Are Cartel Laws Bad for Business? Evidence from the UK

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Abstract: This paper examines the impact of cartel policy on firms' profits using a panel data set of UK manufacturing industries over 1954-1973. The introduction of cartel laws in the UK in the late 1950s caused an intensification of price competition in previously cartelised manufacturing industries, but it did not affect those industries which were not cartelised. The econometric results from a comparison of the two groups of industries suggest that the UK cartel legislation had no significant impact on firms' profits, although it had a strong effect on market structure. These results are in line with theoretical models that endogenise market structure by means of a free-entry condition, such as Selten (1984) and Sutton (1991).

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1. Introduction.

Recent advances in oligopoly theory have shed new light on the much-debated issue of the links between firms' conduct, market structure and market performance. Selten (1984) predicted that a switch from collusive to non-collusive behaviour caused by a toughening of cartel policy would have no adverse effect on firms' profits in the long run, although it would cause a decrease in the number of firms in a homogeneous-good industry. The reason is that the number of firms in an industry is determined by a free-entry condition which requires that net profit be driven to (almost) zero by entry irrespective of firm conduct. This insight was confirmed by Sutton (1991, 1998) and cast within his general theory of the determinants of market structure in exogenous sunk cost, advertising-intensive and R&D-intensive industries.

This paper provides an econometric analysis of the impact of the intensification of price competition following the introduction of cartel laws on firms' profits. A unique opportunity to study this issue is given by a 'natural experiment' that occurred in the UK in the 1960s. As a result of the introduction of the 1956 Restrictive Trade Practices Act, restrictive agreements between firms, covering a wide range of industries, were cancelled. This caused an intensification of price competition in many industries during the 1960s. These can be compared to a 'control' group of industries which had not been subject to agreements significantly restricting competition and were therefore not affected by the 1956 Act.

The only previous statistical analysis of the effects of the 1956 legislation on profitability is the study by O'Brien et al. (1979). They used firm-level data taken from company accounts for a sample of about 30 industries and found no evidence of any significant difference in the evolution of either profitability or merger activity during the 1960s between firms in industries affected by the 1956 Act and those in industries not affected. However, this study was subject to methodological limitations, including the use of a rather small sample of industries and the fact that the criteria for classifying industries across groups were somewhat dubious in a few cases.

In this paper, I provide econometric results on the joint effect of price competition on market structure and profitability using a comprehensive dataset on competition, explicit criteria to classify industries according to their competitive status, and a sample that extends over a long time period and covers the whole of manufacturing industry. My market structure measures are the number of firms and the number of plants; this part of the analysis complements therefore the one carried out elsewhere (Symeonidis 2000a, 2000b) using the concentration ratio. The main advantage of using firm or plant numbers is that data on these come from exactly the same sources as the profit data. Therefore the samples used for the market structure regressions and the profit regressions in this paper are identical. In addition, I will examine the effect of price competition on profits in the short run and in the long run. I will use three different profit measures: the gross profit of the average firm, the gross profit of the average plant, and the price-cost margin. In all cases, these are industry-level rather than firm-level data.

The econometric results from the analysis of a panel data set of manufacturing industries in this paper suggest that the intensification of price competition following the 1956 Act had no significant long-run effect on profits, while it had a strong negative effect on the number of firms. Additional insight is provided by several brief case studies which serve to illustrate in greater detail the mechanism that lies at the core of the Selten-Sutton theoretical approach. The evidence suggests that, in long-run equilibrium and in the absence of any institutional barriers to entry, cartels do not usually result in higher profits, but rather they allow for excessive entry (and/or insufficient exit). The long-run effect of cartel policy is then to reduce the number of firms rather than their profits.

2. Theoretical background.

The mechanism behind the Selten-Sutton predictions can be summarised as follows (a more formal and detailed discussion is provided in Symeonidis 2000a, 2001). Under free entry, the net profit of each of a number of symmetric single-plant firms must be zero (or almost zero, taking account of the integer constraint and assuming that the number of firms is not

very small) irrespective of firm conduct. An increase in the intensity of price competition, caused by the introduction of cartel laws, economic integration or some other exogenous institutional change, will cause gross profit to fall, given the initial number of firms. The price-cost margin should also fall, since sales revenue should normally not decrease when competition intensifies. As a result, firms will no longer be able to cover their fixed costs at the initial free-entry equilibrium. In an exogenous sunk cost industry (i.e. an industry without significant advertising or R&D), this will inevitably lead to mergers and exit until the gross profit of each firm rises sufficiently to cover the fixed cost, which has remained unchanged. Thus the number of firms (or plants) will fall, but there will be no significant effect on firm (or plant) gross or net profit in the long run. More specifically, one would expect profitability to decline in the short run, i.e. before any significant change in market structure occurs, and then be restored, or partially restored, in the long run through a fall in firm numbers.[1]

Clearly, these results depend on two crucial assumptions. The first is that incumbent firms under a collusive regime cannot prevent entry of new firms into the industry, or, more generally, that the scope for entry deterrence is not larger in a collusive equilibrium than in a non-collusive one. If this were not the case, then a breakdown of collusion would reduce net and gross profit and would have an ambiguous effect on the number of firms. It

[1] If the integer constraint is taken into account, little can be said about the precise effect of more intense price competition on profit without imposing more structure on the model. In the specific model analysed by Selten (1984), both total industry net profit and plant (or firm) net profit are more likely to increase than to decrease following a switch from a collusive to a non-collusive regime (see also Phlips 1995, chapter 3). However, in a context where the integer constraint is the only reason for positive net profit, this can be expected to be small in general, at least at the plant or firm level, so any change may be difficult to identify empirically. Since there is no clear prediction as to the direction of the change either, it seems legitimate to consider a weaker version of the Selten result as the main testable prediction of the theory, namely that a switch of competition regime will have no significant effect on plant (firm) gross or net profit in the long run. Also, the effect on total industry net profit will be ambiguous, although industry gross profit should fall because of the fall in the number of firms.

is, in fact, possible to construct theoretical models of collusion where firms make supranormal profits either by adopting trigger strategies that deter entry (Harrington 1989, 1991) or by adopting a strategy of gradually accommodating entry (Friedman and Thisse 1994). In such models, a decrease in the degree of collusion will reduce net and gross profit and will have an ambiguous effect on the number of firms (assuming that the scope for entry deterrence is smaller in a more 'competitive' equilibrium). Hence an empirical test of the present theory regarding the effect of competition on profits may also be interpreted as a test of alternative theories of collusion.

The second key assumption is the symmetry assumption. However, the typical industry is subject to significant asymmetries, due to a variety of factors including multi-plant or multi-product firms, or efficiency differences between firms. In the presence of asymmetries, free entry is consistent with supranormal profits for all but the *marginal* firm in an industry, and it is not clear whether any general theoretical prediction can be derived about the long-run equilibrium effect of more price competition on the profit of the *average* firm. Results from specific models suggest that the effect of tougher price competition on firm profit and even on the price-cost margin can be positive in the presence of efficiency differences even when no account is taken of the integer constraint (see Montagna 1995). The intuition is that an exogenous shock that reduces prices in the short run drives the less efficient firms out of the industry, so in long-run equilibrium price may fall by less than the marginal cost of the average firm in the industry and thus the price-cost margin of the average firm may rise. In other words, low-cost firms will expand at the expense of high-cost rivals, and as low-cost firms always have higher margins in an asymmetric industry, the possibility arises that the margin of the average firm will be higher in the new equilibrium despite the increase in the intensity of competition. Of course, this is only a possibility and it could also be the case that the overall effect is a fall in the margin of the average firm. For my present purposes, it is sufficient to note that the long-run effect of price competition on profitability is ambiguous.

I have so far focused on the case of an exogenous sunk cost industry. Things can be more complicated in industries with significant endogenous sunk costs such as advertising or R&D. A change in the intensity of price competition will affect the incentive of each firm to spend on advertising or R&D, which is part of the fixed cost incurred. As a result, it may not always be the case that more intense price competition causes the number of firms to fall (see Symeonidis 2000b, 2000c for a formal analysis). On the other hand, the long-run effect on net profit will still be (approximately) zero, although gross profit may change because of the change in advertising/R&D expenditure, and the direction of that change is not predictable in general.

As shown in Symeonidis (2000a, 2000b, 2000c), however, any effect of price competition on advertising or R&D is likely to be rather modest in practice, and hence the competition-concentration relationship will only infrequently break down in advertising-intensive or R&D-intensive industries. Thus one should not overemphasise the potential differences across classes of industries in this respect. The same may be true for the effect of price competition on profitability. It is not difficult to show that, under plausible assumptions, this effect should be negative in the short run, i.e. before any change in market structure occurs, and can be ambiguous in the long run, i.e. once market structure adjusts, in industries with endogenous sunk costs just like in exogenous sunk cost industries. To see this, consider two cases. Suppose, first, that price competition has no significant effect on advertising/R&D at the industry level. Gross profit must then fall in the short run when price competition intensifies, given that neither advertising/R&D nor market structure have changed. The price-cost margin must also fall under the plausible assumption that sales revenue has not decreased as a result of tougher price competition. In the long run, both gross profit and the price-cost margin can rise or fall, depending on market structure, total industry sales revenue and the type and degree of asymmetries between firms. Next, suppose that price competition has a negative effect on the non-price variable at the industry level. In the short run, gross profit (and the price-cost margin) should decline not only because of more price competition but also because of the fall in

advertising/R&D, which reduces the consumers' willingness to pay. In the long run, the effect is again ambiguous.[2]

Two main conclusions can be drawn from the above discussion. First, in the presence of asymmetries between firms or endogenous sunk costs, such as advertising or R&D, it is difficult to derive any strong theoretical results regarding the effect of price competition on profitability in the long run. Second, the basic intuition from the benchmark case, namely that profitability should initially decline following a rise in the intensity of price competition, and then be restored, or partially restored, through a fall in firm numbers, emerges as the dominant mechanism driving the joint evolution of structure and performance across classes of industries, except perhaps for rather special cases where price competition has a particularly strong effect on non-price variables.

