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Competition and Innovation in 1950's Britain

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ABSTRACT

Competition and Innovation in 1950's Britain

We find little support for the Schumpeterian hypothesis of a positive relationship between market power and innovation in 1950's Britain even though many economists and policymakers accepted it at the time. Price-fixing agreements were very widespread prior to the 1956 Restrictive Practices Act and they seem to have had adverse effects on costs and productivity. Competition policy appears to have been much too lenient but the productivity problems of British industry at this time are best viewed as arising largely from the difficulties of reaping the benefits of innovation rather than from a failure to innovate *per se*.

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There has been a revival of interest in competition policy as a means of promoting productivity performance. Thus, the present government's first competitiveness white paper asserts that 'Competition keeps businesses on their toes and makes them work harder to keep their customers satisfied. It provides the greatest possible incentive for businesses constantly to improve and to become more productive. That is why competitive markets at home are a crucial springboard for global success'.[1] One of the new Labour government's first major pieces of legislation was the 1998 Competition Act.

The present emphasis on the virtues of competition as a prime mover of innovation contrasts quite strongly with both the timidity of early postwar anti-trust policy and also the view of the majority of applied economists of the 1950's and early 1960's.[2] For example, the well-known study of technical progress by Carter and Williams was ostensibly agnostic but directed its emphasis strongly towards criticising suggestions that competition promotes and that restrictive agreements impede technical change.[3] Many commentators noted how impressed the early Monopolies Commission was by the argument that the existence of large firms in oligopolistic or cartelised industries was conducive to technological progress.[4] Rowley saw himself in a minority in arguing that the Commission had been too easily impressed by claims that cartels were good for innovation in cases such as insulin (1949) and electric lamps (1951) and pointed out that contentions that price-fixing agreements encourage R&D were commonplace.[5]

[1] Department of Trade and Industry, *Our Competitive Future: Building the Knowledge Driven Economy* (London, 1998), Cm 4176, p.51.
[2] H. Mercer, *Constructing a Competitive Order* (Cambridge, 1995).
[3] C.F. Carter and B.R. Williams, *Industry and Technical Progress* (London, 1957).
[4] A. Hunter, *Competition and the Law* (London, 1966).
[5] C. K. Rowley, *The British Monopolies Commission* (London, 1966), pp.142, 249.

Schumpeter had, of course, already discussed the issue of the relationship between market structure and technological change prior to the establishment of the Monopolies and Restrictive Practices Commission in 1948.[6] Schumpeter's famous argument was that the profits earned by large, monopolistic enterprise were the allies of innovation as 'the baits that lure capital on untried trails' and it seems clear that this hypothesis had considerable influence during the early postwar period, particularly through the work of Galbraith.[7] Greater heed should perhaps have been paid to Hicks who had already made his well-known remark that the 'best of all monopoly profits is a quiet life', although not specifically with regard to innovative activity.[8]

Today's growth economics sees market power as potentially good for innovation and growth because in Schumpeterian fashion it raises the appropriability of returns while recognising that in a world where shareholders have difficulty in monitoring managers, principal agent problems may be reflected in a lack of energy in pursuing cost reduction in a Hicksian fashion. Thus, Aghion et al. formalise the argument and show that it can go either way.[9] Their model shows that, when managers find cost-reducing effort sufficiently costly, product market competition can act as a disciplinary device fostering technology adoption and growth. If this 'conservative' type of firm predominates, then stronger competition policy is good while industrial policy that subsidises incumbent firms is bad for technological change whereas for profit-maximising firms free of agency costs the opposite is the case.

On the other hand, generally speaking, industrial economists have become rather sceptical of claims that *ex ante* market power conferred by

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[6] J.A. Schumpeter, *Capitalism, Socialism and Democracy* (London, 1943).

[7] Ibid., p.90; J.K. Galbraith, *American Capitalism: The Concept of Countervailing Power* (London, 1957). Schumpeter's claim has two components, namely, that innovative activity increases more than proportionately with firm size and that the prospect of appropriating monopoly rents means that market power encourages technological progress. In this paper we are concerned only with the latter proposition which we term the Schumpeterian hypothesis.

[8] J.R. Hicks, 'Annual Survey of Economic Theory: The Theory of Monopoly', *Econometrica*, Vol.3 (1935), p.8.

[9] P. Aghion, M. Dewatripont, and P. Rey, 'Corporate Governance, Competition Policy and *European Economic Review*, Vol.41 (1997), pp.797-805.

industrial concentration promotes research and development (R&D) and a recent survey concluded that empirical research findings offer little support for this view.[10] This may not be so surprising since the most comprehensive survey data available suggests that imperfections in competition resulting from learning and imitation lags are the most important source of rents for innovating firms.[11] Studies of the impact of market structure on innovation as opposed to R&D are relatively rare. The most important British research has concluded strongly against the Schumpeterian hypothesis. Geroski found that, once differences in technological opportunity across industries were taken into account, the positive indirect effects of market power working through appropriation were heavily outweighed by negative direct effects of lack of competition on managerial innovative effort.[12] The results reported by Blundell et al. showed that increased industrial concentration had a negative and increased import penetration a positive effect, and the authors concluded that, overall, competition promoted innovation.[13] Both studies used data from the Science Policy Research Unit and were for the 1970s.

Nickell notes that competition in the product market may either increase the opportunity for shareholders effectively to monitor managers' performance by providing yardsticks and/or sharpen incentives through raising the sensitivity of profits to managerial effort.[14] These effects can be expected to matter much more, however, where free-rider problems inhibit the exercise of shareholder control and this is what he and his colleagues found in an empirical study of British manufacturing firms during 1985-94 where a reduction in the share of rents from 15 to 3 per cent of value added was found

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[10] W. Cohen, 'Empirical Studies of Innovative Activity', in P. Stoneman (ed.), *Handbook of the Economics of Innovation and Technological Change* (Oxford, 1995), pp.182-264.

[11] R.C. Levin, A.K. Klevorick, R.R. Nelson, and S.G. Winter, 'Appropriating the Returns from *Brookings Papers on Economic Activity*, Vol.3 (1987), pp.783-820.

[12] P. Geroski, 'Innovation, Technological Opportunity, and Market Structure', *Oxford Economic Papers*, Vol.42 (1990), pp.586-602.

[13] R. Blundell, R. Griffith and J. Van Reenan, 'Market Share, Market Value and Innovation in a Panel of British Manufacturing Firms', *Review of Economic Studies*, Vol.66 (1999), pp.529-554.

[14] S.J. Nickell, 'Competition and Corporate Performance', *Journal of Political Economy*, Vol.104 (1996), pp.724-745.

to raise productivity growth by 1 per cent per annum in firms without a dominant external shareholder but to have no effect where there was such an ownership interest.[15]

In the 1950's, market power in Britain was frequently exercised through collusive behaviour. As with other departures from competition, economic theory is ambivalent about the impact of collusion on R&D and innovation. A recent review of this literature did point out, however, that the presumption that cartels are welfare enhancing on Schumpeterian grounds is harder to accept because, unlike the case of a monopoly which restricts output, collusive agreements may well operate on the basis of equiproportionate cuts in output of all members with the least efficient plants remaining in production as members seek to ensure their survival if the cartel breaks down.[16]

The ultimate objective of this paper is to investigate the Schumpeterian hypothesis that market power promotes technological change as applied to 1950's Britain. Was the support for this idea valid then but not later or did it represent an unfortunate policy error ? In order to answer this question, it is necessary in section II first to establish the incidence of cartels at the industry level. Section III then analyses the cross-sectional relationship between market structure and the volume of innovation as measured by the Science Policy Research Unit database while section IV places the results in the context of early postwar productivity performance and competition policy. Conclusions are in section V.

