Effectiveness and effects of attempts to regulate the UK petrol industry

Nigel Driffielda,*, Christos Ioannidisb

aCardiff Business School, Aberconway Building, Colum Drive, Cardiff CF1 3EU, UK
bDepartment of Economics and Finance, Brunel University, Uxbridge UB3 3PH

Abstract

This paper evaluates the impact that investigation and regulation of the UK petrol industry has had on the profitability of the companies. Using a gross margin for petrol, we estimate a series of variable parameter autoregressive processes. The results demonstrate that the 1979 Monopolies and Mergers Commission investigation into the industry, caused a long-term decline in profit margins in the industry, despite the fact that no recommendations or undertakings were made. This cannot, however, be said for subsequent investigations. © 2000 Elsevier Science B.V. All rights reserved.

JEL classifications: L10; L51

Keywords: Petrol margins; Regulation; monopolies and Mergers Commission

1. Introduction

The petrol industry is one of the most investigated industries in the UK. It has experienced in the past 20 years, two Monopolies and Mergers Commission industry investigations, and two investigations by the House of Commons Trade and Industry Select Committee (1988a,b). In all of the investigations since 1979, the various committees have found that while the industry is a ‘complex monopoly’, there is nothing evident in the industry’s conduct which is against the public interest.
This paper will focus on the impact on the gross margin of the main investigations into the industry, the two MMC enquires (The Monopolies and Mergers Commission, 1979, 1990). These investigations have essentially been concerned with the oligopolistic nature of the petrol industry, and the possible anticompetitive effects. However, the only outcome of these has been for the Office of Fair Trading (OFT) to ‘keep the industry under review’. This is despite the fact that the industry has many characteristics which are associated with anticompetitive conduct and monopoly rents.

Section 2 is concerned with a description of why monopoly profits are likely in the petrol industry. Section 3 outlines the investigations that have been carried out into the potential for monopoly abuse, and Section 4 focuses on the impact of the investigations on the profit margin. Section 5 outlines the procedures used in the analysis, while Sections 6 and 7 present the results and conclusions.

2. Oligopoly in the UK petrol market

The five firm concentration ratio was above 70% during the period 1973–1993, and as such, the likelihood of monopoly pricing in the industry is high. The Monopolies and Mergers Commission (1990) reports that there is very little variation in price across firms, and the market shares of the five leading companies have been very stable over time. In addition, there is significant evidence of sticky pricing in petrol (Bacon, 1991). Borenstein et al. (1997) show that retail petrol prices in the US, respond faster to oil price increases than they do to oil price falls. They attribute this to asymmetry in the costs of inventory adjustment, but also possibly to the oligopolistic nature of the industry.

2.1. Vertical restraints in petrol supply

The MMC determined in 1979 that the industry was a ‘complex monopoly’ in favour of the major firms, as a result of vertical restraints. The most obvious efficiency explanation for vertical restraints or vertical integration in the petrol industry is the ‘double marginalisation’ principle. The industry has, however, never used this argument, denying that upstream monopoly power exists. Rather, in submissions to the The Monopolies and Mergers Commission (1990), the large petrol companies have employed the ‘Chicago School’ argument [see for example Bork (1978), or Posner (1981)] to defend their position. In addition, one of the most powerful arguments in favour of permitting the vertical relations in the petrol industry is put forward by Dobson and Waterson (1996). They suggest that, as there are no economies of scope in petrol retailing, the stance taken by the MMC to view these arrangements as not against the public interest is a fair one.

Vickers and Waterson (1991) discuss the general effects of vertical restraints, many of which are applicable to the petrol industry. Vertical restraints are employed to remove inter-brand competition at the retail level, while the petrol companies ensure through their licensing of sites that there is little intra-brand
competition. Slade (1993) demonstrates a similar result in a study of petrol retailing in Vancouver. While it would appear to be the case that oil companies gain from these arrangements, the extent to which the retailers gain is a function of local market conditions.

2.2. Price discrimination

The petrol companies utilise the system of Selective Price Support. Under these agreements, wholesalers provide retailers with discounted prices, in locations where they face significant inter-brand competition. Gupta et al. (1994) show that spatial price discrimination will serve to increase monopoly profits, while Armstrong and Vickers (1993) show that, when used to protect certain markets, such price discrimination can form a significant barrier to entry.