3. The competition data.

As a result of the 1956 Restrictive Practices Act, explicit agreements significantly restricting competition were abandoned across a wide range of British manufacturing industries. A detailed description of the institutional changes and of the evolution of competition in UK manufacturing from the 1950s to the early 1970s can be found in Symeonidis (1998, 2001). In what follows I briefly summarise those aspects that are particularly important for the purposes of the present paper.

The 1956 Act required the registration of restrictive agreements, including verbal or even implied arrangements, on goods. Registered agreements should be abandoned, unless they were successfully defended by the parties in the newly created Restrictive Practices Court as producing benefits that outweighed the presumed detriment (or unless they were considered by the Registrar of Restrictive Trading Agreements as not significantly

[2] If price competition has a positive effect on the non-price variable at the industry level, these results may change. But this case is not relevant in the present empirical context (see Symeonidis 2000b, 2001).

affecting competition). Because the attitude of the Court could not be known until the first cases had been heard, the large majority of industries registered their agreements rather than dropping or secretly continuing them. The first agreements came before the Court in 1959 and were struck down. This induced most industries to voluntarily abandon their agreements rather than incur the costs of a Court case with little hope of success. Most agreements were cancelled between 1959 and 1963.

Many agreements provided for minimum or fixed producer prices. On the other hand, there were typically no restrictions on media advertising or R&D expenditure. Free entry was a key element in the theoretical discussion of the previous section, so a crucial question is whether entry was restricted in cartelised industries. The evidence from the agreements registered under the 1956 Act, the reports of the Monopolies and Restrictive Practices Commission (cf. Guenault and Jackson 1974, Rowley 1966) and the case studies in Swann et al. (1973) suggests that this was not the general case. Although practices such as collective exclusive dealing and aggregated rebates were often used by the cartels as a way of limiting competition from outside firms, it is not at all clear that these practices also restricted entry. In most industries the agreements were operated within trade associations and there were often no significant restrictions on association membership, so that entry would not be difficult if the entrant was willing to become a party to the agreement. In some industries, on the other hand, the existing association members might reject some applications for membership, although they would usually accommodate (for lack of a better alternative) any powerful non-member firm. Such restrictions would be easier in industries where the association firms had some control over distribution channels, usually through agreements with distributors' associations. Even in such cases, of course, entry would not be restricted unless the barriers to outside competition were fully effective.

Moreover, profits of firms in cartelised industries were thought to be more often 'reasonable' than 'excessive', and there were typically marked variations in costs and profits across firms. This often meant that the profitability of the less or least efficient was 'low', and sometimes even negative in particular lines of production. In fact, price setting

by the cartels often consisted in a compromise between high-cost and low-cost firms, with prices set at a level that allowed the high-cost firms to break even. Of course, it is not clear why cartel firms should not make excessive profits if they could defend them against entry. The absence of excessive profits in most British cartels is consistent with a regime of non-restricted entry.

The lack of excessive profits does not mean that the agreements were not effective. In fact, case-study evidence (for example, Swann et al. 1973, 1974) suggests that in most industries the agreements had been operated honourably before cancellation and outside competition, from domestic or foreign firms, was limited. This evidence also indicates that price competition intensified in the short run in many industries following the abolition of cartels. However, in several cases agreements to exchange information on prices, price changes etc replaced the former restrictive arrangements in the short run, and price competition emerged only after these information agreements were abandoned in the mid-1960s, i.e. about a decade after the 1956 Act was passed, following adverse decisions of the Restrictive Practices Court. In sum, while one cannot rule out cases of ineffective agreements or cases of collusion continuing secretly in the 1960s, the available evidence suggests that such cases were not numerous. The majority of industries with collusive agreements in the 1950s did experience, sooner or later, an intensification of price competition as a result of the 1956 Act, and so it is, on the whole, legitimate to think of this evolution as a change of competition regime induced by an exogenous institutional change.

The main source of data on competition are the agreements registered under the 1956 Act. I have also used a number of other sources to identify unregistered agreements or agreements modified before registration, including various Monopolies Commission reports, the Board of Trade annual reports from 1950 to 1956, and unpublished background material for the Political and Economic Planning (1957) survey of trade associations. The approach to modelling the competition effect in the present paper involved distinguishing between those industries with a change of competition regime following the 1956 Act and those without a change in regime. All industries in the sample were classified according to

their state of competition in the 1950s on the basis of three criteria: the reliability of the data source; the types of restrictions; and the proportion of an industry's total sales covered by products subject to agreements and, for each product, the fraction of the UK market covered by cartel firms.

In particular, the various types of restrictions were classified as significant, non-significant or uncertain, according to their likely impact on competition. Next, the products which were subject to agreements were assigned to the various industry categories. Now certain products within a particular industry were subject to significant restrictions, while others were not. An industry was classified as collusive in the 1950s if the products subject to *significant* restrictions accounted for more than 50% of total industry sales. It was classified as competitive if the products subject to *significant or uncertain* restrictions accounted for less than 10% of industry sales. And it was classified as ambiguous in all remaining cases.[3] All industries with ambiguous state of competition in the 1950s (as well as a few with ambiguous state of competition in the late 1960s and early 1970s) were then excluded from the sample.

Finally, the dummy variable *CHANGE* was defined, which takes the value 1 for industries with a change in competition regime sometime after 1958 and 0 for industries without a change in regime. An analysis of the competition effect on profits and market structure could then be performed by testing whether the time effects on these variables

[3] In fact, most industries classified as competitive were free from any restrictive agreements. I have used the 10% cut-off point because in some cases secondary industry products were subject to restrictive agreements, although core industry products were not. Similarly, most industries classified as collusive had agreements covering all industry products. I have used the 50% cut-off point because in some cases most core industry products were subject to price-fixing, although some were not; clearly, one would expect a significant impact of the 1956 Act in such cases. Small variations in the cut-off points (in particular using 20% instead of 10%, or using 40% or 70% instead of 50%) do not significantly affect the results reported in section 4. The use of a continuous competition measure instead of cut-off points has proved impractical for a variety of reasons (see Symeonidis 2001 for an extensive discussion).

after 1958 are different for the two groups of industries in regressions that also control for other factors that may have influenced profits and market structure during the period examined. Data on profits and firm/plant numbers over the relevant period are available for five different years, namely 1954, 1958, 1963, 1968 and 1973. Note that, although the Act was introduced in 1956, it was not until 1959 that industries, on the whole, started cancelling their agreements. Moreover, competition did not break out immediately in several industries, so the impact of the Act was felt at least until the late 1960s or early 1970s.

4. Empirical models and results.

To study the joint effect of price competition on market structure and performance, I estimate in this section reduced-form equations derived from the theory sketched in section 2 above. According to this theory, market structure and profits are both endogenous and determined by the same set of exogenous variables. These include market size, the level of setup costs or scale economies, the intensity of price competition, union power, and various unspecified time-invariant industry-specific characteristics (such as the degree of product differentiation or the elasticity of demand).[4]

Some of the theoretical predictions of this paper would be best tested using data for net profit, i.e. gross profit minus fixed costs. Unfortunately, it is not possible to construct measures of net profit with the data available. The capital stock figures are estimates, and, while the estimated proportional changes in capital stock over time in any given industry are reasonably accurate, the estimated levels should be treated with caution (see Oulton and O'Mahony 1990). As a result, only measures of gross profit can be used. While this is a limitation of the present analysis, it should be emphasised that the theory also provides predictions regarding gross profit. Thus a key prediction is that industry gross profit

[4] Union power is included in this list since it has often been found to have a positive effect on profitability in empirical studies of the effects of unions, and this result is consistent with theoretical models of firm-union bargaining.

divided by the number of plants should not change significantly following an intensification of price competition. This will not be true if, contrary to the present theory, cartels generally deter entry in long-run equilibrium. Moreover, a key insight of the present theory is that profitability should initially decline following a rise in the intensity of price competition, and then be restored, or partially restored, through a fall in firm numbers. Finally, if it can be shown that the long-run effect of cartel laws on the industry price-cost margin is not significant, on the whole, across industries, then the effect on total industry gross profit cannot be negative under the plausible assumption that industry output does not fall as a result of more competition. Provided that total industry fixed costs do not rise as a result of more competition (which, in a model with exogenously determined setup cost, is equivalent to saying that the number of plants does not rise), total industry net profit will not fall: cartel laws will be, in this case, definitely not bad for business.

The basic sample of industries for the present analysis contains 201 industries and 760 observations. As the theoretical predictions for the effect of price competition on profit are perhaps less clear for advertising-intensive and R&D-intensive industries than for exogenous sunk cost industries, I will also present results for a sub-sample of exogenous sunk cost industries. The main purpose of this is to check that the results for the whole sample are not driven by advertising-intensive or R&D-intensive industries, as this would not be consistent with the theory. The sample of exogenous sunk cost industries was derived from the basic sample by dropping all industries with ADS > 1% or RDS > 1%, where ADS and RDS denote the typical or average advertising-sales ratio and R&D-sales ratio, respectively, over the relevant period. This sample contains 134 industries and 502 observations. Industries with ambiguous state of competition in 1958 (or, in a few cases, in the late 1960s and early 1970s) were excluded from both samples, as were industries for which there were not at least two available observations for the period 1958-1968 (in other words, industries with data only for 1954-1958 or 1968-1973).