II

THE INCIDENCE OF PRICE-FIXING BASED ON AGREEMENTS REGISTERED UNDER THE 1956 ACT

The 1956 Restrictive Practices Act required that all collusive agreements were registered. The presumption embodied in the Act was that agreements were against the 'public interest' but participants had the

[15] S.J. Nickell, D. Nicolitsas and N. Dryden, 'What Makes Firms Perform Well?', *European Economic Review*, Vol.41 (1997), pp.783-796.

opportunity to defend their agreements in the Restrictive Practices Court to show that there were economic benefits that outweighed any possible loss from anti-competitive practices. Indeed, the 1956 Act itemised six so-called 'gateways' through which a public interest exemption could be obtained. The legislation also created a Registrar of Restrictive Practices whose function was to maintain a public register of agreements and take them to the Court unless they were minor or of no economic significance. The Registrar published Reports initially every two and then every three years.[17]

Although some agreements may have been abandoned straightaway or gone underground, it is generally agreed that registration was fairly complete since, initially, most industrialists were anticipating that there was a good chance that their agreements would be judged not to be against the public interest. Indeed, the window on collusion provided by the 1956 Act offers a unique opportunity to measure the extent of price-fixing. This is because before the Act, investigators had to rely on survey methods, which they fully accepted were unable to give a complete picture of price-fixing.[18] And once it became clear that many of the registered agreements would not be allowed to stand, collusive behaviour became tacit or concealed.

The agreements were subsequently made available for inspection under the auspices of the Registrar for Restrictive Trading Agreements. Elliott and Gribbin analysed their contents with a view to establishing both the extent of price-fixing collusion and also its sectoral incidence at SIC order level.[19] They estimated that 54.1 per cent of output in 1958 manufacturing was subject to cartel regulation while in orders VI (metal manufacture), IX (electrical engineering) and XVI (bricks etc.) the cartelised output share was over 75 per cent. This was a considerably greater proportion than might have

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[16] W.J. Baumol, 'Horizontal Collusion and Innovation', *Economic Journal*, 102 (1992), p.130.
[17] Registrar of Restrictive Trading Agreements, *Report* (London: HMSO).
[18] D. Swann, D.P. O'Brien, W.P.J. Maunder and W.S. Howe, *Competition in British Industry* (London, 1974); Political and Economic Planning, *Industrial Trade Associations* (London, 1957).
[19] D.C. Elliott and J.D. Gribbin, 'The Abolition of Cartels and Structural Change in the United Kingdom', in A. P. Jacquemin and H. W. de Jong (ed.), *Welfare Aspects of Industrial Markets* (Leiden, 1977), pp.345-365.

been supposed from Political and Economic Planning (PEP), who examined the situation immediately prior to the 1956 Act.[20] The PEP estimates, which were based on a survey approach, implied that only about 21 per cent of manufacturing output was cartelised. Elliott and Gribbin provided only a brief description of their methods but their results have generally been accepted as those of well-informed civil servants.[21] They did not, however, disaggregate to Minimum List Heading level which is essential for our purposes.

The only attempt at an MLH classification of which we are aware is by Symeonidis in the research for his unpublished thesis.[22] He revisited both the registered agreements and contemporary secondary sources to see whether there were significant agreements aimed at raising prices. Although he classified industries at Minimum List Heading level, he reported only briefly on his methodology. On the basis of his unpublished estimates, we calculate that he found that 28.6 per cent of value added in manufacturing fell in this category with a further 46.0 per cent regarded as uncertain and only 25.4 per cent definitely free of such agreements. Thus, his results seem to cast some doubt on the accuracy of earlier estimates of the extent of collusive price-fixing.

This section seeks to clarify the incidence of price-fixing in mid-1950's Britain by performing a full analysis of the registered agreements at the MLH level. This will provide the basis for our investigation of the Schumpeterian hypothesis in section III. For research purposes, especially of a quantitative nature, however, it is also useful to provide an inventory of the relevant

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[20] Political and Economic Planning, *Industrial Trade Associations*. The data underlying this study were used by A.L. Phillips, 'An Econometric Study of Price-Fixing, Market Structure and Performance in British Industry in the Early 1950s' in K. Cowling (ed,), *Market Structure and Corporate Behaviour: Theory and Empirical Analysis of the Firm* (London, 1972), pp.177-192, to examine the relationship between price-fixing and profitability.

[21] Elliott and Gribbin, 'Abolition of Cartels'. See, for example, H. Mercer, *Constructing a Competitive Order* (Cambridge, 1995).

[22] G. Symeonidis, 'Competition and Market Structure: Theory and Evidence on the Effects of Restrictive Trade Practices Legislation in the UK, 1954-1977', Ph.D Thesis, University of London (1997).

agreements, and also to set out more transparently the methodology on which the estimates are based. These are the further objectives of this section.

The restrictive agreements have been filed by date of registration. We have examined all files numbered through 3000 covering the period up to 1963 by which time 2430 agreements had been registered.[23] Many of them do not concern price-setting or are quite local in their coverage. For each agreement we recorded the name of the major party involved, product description, date of agreement, details of court proceedings, objects of the agreement including whether these included price-fixing or market-sharing, whether there were detailed price schedules, whether there were lists of who may supply whom, and the number and geographic spread of members. The resulting profile of an agreement could differ quite radically. Thus, file no. 579 on the Electric Light Fittings Association concerns an agreement made in 1954 with has a clear price-fixing objective and detailed price lists which was struck down by the Court in 1960. There were a large number of members from all over the country. By contrast, file no. 2317 on the Manchester and District Brewers' Society details a local agreement from 1958 which has no reference at all to price-fixing or market-sharing among the brewers.

In seeking to establish which industries were most affected by collusive price-fixing, we identified only those agreements containing detailed price lists which applied nationally to manufactured products and assigned these to the appropriate 1968 Standard Industrial Classification MLH.[24] From this category, on the advice of officials in the Office of Fair Trading, notably David Elliott, one of the authors of the 1977 paper, a further subset were identified as serious cases, namely, those which were taken to the Restrictive Practices Court by the Registrar or where the abandonment of agreements was announced by the Registrar as freeing a sector from price-fixing. Thus, file no. 579 (assigned to MLH 369) is in this category whereas file no 2317 plainly is not.

[23] The agreements are available for public inspection at the Government Building, Bromyard Avenue, London W3 7BB. The files are in room 405B (Restrictive Trade Practices).
[24] We did not include very broadly defined industries where only a very small proportion of output was covered by price-fixing agreements.

Industries which had no detailed price list agreements were classified as free of price-fixing cartels. In some cases, only national agreements without price lists were found but in virtually all these sectors these appear to have been quite limited in their impact. In general, a high incidence of agreements without price lists was found only in cases where there was also significant evidence of detailed list agreements. Sectors in which there were detailed price list agreements which were not serious enough for court action or mention of termination in the Registrar's reports were classified in an intermediate category as uncertain. This procedure found 37 three digit MLH industries in the Census of Production subject to serious price-fixing cartels. These sectors are listed in Table 1 while Table 2 lists 47 sectors in which no agreements of any consequence were found. The remaining 148 sectors showed some evidence of price-fixing agreements but these are likely to have had less important economic effects than for the sectors listed in Table 1.

