petrol stations lay in their customers' strategy for shopping around, regardless of the degree of competition between (i.e. the number of) separate petrol companies.

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[20] Matthew Lewis (2004), "Asymmetric Price Adjustment and Consumer Search: An Examination of the Retail gasoline Market", 1 September 2004, p 13.

[21] Matthew Lewis (2004), p 13.

2.4.3. Edgeworth undercutting

Noel (2009) attributes the observed pattern of pricing to a particular form of competition, called the "Edgeworth cycle", in which competing retailers face a tradeoff between securing market share and maximizing retail margins:

> "In an Edgeworth Cycle, firms selling homogeneous goods repeatedly undercut one another by small amounts to steal market share. When margins get too low, one firm 'relents' by raising its price significantly higher. Other firms follow quickly by relenting themselves, and then, from the new high price, another round of undercutting begins. The asymmetric price process—large increases and small decreases— repeats over and over. This is true even in the absence of any cost shocks at all."[22]

This process requires that prices change continually, but infrequently enough so that undercutting by any one petrol station does not lead to an immediate reaction by the others. It might provide grounds for examining whether "creeping" reductions via online tariffs offset sudden increases in standard tariffs.

2.5. Conclusion

When analysing any market, it is important not to leap from (1) the observation that price adjustments are asymmetric to (2) the accusation that the market must be uncompetitive. In recent decades, economists have identified many markets where prices appear not to reflect a simplistic idea of competition – so many that it is the simplistic idea that must be questioned, not the performance of the markets. Many explanations have emerged as to why prices may be sticky, or price adjustments asymmetric, for reasons other than a lack of competition. Proving which one of these reasons applies in any one case is difficult, not least because the available data may not permit a very close examination of actual business decisions.

If price stickiness or asymmetry is a rational and efficient response to particular costs, such as menu costs and/or inflation, then interventions that impose alternative forms of behaviour will most likely be inefficient, and to offer consumers a lower level of welfare.

For instance, there is no real theory of the optimal rate of price response to changes in underlying costs, especially when those changes represented volatility that may be reversed in a short while. Customers will not necessarily be better off, or better able to appraise the offers of different suppliers, if their energy tariffs rise and fall frequently in order to track short term movements in wholesale prices. A demand to equalise the rates of upward and downward response (if it could be enforced) might simply lead to slower upward changes, meaning longer periods when prices did not reflect costs, which is not efficient.

In any case, it does not seem likely that price asymmetry by itself can be a source of excessive profit. Suppose all suppliers in a market raise prices quickly and lower them slowly, with the result that they make additional profits above the necessary level. These additional profits will attract new entrants, leading to a decline in average retail margins

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[22] Noel (2009), RAND Journal of Economics Vol. 40, Autumn 2009, p583.

overall (even if the asymmetric responses persist). On the other hand, if new entry does not take place, despite a lack of institutional barriers, it would be hard to conclude that the incumbents were making more profit than necessary.

Ultimately, the existence of price asymmetry neither proves nor disproves that there is any problem with the state of competition. (The absence of price asymmetry does not prove or disprove that a market is competitive, either.) If a market does exhibit price asymmetry, it may simply indicate that suppliers face certain costs, which government intervention is not be able to reduce.

3. Ofgem's Econometric Analysis

Any observation about the performance of a market requires robust evidence. There are many reasons to believe that apparent findings of asymmetry are in fact only capturing spurious statistical phenomena, rather than real world behaviour, as I discuss in this section.

At the centre of Ofgem's paper stands a piece of econometric analysis, by which Ofgem tries to estimate separately (1) the speed with which energy tariffs (i.e. standard dual fuel tariffs) rise when wholesale energy prices rise, and (2) the speed with which energy tariffs fall when wholesale energy prices fall. According to Ofgem, the former is higher than the latter – prices respond to rising costs faster than they respond to falling costs. However, there are reasons to doubt whether Ofgem's analysis accurately defines and identifies such asymmetric price responses.

3.1. Ofgem's Method of Approach

Ofgem analyses the relationship between retail energy tariffs ("R") and costs – that is, wholesale energy prices ("W") and other costs ("OC") paid by the supply business for the use of networks and to meet social and environmental obligations (but excluding the internal costs of running an energy supply business). Ofgem's analysis uses regression in two stages.