Descriptive statistics on initial levels in profit and market structure measures are presented in Table 1. In particular, the table reports means and standard deviations of five

different variables in 1954 and 1958, for industries that experienced subsequently an intensification of price competition as well as for industries not affected by the legislative changes (the latter group includes a few industries where the agreements continued). The variables are the number of firms, *NFIRMS*, the number of plants, *NPLANTS*,[5] the industry gross profit deflated by the general producer price index for all manufacturing and divided by the number of plants, *PLANTPROFIT*, the deflated industry gross profit divided by the number of firms, *FIRMPROFIT*, and the price-cost margin, *PCM*, defined as net value of output minus wages and salaries divided by sales revenue. For the first four of these variables a log transformation is used. The figures are based on industries with available data for both 1954 and 1958, and can therefore also provide information on the evolution of profits and market structure across different groups of industries before the implementation of the 1956 legislation.

The first thing to note is that there is little difference in initial conditions between industries affected by the 1956 Act and those in the control group, especially when one looks at the full sample. Note that the price-cost margin is slightly higher for industries in the control group when using the full sample, but lower when focusing on exogenous sunk cost industries. This is partly due to the fact that advertising-intensive and R&D-intensive industries tend to have higher price-cost margins, but they are also less likely to be collusive than exogenous sunk cost industries. Even more interesting is the comparison of the 1954-1958 changes in the two groups. The evolution of ln*NFIRMS* and ln*NPLANTS* is very similar in the two groups, especially ln*NFIRMS*. Thus, on the basis of the raw data at least, one could probably conclude that any differences observed after 1958 should be attributed to the legislation rather than to any pre-existing differential trend in the two groups.

[5] A limitation of using these variables as measures of market structure is that they are sensitive to the number of small firms (or plants). It is well known that small firms often do not produce core industry products. This problem are somewhat alleviated by the fact that very small firms (namely, firms with less than 25 employees) are not taken into account in my data. Other measures of market structure, such as concentration measures, are not available for the industry categories used here.

On the other hand, the average *PCM* is roughly constant between 1954 and 1958 in industries with *CHANGE* = 1 but falls somewhat in industries with *CHANGE* = 0. The difference is not large, at least for the full sample (about half a percentage point). Moreover, it can be argued that, if it turns out that the average *PCM* has fallen during 1958-1963 in industries with a change in the intensity of competition relative to the control group, then this must surely be the effect of the 1956 legislation, since the trend was, if anything, exactly the opposite before 1958. I will return to these issues when discussing the regression results below.

Table 2 presents statistics on the average change in each of the five endogenous variables of interest over 1958-1963 and also over 1963-1968. (There are less observations for 1973 than for 1958-1968, so descriptive statistics for 1958-1973 would be less informative.) In both periods, ln*NFIRMS* and ln*NPLANTS* decreased considerably more, on average, in industries with a change in competition regime than in industries without such a change. For the period 1958-1968 as a whole, the number of firms in the former group fell by about 45%, while it fell by only about 20% in the latter. Also, the number of plants fell by about 25% in the former group as compared to 8% in the latter. Of course, these comparisons do not control for changes in other variables; still, the differences between the two groups are indeed very large.

With respect to the profit measures a different picture emerges. Consider the price-cost margin, which is perhaps the 'cleaner' of the three measures, since it is not directly affected by the changes in firm or plant numbers. The most interesting figures are those for the whole sample. In both groups of industries the average *PCM* increased over 1958-1963 as well as over 1963-1968. However, during 1958-1963 the rise was larger for industries with *CHANGE* = 0 by about one percentage point, while the exact opposite is the case for 1963-1968. In other words, the average *PCM* in industries with *CHANGE* = 1 *fell* during 1958-1963 by about one percentage point relative to the control group, but then it recovered during 1963-1968. In exogenous sunk cost industries, on the other hand, we still have a relative fall in *PCM* during 1958-1963 in industries where price competition

intensified, but no obvious recovery during 1963-1968. Admittedly, these changes are not large, and it is difficult to draw any conclusions on the basis of these statistics alone. To unravel the link between changes in market structure and changes in profitability in industries affected by the 1956 Restrictive Trade Practices Act, I now turn to the econometric analysis.

The specifications used here are panel data models with individual-specific effects. This allows controlling for industry characteristics that are important for market structure and profitability but are relatively stable over time, such as the degree of horizontal differentiation or the elasticity of demand. Time dummies are also included among the regressors in an attempt to control for other factors that may have influenced the evolution of market structure and profitability over the period examined, such as changes in the tax system in the mid-1960s that are thought to have encouraged mergers, economies of scale in distribution and the raising of finance, the progressive opening of the British economy, the UK government's prices and incomes policies between 1965 and 1973, and macroeconomic fluctuations. It is very difficult to measure these factors at the industry level, but it is plausible to assume that their effect would have been more or less equally realised across all industries, or, at least, that there would not be a systematic difference between previously collusive and non-collusive industries with respect to these factors.

Of all these factors, the one whose omission from my empirical specification is the most regrettable is the intensification of foreign competition caused by the gradual opening of the British economy during the 1960s and 1970s. Unfortunately, it is difficult to control for this in a more satisfactory way.[6] It should be emphasised, however, that there is no

[6] Ideally, one would need some measure of the extent of foreign competition for each industry across time. Two possible candidates are the import penetration ratio and the rate of effective protection. However, there are serious problems, theoretical and practical, with both of these measures. Estimates of effective rates of protection are available at a high level of aggregation and only for some years in my sample; also, they are often subject to measurement error. The import penetration ratio, on the other hand, is a poor proxy for the extent of foreign competition, since it cannot capture the effect of the mere threat of competitive imports, it does not take into account

reason to think that foreign competition may have had a differential effect across the two groups of industries, i.e. the group with *CHANGE* = 1 and the one with *CHANGE* = 0, after 1958. As pointed out in Symeonidis (1999b), there is no strong evidence of any difference in initial conditions between the two groups with respect to foreign competition. Moreover, although tariff reductions occurred throughout the 1960s and the 1970s, they became in fact more pronounced after 1967, when the Kennedy Round was completed. This may be part of the reason why Kitchin (1976) was not able to identify any overall pattern of falling or rising effective protection between 1963 and 1968 in UK manufacturing. On the other hand, the effect of the 1956 restrictive practices legislation was mostly realised between 1958 and 1968, i.e. before the first stage of the Kennedy round tariff cuts. Finally, there is no evidence that changes in the level of effective protection were any different between industries with a change in competition regime and industries in the control group, at least between 1963 and 1968. Kitchin provides estimates of effective protection for both these years at a level of aggregation between the two-digit and the three-digit industry level. Effective tariff protection increased, according to these figures, in 6 out of 12 industry groups that I could classify as having experienced a change in competition regime, and decreased in the other 6. For industry groups that I could classify as having experienced no change in competition regime the respective numbers were 8 and 10. In summary, it is not unreasonable to argue (although it is very difficult to prove) that the estimated effect of the 1956 Act from my regressions in this paper is not biased by the failure to control for foreign competition.

The basic specification for the number of firms is

$$\ln NFIRMS_{it} = \alpha_i + \beta_1 \ln SS_{it} + \beta_2 \ln(K/L)_{it} + \beta_3 Y54 + \beta_4 Y63 + \beta_5 Y68 + \beta_6 Y73 + \beta_7 CHANGE * Y54 + \beta_8 CHANGE * Y63 + \beta_9 CHANGE * Y68 + \beta_{10} CHANGE * Y73 + u_{it},$$

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imports by domestic producers (which may not be in competition with domestic products), and it is itself clearly endogenous. Moreover, the industrial classification used in the foreign trade statistics during the period examined in this book has been subject to changes over time and is often difficult to match with the one used in the Census of Production.

and similarly for the number of plants. *SS* is the industry sales revenue deflated by the general producer price index for all manufacturing and serves as a proxy for market size.[7] *K/L* is the capital-labour ratio, a proxy for setup costs (or economies of scale). Since the model includes industry-specific effects, one need not assume that *K/L* is an accurate measure of setup cost; all that is required is that the *change* in *K/L* is an accurate measure of the *change* in setup cost, an assumption which seems quite plausible. *Y54*, *Y63*, *Y68* and *Y73* are time dummies for 1954, 1963, 1968 and 1973 respectively. In some regressions the variable *UNION*, which represents union density, is also included, and serves as a proxy for union power. Details on variable definition and data sources are provided in Appendix A.[8]

The interaction terms should pick up any differences after 1958 between industries with a change in competition regime and industries without such a change. Thus the coefficient on *CHANGE*Y63* (*CHANGE*Y68*, *CHANGE*Y73*) measures the effect of the 1956 Act between 1958 and 1963 (1968, 1973). The benchmark year is 1958, as it is generally accepted that the Act had little effect on competition before then. The coefficient on *CHANGE*Y54* serves as an indirect check of this presumption, as well as a check that the evolution of market structure during 1954-1958 was not significantly different between the two groups of industries.

[7] The potential endogeneity of prices, especially in profit regressions, suggests using the general producer price index as a deflator. In any case, using industry-specific price indices as deflators gave broadly similar results to those reported here. Another proxy for market size with a potential endogeneity problem, namely the net value of output deflated by the general producer price index, also gave similar results to those reported in Tables 3-5.

[8] A potential objection to including a proxy for union power among the regressors is that this variable could be endogenous. For instance, the prospect of plant closures following an intensification of competition might lead to a reduction of union power to the extent that it represents a bigger threat for the welfare of workers than for that of shareholders or managers. While this may be correct under many circumstances, it is far less obvious that the same applies to union density, which is the proxy used here: there is no reason to expect union membership to fall even if the bargaining power of the union decreases because of changes in the competitive environment. Essentially, union density is seen here as a variable that picks up primarily exogenous influences on union power.