All told, this categorisation of restrictive practice agreements yielded 140 price-fixing agreements that were taken to court of which 132 were struck down or modified. A further 408 agreements with detailed price lists were found which did not go to court and are presumed to have been abandoned or varied so as to eliminate their price-fixing aspects. Of the 2430 agreements registered by June 30, 1963, 1585 were voluntarily terminated.[25] Those agreements which were taken to the Restrictive Practices Court are listed by MLH industry in Table 3. In addition, those which were not taken to court are listed in Appendix Table A1. A few agreements cover more than one MLH heading and 30 were not assigned to an MLH sector either because they do not identify the product clearly enough or because they probably do not relate to manufactured products. Appendix Table A2 reports the classifiable agreements from the 151 without detailed price lists by MLH industry - in this case none was taken to court but in the two italicised cases the ending of the agreement was recorded in the Report by the Registrar even though there were no detailed list agreements.

This method seems to confirm that PEP substantially underestimated the extent of price-fixing agreements in 1950's British industry.[26] The estimates in Tables 1 and 2 suggest that 35.7 per cent of value added in 1958 manufacturing originated in sectors subject to cartelisation and only 27.4 per cent in sectors that were completely free of price-fixing behaviour. At the same time, it is striking that the remaining 36.9 per cent of 1958 manufacturing value added originated in industries where there clearly were attempts at price-fixing but where this may have been rather less than comprehensive or relatively unsuccessful in raising prices above the competitive level.

Comparison of our three-way classification with that made available to us by Symeonidis based on the work for his thesis shows that, in both cases, relatively few sectors were classified as completely free of attempts at price-fixing. Nevertheless, the categorisation of sectors in the two studies varies in about 45 per cent of sectors - in virtually every case by one class. Given this and the relatively high fraction of output in the 'uncertain' category in each case, it would be sensible to regard the point estimate of 54.1 per cent of output under effective cartel regulation in Elliott and Gribbin as subject to a wide margin of error.[27] It also seems desirable in empirical work to recognise that the sectoral incidence of cartelisation is somewhat uncertain and in the econometric work of section III we have experimented with a variable based on the classification given by Symeonidis as an alternative to our own.

Finally, our examination of price-fixing agreements shows that investigation of the Schumpeterian hypothesis must take account of cartels as well as industrial concentration. This point is made by the lack of correlation at the MLH level between our assessment of the degree of price-fixing and the 5 firm concentration ratio. In Table 1, in the cartelised industries, CR5 in 1963 ranges from 10 per cent of employment in Printing & Publishing to 90 per cent in Cement.[28] In Table 2, in the industries without agreements, the range of

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[25] Swann et al., *Competition*, p. 73.
[26] Political and Economic Planning, *Industrial Trade Associations*.
[27] Elliott and Gribbin, 'Abolition of Cartels'.
[28] Although CR5 data also exist for 1958, they are not available on the 1968 SIC basis.

CR5 in 1963 is even wider – from 7 per cent in Timber to 99 per cent in Manmade Fibres. In fact, the average CR5 is very similar in each of the three categories of industry – 44.0 for the cartelised, 40.4 for the no agreement and 44.6 for the uncertain categories, respectively.

III
INNOVATION AND MARKET STRUCTURE

This section uses regressions to investigate the relationship between market structure and innovation in the early postwar period through a cross-section analysis of manufacturing based on the 1968 SIC classification at MLH level. To capture the effects of market power on innovation in a reduced form equation, we follow the specification of Geroski and suppose that innovation in industry *i* (I_i) depends on expected profitability (p_i^e), technological opportunity (m_i), the degree of monopoly (M_i) and other factors (Z_i):[29]

$$I_i = a_0 + a_1 p_i^e + a_2 m_i + a_3 M_i + a_4 Z_i \quad (1)$$

Expected profitability depends in turn on the degree of monopoly, innovation and other factors:

$$p_i^e = b_0 + b_1 M_i + b_2 I_i + b_3 Z_i \quad (2)$$

Substituting for expected profitability from (2) into (1) yields:

$$I_i = g_0 + g_1 M_i + g_2 m_i + g_3 Z_i \quad (3)$$

where the g coefficients depend on the a's and b's. Note that the coefficient on the degree of monopoly in equation (3), $g_1 = \left(\frac{a_3 + a_1 b_1}{1 - a_1 b_2} \right)$ captures both the Schumpeterian and the Hicksian effects of monopoly power on innovation. The Hicksian (direct) effect is captured through the coefficient a_3, which is expected to be negative. The Schumpeterian (indirect) effect is captured through the term $a_1 b_1$, which is expected to be positive. The sign of g_1 is therefore ambiguous.

[29] Geroski, 'Innovation.'

The empirical implementation of equation (3) requires solving a number of issues of measurement, specification and estimation. The first issue concerns the measurement of innovation. Here, following Geroski and Blundell et al., our dependent variable (INNOV) is the number of innovations in each industry, taken from the Science Policy Research Unit (SPRU) data set.[30] The study contains detailed information on 4,378 major innovations in Britain between 1945 and 1983, and we have used data on 986 innovations between 1945 and 1960. Innovations have been assigned to industries on the basis of the Standard Industrial Classification (SIC) of the principal activity of the first user, using the 1968 SIC. As an alternative, it is possible to restrict attention to 845 innovations that were actually produced by the innovating firm. In fact, as we shall see, this makes little difference to the results, since the inter-industry variation is very similar whether innovations are classified by the SIC of the first user or the producer. The SPRU innovation count was derived from a survey of experts who were asked to identify significant technical innovations that had been successfully commercialised in the United Kingdom. The compilers of the survey said that they tried very hard to make sure that the efforts of small firms were fully included but that it is possible that the activities of large firms are over-represented.[31] If anything, then, we might suppose that use of this variable runs some risk of bias in favour of the Schumpeterian hypothesis in our results.

The second issue concerns the variables to capture the degree of monopoly. The strength of domestic competition is captured by the 5-firm concentration ratio (CR5) from Hart and Clarke supplemented by a dummy variable for cartelisation (RESPRAC).[32] The latter is a 0-1-2 variable based on the research reported in section II with a value of 0 assigned to industries

[30] Ibid.; Blundell et al., 'Market Share'. The SPRU data set was obtained from The Data Archive, University of Essex, File No. SN 1675.

[31] For further discussion of this point, see K.Pavitt, M. Robson and J.Townsend, 'The Size Distribution of Innovating Firms in the UK: 1945-1983', *Journal of Industrial Economics*, Vol.35 (1987), pp.297-316.

[32] P.E. Hart, and R. Clarke, *Concentration in British Industry, 1935-1975: A Study of the Growth, Causes and Effects of Concentration in British Manufacturing Industries* (Cambridge, 1980).

listed in Table 2, a value of 2 assigned to industries listed in Table 1 and a value of 1 assigned to the intermediate cases which do not qualify for inclusion in either table. We also wish to take account of the state of international competition. IMPORT is the share of imports in final demand while EXPORT is the share of exports in production by industry. These variables have been calculated for 1948 by reclassifying the trade data on the basis of the 1968 SIC. As a result of this reclassification, we also have a variable EMPIRE, the share of exports going to 'soft' Empire markets in 1948. Confirmation of the Schumpeterian hypothesis that market power encourages innovation would require positive coefficients on CR5, RESPRAC and EMPIRE and negative coefficients on IMPORT and EXPORT.

The third issue concerns the measurement of technological opportunity (m_i) which we tried to capture using two methods. TECH is a zero-one variable, based on the classification made by Robson et al., where industries with a strong potential for innovation take a value of one.[33] The alternative approach of Scherer identifies seven types of technology based on organic chemistry, inorganic chemistry, metallurgy, electronics, electrical engineering, traditional technology (e.g. textiles) and the baseline mechanical engineering.[34] This results in the use of six dummy variables (ORGANIC, INORGANIC, METAL, ELECTRONIC, ELECTRICAL, TRADITIONAL).