First, Ofgem carries out a simple study of the relationship between current tariffs and current costs, by estimating the following "long run relationship":

$$R_t = \beta_1 + \beta_2.W_t + \beta_3.OC_t + \upsilon_t \qquad (1)$$

In equation (1), the retail energy tariff (R_t) at any time (t) is a constant (β_1), plus a multiple (β_2) of the wholesale price at that time (W_t), plus a multiple (β_3) of the other costs (OC_t), plus a residual item (υ_t). The residual item just represents any variation in the retail tariff not captured by the other elements in this long run model. In the second stage, Ofgem uses this unexplained element to indicate deviations from the "stable long run relationship", to see whether it can explain how fast retail energy tariffs are changing.

Specially, Ofgem looks at the residual item three months earlier (υ_{t-3}) and divides it into positive residuals ("υ^{+}_{t-3}") and negative residuals ("υ^{-}_{t-3}"). Ofgem then carries out another regression to see how fast the retail energy tariff is changing in relation to these positive and negative deviations from the "stable long run relationship". This second regression produces a "tariff adjustment formula", i.e. a model of the way in which retail energy tariffs adjust when the margin between tariffs and costs deviates from the long run level. It also takes account of positive and negative changes (Δ) in wholesale energy prices (ΔW^+ and ΔW^-) and some other variables representing lagged values and moving averages of R, and a new set of residuals (ε_t) specific to this "tariff adjustment formula":

$$\Delta R_t = \alpha_1 + \alpha_2.\upsilon^{+}_{t-3} + \alpha_3.\upsilon^{-}_{t-3} + \alpha_4.\Delta W^{+}_{t} + \alpha_5.\Delta W^{+}_{t} + [\text{lagged and average R}] + \varepsilon_t \qquad (2)$$

Ofgem refers to the lagged residual terms as "error correction mechanisms", since they indicate how much retail energy tariffs change to correct an "error", defined as a tariff that is out of line with the long run relationship. The basis of Ofgem's conclusion is the finding that (ignoring signs) α_2 is smaller than α_3. These coefficients measure, respectively, how much on average the retail energy tariff fell three months after a positive residual (a relatively high margin), and how much on average the retail energy tariff rose three months after a negative residual (a relatively low margin). Since the former is less than the latter, Ofgem concludes that tariffs rise more quickly than they fall in response to a change in costs (and margins). However, as I explain below, there are serious problems with the econometric analysis behind this conclusion, both with the "stable long run relationship" and with the "tariff adjustment formula", let alone any interpretation about the state of competition in retail energy markets.

3.2. Problems with the "Stable Long Run Relationship"

The specification of the long run relationship, equation (1), is an attempt to predict retail prices. However, the estimated long run relationship might be wrong, because the equation omits key variables, or because of structural breaks in the underlying relationship, or for both of these reasons.

3.2.1. Other cost elements in tariffs

Equation (1) omits the suppliers' own operating costs and actual quantities of energy demanded. To the extent that operating costs per customer vary (positively or negatively) with the actual quantity sold, the estimates of the coefficients (β_1, β_2, β_3, etc) will be inaccurate (i.e. "biased" estimates) to an unknown degree and in an unknown direction. That is to say: the estimated "long run relationship" would be incorrect, so any subsequent inferences based on deviations from this "long run relationship" would be misleading.

Similar problems arise because Ofgem's long run relationship does not allow for the visible increase in margins over the period of analysis. Over the period studied, the sector went from negative to positive margins (Ofgem's Figure 1), possibly because the negative margins were not sustainable, at a time when wholesale costs were also rising. In such conditions, the industry might well show more positive price response and negative price response, i.e. an overall rise in prices relative to costs. That trend would not indicate either a lack of competition or an asymmetric price response, but merely a slow reversion to a long run equilibrium from a persistent ***dis***equilibrium with unsustainably low margins.

Pelzman (2000) also observed that the asymmetry in his results persisted five and eight months after a cost increase. He examined whether this effect was due to widening of retail margins over the period and found that it was not. He therefore suggested that the return to long run equilibrium prices must therefore have taken even longer than allowed for in his model.[23] However, his tests of margins applied to the period 1982-1996, and so omitted any recovery of margins that occurred during the inflationary years 1978-1981, which might have accounted for the overall findings.