2.3. Empirical evidence of pricing and oligopolistic interaction in the petrol industry

Much of the work carried out in this area focuses on petrol pricing within an oligopolistic market in North America [see, for example, Slade (1990, 1992, 1993) and Borenstein and Shepard (1996)]. Borenstein and Shepard (1996), for example, report significant evidence of tacit collusion between petrol retailers, based on a standard model of petrol prices. However, given the extensive vertical links that exist within the UK petrol industry, we focus, not merely on the retail price, but on the gross margin which is generated by the companies, as a more suitable indicator of conduct and performance.

3. Investigation into the UK petrol industry

3.1. Monopolies and Mergers Commission investigation (1979)

The 1979 MMC investigation concluded that a ‘complex monopoly’ existed in favour of the petrol companies (there are 15 companies listed in the report). That is to say that ‘one or more of the companies..., conduct their respective affairs by means of one or more specified practices as in any way to prevent, restrict or distort competition’ (The Monopolies and Mergers Commission, 1979, p. 49). The main area of concern was the extent of discriminatory pricing, through the system of rebates and selective price support. However, in spite of this, the MMC took the view that the actions of the companies in this respect were not against the public interest, and as such should be permitted.

The MMC also took the view that price competition in the petrol market had increased in the years leading up to the report, and as such there was little evidence of monopoly pricing. The MMC made no attempt, however, to analyse the profitability of the petrol industry, or the return on capital for any of the leading firms. With the exception of the issues concerning price discrimination, the MMC made no comment on the pricing policies of the firms.
3.2. The 1990 MMC investigation

In contrast with the previous report, the 1990 investigation discusses pricing of petrol at length. The commission found that pump prices follow the Rotterdam spot price, and that there was little reason to assume monopoly profits in the industry. The analysis employed by the MMC, however, is somewhat simplistic, and several of their conclusions have, however, been questioned. Bacon (1991), for example, demonstrates that petrol price responses to oil price changes are asymmetric.

Despite this evidence of monopoly behaviour, there are several explanations of why the commission again came to the conclusion that the conduct of the petrol companies was not against the public interest. Much of the reasoning was based on the increasing market share of supermarkets in petrol retailing, acting to increase competition. However, by 1988 the share of the market controlled by supermarkets had only increased to 5.5%, while sites directly controlled by wholesalers still accounted for 54%.

3.3. Other investigations and regulations

Having outlined the major investigations into the UK petrol industry, the discussion briefly turns to other regulations or investigations and their potential impact on profitability.

A major factor in the subsequent referral of the industry was the recommendation of the Trade and Industry Select Committee that the industry be investigated again. The Committee’s concerns surrounded price differences over small geographical distances, supported through the Selective Price Support system. The investigation that was carried out by the House of Commons Trade and Industry Select Committee (1988a) took the view that intra-firm price differences provided evidence of some monopoly pricing in particular locations. They concluded, however, that this was an extremely complex issue, and recommended a reference to the MMC. One would not anticipate a change in conduct of the companies during such an investigation, given the limited powers of stricture that the Select Committee possesses.

The Price Marking (Petrol) Order came into operation in January 1981.¹ This was introduced to ensure that prices were displayed in gallons as well as litres, as litres were viewed at the time to be misleading. As such, displaying prices in the more ‘transparent’ pence per gallon, was viewed as facilitating greater competition. This has since been superseded by European regulations. One would expect the introduction of this regulation to have a negative impact on margins, although this effect is likely to be somewhat limited.

¹The Energy Committee (1980).
4. The impact of investigations

Following the above discussion, and the empirical work by Bacon (1991) and Driffield (1999), a two-part hypothesis can be formed. Firstly, that petrol companies were able to generate some monopoly rents over at least a part of the period leading up to the investigations. Secondly, that the investigations and subsequent regulation had an impact on profit margins. One possibility is that these firms were engaging in monopoly pricing, and amended their conduct as a result of the threat of action by the MMC. This would be particularly pertinent to the 1979 investigation, as there had been significant criticism of the industry following the 1975 oil price shock.

4.1. The data

The data used here are monthly from May 1973 to April 1993. The net petrol price is retail price minus excise duty and VAT, while the oil price is the sterling equivalent price of a gallon of oil.

4.2. Analysis of the profit margin

To determine whether the attempts to investigate the pricing behaviour of the oil companies were effective, we need to generate a statistical proxy which captures the ‘profit’ incorporated into the retail price of petrol.

Driffield (1999), and Driffield et al. (1999) established that the ‘equilibrium’ price of petrol is log-linearly related to the price of oil and the retail price index (acting here as a portmanteau variable, which captures all other costs).