The fourth issue concerns the other independent variables (Z_i). CAP and CAPLAB are the capital stock and capital labour ratio in 1954, described in Oulton and O'Mahony and made available to us by Mary O'Mahony.[35] These variables capture the size and capital intensity of industries, respectively. In addition, LOCALAGT, which measures the extent to which

[33] M. Robson, J. Townsend, and K. Pavitt, Sectoral Patterns of Production and Use of Innovations *Research Policy*, Vol.17 (1988), pp.1-14.

[34] F.M. Scherer, 'Demand-Pull and Technological Invention: Schmookler Revisited', *Journal of Industrial Economics*, Vol.30 (1982), pp.225-237.

[35] N. Oulton and M. O'Mahony, *Productivity and Growth: A Study of British Industry, 1954-1986* (Cambridge, 1994).

workers were covered by local (not national) agreements captures the impact of collective bargaining. This variable is described in Broadberry and Crafts.[36]

The fifth issue concerns the estimation method. Since the dependent variable INNOVATION cannot fall below zero, ordinary least squares will tend to bias coefficients towards zero. However, as Geroski notes, the Tobit estimator, the standard procedure to deal with this problem, is not always robust to minor mis-specifications, so that the choice between OLS and Tobit estimates is not necessarily straightforward.[37] Accordingly, we report estimates using both methods.

Before proceeding to the regression results, it may be useful to get a feel for the data. For illustration, Table 4 lists the top innovation sectors together with indicators of their market structure in terms of both cartelisation and industrial concentration. Two points immediately stand out. First, the importance of technological opportunity, and associated with this the potency of R&D, for innovation is apparent. Thus 'hi-tech' sectors like scientific instruments and aerospace equipment are right at the top of the list while 'traditional' sectors like food processing and textiles are nowhere to be seen. Second, it is equally clear that there is no simple relationship between market structure and innovation either in terms of concentration or cartelisation. To judge the validity of the Schumpeterian hypothesis, a multiple regression framework is needed.

The regressions reported in Table 5 display a fairly consistent picture. As expected, technological opportunity exerts an important and statistically

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[36] S.N. Broadberry and N.F.R. Crafts, 'British Economic Policy and Industrial Performance in the *Business History*, Vol.38 No.4 (1996), pp.65-91. J. Tomlinson and N. Tiratsoo, 'An Old Story Freshly Told? A Comment on Broadberry and Crafts' Approach to Britain's Early Post-War Economic Performance', *Business History*, Vol.40 No.2 (1998), pp. 62-72, criticises this variable as a proxy for multiple unionism on the grounds that it is an indirect measure, is measured for a relatively late year, 1973, and that multiple unionism was such that local agreements were pervasive. As S.N. Broadberry and N.F.R. Crafts, 'The Post-War Settlement: Not *Business History*, Vol.40 No.2 (1998), p.77, point out, however, LOCALAGT actually varies between 13.8 per cent and 91.8 per cent in the sample of industries, and there is no evidence to suggest that the pattern of industrial relations changed substantially between 1954/63 and 1973.

[37] Geroski, 'Innovation', p. 595.

significant influence. Note that it makes little difference which form of allowance is made for technological opportunity. Equation (ii) controls for technological opportunity using the single variable TECH, while equations (iii) and (iv) use the six dummy variables. Relative to the baseline of mechanical engineering, opportunities are substantially greater in electronics and lower in traditional technologies. Not surprisingly, the size of the industry in terms of its capital stock has a significant positive influence on the number of innovations used. These results carry over to estimation by Tobit as well as OLS.

Our test of the Schumpeterian hypothesis is based on the variables IMPORT, EXPORT, EMPIRE, CR5 and RESPRAC. On balance, the evidence of these regressions goes against the claim that market power promotes innovation. The export variable is always positive and statistically significant in equations (i) and (iii). CR5 always has a negative sign and is significant when estimation is by Tobit. The signs on RESPRAC and EMPIRE vary across equations but are never statistically significantly positive. IMPORT does always have the required negative sign but the estimated coefficient is small and always has a very low t-statistic. These conclusions are robust to all the permutations that we tried, including omitting variables and replacing RESPRAC with a similar variable based on the cartelisation classification proposed by Symeonidis.[38]

Thus, our results suggest that, if anything the net effect of market power on innovation is negative with the direct Hicksian effect of agency costs tending to dominate the indirect Schumpeterian effect of high expected rents. These results are broadly similar to those of Geroski, who analysed the SPRU data on innovations for the post 1970 period.[39] There is, however, an interesting difference from Geroski's results in that, although TECH and some of the multiple technology dummies are statistically significant, it actually makes little difference to the evaluation of the Schumpeterian hypothesis if no allowance is made for technological opportunity as in equation (i).

[38] In particular, CR5 and RESPRAC remain statistically insignificant if either is dropped or if an interaction term is included.

Predictions concerning the impact of the collective bargaining variable, LOCALAGT, might well vary. On the one hand, it may reflect situations where multiple unionism leads to reluctance to innovate by employers worried about *ex post* threats to profits from workers as in Bean and Crafts, while on the other hand it might be argued that bargaining at the local rather than the national level allows greater flexibility in the adjustment of working practices to facilitate innovation.[40] The latter effect seems to dominate here as LOCALAGT always has a positive sign and is statistically significant in equation (iv). This suggests that the negative impact of LOCALAGT on productivity growth in the 1954-63 period found by Broadberry and Crafts reflects the adverse implications of collective bargaining for manning levels and perhaps organisational change rather than technological change.[41] If so, this would resemble the findings of the early 1980's Workplace Industrial Relations Survey.[42]

IV

PRODUCTIVITY PERFORMANCE AND 1950'S COMPETITION POLICY

In section III we reported that the impact of cartelisation on innovation appears to have been negligible. By contrast, Broadberry and Crafts found that in regressions to explain labour productivity growth in 1954-63 across industries the same variable RESPRAC had a substantial and statistically significant negative effect.[43] The adverse effects of cartels for productivity growth would not surprise readers of the early reports of the Monopolies and Restrictive Practices Commission. The summary of these reports in Elliott and Gribbin underlines that the tendency for prices to be set high enough to allow normal profits (and survival) of the least efficient lowered average productivity

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[39] Geroski, 'Innovation'.
[40] C. Bean and N.F.R. Crafts, 'British Economic Growth Since 1945: Relative Economic Decline …and Renaissance?', in N.F.R. Crafts and G. Toniolo (eds.), *Economic Growth in Europe Since 1945* (Cambridge, 1996), pp.131-172.
[41] Broadberry and Crafts, 'British Economic Policy'.
[42] W.W. Daniel, *Workplace Industrial Relations and Technical Change* (London, 1987).
[43] Broadberry and Crafts, 'British Economic Policy'.

and that the absence of competitive pressure prevented the exit of high cost plant while collective decision-making did not require the cost comparisons that would be made by an efficient monopolist.[44] The review of these early reports by Howard reaches a conclusion similar to the theoretical prediction of Baumol, namely, that rationalisation of production in cartels was precluded by fears of high-cost firms of the consequences in the event of cartel collapse.[45]

While we have found little evidence to support the Schumpeterian hypothesis that market power was associated with high levels of innovation, this does not imply strong support for the view that competitive markets were good for innovation. Rather, it suggests a balance between the Schumpeterian and Hicksian effects. Nevertheless, it is hard to resist the inference that, prior to the Restrictive Practices Act, competition policy was much too lenient. Price-fixing agreements were widespread but there is no evidence that, on average, the static welfare losses that this entailed were compensated by faster technological progress while there do seem to have been negative implications for productivity performance.