The estimated model for each of the three profit measures defined above is

$$\ln \textit{Profit measure}_{it} = \alpha_i + \gamma_1 \ln SS_{it} + \gamma_2 \ln(K/x)_{it} + \gamma_3 Y54 + \gamma_4 Y63 + \gamma_5 Y68 + \gamma_6 Y73$$
$$+ \gamma_7 CHANGE * Y54 + \gamma_8 CHANGE * Y63 + \gamma_9 CHANGE * Y68 + \gamma_{10} CHANGE * Y73 + e_{it},$$

where the 'profit measure' is ln*PLANTPROFIT*, ln*FIRMPROFIT* or *PCM*, 'K/x' is either the capital stock of the average plant, *K/N*, or the capital-labour ratio, *K/L*, and the other variables are the same as above.[9] Again, *UNION* is sometimes also included as an additional regressor.[10]

A remark on the interpretation of the capital-labour ratio in profit equations may be in order. This variable, or the capital-output ratio, has often been used in profitability studies to control for the fact that the endogenous variable, namely the price-cost margin or the rate of return on capital, includes the gross return to capital. In the present study, the capital-labour ratio is seen as a proxy for setup cost (net of resale value). This is not a real difference, however, since the setup cost is essentially the cost of installing capital (plant and machinery).

Note that the above specification is very different from those typically used in 'traditional' studies of the link between market structure and profitability (such as Cowling and Waterson 1976). In these studies, a measure of market structure is always included as a regressor. My specification, on the other hand, is a reduced-form equation derived from a theoretical model in which market structure and profit are both endogenous. The model's predictions regarding the effect of a change in the intensity of price competition on

[9] I use either one of these two proxies in regressions with the price-cost margin as dependent variable. However, in regressions where the number of firms or plants directly enters into the definition of the dependent variable I only use *K/L*, since the use of *K/N* would not be appropriate.

[10] The denominator of *PCM* is sales revenue. Some studies (e.g. Hart and Morgan 1977, Conyon and Machin 1991) have used net output as the denominator of *PCM* on the grounds that sales revenue is influence by input prices, duties and subsidies, and the degree of vertical integration within an industry. These arguments are more important for cross-section studies than for studies using panel data. In any case, regressions using this alternative definition of *PCM* gave results similar to those reported here.

profitability depend on allowing market structure to change to restore the long-run equilibrium. It is therefore important for testing these predictions that one does *not* control for changes in market structure when specifying the profit equation. Moreover, a simultaneous equations approach cannot be used here because it is simply very difficult to find any variable that affects the number of firms and does not also influence profitability. This would be difficult even with much more detailed data than the data available for the present study. Nevertheless, the reduced-form equations can still provide important insights on the interaction between market structure and profitability through a comparison of short-run and long-run effects of competition, as will be shown later in this section.

Let me also point out that it is not possible to use a dynamic panel data model in the present context. This would imply losing the observations for the exogenous variables for the first two periods, and would amount to eliminating much of the variation picked up by the interactions of *CHANGE* with the time dummies. Given that the years in the panel are separated by periods of four or five years, however, it is not clear why there should be any significant effect of lagged values on the endogenous variables in my regressions because of adjustment lags or for other reasons.

A possible objection to the above specification is that some of the independent variables may be endogenous. This is probably not a serious problem for the market size and setup cost proxies, as the variation in these measures across industries and five-year periods is likely to be mainly driven by the variation in the corresponding theoretical variables.[11] A more serious objection is the potential endogeneity of *CHANGE*. In particular, the objection is that whatever difference one may observe in the evolution of concentration after 1958 between industries with *CHANGE* = 1 and industries with *CHANGE* = 0 may be to some extent due to unobserved characteristics that differ between

[11] In the case of market size, an indirect check of this claim is also provided by a comparison of results using ln*SS* with those using sales revenue deflated by industry-specific price indices. If there was an endogeneity problem, one would expect the two sets of results to differ. However, the results are in fact similar.

the two groups of industries rather than to the 1956 legislation. Unfortunately, it is not possible to test formally for exogeneity since there are no appropriate instruments for *CHANGE*. However, there are several reasons to believe that the potential endogeneity of *CHANGE* is not a serious problem in the present context. First, Table 1 suggests that the difference in initial conditions between industries affected by the legislation and those not affected is not very pronounced. Second, one could argue that even if *CHANGE* is influenced by certain variables that also affect concentration and are not included in the model, these variables are more likely to be part of the industry-specific effect than of the error term, since the large majority of industries classified as collusive in 1958 were subject to restrictive agreements for many years before the introduction of the 1956 legislation. Such correlations between the industry-specific effects and endogenous variables, if they exist, will not cause any econometric difficulties if an appropriate specification is used.

Moreover, a powerful indirect check of the claim that endogeneity is probably not a serious problem is to examine the evolution of market structure and profitability in the two groups of industries *before* 1958. As pointed out above, the descriptive statistics in Table 2 provide no evidence that any differences between the two groups after 1958 could be attributed to pre-existing differential trends. This will be confirmed by the econometric results below: the coefficient on *CHANGE*Y54* will be nowhere statistically significant, even at the 20% level, suggesting that there was no difference in the evolution of market structure and profitability between the two groups of industries before 1958.

The model was estimated for the whole sample as well as for the sample of exogenous sunk cost industries and the results are presented in Tables 3-5. All the results are for a fixed-effects specification.[12] The reported standard errors are heteroskedasticity-consistent, adjusted for small sample bias following MacKinnon and White (1985). Note

[12] The Hausman test always rejects the random-effects model. In any case, the results from this model with respect to the competition effect are similar with those obtained using fixed-effects estimation.

that two different R^2's are reported: the first does not include the fixed industry effects, while the second does.

Table 3 contains regression results for ln*NFIRMS* and ln*NPLANTS*. Note that in the regressions using the whole sample interaction variables are used to control for possible differences between exogenous sunk cost, advertising-intensive and R&D-intensive industries regarding the effect of market size on the number of firms or plants. In particular, *AD2**ln*SS* (*RD2**ln*SS*) is equal to ln*SS* for industries with typical or average advertising-sales ratio (R&D-sales ratio) over the period higher than 2% and to 0 for industries with advertising-sales ratio (R&D-sales ratio) lower than 2%.[13] The results in Table 3 suggest that the 1956 Act had a strong and statistically significant negative effect on the number of firms in the long run. This effect was only partly realised by 1963 and it was mostly realised by 1968. The magnitude of the coefficient on *CHANGE*Y73* implies that the intensification of price competition following the 1956 Act reduced, on average, the number of firms across all classes of industries by about 12-13% between 1958 and 1973. For exogenous sunk cost industries the effect was even stronger, a fall of about 15-20%. This may understate the impact of competition to the extent that there is measurement error in the construction of *CHANGE* as a result of ineffective or unregistered agreements.

The effect of competition on the number of plants was somewhat weaker: the coefficients on *CHANGE*Y68* and *CHANGE*Y73* in regressions with ln*NPLANTS* are negative but smaller in absolute value than the corresponding coefficients in regressions with ln*NFIRMS* and usually not statistically significant at the 5% level. This implies that, while much of the structural adjustment in British manufacturing following the 1956

[13] I also experimented with alternative interaction variables, namely using 1% instead of 2% as the cut-off point, but these were not statistically significant. In preliminary regressions, I included such interaction variables also for the competition effect, but they were not statistically significant, either individually or jointly. Note that whether an industry's typical advertising-sales ratio or R&D-sales ratio over a period of ten or twenty years is higher or lower than 2% is largely determined by exogenous characteristics such as advertising effectiveness and technological opportunity, so the interaction variables are not endogenous.

legislation took the form of exit, mergers were also part of the process, and hence the reduction in firm numbers was more pronounced than the reduction in plant numbers. Finally, note that the coefficient on the capital-labour ratio is negative and usually statistically significant at the 5% level in these regressions, while that on market size is large, positive and statistically significant at the 1% level. A comparison with the coefficients on the interaction variables *AD2**ln*SS* and *RD2**ln*SS* suggests that market size has a positive effect on firm or plant numbers across classes of industries, although this effect is less pronounced in advertising-intensive industries.[14]

Table 4 presents results for ln*PLANTPROFIT* and ln*FIRMPROFIT*. The first of these variables may be the one more closely associated with the theory described in section 2. This is because the capital-labour ratio is meant to control for setup costs at the *plant* level. (Note, in this respect, that the coefficient on ln*K/L*, which is everywhere positive and statistically significant, is larger in the regressions with ln*PLANTPROFIT*.) To the extent that the plant-to-firm ratio increases, gross profit per firm could rise relative to gross profit per plant if there are significant economies of multi-plant operation. The results in Table 4 provide no evidence of any significant impact of the 1956 Act on the gross profit of the average plant, which is consistent with the theory. Moreover, there is no evidence of any significant impact of the Act on firm gross profit either.

An interesting feature of the results in Tables 3 and 4 is the magnitude of the coefficients on the year dummies. After controlling for market size, the capital-labour ratio, union density, the effect of cartel policy and industry effects, the number of plants or firms in any given industry in 1973 was, on average, about 35-40% lower than in 1958; also, the gross profit of the average plant or firm was more than 60% higher in 1973 than in 1958. This evolution seems in several cases to have continued a trend present during 1954-1958

[14] It is not surprising that differences across classes of industries with respect to the market size effect on firm numbers are not significant. Numerous small firms in advertising-intensive and R&D-intensive industries spend little or nothing on advertising or R&D and may even produce secondary industry products. The endogenous sunk cost models of Sutton (1991, 1998) are not relevant for these firms.

as well. To some extent these high coefficients must be due to the crudeness of the setup cost proxy used here. As *K/L* has been increasing across industries throughout the period, it is correlated with the time dummies; so to the extent that *K/L* is only an imperfect proxy for setup costs and these have also been increasing, their effect could be partly picked up by the time dummies. Note, in this respect, that *K/L* is not statistically significant at the 5% level in some regressions for ln*FIRMS*, and that in random-effects specifications its explanatory power is considerably higher while that of the time dummies is somewhat lower. Moreover, the time dummies may be capturing the effect of scale economies not directly associated with the cost of plant and machinery, such as scale economies in marketing or the raising of finance. Finally, some of the apparent explanatory power of the time dummies may be an artefact of the unbalanced structure of the panel. Still, it is difficult to escape the conclusion that much of the fall in firm and plant numbers during this period was due to factors not explicitly included in the present theory. This, of course, does not invalidate the comparison between industries affected by the 1956 Act and industries not affected to the extent that these other factors are not correlated with the variable *CHANGE*.