The most volatile of the two elements is the spot price of oil, which of course will resonate in petrol prices. We impose this restriction and argue that oil prices are fully reflected in petrol prices.

We therefore calculate a margin for the petrol companies, given by:

\[ \phi = \text{net petrol price} - \text{oil price (\£)} \]

This therefore generates the component of petrol price, which is fully independent of the price of oil. This allows us to study the behaviour of retail prices after fluctuations in the price of the ‘main’ input have been fully discounted. Therefore the main cause of ‘breaks’ in \( \phi \) will be caused either by discrete changes in costs and/or discrete changes in the ‘profit’ margin.

---

2 With the exception of the petrol price data, and the excise duty, which are taken from the Digest of UK Energy Statistics, and the Herfindahl index, which is taken from the MMC 1990 report all the data can be extracted from Datastream.

3 Clearly, a given barrel of oil will be used to manufacture many products besides petrol. However, as we demonstrate subsequently, the only necessary assumption here is the fraction of a unit Saudi Light oil which is distilled to petrol is time invariant. There is no technological reason to contradict this.
Fig. 1 then illustrates the spot oil price, and retail petrol prices. In order therefore to examine the conduct of the petrol companies, this paper focuses on the aggregate profit margin, and the impact on this of various attempts to investigate or regulate the industry.

We first present some graphical evidence based on the decomposition of the margin into a flexible trend, which captures fluctuations in low frequencies and cyclical and other high frequency random fluctuations. The Hodrick–Prescott filter, Hodrick and Prescott (1984) allows the data to determine this trend by splitting the series into a low frequency (trend) and higher frequency (cyclical) components.

Fig. 2 illustrates the ‘raw’ margin data, and the smoothed (trend) data using the filter. The shaded periods are the times between the announcements of MMC enquiries, and the completion of the report. In both cases, it is clear that the ‘trend’ in petrol margins declined as soon as an enquiry was announced. This therefore tentatively suggests that the petrol companies modified their behaviour once an investigation was announced.

While this provides an interesting insight into the possible impact of the MMC out measure of ‘profit’, it is not sufficient to demonstrate that profit margins were

---

4Coefficient of variation in oil spot price in sterling = 0.511; coefficient of variation in petrol retail price = 0.379; and correlation coefficient between oil and petrol prices = 0.773.
previously abnormally high, nor does it provide information as to the duration of the ‘profit margin’ reduction in relation to its ‘trend’ value.

5. Investigations and changes in the petrol margin

As noted above, there have been several regulatory measures which may have impacted on the profitability of the petrol company. The issue here is not merely whether the judgements of the investigators changed the conduct of the firms, but whether the change in conduct persisted beyond the duration of the investigation.

In a general sense, the problem of determining the impact of the investigation, can be defined as follows: suppose a stationary time series is generated by an autoregressive process. Define a ‘break’ in the series as a shift in the mean value which corresponds to a change in the intercept of the autoregressive process. The question is how does one determine whether such breaks occur and, if so, where they occur. A subsequent question is to what extent these breaks are long or short lasting.
Consider the regression:

\[ p_t = a_0 + A(L)p_{t-1} + u_t \]  \hspace{1cm} (1)

where \( p_t \) is the variable of interest, \( a_0 \) is the constant term \( A(L) \) is a polynomial in the lag operator and \( u_t \) is a white noise error term. Define the dummy variable \( D_s = 1 \) if the date is ‘on or after date \( s \)’ (when the event occurs), and zero otherwise.

Conventionally, dummy variables are used to augment the regression

\[ p_t = a_0 + A(L)p_{t-1} + b_s D_s + u_t \]  \hspace{1cm} (2)

In effect then \( b_s \) is measuring the magnitude of the hypothesised mean change that occurred in date \( s \).

However, when there are several such breaks that may counteract each other the parameter vector \( b_s \) will not be precisely estimated, and furthermore, the secondary question of whether the break persisted into the long-term cannot be adequately answered.

To avoid such problems Willard et al. (1996) follow a procedure suggested by Banerjee et al. (1992) which mimics that of Hamilton (1989) although is computationally less cumbersome. The procedure estimates by a series of autoregressive processes using a rolling regression (of fixed window length) and sequentially tests for the significance of the coefficient of the dummy variable. When the hypothesis is strongly rejected, one is able to identify the period of break, and using the ‘latest’ estimated parameters estimate the short- and long-run change in the mean of the series due to the event. By estimating a series of rolling regressions, this approach implies that both the constant term and the autoregressive parameters change over time, and in addition the results will be conditioned on the window length.