Put together with the results on productivity growth during the period 1954-63 presented in Broadberry and Crafts, the above results on innovation aid our understanding of the way that the climate of collusion in early postwar Britain affected industrial performance.[46] Our earlier paper showed that concentration and cartelisation lowered productivity growth, while the current paper shows that concentration and collusion did not have a significant adverse effect on innovation. This suggests that the problems of British industry at this time arose largely not from a failure to innovate *per se,* but rather from difficulties in converting those innovations into higher productivity. This, in turn, offers further support for the emphasis on restrictive labour practices in our earlier paper.[47]

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[44] Elliott and Gribbin, 'Abolition of Cartels' pp.350-1.
[45] J.A. Howard, 'Collusive Behavior', *Journal of Business*, Vol.27 (1954), pp.196-204; W.J. Baumol, 'Horizontal Collusion and Innovation', *Economic Journal*, Vol.102 (1992), pp. 129-137.
[46] Broadberry and Crafts, 'British Economic Policy', p.79.
[47] Broadberry and Crafts, 'British Economic Policy', pp.76, 83-85.

It seems likely that industry quickly perceived that, although a public interest defence of price-fixing on Schumpeterian grounds was possible, it was not very likely to convince the Restrictive Practices Court. Only 10 agreements were successfully defended under the gateway of specific and substantial benefits to the public, of which Stevens and Yamey list only two (Permanent Magnets and Metal Windows) as allowed on the grounds of technical collaboration.[48]

Today's economic theorists stress that, if agency costs in large firms are sufficiently serious, a strengthening of competition will enhance productivity performance and cost reductions while industrial policy subsidies and public ownership will do the opposite. This needs to be set against the resource allocation gains from correcting market failures through such interventions. The history of postwar British microeconomic policy suggests that this point was given far too little weight prior to the 1980's. Thus, the undue influence of Schumpeterian ideas in competition policy in the 1950's is exactly on a par with the naive reliance on nationalisation as a response to natural monopoly and negative externalities which the post-privatisation evidence indicates badly underestimated the problems of monitoring and controlling managers in state enterprises.[49]

V

CONCLUDING COMMENTS

The principal focus of this paper has been to investigate the Schumpeterian hypothesis that market power promoted technological progress in 1950's Britain. We find that there is little evidence to support this proposition despite the support that it commanded at the time and this

[48] R.B. Stevens and B.S Yamey, *The Restrictive Practices Court: A Study of the Judicial Process and Economic Policy* (London, 1965); Department of Prices and Consumer Protection, *A Review of Restrictive Trade Practices Policy*, Cmd. 7512 (1979).

[49] R. Millward, 'The 1940s Nationalizations in Britain: Means to an End or the Means of *Economic History Review*, Vol.50 (1997), pp.209-234; I. Cragg and I.J.A. Dyck, 'Management Control and Privatization in the United Kingdom', *Rand Journal of Economics*, Vol.30 (1999), pp.475-497.

conclusion matches that of later industrial economists. We conclude that there was nothing special about the 1950's and that the economists and policymakers of the day paid too little attention to the Hicksian view of monopoly. Since cartels had adverse effects on productivity performance and on consumers, the absence of any significant effect in promoting innovations suggests that the weakness of anti-trust policy in early postwar Britain was most unfortunate.

During the 1970s, continued state intervention on a large scale suggests that the agency costs issue was not well understood in government. Policies of widespread industrial subsidy, nationalisation and encouragement of mergers would not have been pursued so vigorously had an analysis of their effects based on the "conservative firm" model informed the orthodox view. This raises two important questions for further research. First, is it possible to distinguish between "conservative" and profit-maximising firms in postwar Britain? And second, how and when did serious appreciation of the principal-agent problem take hold in Whitehall?

Table 1. Industries with Price-Fixing Cartels

MLH	CR5 1963	Value Added 1958	In Other Lists
211 Grain Milling	56	67.6	B, P
212 Bread & Flour Confectionery	60	114.0	B
215 Milk & Milk Products	47	43.5	
217 Cocoa, Chocolate & Sugar Confectionery	54	95.8	
232 Soft Drinks	45	35.4	
261 Coke Ovens & Manufactured Fuel	63	36.2	
272 Pharmaceuticals	39	74.1	P
311 Iron & Steel	47	371.3	B, P
312 Steel Tubes	77	69.8	B, P
313 Iron Castings etc.	27	108.7	B, P
322 Copper, Brass	50	69.8	
331 Agricultural Machinery	36	22.8	
335 Textile Machinery	46	43.0	
339(6) Portable Power Tools	24	29.0	
353 Surgical Appliances	23	16.6	
361 Electrical Machinery	53	212.2	
362 Insulated Wires & Cables	73	48.4	B
364 Radio & Electronic Components	44	149.3	B
391 Hand Tools & Implements	29	20.4	P
393 Bolts, Nuts, Screws & Rivets	43	42.3	P
394 Wire & Wire Manufactures	32	42.7	P
412 Cotton Spinning & Doubling	32	80.2	P
415 Jute	60	10.2	
416 Rope, Twine & Net	51	10.1	
419 Carpets	35	31.0	P
422 Made-Up Textiles	15	23.3	
423 Textile Finishing	28	57.9	B, P
446 Hats & Caps	22	9.5	
461 Bricks & Fireclay	27	61.7	B, P
462 Pottery	20	38.7	B, P
463 Glass	52	76.1	B, P
464 Cement	90	25.9	B, P
469(2) Building Materials	19	84.8	B, P
481 Paper & Board	42	105.6	P
486 Newspapers & Periodicals	48	164.0	
489 Printing & Publishing	10	191.0	P
491 Rubber	43	102.8	P
492 Linoleum	62	16.2	B, P

Sources: CR5 is the 5 firm concentration ratio from P.E. Hart and R. Clarke, *Concentration in British Industry, 1935-1975: A Study of the Growth, Causes and Effects of Concentration in British Manufacturing Industries* (Cambridge, 1980); value added is from the Census of Production; B indicates a cartel listed in Board of Trade, *Survey of Internal Cartels* (London, 1946); P is a price-

fixing agreement listed by Political and Economic Planning, *Industrial Trade Associations* (London, 1957).

Table 2. Industries With No National Price List Agreements

MLH	CR5	Value Added	In Other
	1963	1958	Lists
218 Fruit & Vegetable Products	42	56.3	
219 Animal & Poultry Foods	43	52.9	
229(1) Margarine	89	9.2	
229(2) Starch	34	33.8	
239(1) Spirit Distilling	79	43.2	
239(2) British Wines	78	8.0	
240 Tobacco	97	84.7	
263 Lubricating Oils & Greases	39	24.4	
273 Toilet Preparations	32	24.7	
277 Dyestuffs & Pigments	75	25.1	
278 Fertilisers	79	36.6	
279(1) Polishes	63	10.6	
279(4) Pesticides	43	12.7	
279(5) Ink	57	10.9	
332 Metalworking Machine Tools	26	66.3	
339(1) Mining Machinery	37	30.1	
339(2) Printing Machinery	48	24.3	
339(3) Refrigerating Machinery	52	13.7	
339(5/8/9) Other Machinery	24	86.5	
342 Ordnance & Small Arms	77	37.4	
349 General Mechanical Engineering	22	186.8	
351 Photographic Equipment	57	3.6	
366 Electronic Computers	92	10.4	
367 Radio, Radar, etc	69	54.0	
370 Shipbuilding	43	227.0	
382 Motor Cycles & Cycles	73	28.4	
383 Aerospace Equipment	68	284.8	
385 Railway Carriage & Wagon	88	52.6	P
392 Cutlery	41	15.0	
396 Jewellery	33	22.9	
411 Manmade Fibres	99	49.5	P
414 Woollen & Worsted	18	136.7	P
417 Hosiery	18	83.8	
418 Lace	28	8.2	
421 Narrow Fabrics	25	13.7	P
429(2) Miscellaneous Textiles	36	4.7	
431 Leather & Fellmongery	14	25.2	
433 Fur	23	6.7	
449(2) Gloves	29	5.2	
471 Timber	7	63.8	
475 Wooden Containers & Baskets	9	16.0	
479 Misc. Wood & Cork Manufactures	9	18.2	

493 Brushes & Brooms	32	10.6	
494 Toys, Games & Sports Equipment	36	25.5	P
495 Miscellaneous Stationers' Goods	34	13.0	
496 Plastics Products	13	32.8	P
499 Miscellaneous Manufactures	17	26.5	

Sources: as Table 1.