While the results in Table 4 are consistent with the theory, the discussion in the previous paragraph and the fact that the overall changes in ln*PLANTPROFIT* and ln*FIRMPROFIT* during the period examined here were probably mainly driven by the large decrease in firm and plant numbers suggest that it is necessary to also look at other profit measures to assess the impact of the 1956 Act on firms' profits. A measure not directly influenced by firm or plant numbers, such as the price-cost margin, should be particularly useful. Table 5 reports the results. The first thing to note is that the coefficients on *CHANGE*Y68* and *CHANGE*Y73* are nowhere statistically significant, even at the 10% level. The failure to detect any long-run effect of price competition on the price-cost margin is consistent with the theory developed in section 2 and justifies the Selten-Sutton emphasis on the effect of firm conduct on market structure rather than on profits. Other variables also have the expected signs and are, on the whole, statistically significant: *K/L* or

K/N has a positive effect on the profit margin, while union density has a negative effect. The coefficient on market size is highly non-significant. The time dummies may again be picking up some of the effect of scale economies on the price-cost margin, given that *K/L* or *K/N* are imperfect proxies and are measured with some error.

It is also very interesting to compare the short-run and long-run impact of competition. This is perhaps the most decisive test of the present theory, since this latter predicts a specific link between the evolution of market structure and the evolution of profitability in the short run and in the long run. Table 3 shows that it was between 1963 and 1968 that most of the restructuring of previously cartelised industries occurred. Also, the overall picture from Table 5 (despite small differences between regressions) is that the price-cost margin declined, on average, between 1958 and 1963 in these industries, before recovering mostly during 1963-1968. Note that the coefficient on *CHANGE*Y63* is everywhere negative and typically statistically significant at the 5% or the 10% level, while the coefficients on *CHANGE*Y68* and *CHANGE*Y73* are sometimes positive, sometimes negative, and nowhere statistically significant. This is exactly the sort of link the theory predicts between the evolution of market structure and the evolution of profitability in previously collusive industries: a moderate effect on the number of firms by 1963, at which date several industries were in short-run disequilibrium with reduced margins; then a significant negative effect on firm numbers between 1963 and 1968, leading to a rise in margins of those industries.

It should also be noted that the coefficient on *CHANGE*Y63* in regressions using *PCM*, although typically significant at the 5% or the 10% level, is nevertheless not large: about one percentage point. This is consistent with the evidence provided by the descriptive statistics of Table 2. It has to be borne in mind that only a subset of the previously cartelised industries were in short-run disequilibrium in 1963. In several industries competition had not yet emerged, and there must have also been many others where competition had emerged but much of the adjustment of market structure had already taken place. Thus the magnitude of the coefficient on *CHANGE*Y63* should not be taken as a

measure of the fall in the price-cost margin following a change of competition regime and prior to any adjustment of market structure; this is likely to be quite larger than one percentage point.

Finally, it may be argued that the profit equations estimated above may inadequately control for industry-specific factors that cause departures from long-run equilibrium. Hence regressions were also run including the variable $\Delta \ln SS$ among the regressors, defined for industry i and year t as the change in $\ln SS$ in the five-year period preceding year t. The coefficient of this variable was everywhere positive and sometimes statistically significant, but the rest of the results did not change. A disadvantage of this alternative specification is that the first-year observation for each industry cannot be used (since $\Delta \ln SS$ is then not available), and this implies dropping all 1954 observations. This is why results have been reported here using the more restricted specification.

5. Concluding remarks.

The results of this paper support the hypothesis of a negative overall effect of the 1956 Act on the number of firms and of no significant effect on profitability. The former result is consistent with the finding of a positive overall impact of the Act on concentration in Symeonidis (2000a). Moreover, the comparison of short-run and long-run effects of competition suggests a link between changes in market structure and profitability: in the short run, when the number of firms has not yet fallen very much, profit margins decline; but they recover in the long run, once the number of firms falls. These results are consistent with the theoretical framework developed here, which emphasises the effect of price competition on market structure rather than on profitability. The results say that in long-run equilibrium most cartels will result in excess entry rather than excess profits relative to the absence of collusion. Legislation prohibiting cartels will therefore typically reduce the number of firms rather than their profits.

There can be exceptions to this. Appendix B examines three case studies of the effect of the 1956 Act on market structure and profitability in an attempt to provide

additional insight on the present theory. While two of the case studies conform to the overall picture suggested by the econometric analysis, the third is a counterexample of an industry where competition caused profits to fall and had little effect on firm numbers. It is shown that this was probably due to the violation of a key assumption of the present theory, namely the free-entry zero-profit condition under collusion. In addition to illustrating the limitations of the present theory, this counterexample demonstrates in a powerful way the theory's predictive power. In particular, the reason the theory fails in this special case is that its key assumption fails, which essentially confirms the mechanism driving the theoretical predictions of the present paper.

One thing that has not been much emphasised here is the fact that price-cost margins can change for two different reasons: either because prices change or because unit costs change. Throughout this paper I have tended to focus on changes in margins and to play down the distinction between price and cost changes on the assumption that cost changes are generally passed on to prices, everything else being equal. Nevertheless, I have implicitly attributed the short-run fall in profitability in previously collusive industries to a fall in prices caused by the abolition of price-fixing agreements. On the other hand, the recovery of profitability in the longer term could be due to a recovery in prices or a fall in unit costs or both. Again, I have implicitly attributed much of this recovery to price increases following the drastic fall in the number of firms. But my results are not inconsistent with the view that margins also increased because less efficient firms could not survive in the more competitive conditions of the 1960s and so the unit cost of the average firm fell. In fact, I have hinted in section 2 that such an effect could be part of the story, and in one at least of the case studies discussed in Appendix B it probably was. The point is, however, that any such fall in the unit cost of the average firm that is not fully passed on to prices could not occur without the restructuring of the previously collusive industries. Similarly, the price increases observed in the long run in several industries affected by the 1956 Act could not occur in the absence of mergers and exit.

It may also be worth emphasising that this paper does not provide any direct test of the free-entry zero-profit condition. What has been tested here is not whether net profit is approximately zero in the long run for the marginal firm; this is a very difficult task without firm-level data on profits and capital costs. What this paper has tested is whether a change in firm conduct has any effect on profit in the short run and in the long run. Thus the results presented here would also be consistent with a model that predicts that the net profit of the marginal firm is consistently larger than zero by a non-trivial amount, and that this amount is not much affected by a change in conduct. Of course, one could argue that it is not clear what systematic mechanism could account for the existence, across industries, of supranormal profits for the marginal firm which are relatively stable irrespective of whether firms collude to fix prices or not. In the absence of such a mechanism, the results presented here seem to suggest that the zero-profit condition is a valid assumption, at least as a first approximation, for most industries characterised by free entry. Still, as pointed out by Scherer and Ross (1990), this approximation may be indeed rough, especially for R&D-intensive industries, where firms' capabilities often change at a rate slower than the rate at which technology and demand conditions shift. In such industries, and perhaps also in others, it may be questionable whether a zero-profit equilibrium is actually achieved at any point in time. However, it is probably safe to suggest, on the basis of the results presented here, that in these as in almost all other industries the level of excess profits does not depend, in the long run, on firms' pricing conduct, because of forces such as entry and exit that push industries towards the zero-profit equilibrium. In this sense, the free-entry zero-profit condition stands out as a very useful approximation for the study of competition and the determinants of market structure and profitability.

Table 1. Initial conditions (1954, 1958) in industries affected by the 1956 Act and in industries not affected.

	Mean (St.dev) of ln*NFIRMS*	Mean (St. dev) of ln*NPLANTS*	Mean (St. dev) of ln*PLANTPROFIT*	Mean (St. dev) of ln*FIRMPROFIT*	Mean (St.dev) of *PCM*
All industries with *CHANGE* = 1 (n = 55)					
1954	4.17 (0.96)	4.53 (0.93)	4.22 (0.85)	4.57 (0.91)	0.169 (0.063)
1958	4.06 (0.92)	4.47 (0.90)	4.29 (0.89)	4.70 (0.95)	0.170 (0.061)
All industries with *CHANGE* = 0 (n = 79)					
1954	4.24 (1.16)	4.56 (1.08)	4.09 (1.10)	4.39 (1.23)	0.181 (0.080)
1958	4.10 (1.13)	4.43 (1.08)	4.20 (1.15)	4.51 (1.25)	0.175 (0.078)
Exogenous sunk cost industries with *CHANGE* = 1 (n = 45)					
1954	4.20 (0.95)	4.54 (0.93)	4.05 (0.77)	4.39 (0.83)	0.168 (0.065)
1958	4.08 (0.90)	4.48 (0.90)	4.08 (0.80)	4.48 (0.86)	0.168 (0.064)
Exogenous sunk cost industries with *CHANGE* = 0 (n = 47)					
1954	4.55 (1.01)	4.86 (0.94)	3.65 (0.86)	3.95 (1.00)	0.156 (0.050)
1958	4.43 (1.00)	4.74 (0.93)	3.65 (0.84)	3.98 (0.98)	0.144 (0.042)

Notes: (i) The figures are based on industries with available data for both 1954 and 1958. The figures for ln*FIRMS* and ln*FIRMPROFIT* are based on 77 (rather than 79) industries with *CHANGE* = 0 and 46 (rather than 47) exogenous sunk cost industries with *CHANGE* = 0. The group of industries without change in regime includes 8 collusive industries (7 in the exogenous sunk cost sample). n indicates the number of industries.