Here we develop a similar approach that (a) takes into account explicitly the possibility of the moving parameters and (b) is independent of the arbitrarily chosen window length used in the rolling regressions.

We estimate the autoregressive process by a Kalman filter algorithm, thus the parameters are updated as to produce optimal forecasts. We then use the state vector to test whether its observed variability can be accounted by the presupposed events. Having taken into account the coefficient’s inertia we are then able to estimate the persistence of the break on the intercept.

This analysis involves the use of a Kalman filter to analyse the movements in our margin.

### 5.1. Kalman filter analysis

#### 5.1.1. State-space form

Following Hamilton (1989) the vector of the observed variables at time \( t \), \( \phi_t \), is related to the vector of betas, known as the ‘state vector’, via the measurement equation.
\[\phi_t = I_t + \theta_t \ast \phi_{t-1} + M_t\]  
(3)

where \(E(M_t) = 0\) and \(\text{var}(M_t) = H_t\).

The elements of the state vector are generally not observable but they are assumed to follow a first-order Markov process. This is incorporated in the transition equation.

\[\theta_t = T_t \ast \theta_{t-1} + O_t\]  
(4)

where \(T_t\) is a square matrix

\[E(O_t) = 0 \quad \text{and} \quad \text{var}(O_t) = Q_t.\]

To complete the specification of the state-space system two further assumptions are made.

- The initial state vector has a mean of \(b_o\) and a covariance matrix of \(P_0\) thus \(\hat{\theta}_0 \sim N(b_0, P_0).\)
- The disturbances \(O_t\) and \(M_t\) are uncorrelated with each other across all time periods, and uncorrelated with the initial state.

\[E(M_t, O_t) = 0 \quad E(M_t, b_0) = 0 \quad E(O_t, b_0) = 0\]

For a detailed account of the technique see Harvey (1989).

The essential advantage of this process, is that it allows for the continual updating of parameters as more information becomes available. Slade (1989), for example, demonstrates the gain from this procedure in modelling price wars. In the case presented here, however, rather than the companies updating their information on the demand equation, they are effectively updating their supply behaviour based on anticipated regulatory action. The use of the Kalman filter allows for the presence of an autoregressive process in the parameters. This therefore allows the impact of any change due to regulation to be carried beyond the period of regulation. Thus, if there is an exogenous factor which acts to change the margin, the influence of this factor will continue beyond the period of the shock.

The process here uses an expression for the margin, \(\phi_t:\)

\[\phi_t = a_t + \beta_{1t} \ast \phi_{t-1} + \beta_{2t} \ast \phi_{t-2} + u_t\]  
(5)

The Kalman filter is applied to this, to extract \(a_t\), which is the ‘long-run’ or ‘mean’ margin. This, however, is not merely a fixed coefficient, as the Kalman filter technique continually updates it given new information. It is then possible to test the extent to which exogenous influences impact on this long-run margin.

Thus, the final expression which is used to evaluate the long-run impact of investigation or regulation is:

\[\hat{a}_t = c + c_1 \ast \hat{a}_{t-1} + \sum_{j=2}^{7} c_j \ast D_{t-j} + e_t\]  
(6)
Table 1
Determinants of the gross margin

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimated coefficient</th>
<th>t-Statistic</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.528</td>
<td>6.42**</td>
<td>[0.000]</td>
</tr>
<tr>
<td>( \hat{a}_{-1} )</td>
<td>0.676</td>
<td>14.22**</td>
<td>[0.000]</td>
</tr>
<tr>
<td>( D_1 )</td>
<td>-0.157</td>
<td>-2.23**</td>
<td>[0.026]</td>
</tr>
<tr>
<td>( D_2 )</td>
<td>-0.058</td>
<td>-0.62</td>
<td>[0.539]</td>
</tr>
<tr>
<td>( D_3 )</td>
<td>-0.102</td>
<td>-1.19</td>
<td>[0.236]</td>
</tr>
<tr>
<td>( D_4 )</td>
<td>0.097</td>
<td>0.98</td>
<td>[0.326]</td>
</tr>
<tr>
<td>( D_5 )</td>
<td>-0.029</td>
<td>-0.22</td>
<td>[0.827]</td>
</tr>
<tr>
<td>( D_6 )</td>
<td>0.099</td>
<td>0.81</td>
<td>[0.418]</td>
</tr>
</tbody>
</table>