Table 3. Detailed List Price-fixing Agreements by MLH Industry: Cases Contested in the Restrictive Practices Court

211: Grain Milling
782, 784: Incorporated National Association of British & Irish Millers
212: Bread & Flour Confectionery
169: Wholesale Confectioners' Alliance
962: Federation of Wholesale & Multiple Bakers
217: Cocoa, Chocolate & Sugar Confectionery
169: Wholesale Confectioners' Alliance
287: Cadbury Bros
261: Coke Ovens & Manufactured Fuel
650: British Coking Industry Federation
271: General Chemicals
219: Phenol Producers' Association
275: Soap & Detergents
640: UK Glycerine Producers' Association
279(2): Adhesives
2970: Adhesive Tapes Ltd
311: Iron & Steel
414: Silver Steel Association
864: Hardened & Tempered Steel Strip Association
976: Grand Flat Stock Manufacturers' Association
1058: National Bright Steel Stockholders' Association
1059: Alloy Steel Stockholders' Association
1060: National Association of Iron & Steel Stockholders
1079: Crucible & Tool Steel Association
1081: Highspeed Steel Association
1084: Sheetmakers' Conference
1085: Forging Ingots Makers' Association
1092: British Heavy Steel Makers
1093: North East Coast of Scotland Steelmakers' Association
1098: British Steel Bar Association
1100: Cold Rolled Steel Strip Association
1101: British Light Steel Association
1104: Steel Arch & Light Rail Association
1106: Hadfields Ltd.
1109: Stainless Steel Manufacturers' Association
1111: Alloy Steel Bright Bar Association
1112: Alloy Steels Black Bar Association
1113: Alloy Steels Billet Association
1122: National Forgemasters' Association
1125: Railway Tyre & Axle Manufacturers' Association
1128: Rolled Steel Ring Association
1130: Shell Steel Group
1131: National Billet Association

1243: United Steel Companies Ltd.
2049: UK Ferro-Manganese Co. Ltd.
2445: British Iron & Steel Federation*
2801: Federated Forgemasters

312: Steel Tubes

1129: Tube Steel Association

313: Iron Castings

548: British Bath Manufacturers' Association
552: Federation of Hardware Factors
1094: National Association of Hematite Pig Iron Manufacturers
1096, 1097: Basic Pig Iron Producers' Association
2797, 2800: British Ironfounders' Association

322: Copper & Brass

91: Tuyere Makers' Association
508: High Conductivity Copper Association

323: Other Base Metals

1052: Lead Sheet & Pipe Manufacturers' Association

333: Pumps, Valves & Compressors

1301: Portable Air Compressor Association

336: Construction & Earthmoving Equipment

880: Road Roller Manufacturers' Association
958, 2373: Concrete Mixers Manufacturers' Association

339(6): Portable Power Tools

308: Pneumatic Tool Association
478: Twist Drill Association

341: Industrial Plant & Steelwork

1593: Water Tube Boilermakers' Association*
210: British Constructional Steelwork Association

353: Surgical Appliances

2816: British Surgical Trades' Association

354: Scientific & Industrial Instruments

878, 1492: Summation Meter Manufacturers' Association

361: Electrical Machinery

689: English Electric Ltd.
693: Fractional Horsepower Motor Agreement
704: Large Turbine Price Agreement
707: Association of Transformer Manufacturers' Agreement
711: Switchgear Home Agreement
818: Electric Resistance Furnace Agreement
1932: Large Turbine & Large Turbotype Alternator Intercontracting Agreement
1933: British Thomson-Houston Co. Ltd.
1935: Permanent Magnet Association*

362: Insulated Wires & Cables

1461: Mains Cables Manufacturers' Association

364: Radio & Electronic Components
313: British Radio Valve Manufacturers' Association
368: Domestic Electrical Appliances
106: Associated Manufacturers of Domestic Electric Cookers
369: Other Electrical Goods
579: Electric Light Fittings Association
381: Motor Vehicles
1075: National Caravan Council Ltd.
1105: English Steel Forge & Engineering Corporation Ltd.
383: Aerospace
348: Aircraft Bolt & Nut Manufacturers' Association
390: Engineers' Small Tools
1115: High Speed Drill Rod Association
393: Bolts, Nuts, Screws & Rivets
250: Heat Treated Bolt Association
351: Black Bolt & Nut Association of Great Britain*
1057: National Association of Bolt & Nut Stockholders
394: Wire & Wire Manufactures
659: Mild Steel Wire Manufacturers' Association
869: Wire Rope Manufacturers' Association
1005: Patented Steel Wire Association
1031: Rylands Bros.
1068: Reinforcement Conference
1072: British Wire Netting Manufacturers' Association
1123: British Wire Rod Rollers' Association
399: Metal Industries, n.e.s
135: Association of Steel Drum Manufacturers
354: Galvanised Tanks Manufacturers' Association
994: Heavy Coil Spring Association
1002: Laminated Railway Spring Manufacturers
1028: Steel Hinge Makers' Association
1226: Metal Bedstead Association
1530: Pressed Bowl Makers' Association
2618: Group Standard Metal Window Scheme*
412: Cotton Spinning & Doubling
79: Yarnspinners' Agreement
269: Cotton Yarn Doublers' Association
415: Jute
1334: Jute Trade Co-ordination Scheme
1337: Imported Hersian Piece Goods Recommended Prices Agreement
1338: Dundee Hersian Piece Goods Recommended Prices Agreement
1339: Jute Cloth Producers' Association
1340: Dundee Jute Trade
416: Rope, Twine & Net
617: Association of Hard Fibre Rope Manufacturers
618: Trawl Twine Manufacturers' Association

619: Association of Hard Fibre Cord and Twine Manufacturers
867, 993: Locked Coil Ropemakers' Association

419: Carpets

1316: Federation of British Carpet Manufacturers

421: Narrow Fabrics

562: Tape Manufacturers' Association

422: Made-Up Textiles

801: Blanket Manufacturers' Association
1336: Jute Sack & Bag Manufacturers' Association

423: Textile Finishing

393: Dyers & Finishers' Association

441-443: Outerwear

546: Clothing Manufacturers' Federation of Great Britain

446: Hats & Caps

312: Millinery Distributors' Association
1971: Millinery Guild

449: Dress Industries, n.e.s

547: Tie Manufacturers' Association

462: Pottery

2434: Glazed Floor Tile Manufacturers' Association*

463: Glass

660: British Bottle Association
821: Plate Glass Association
837: Glass Benders' Association

464: Cement

77: Cement Makers' Association*

469: Building Materials

512: Associated Paving & Kerb Manufacturers
951: British Concrete Pipe Association

472: Furniture & Upholstery

172: National Association of Retail Furnishers

481: Paper & Board

71, 925: British Paper & Board Makers' Association

482: Packaging Products

71: British Paper & Board Makers' Association

484: Paper & Board, n.e.s

71, 925: British Paper & Board Makers' Association

485-486: Newspapers & Periodicals

656: National Federation of Retail Newsagents, Booksellers & Stationers

489: Printing & Publishing

278: Federation of Master Process Engravers
1586, 1587: Net Book Agreement*
2584: National Federation of Book Trades' Association Ltd.