Table 2. Average change, 1958-1963 and 1963-1968, of ln*NFIRMS*, ln*NPLANTS*, ln*PLANTPROFIT*, ln*FIRMPROFIT* and *PCM*.

	Δln*NFIRMS*	Δln*NPLANTS*	Δln*PLANTPROFIT*	Δln*FIRMPROFIT*	Δ*PCM*
All industries with *CHANGE* = 1 (n = 62)					
1958-1963	-0.18	-0.09	0.35	0.44	0.024
1963-1968	-0.20	-0.15	0.29	0.33	0.012
All industries with *CHANGE* = 0 (n = 82)					
1958-1963	-0.09	-0.03	0.40	0.47	0.032
1963-1968	-0.09	-0.05	0.24	0.27	0.004
Exogenous sunk cost industries with *CHANGE* = 1 (n = 52)					
1958-1963	-0.19	-0.10	0.35	0.44	0.024
1963-1968	-0.22	-0.16	0.28	0.33	0.011
Exogenous sunk cost industries with *CHANGE* = 1 (n = 48)					
1958-1963	-0.12	-0.07	0.43	0.48	0.033
1963-1968	-0.11	-0.08	0.23	0.26	0.012

Notes: Figures based on industries with available data for 1958, 1963 and 1968. n denotes the number of industries.

Table 3. Regression results for ln*NFIRMS* and ln*NPLANTS*. (Fixed effects estimation.)

	Dependent variable: ln*FIRMS*				Dependent variable: ln*PLANTS*			
	All industries		ADS, RDS < 1%		All industries		ADS, RDS < 1%	
ln*SS*	0.582	0.581	0.518	0.515	0.658	0.658	0.605	0.604
	(0.041)	(0.041)	(0.041)	(0.040)	(0.031)	(0.031)	(0.031)	(0.031)
ln*K/L*	-0.065	-0.064	-0.108	-0.110	-0.125	-0.124	-0.138	-0.138
	(0.047)	(0.047)	(0.055)	(0.055)	(0.041)	(0.041)	(0.048)	(0.048)
UNION	-	-0.346	-	-0.514	-	-0.209	-	-0.194
		(0.293)		(0.381)		(0.226)		(0.286)
Y54	0.113	0.119	0.080	0.086	0.100	0.103	0.063	0.065
	(0.024)	(0.025)	(0.030)	(0.030)	(0.021)	(0.024)	(0.028)	(0.029)
Y63	-0.182	-0.177	-0.191	-0.184	-0.102	-0.099	-0.114	-0.111
	(0.022)	(0.022)	(0.026)	(0.026)	(0.021)	(0.022)	(0.025)	(0.025)
Y68	-0.351	-0.340	-0.321	-0.310	-0.234	-0.228	-0.226	-0.222
	(0.034)	(0.034)	(0.041)	(0.040)	(0.032)	(0.032)	(0.039)	(0.038)
Y73	-0.450	-0.408	-0.401	-0.355	-0.381	-0.356	-0.319	-0.302
	(0.051)	(0.059)	(0.061)	(0.067)	(0.045)	(0.052)	(0.053)	(0.056)
*CHANGE*Y54*	0.004	0.005	0.028	0.030	-0.054	-0.054	-0.028	-0.027
	(0.040)	(0.040)	(0.045)	(0.045)	(0.035)	(0.035)	(0.041)	(0.041)
*CHANGE*Y63*	-0.037	-0.035	-0.021	-0.017	-0.025	-0.024	-0.014	-0.012
	(0.031)	(0.031)	(0.035)	(0.035)	(0.029)	(0.029)	(0.034)	(0.033)
*CHANGE*Y68*	-0.095	-0.086	-0.110	-0.090	-0.063	-0.057	-0.062	-0.545
	(0.041)	(0.043)	(0.048)	(0.052)	(0.035)	(0.036)	(0.040)	(0.043)
*CHANGE*Y73*	-0.133	-0.119	-0.190	-0.155	-0.080	-0.071	-0.128	-0.115
	(0.061)	(0.062)	(0.066)	(0.071)	(0.054)	(0.054)	(0.061)	(0.064)
*AD2**ln*SS*	-0.305	-0.297	-	-	-0.300	-0.296	-	-
	(0.078)	(0.078)			(0.066)	(0.067)		
*RD2**ln*SS*	0.087	0.095	-	-	-0.053	-0.048	-	-
	(0.081)	(0.082)			(0.073)	(0.073)		
R^2	0.64	0.65	0.68	0.68	0.65	0.65	0.65	0.65
R^2_{LSDV}	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hausman statistic	159.8	162.9	143.6	142.7	127.4	130.9	74.4	70.1
Prob-value	≈0	≈0	≈0	≈0	≈0	≈0	≈0	≈0
No. of industries	201	201	134	134	201	201	134	134
No. of industries with *CHANGE* = 1	77	77	65	65	77	77	65	65
No. of observations	758	758	501	501	758	758	501	501

Note: Heteroskedasticity-consistent standard errors in parentheses.

Table 4. Regression results for ln*PLANTPROFIT*, ln*FIRMPROFIT*. (Fixed effects estimation.)

	Dep. variable: ln*FIRMPROFIT*				Dep. variable: ln*PLANTPROFIT*			
	All industries		ADS, RDS < 1%		All industries		ADS, RDS < 1%	
ln*SS*	0.441	0.440	0.455	0.453	0.363	0.362	0.365	0.362
	(0.058)	(0.058)	(0.059)	(0.058)	(0.054)	(0.054)	(0.051)	(0.050)
ln*K/L*	0.146	0.147	0.154	0.152	0.200	0.202	0.182	0.179
	(0.055)	(0.055)	(0.065)	(0.065)	(0.052)	(0.052)	(0.059)	(0.060)
UNION	-	-0.532	-	-0.446	-	-0.638	-	-0.767
		(0.389)		(0.421)		(0.316)		(0.361)
Y54	-0.078	-0.070	-0.018	-0.012	-0.068	-0.058	-0.003	0.007
	(0.036)	(0.036)	(0.039)	(0.039)	(0.035)	(0.035)	(0.038)	(0.037)
Y63	0.347	0.354	0.379	0.385	0.268	0.277	0.302	0.314
	(0.031)	(0.031)	(0.036)	(0.036)	(0.031)	(0.030)	(0.036)	(0.036)
Y68	0.524	0.542	0.575	0.585	0.411	0.431	0.481	0.498
	(0.046)	(0.046)	(0.052)	(0.051)	(0.044)	(0.044)	(0.050)	(0.049)
Y73	0.616	0.680	0.694	0.734	0.566	0.641	0.616	0.685
	(0.067)	(0.070)	(0.075)	(0.077)	(0.059)	(0.066)	(0.069)	(0.074)
*CHANGE*Y54*	-0.043	-0.042	-0.085	-0.083	0.017	0.018	-0.026	-0.024
	(0.057)	(0.057)	(0.062)	(0.062)	(0.054)	(0.054)	(0.060)	(0.059)
*CHANGE*Y63*	-0.014	-0.011	-0.031	-0.028	-0.026	-0.022	-0.038	-0.033
	(0.046)	(0.046)	(0.050)	(0.050)	(0.045)	(0.045)	(0.050)	(0.050)
*CHANGE*Y68*	0.069	0.082	0.028	0.045	0.035	0.052	-0.020	0.009
	(0.055)	(0.057)	(0.061)	(0.065)	(0.051)	(0.051)	(0.056)	(0.059)
*CHANGE*Y73*	0.092	0.114	0.115	0.145	0.012	0.040	0.035	0.088
	(0.086)	(0.090)	(0.086)	(0.094)	(0.079)	(0.081)	(0.087)	(0.094)
*AD2**ln*SS*	0.250	0.261	-	-	0.242	0.257	-	-
	(0.125)	(0.125)			(0.112)	(0.113)		
*RD2**ln*SS*	-0.232	-0.220	-	-	-0.096	-0.081	-	-
	(0.114)	(0.115)			(0.110)	(0.111)		
R^2	0.78	0.78	0.80	0.80	0.74	0.75	0.74	0.74
R^2_{LSDV}	0.97	0.97	0.97	0.97	0.97	0.97	0.96	0.96
Hausman statistic	70.3	79.7	64.1	65.5	46.8	60.5	39.1	45.0
Prob-value	≈0	≈0	≈0	≈0	≈0	≈0	≈0	≈0
No. of industries	201	201	134	134	201	201	134	134
No. of industries with *CHANGE* = 1	77	77	65	65	77	77	65	65
No. of observations	758	758	501	501	758	758	501	501

Note: Heteroskedasticity-consistent standard errors in parentheses.

Table 5. Regression results for *PCM*. (Fixed effects estimation.)