One further problem with the tariffs concerns Ofgem's use of data for standard tariffs, without any adjustment for "online discounts". Although most customers pay standard tariffs (Ofgem quotes an estimate of 75%), an element of pricing behaviour is missing, if the estimated tariff excludes the discounts actually offered to other customers. It would, for

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23 Pelzman (2000), pp 484-485.

instance, be interesting to know if reductions in cost result in immediate changes in online discounts, and only later in a change in the standard tariff, once the fall in wholesale costs has established itself as permanent. Such behaviour might reflect suppliers' expectations that falling wholesale prices (amid a general upward trend) are only temporary and that it would be more costly and disruptive to change standard tariffs than to adjust online discounts.

In practice, it may not be possible to assemble accurate data on tariffs including online discounts, but the existence of such discounts means that one must be careful not to put too much weight on findings relating to standard tariffs alone.

3.2.2. Structural breaks

Studies of a relationship generated using a known underlying formula (with some Monte-Carlo type randomness thrown in) show that models of the type used in this study will falsely identify asymmetric adjustment if there are structural breaks in the underlying long run relationship.[24] Intuitively, there is a structural break if the slope of the regression equation (i.e. the relationship between wholesale costs and retail prices captured by the constant β_1 and the multiples β_2 and $\beta_{3)}$ changes over time. If it does, then Ofgem's model will spuriously detect "asymmetric adjustment" because it is comparing prices to the wrong long run relationship.

There are several good reasons to think that there are structural breaks in the relationship between costs and retail prices:

- The level of gross margins plotted in Figure 1 of the Ofgem paper appears to hover around distinct levels for prolonged periods - including one long period when gross margins are negative, followed by another long period when gross margins are positive;
- The data include prolonged periods of rising wholesale prices, which can create (or indicate) expectations of further price rises, whereas periods of volatility do not;
- Wholesale prices show many periods of rapid increase, but fewer periods of rapid decline (implying some asymmetry in the underlying cost pattern, which may translate into an asymmetry in responses to price changes – see below);
- The data extend over the period of a major financial crisis and recession, which may affect observed responses.

Ofgem gives no indication that its analysts performed any form of testing for structural stability of the long run relationship, nor does it provide any reason to believe that the relationship between retail tariffs and costs should be constant over this period.

[24] https://www.msu.edu/course/aec/845/READINGS/MeyerCramon-Taubach2004.pdf

3.2.3. Unlikely coefficients

The Ofgem paper rightly acknowledges some concern about Ofgem's own estimate of the long run relationship, equation (1), because the estimated coefficients do not have sensible interpretations.[25]

§ The coefficients imply that energy suppliers only adjust retail energy tariffs by 3.5% for a 10% change in wholesale energy costs, which is rather low. Such costs make up around 50% of total costs. A 10% change would be expected to change retail tariffs by 5% (i.e. to give a coefficient of 0.50 instead of 0.35).

§ Conversely, the coefficient on "Other Costs" seems rather high, at 0.85, implying that a 10% change in these costs causes a change of 8.5% in the retail tariff. Given the share of such costs in the total, a change of less than 5% (i.e. a coefficient less than 0.5) would have been expected.

These results indicate a likely problem in the specification of the long run relationship (equation (1)), on which all Ofgem's subsequent analysis is based.

3.3. Problems with the "Tariff Adjustment Model"

3.3.1. Offsetting asymmetrical effects

The authors conclude that tariff adjustments occur faster for upward changes (in response to negative deviations in the margin) than for downward changes (in response to positive deviations in the margin). To reach this conclusion, Ofgem only conducted statistical tests on α_2 and α_3, the coefficients for the "error-correction" variables (υ^{+}_{t-3} and υ^{-}_{t-3}, the positive and negative residuals lagged by three months). Even within the Tariff Adjustment Model, equation (2), part of the explanation for tariff changes may lie in the contemporaneous changes in wholesale energy costs (ΔW^{+}_{t} and ΔW^{+}_{t}) and the associated coefficients (α_4 and α_5). Ofgem reports these results on page 11, but does not consider their implications.