*Dependent variable: \( \hat{a} \). **Significant at the 95% level. Mean of dependent variable = 1.603; S.D. of dependent var. = 0.4708; sum of squared residuals = 22.76; variance of residuals = 0.099; S.E. of regression = 0.3139; \( R^2 = 0.568 \); adjusted \( R^2 = 0.556 \); Durbin’s \( h = 0.096 \) \( P = 0.923 \); Durbin’s \( h \) alternative = 0.288 \( P = 0.773 \); Breusch/Godfrey LM: AR/MA1 = 0.0831 \( P = 0.773 \).\

where \( D \) is the set of dummy intervention variables given above.

The possible causes of changes in the margin are as follows:

\( D_1 \) = 1 for the duration of the 1979 MMC report;
\( D_2 \) = 1 for the duration between the publication of the report and any decision made by the Secretary of State;
\( D_3, D_4 \) as above for the 1990 report;
\( D_5 \) the duration of the Trade and Industry Select Committee investigation; and
\( D_6 \) = 1 for the duration of the imposition of the petrol price marking order.

Given the very nature of \( \hat{a} \) variable, this a very rigorous test of the long-run impact of intervention. The results from the estimation of Eq. (6) by OLS are given in Table 1.

6. Results

The results here show clearly that the instigation of the 1979 MMC inquiry had a significant negative effect on the margins of the petrol companies. This result would appear to contradict the MMC, that the petrol companies were not generating monopoly profits, as the companies responded to the announcement of the investigation by reducing their margins. All other investigations, or attempts at regulation, such as the Marking Order, have been ineffective at reducing profitability. The instigation of the second report did not have similar effect on profitability. This is the expected result. The MMC had already given the industry a favourable verdict in 1979, so the industry had little reason to suppose that its conduct would be found to be against the public interest the second time.

As this paper demonstrates, the 1979 investigation, therefore, changed the conduct of the oil companies in the long-term, such that margins were reduced.
6.1. Simulations

To ‘simulate’ the behaviour on the profit margins of the impact of the MMC report we solve the ‘margin’ and ‘intercept’ equations dynamically and compared the evolution of the margin with and without the investigation. This simulation captures the full effect of the inertia inherent in the estimated variable coefficients on the dependent variable $f$.

The graph (Fig. 3) shows that profit margins fell rapidly (sim1) within the first few months following the announcement of the investigation (MMCA1), and only began to recover several months after the publication of the committee’s report. It took approximately 2.5 years for ‘mean’ profit margins to return to their long-run values.

---

**Fig. 3.** The impact on the MMCA investigation on the margin.
As such, therefore, given the previous findings of the MMC, there was little reason for the companies to anticipate an adverse finding 11 years on. Finally, concerning the deliberations of the MMC in general, Clarke et al. (1997) report that the likelihood of an industry being found to be not acting against the public interest has significantly increased since 1979. In addition, there is significant evidence that firms involved in more than one investigation learn a good deal from the experience in terms of how to put their case to the Commission, and in subsequent investigations hire specialists, and employ much higher levels of resources in producing their submissions than the first time, thus increasing their chance of ‘success’.

7. Conclusions

This paper demonstrates that the regulatory bodies in the UK inadvertently had a significant effect on consumption efficiency within the petrol industry. This is despite the fact that the industry has never been found to be acting against the public interest.

There are many reasons to believe that this industry may behave as a collusive oligopoly, and there is significant evidence of restrictive practices in the industry. Intra-brand competition is all but negated by the petrol companies, and horizontal restrictions act to severely limit inter-brand competition. While it is impossible to prove monopoly pricing on the part of the petrol companies, certain conclusions can be inferred. The threat of an adverse report, or government regulation of the petrol industry, was sufficient to change the conduct of the companies. This had the effect of reducing profit margins from 1977 onwards. There is also evidence that this effect persisted after the publication of the report. Finally, there is no evidence that any subsequent investigations have been as effective.

Appendix A. Unit root tests on the profit margin


<table>
<thead>
<tr>
<th>No. of lags</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test stat.</td>
<td>-23.98</td>
<td>-25.96</td>
<td>-26.25</td>
<td>-26.92</td>
<td>-26.95</td>
</tr>
<tr>
<td>P-Value</td>
<td>0.03</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
</tbody>
</table>

References