	Dependent variable: *PCM*							
	All industries				ADS, RDS < 1%			
ln*SS*	0.008	0.006	0.008	0.005	0.004	0.002	0.003	0.001
	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)
ln*K/L*	0.020	-	0.021	-	0.014	-	0.014	-
	(0.007)		(0.007)		(0.008)		(0.008)	
ln*K/N*	-	0.012	-	0.013	-	0.007	-	0.007
		(0.006)		(0.006)		(0.007)		(0.007)
UNION	-	-	-0.177	-0.176	-	-	-0.186	-0.188
			(0.042)	(0.041)			(0.051)	(0.051)
Y54	0.006	0.005	0.008	0.008	0.010	0.009	0.012	0.011
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Y63	0.029	0.030	0.031	0.033	0.030	0.032	0.033	0.034
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Y68	0.026	0.030	0.032	0.035	0.036	0.040	0.040	0.043
	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
Y73	0.021	0.030	0.042	0.050	0.040	0.046	0.057	0.062
	(0.009)	(0.009)	(0.009)	(0.009)	(0.011)	(0.010)	(0.010)	(0.009)
*CHANGE*Y54*	-0.003	-0.003	-0.003	-0.003	-0.005	-0.005	-0.005	-0.005
	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
*CHANGE*Y63*	-0.012	-0.012	-0.011	-0.011	-0.011	-0.011	-0.009	-0.009
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
*CHANGE*Y68*	-0.004	-0.004	0.001	0.001	-0.010	-0.010	-0.003	-0.003
	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)	(0.008)	(0.008)
*CHANGE*Y73*	-0.003	-0.011	0.005	-0.003	-0.008	-0.014	0.004	-0.001
	(0.011)	(0.011)	(0.011)	(0.011)	(0.013)	(0.013)	(0.013)	(0.014)
*AD2**ln*SS*	-0.013	-0.015	-0.009	-0.012	-	-	-	-
	(0.015)	(0.015)	(0.015)	(0.015)				
*RD2**ln*SS*	-0.025	-0.026	-0.021	-0.022	-	-	-	-
	(0.014)	(0.014)	(0.014)	(0.014)				
R^2	0.28	0.28	0.31	0.30	0.33	0.32	0.36	0.35
R^2_{LSDV}	0.89	0.89	0.89	0.89	0.88	0.88	0.88	0.88
Hausman statistic	29.62	29.15	39.58	37.52	19.82	17.73	28.94	26.56
Prob-value	0.003	0.004	0.0002	0.0004	0.03	0.06	0.002	0.005
No. of industries	201	201	201	201	134	134	134	134
No. of industries with *CHANGE* = 1	77	77	77	77	65	65	65	65
No. of observations	760	758	760	758	502	501	502	501

Note: Heteroskedasticity-consistent standard errors in parentheses.

APPENDIX A

The industry definitions used in this paper are sometimes at the three-digit level of aggregation and sometimes at the four-digit level. In particular, in most cases they are the 'principal products' within any three-digit 'minimum list heading' (MLH) industry, as defined in the individual industry reports of the UK Census of Production. Whenever a MLH industry is not further subdivided in the Census reports, it was used as the industry definition for this chapter. Because of changes over time in the Census industry or principal product definitions, the panel is unbalanced.

Information on competition was taken from the agreements registered under the 1956 Act, the various reports of the Monopolies Commission, the 1955 Monopolies Commission report on collective discrimination, the 1949 report of the Lloyds' Committee on resale price maintenance, industry studies contained in Burn (1958) and Hart et al. (1973), the Board of Trade annual reports from 1950 to 1956, and the Political and Economic Planning (1957) survey of trade associations (including unpublished background material for this survey).

Data on gross and net output at current net producer prices, wages and salaries, firm numbers, and plant numbers were obtained from the industry reports of the Census of Production (various years) and from 1973 Business Monitors. The figures are for all firms employing at least 25 persons. Certain figures were adjusted to ensure comparability over time. A series of general producer price indices was obtained from the *Annual Abstract of Statistics*.

Industry gross profit is defined as the net value of output minus wages and salaries, and therefore includes fixed costs, such as capital costs, advertising expenditure and R&D expenditure. Unfortunately, it also includes some variable costs, the most important of which are employers' contributions to National Insurance, pension funds, etc. Data on these are not available for most years, and the implicit assumption has been made that these

costs are more or less homogeneous across industries and are therefore picked up by time effects.

Estimates of capital stock, defined as plant and machinery, are available from O'Mahony and Oulton (1990) at the three-digit level of aggregation, i.e. for Census MLH industries. These are net stock estimates constructed on the assumption of fixed and 'short' asset lives and exponential depreciation rates. Given that these figures are at the three-digit level of aggregation, there were two ways to proceed. One was to simply use the three-digit *K/L* or *K/N* on the assumption that changes in these variables over time should be roughly similar for all four-digit industries within any given three-digit industry. An alternative procedure was to adjust the capital stock estimates on the basis of Census data on the fraction of investment on plant and machinery accounted for by each 'principal product' within any given three-digit MLH industry. A very simple adjustment was applied in this paper: the three-digit industry capital stock was in each case multiplied by the ratio of principal product investment to MLH industry investment, averaged over two years. These estimates of capital stock were then matched with employment data or with data on plant numbers at the same level of aggregation. Both the investment figures and the employment figures were taken from the Census industry reports. Small corrections were made to some of these figures to ensure comparability over time.

The adjustment applied here to the capital stock figures is admittedly rough. However, it should produce reasonable approximations of capital stock, or at least of *changes* in capital stock, at the four-digit level. As it turned out, the regression results were largely similar whether I used the three-digit industry estimates of *K/L* or *K/N* or my more refined four-digit industry estimates of *K/L* or *K/N* derived using the procedure outlined above. The only significant difference between the two sets of results was that the use of the adjusted data resulted in larger coefficients and t-statistics on the setup cost proxies themselves. This suggested (i) that the adjustment was in the right direction, and (ii) that any further refinement of the capital stock estimates would not affect the results for the

variables of interest, namely those capturing the competition effect. The results reported in section 4 are those obtained using the adjusted capital stock data.

Union density is defined as the number of unionised employees over the total number of employees. Data on this variable for the period examined here are available at a level of aggregation between the two-digit and the three-digit level and were taken from Bain and Price (1980).

Finally, the procedure for constructing ADS and RDS was essentially the same as in Symeonidis (2000a); see that paper for details and a listing of the sources used. The only complication was the generally low advertising-sales ratios for 1954, sometimes even for industries with high advertising intensity in later years. As the 1954 advertising levels were often not typical, I largely ignored them and used mostly the values of ADS during the period 1958-1968 (or 1958-1973 whenever relevant) to classify the industries according to their typical advertising intensity.

APPENDIX B

Several of the case studies of the effect of the 1956 Restrictive Trade Practices Act analysed in Swann et al. (1973) provide evidence that is consistent with the theory described in this paper. Admittedly, the evidence is somewhat sketchy, as these case studies were not meant to test any specific hypothesis about the effects of the 1956 Act. Moreover, it is not always easy to separate the effect of competition from the influence of other factors on profitability and market structure in the industries examined. Nevertheless, a brief description of the evolution of some of the industries in the Swann et al. sample between the late 1950s and the early 1970s may be useful in providing a better understanding of the kinds of effects that I have tried to identify across industries using econometric analysis in this paper. Two of the best-documented cases are the transformer industry and the glass container industry.

The details on the operation of collusive arrangements in the electrical power transformer industry during the 1950s became widely known even before the implementation of the 1956 Act, since the industry was the subject of a Monopolies Commission inquiry in the mid-1950s, together with other subdivisions of the heavy electrical machinery industry (see Monopolies and Restrictive Practices Commission 1957). Subsequently, the industry registered its agreements and even defended the most important of these in the Restrictive Practices Court, where it was struck down in early 1961. This agreement covered the home market and related to all but the smallest sizes of transformers. It provided for common minimum net selling prices, the reporting of enquiries and orders received from customers, and aggregated rebates, i.e. discounts to buyers on the basis of the total quantity purchased by firms who were parties. These firms were members of the Transformer Makers' Association, which had always included all the producers of very large transformers. However, there was some competition from a few outside firms for large, as opposed to very large, transformers, as well as significant competition from outside firms for smaller equipment. It is therefore not surprising that the

Monopolies Commission found that the profitability of Association firms was lower for the smaller sizes of transformers than for the larger sizes. On the whole, profitability was higher than the average for all manufacturing, but not excessive, according to the Commission. The membership of the Association declined somewhat in the late 1950s, so outside competition may have been stronger in 1961 than at the time of the Monopolies Commission's investigation.

Collusion among members of the Association had been effective during the 1950s, and competition was slow to emerge after the agreement was formally abandoned following the judgement of the Court. Explicit price-fixing was replaced by the exchange of information on prices and tenders, and this helped to sustain prices and margins for several years, despite occasional price-cutting (see Swann et al. 1973). Interestingly, many firms who were not members of the Association at the time of the Court hearing seem to have also adhered to the implicit arrangements after 1961. Eventually, however, competition was triggered by a combination of events, the most important of which may have been a significant fall in demand after 1964. A second factor was the decision of the Restrictive Practices Court to strike down two information agreements in other industries on the grounds that they had the same effect as explicit price fixing. A third factor was a more aggressive purchasing policy on the part of certain buyers. As a result, prices fell by as much as 25-40% between 1964 and 1968, according to figures reported by Swann et al., while costs slightly increased during the same period. The price fall was more pronounced for medium-sized transformers than for very large equipment.

The main response of the industry to this substantial decline in prices and profits was merger and exit. The evolution of market structure in transformers was, of course, closely linked to developments in other markets for heavy electrical equipment, all of which experienced an intensification of price competition during the 1960s. But nowhere was the change in market structure so pronounced as in transformers. According to figures based on the Census of Production, the five-firm sales concentration ratio in the industry, which had actually fallen from 50% in 1958 to 45% in 1963, jumped to 76.7% in 1968, an

increase of over 30 percentage points in five years. Admittedly, this was probably a case of overshooting, as suggested by the fact that subsequently the five-firm concentration ratio declined slightly, and was 68.8% in 1975.