Ofgem reports results for different versions of wholesale energy costs, constructed as a portfolio of contracts assembled over 12, 18 or 24 months, or 90% assembled over 18 months and 10% day ahead. For the purpose of monitoring retail energy margins on a regular basis, Ofgem uses an 18 month portfolio. However, the versions of the model that use either an 18-month or 24-month hedging portfolio show asymmetry in the response to *contemporaneous* wholesale energy costs that is opposite to the asymmetry in the *lagged* "error-correction" variables. Thus, within any month, retail energy tariffs react more to a fall in wholesale energy costs than to a rise in wholesale energy costs.

That means that Ofgem's view of the results for these models overstates the overall asymmetry in response (which may not even be statistically significant).

Moreover, Ofgem's interpretation of the results does not appear to hold for other definitions of the wholesale cost portfolio. That suggests that the results are not robust to this choice of assumption.

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25 Ofgem (2011), paragraph 2.8.

3.3.2. Selective view of lagged adjustments

The authors simply impose an "error correction" variable with a three month lag, without saying why it is correct to examine a three month lag.[26] They do not test the robustness of their conclusions to this assumption. Given the limited number of periods of falling wholesale prices, the imposition of a three month lag could lead to a bias in favour of finding asymmetry, if falling costs sometimes resulted in lower retail energy tariffs within one month or two months. Precisely such a pattern appears to occur in early 2009.

In fact, there is good reason to believe that tariffs might react within one or two months, since that appears to be the time that it takes to implement a tariff change.[27] The precise lag might also vary, depending on when the relevant decision-making body meets to approve the decision – within the first or second month. Thus, whilst the error correction terms for individual months might be insignificant, a combined variable (e.g. "either a one month lag or a two month lag") might be significant.

Incidentally, although Ofgem reports that there is a *statistically* significant difference between the coefficients on positive and negative error correction coefficients, Ofgem provides no estimate of the *economic* significance of the coefficient values, i.e. what these variables mean for actual prices. In any economic model, it is possible to identify a statistically significant difference (i.e. one that is clearly observable in the data) that has little or know economic significance (because the size of the difference is too small to matter to any real person).

3.3.3. Non-Linear Adjustments

As well as selecting a particular lag, the model assumes a linear relationship between tariff adjustments and lagged deviations from the long run relationship. In other words, Ofgem assumes that small deviations should lead to small changes in tariffs, whilst larger deviations should lead to proportionately larger changes in tariffs. In fact, the relationship may take a quite different form.

For example, Bacon (1991)[28] – one of the papers listed in Ofgem's bibliography – uses a *quadratic* quantity adjustment model to investigate how fast UK retail petrol prices react to increases and decreases in wholesale costs:

> "The second approach, and the one pursued in this paper, is to introduce an adjustment function which is potentially non-linear in quantities so that it encompasses the possibility of different adjustments to cost increases and decreases. A particularly simple model is the quadratic quantity adjustment model:
>
> $$Y_t = Y_{t-1} + \alpha.(Y^T - Y_{t-1})^2 + \beta.(Y^T - Y_{t-1}) \quad "$$

[26] Ofgem (2011), paragraph 1.3.v.

[27] Source: personal communication from suppliers.

[28] Bacon (1991), "Rockets and feathers: the asymmetric speed of adjustment of UK retail gasoline prices to cost changes", Energy Economics (July 1991), page 216.

In this equation, the squared item whose coefficient is α represents a non-linear element in the adjustment. Non-linearity means that large deviations are ***more than proportionately*** likely to prompt a tariff change than small deviations. This type of relationship is quite likely to arise if there is a fixed cost associated with changing tariffs – the so-called "menu cost" – and might lead to the kind of response shown in Figure 2.1. Given this fixed cost, energy suppliers would wait until a deviation is substantial before changing their tariffs, which means that small deviations would have no effect. As I discuss in section 2.2, this non-linearity could affect upward and downward changes differently. To capture non-linearity, the equation should have included not just the error correction terms (υ^{+}_{t-3} and υ^{-}_{t-3}), but also their squares, $(\upsilon^{+}_{t-3})^2$ and $(\upsilon^{-}_{t-3})^2$, and perhaps even higher powers, $(\upsilon^{+}_{t-3})^3$, $(\upsilon^{-}_{t-3})^3$, etc.