2608: Diary Publishers' Association
2747: Electrotyping & Stereotyping Employers' Federation

491: Rubber

914: Rubber Producers' Association
963: Staffordshire Motor Tyre Co. Ltd.
964: Tyre Manufacturers' Conference Ltd.

492: Linoleum

729: Linoleum Manufacturers' Association

Source: derived from survey of agreements (based on file numbers) registered with the Registrar for Restrictive Trade Agreements; all entries in this table were contested in the Restrictive Practices Court of which those marked * were allowed to stand.

Table 4. Top Ten Innovating Industries, 1945-1960.

MLH	Innovation Count	CR5 1963	RESPRAC
354 Scientific Instruments	75	22	1
383 Aerospace Equipment	58	68	0
364 Radio & Electronic Components	58	44	2
332 Metalworking Machine Tools	48	26	0
311 Iron & Steel	45	47	2
335 Textile Machinery	41	46	2
272 Pharmaceuticals	35	39	2
333 Pumps, Valves & Compressors	35	23	1
339(1) Mining Machinery	35	37	0
381 Motor Vehicles	32	52	1

Sources: innovations from Science Policy Research Unit, 'Innovations in the UK Since 1945', Data Archive Study Number 1675, (1984); CR5 from P.E. Hart and R. Clarke, *Concentration in British Industry, 1935-1975: A Study of the Growth, Causes and Effects of Concentration in British Manufacturing Industries* (Cambridge, 1980); for RESPRAC, see text.

Table 5. Innovations 1945-1960: Cross-Section Regressions

Estimation Method	OLS (i)	OLS (ii)	OLS (iii)	Tobit (iv)
CONSTANT	3.662	4.126	4.905	-7.536
	(0.534)	(0.661)	(0.701)	(-0.708)
CAP	0.007	0.007	0.007	0.007
	(2.576)	(2.806)	(2.973)	(2.242)
CAPLAB	0.077	-0.005	-0.037	0.053
	(0.419)	(-0.027)	(-0.197)	(0.203)
IMPORT	-0.107	-0.012	-0.031	-0.052
	(-1.095)	(-0.127)	(-0.335)	(-0.345)
EXPORT	0.425	0.177	0.192	0.204
	(4.605)	(1.755)	(2.022)	(1.561)
EMPIRE	-0.113	-0.079	-0.013	0.017
	(-1.317)	(-1.013)	(-0.159)	(0.129)
CR5	-0.081	-0.062	-0.088	-0.182
	(-1.199)	(-1.007)	(-1.406)	(-1.944)
RESPRAC	-1.302	0.159	-0.516	1.223
	(-0.714)	(0.094)	(-0.301)	(0.483)
LOCALAGT	0.150	0.051	0.135	0.318
	(1.675)	(0.599)	(1.449)	(2.278)
TECH		15.685		
		(4.463)		
ORGANIC			3.461	5.607
			(0.513)	(0.640)
INORGANIC			1.001	4.108
			(0.199)	(0.609)
METAL			-4.055	-8.736
			(-0.704)	(-1.113)
ELECTRONIC			35.087	38.309
			(4.689)	(3.960)
ELECTRICAL			-2.157	-1.453
			(-0.363)	(-0.188)
TRADITIONAL			-7.129	-14.816
			(-1.892)	(-2.744)
$\overline{R}^2$	0.297	0.417	0.448	
Log L	-397.05	-387.05	-381.47	-262.48

Notes: dependent variable is INNOV, sample size is 101, t-statistics are reported in parentheses.

APPENDIX: Price Fixing Agreements

Table A1. Detailed List Price Fixing Agreements: Cases Not Contested in the Restrictive Practices Court

212: Bread & Flour Confectionery
185: Self-Raising Flour Association
843: Association of Millers of Proprietary Brown Flour
1542: National Association of Master Bakers, Confectioners & Caterers
2580: Federation of Wholesale & Multiple Bakers
213: Biscuits
610: Rusk Manufacturers Association
1519: National Association of Biscuit Manufacturers
214: Bacon Curing, Meat, Fish
241: British Salted Fish Curers & Exporters
215: Milk & Milk Products
395: Clotted Cream Makers' Association
421: Milk Powder Marketing Company
582: Association of Tinned Cream Manufacturers
584: Association of British Manufacturers of Milk Powder
585: Association of British Dominion Condensed Milk Manufacturers
812: National Association of Creamery Proprietors & Wholesale Dairymen
814: English Butter Conference
1047: Butter Makers & Packers Association
1360: National Dairymen's Association
216: Sugar
842: UK Sugar Dealers' Association
217: Cocoa, Chocolate & Sugar Confectionery
747: Cocoa, Chocolate & Confectionery Alliance
1055: National Union of Retail Confectioners
1246: British Federation of Wholesale Confectioners
218: Fruit & Vegetable Products
1848: Association of Dealers of Crystallised Fruits
219: Animal & Poultry Foods
96: National Association of Dog Biscuit Manufacturers
221: Vegetable & Animal Oils & Fats
755: British Tanning Extract Manufacturers' Association
1182: United Tanners' Federation
232: Soft Drinks
550: Federation of Bottlers' Association
239(1): Spirit Distilling
206: White Spirit Association
261: Coke Ovens & Manufactured Fuel
649: Joint Coke Consultative Committee
2826: Naphthalene Producers' Committee

262: Mineral Oil Refining
1025: National Benzole Co. Ltd.
271: General Chemicals
221: Cresylic Acids Refiners' Committee
415: British Sulphate of Ammonia Federation Limited
785: Potassium Carbonate Association
1033: Association of Tar Distillers
2045: Zinc Oxide Federation
272: Pharmaceuticals
1134: Association of the British Pharmaceutical Industry
2575: National Pharmaceutical Union
274: Paint
598: Scottish Road Emulsion Association
786: White Lead Convention
2595: Wallpaper & Paint Retailers' Association
276: Synthetics
272: 1972 Club (Polythene)
279(2): Adhesives
242: British Dexterine Manufacturers' Association
538: Gelerine & Glue Manufacturers' Association
279(3): Explosives
561: British Pyrotechnists' Association
279(6): Bandages
149: Surgical Dressings Manufacturers' Association
1078: Medical & Surgical Plastermakers' Conference
279(7): Photographic
554: Federation of Engineers' Sensitised Material Manufacturers
1023: Film Laboratory Association
2628: National Photo Finishers' Association
311: Iron & Steel
245: British Steel Founders' Association
256: British Railmakers' Association
861, 862, 1203: Railway Wheel & Axle Manufacturers' Association
893: Cast Iron Axlebox Association
1082: Tinplate Conference
1086: National Sheet Barmakers' Association
1087, 1088: Cylinder & Refined Iron Association
1099: Bright Drawn Steel Flats Association
1107: English Steel Rolling Mills Corporation
1114, 1116: High Quality Staybolt Steel Arrangement
1117, 1118, 1119, 1120: National Forgemasters' Association
1124, 1202: Association of Crank Axle & Crank Axle Component Makers
1126, 1127: Rolled Steel Wheel Manufacturers' Association
1573: Light Rail and Arch Merchants' Association
312: Steel Tubes
276: Cased Tube Association