By 1968, then, the industry was much more concentrated than in the early 1960s or even in 1964, the date when prices started falling. Did prices start to rise again in the late 1960s, as would be predicted by the present theory? The answer is that they did, and indeed quite sharply. The evidence reported by Swann et al. suggests that prices started to rise in 1969 and were higher in 1971 than in 1963. In fact, price rises of up to 50% were reported for 1969-1970 and also for 1970-1971, a fact attributed by industry experts to the elimination of excess capacity through merger and exit.

The experience of the glass container industry has much in common with that of the electrical power transformer industry. As in the case of transformers, collusion had a long history in the glass container industry and had been facilitated during the 1950s by the steady and moderate growth in demand. The agreement among producers of glass containers came before the Restrictive Practices Court in 1961 and was defended by the parties. Under the agreement, the members of the British Bottle Association, who were responsible for about 80% of the total UK production of glass containers, had to observe common minimum prices and standard conditions of sale, and also offered aggregated rebates to distributors. Competition from outside producers of glass containers was weak, as several non-members sold only to specific buyers and/or tacitly observed the Association prices. However, there was also competition from producers of containers of different materials, such as paper, tin and plastic, and this had been on the increase at the time the case was heard in the Court.

Swann et al. (1973) report that price competition emerged in the industry soon after the explicit price-fixing agreement was condemned by the Court, despite an attempt to sustain collusion through the operation of an information agreement. Unlike the transformer industry, however, there were no spectacular price falls in glass containers, possibly because demand fluctuations were not very pronounced. Moreover, the price falls

that occurred are somewhat difficult to interpret because the cost of materials seems also to have fallen during the first half of the 1960s. The clearest indication of a change in competition regime is therefore the decline in profitability in the industry in the first half of the 1960s, as documented in Swann et al. on the basis of data from company reports. The largest firm in the industry experienced a continuous decline in its rate of return to capital, which fell from 18% in 1960 to 5.8% in 1965. For other firms the evidence is somewhat mixed as far as the entire period 1960-1969 is concerned, but for all of them profitability clearly declined over 1962-1964, i.e. in the first few years after the emergence of price competition. However, profitability recovered in the mid-1960s. And although the evidence provided by Swann et al. on the profitability of various firms in the second half of the 1960s is rather sketchy, the overall picture is one of sustained moderate profitability for the industry as a whole. At the same time, prices in early 1969 were at roughly the same level as in late 1965, although wages and costs of materials were rising throughout this period. Why did the rate of return on capital recover in the mid-1960s, and how was it then sustained despite increases in input prices that were not fully passed on to selling prices?

The answer is probably twofold. First, technical progress in the industry led to increased efficiency during the 1960s and helped to keep unit cost low despite increases in input prices. Second, the recovery and subsequent stability of profits must have been related to the restructuring of the industry, which was partly realised through a series of mergers beginning in 1962 and continuing until the late 1960s. Thus, according to data from the Census of Production, the five-firm sales concentration ratio in glass containers increased from about 63.5% in 1958 to 69.5% in 1963, and then further to 87.3% in 1968, a rise of nearly 20 percentage points in five years.

The two case studies briefly described above provide support for the theoretical predictions of the present paper and are consistent with the econometric results. The next case is a counterexample. In one sense, this third case also confirms the theory, albeit in a different way than the two previous cases. In particular, the evolution of the secondary battery industry from the late 1950s to the early 1970s illustrates a case where the

predictions of this paper are not confirmed by the facts precisely because a key assumption of the theory, namely the assumption of free entry under the collusive regime, is violated.

The secondary battery industry was investigated by the Monopolies Commission in the early-1960s in the context of the Commission's inquiry into various classes of electrical equipment for vehicles (see Monopolies Commission 1963). Detailed information on the evolution of the industry in the 1950s and the 1960s can therefore be drawn both from the Commission's report and from Swann et al. (1973). Sales of secondary batteries fall into one of four main types: automotive batteries sold as initial equipment, automotive batteries sold for replacement, traction batteries sold as initial equipment, and traction batteries sold for replacement. The structure of the industry has always been characterised by a relatively high degree of concentration, especially in the initial equipment market, which has been dominated throughout the 1950s and the 1960s by the two leading firms, Lucas and Chloride. In the case of automotive replacement batteries, several smaller firms have also been active, and their market share increased during the second half of the 1950s, as we will see below. Overall, the combined market share of Lucas and Chloride was around 70% of total industry sales revenue in 1960.

These two firms were the most prominent members of the British Starter Battery Association, which also included two smaller firms. A number of other firms remained outside the Association, either because they chose to do so or because they were refused membership. The agreement between the members related to replacement batteries for motor vehicles and provided for common list prices, common discounts for various classes of buyers, as well as restrictions on the relationships between manufacturers and buyers. These latter provisions are of considerable interest for our present purposes. There were several classes of buyers, but a key distinction was between 'service agents' and other types of buyers. Each of the four Association members had its own network of service agents, who could only buy from that particular manufacturer. Their names, addresses and total number had to be reported to the Association, and no transfer of an agent from one manufacturer to another could take place without the consent of both Association members

concerned. In addition, the member firms could sell directly to wholesalers, retailers, or fleet operators; there were no *individual* exclusive dealing arrangements for these classes of buyers, but there was *collective* exclusive dealing. In other words, these buyers were required to deal only with Association firms if they were to be supplied at all.

In addition to the agreement on replacement batteries, there was a tacit understanding between Lucas and Chloride that they would not canvass each other's customers in the automotive initial equipment market. Regarding traction batteries, there were occasional discussions on prices between Chloride and the only two other significant producers of this type of battery.

The arrangements on initial equipment and traction batteries were presumably terminated when the 1956 Act was introduced and were never registered. On the other hand, the agreement of the British Starter Battery Association was modified before registration, possibly in an attempt to make it more acceptable to the Court. Two were the main changes: the abandonment of common list prices, and the abolition of collective exclusive dealing. However, the revised agreement provided for maximum trade discounts, and retained the individual exclusive dealing arrangements with 'service agents'. According to Swann et al., the abolition of collective exclusive dealing had a significant impact on the structure of the industry, since smaller firms that had previously found it difficult to enter the industry or expand due to the lack of distribution outlets could now emerge as legitimate competitors in the replacement market. As a result, the combined market share of non-Association firms in the replacement battery market doubled within a few years to reach approximately 50% by the mid-1960s.

In 1960 this revised agreement was abandoned and replaced by an information agreement. Soon after that, the Monopolies Commission began its investigation of the industry. The principal conclusions of the Commission's report regarding the secondary battery industry were that competition was muted and that the two leading firms, especially Lucas, enjoyed excessive profits, although these mainly came from initial equipment and traction batteries, not from automotive replacement batteries. The Commission thought that

resale price maintenance and the operation of the information agreement had contributed to restricting competition in the industry, and recommended that they be abandoned. The information agreement was indeed abandoned shortly afterwards, while resale price maintenance continued for a few years before being dropped as a consequence of the 1964 Resale Prices Act.

The existing evidence on prices and profits indicates that by the mid-1960s competition had increased in the industry and that this trend continued in subsequent years. In fact, Swann et al. argue that the market power of the leading firms was already being eroded in the early 1960s due to competition from smaller producers of cheap batteries. Between 1963 and 1970, prices of a leading manufacturer only increased by about 20% while the cost of materials more than doubled. In addition, the large producers had to introduce cheaper ranges to protect their market share against smaller firms. According to Swann et al., a key factor in this evolution was the ability of the firms to increase their efficiency and hence reduce unit costs through technical improvements and better organisation. Still, there is little doubt that profit margins fell. Although profit data are not readily available, the report of the National Board of Prices and Incomes on prices of secondary batteries (see NBPI 1968) clearly states that the profitability of the larger firms was by no means excessive in 1968, and that the increase in the cost of materials during that year could not be absorbed without an increase in prices.

While price-cost margins have apparently kept falling during the 1960s, there has been no significant change in market structure. No major mergers or exits of important firms had occurred in the industry by 1970. According to the Census of Production, the number of domestic producers of automotive batteries (which is the major product of the industry) employing at least 25 persons fell from 15 in 1958 to 11 in 1963, and then increased to 16 in 1968, on the background of a moderate overall growth in demand during this period. This number is probably driven by the entry and exit of smaller firms. Unfortunately, separate concentration data for this industry are not available. However, the concentration ratio for the battery industry as a whole, including primary and secondary

batteries, increased by about 6 percentage points between 1958 and 1968. This is slightly less than the average for all manufacturing (8 percentage points), and is consistent with the conclusion that the 1956 Act did not have a major effect on market structure in the secondary battery industry.

In summary, the industry experienced during the 1960s an intensification of price competition, a fall in margins (with no subsequent recovery), and no significant change in market structure. What explains this evolution, which is so different from that of the transformer industry or the glass container industry or indeed several other industries affected by the restrictive practices legislation? The answer is certainly not to be found in any substantial fall in endogenous sunk costs. Both advertising and R&D were moderate in this industry, namely of the order of 1%, and, moreover, did not change very much during the 1960s. Rather the answer has to do with the initial conditions in the industry, and particularly the existing barriers to entry. In the replacement battery market, the system of collective exclusive dealing seems to have acted as a barrier to entry of smaller firms. Its abolition in the late 1950s completely changed the nature of competition in the industry. As for the initial equipment market, the market power of the two leading firms had been based both on their ability to offer better products as well as to the existence of long-standing relationships between the battery producers and the car manufacturers. These were relationships that the battery firms were unwilling to undermine.

The econometric results of this paper suggest that the experience of the secondary battery industry was exceptional among industries affected by the 1956 Act and cannot therefore undermine the key assumptions of the theory set out in the introduction to this chapter. In fact, it can even be regarded as a counterexample that essentially confirms the mechanism driving the theoretical predictions of this paper.

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