3.3.4. Use of average tariff data

Ofgem's model employs weighted-average tariff data and weighted-average cost data. Although the cost data are initially quarterly, the number of observations is effectively increased by estimating with monthly data.

Each of these averaging processes introduces further problems for the interpretation of the results in the paper. The paper identifies statistical relationships between the data series for average prices, but none of the series represents the actual choice variable of any individual company. In contrast, for instance, Pelzman (2000) examined average price indices (in which he found evidence of asymmetry) and individual supermarket prices (in which he did not). This difference suggests that the choice of a series of average price data may significantly affect the results. The use of an average portfolio of wholesale energy costs can have similar effects.

3.4. Conclusion

To estimate the relationship between the costs of supplying retail energy customers and retail energy tariffs, Ofgem (1) selected a long run relationship between costs and tariffs, and (2) used the observed deviations from this long run relationship to explain tariff changes. However, there are problems in both steps.

For instance, Ofgem's proposed long run relationship, equation (1), produces implausible coefficients on key cost items, which suggests that Ofgem's equation may not be a reliable way to identify deviations from long run values.

When using these deviations to explain tariff changes, in equation (2), Ofgem selects explanatory variables in a way that may introduce biases and provide spurious evidence of asymmetric price responses. For instance, Ofgem focused on responses with a three month lag, to the exclusion of all other forms of response. Ofgem's own equation shows that the asymmetry is less marked after allowing for responses with no lag; allowing for lags of one month, two months or one-or-two months,[29] and lags longer than three months, might have removed the asymmetry altogether.

[29] In our dealings with electricity suppliers, it has been suggested to us that a tariff change can take about six weeks, implying that a lag of two months or three months would capture the effect. However, one of the causes of delay is the need for high level management approval. The date of the decision may therefore depend simply on the date on which

4. Conclusion

The observation that price adjustments are asymmetric does not mean that a market must be uncompetitive. Economists have identified price asymmetry in so many markets that the explanation is unlikely to lie in a lack of competition. In fact, there are many possible explanations as to why prices may be sticky, or price adjustments asymmetric, for reasons other than a lack of competition. For instance, the costs incurred by suppliers when they change prices, and the costs incurred by customers when they search for cheaper prices, and both provide an explanation of price asymmetry. Proving which one of these reasons applies in a particular case is difficult and one cannot presume that the problem is lack of competition.

Furthermore, if price stickiness or asymmetry is rational or efficient, imposing a different form of pricing behaviour will be inefficient, and will offer consumers a lower level of welfare.

In any case, there are severe doubts as to whether Ofgem's econometric analysis actually finds evidence of asymmetry in recent changes to retail energy tariffs.

An alternative approach would need to investigate the underlying relationship of costs to tariffs, equation (1), in more detail, to ensure that it produced plausible coefficients, and was not biased by trends or structural breaks. The tariff setting model, equation (2), would then take into account the possibility that small variations in cost do not translate immediately into tariff changes, because of menu cost or other sources of rigidity. The investigation of this model might find that any of the suggestions listed above had some explanatory power, i.e. it should take account of all possible lags in response, and should allow for non-linear response processes (e.g. a margin of error).

It would also be better to apply the model to the individual tariffs of suppliers, rather than to an industry average tariff, in order to review actual business decisions (rather than an aggregated outcome of several separate decisions). Moving from ***average*** retail energy tariffs to ***actual*** retail energy tariffs entails a qualitative change in the type of model that must be used. That is, it is no longer sufficient to re-estimate versions of equation 1 and equation 2 that can be directly compared with Ofgem's results. It becomes necessary to move from a model where tariffs vary continuously to one where tariffs vary discretely. That will limit the extent to which results from the two types of models are comparable. However, such an approach will be more firmly grounded in the economics of the industry and searches for any asymmetry in a more robust manner.

It would, however, still be important to note that any finding of asymmetry in price responses, at a time of generally rising wholesale energy costs, would not necessarily indicate any lack of competition in retail energy markets.

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the relevant management meeting takes place, leading to the need for lagged variables covering a wide period (one-and-two month lags, or two-and-three month lags) to accommodate variation in this date.

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