661, 1937: International Malleable Tubes Fittings Association
677: Large Tube Association
795: Association of Steel Conduit Makers
885: Salt Glazed Conduit Association
1161: Electric Steel Conduit Manufacturers
1258: Collapsible Tube Manufacturers' Association
2500: British Malleable Tubes Fittings Association

313: Iron Castings

828: Cast Iron Chair Association
831: Association of Galvanised Steel Gutter & Pipe Manufacturers
918: Cast Iron Segment Association

321: Aluminium

192: Federation of Light Metal Smelters
1074: British Aluminium Foil Rollers Association

322: Copper & Brass

349: National Brassfoundry Association

323: Other Base Metals

192: Federation of Light Metal Smelters
756: Chrome Green Arrangement
803: Lead Sheet & Pipe Manufacturers' Association
1041: British Hard Metal Association
1399: Associated Lead Manufacturers Ltd.
1625: Magnesite & Chrome Brickmakers' Association

331: Agricultural Machinery

626, 789: Agricultural Machinery & Tractor Dealers' Association
1928: National Master Farmers, Blacksmiths & Agricultural Engineers' Association

332: Metalworking Machine Tools

307: Pneumatic Metal Working Tool Association

333: Pumps, Valves & Compressors

717: Centrifugal & Axial Flow Blower & Compressor Producers' Asociation

334: Industrial Engines

929: Horizontal Engine Agreement

335: Textile Machinery

384: Bobbin Manufacturers' Association
432: Dobby Lag & Peg Makers' Association
515: British Jacquard Engineers' Association
1479: Lace Machine Builders' and Allied Trades' Association
1507: Shuttle Manufacturers' Association

337: Mechanical Handling Equipment

225: Mechanical Handling Engineers' Association
916: Precision Winding Association
1043: National Association of Lift Makers

338: Office Machinery

665: Typewriter Trades' Federation

339(2): Printing Machinery
476: Roll Makers' Association
479: Milling Cutter & Reamer Association
339(4): Space-Heating Machinery
1181: British Heater Federation
339(7): Food & Drink Processing Machinery
264: Milk Filter Medium Manufacturers
530: Food Machinery Association
341: Industrial Plant & Steelwork
182: Range Boilermakers' Association
195: Contractors' Plant Association
229: British Constructional Steelwork Association
391: Association of Shell Boilermakers
685: Large Condenser Price Agreement
715: Small Condenser Price Agreement
953: National Steelwork Erectors' & Sheeters' Association
995, 1303: Scaffold Lashings Association
1073: Gasholder Makers' Association
351: Photographic & Document Copying Equipment
848: Photographic Dealers' Association
352: Watches & Clocks
745: British Impulse Clock Manufacturers' Association
1936: British Clock & Watch Manufacturers' Association
353: Surgical Appliances
672: Opthalmic Prescription Manufacturers' Association
673: British Metal Spectacle Manufacturers' Association
674: Plastic Spectacle Manufacturers' Association
354: Scientific & Industrial Instruments
483, 484: Meter Manufacturers' Association
669: Gas Meter Makers' Conference
675: British Opthalmic Lens Manufacturers' Association
694: Subsidiary Power Instruments Agreement
708: Commercial Instruments Conference
361: Electrical Machinery
668: Association of Manufacturers of Small Switch & Fuse Gear
701: Industrial Electric Motor Control Gear Makers' Agreement
702: Generator Price Agreement
713: Alternator Price Agreement
714: Dynamo & Motor Agreement
716: Small Turbine-Driven Alternator & Generator Price Agreement
720: Marine Type Electric Control Gear Agreement
722: Mining Type Switchgear Agreement
999, 1000, 1001: Permanent Magnet Association
362: Insulated Wires & Cables
750: Independent Cable Makers' Association
1042: Association of Plastic Cable Makers

1462: Mains Cables Manufacturers' Association
1523: Covered Conductors Association
1541: Rubber & Thermoplastic Cable Manufacturers' Association
1553: Rod Rollers Association
1555: Telephone Cable Manufacturers' Association
1556: Home Telephone Cable Manufacturers' Association
1557: Switchboard Cable Association

363: Telegraph & Telephone

37: Automatic Telephone & Electric Co. Ltd.

365: Broadcasting Receiving & Sound Reproducing

2570: Radio & TV Retailers' Association

368: Domestic Electrical Appliances

258: Associated Manufacturers of Domestic Water Heaters
718: AC/DC Electric Ceiling Fans Agreement
719: AC/DC Desk & Bracket Type Electric Fans Agreement

369: Other Electrical Goods

655: British Starter Battery Association
1548: Electric Lamp Industry Council
1620: Electrical Sign Manufacturers' Association

370: Shipbuilding & Marine Engineering

703: Marine Turbo-Generator Agreement
709: Marine Motor & Generator Agreement

381: Motor Vehicles

840: Ford Motor Co. Ltd.

390: Engineers' Small Tools

481: Screw Thread Tool Manufacturers' Association
486: Light Edge Tools & Allied Trades' Association
896: Horstmann Gear Co. Ltd.
1559: Edge Tools Manufacturers' Association

391: Hand Tools & Implements

413: Flexible Back Bandsaw Manufacturers' Association
485: File Trade Association
486: Light Edge Tools & Allied Trades' Association
487: Scythe, Sickle & Hook Manufacturers' Association
888: Bandsaw Association
905: Precision File Association
948: Short Saw & Crosscut Saw Association
977: Circular Longsaw Association
1497, 1670: British Hacksaw Makers' Association
1559: Edge Tool Manufacturers' Association

393: Bolts, Nuts, Screws & Rivets

87: Stainless Steel Bar Products Association
280, 290, 1837: Small Rivet Association
289: Rolled Thread Screw Association
291: Washer Manufacturers' Association of Great Britain
306: Cotter Pin Association

382: Brass Shoe Rivet Association
408, 1466, 1467: Bright Bolt & Nut Manufacturers' Association
492: Shoe Rivet Manufacturers' Association
607, 1838: British Rivet Association
1066: Steel Tack Association
1069: Copper & Zinc Nail Manufacturers' Association
1070: Cut Tip Nail, Cut Bill & Lino Brad Association
1071: Steel Nail Association
1175: British Bolt, Nut, Screw & Rivet Association
1453, 1836: Black Bolt & Nut Association of Great Britain

394: Wire & Wire Manufactures

88: Steel Card Wire Association
110: English Wire Heald Manufacturers' Association
148: Stainless Steel Wire Association
368: Annealed Netting Wire
369: Johnson & Nephew Ltd.
534: Heald Manufacturers' Association
616: Bridgewater Wire Ropeworks Ltd.
623, 624, 1845, 1846: Wire Products Association
627: Upholsterers' Spring Wire Association
628: Strand Association
629: Stitching Wire Association
630: Submarine Cable Wire Arrangement
631: Steel Wire Staples Association
632: Mattress Wire Association
633: Barbed Wire Association
634: Cable Wire Association
865: Combined Wire & Fibre Rope Agreement
945, 1314: UK Paper Machine Wire Manufacturers' Association
996: Brake Cable & Fine Steel Strand Association
998: Woven Wire Association
1004: Piano Wire Association
1281: Chain Link Fencing Association
1302, 1304: Wire Rope Manufacturers' Association
2313: Fencing Wires Association

395: Cans

815: Can Manufacturers' Association

399: Metal Industries, n.e.s

262: Wrought Holloware Trade Employers' Association
390: Pin & Allied Trades' Association
541: Galvanised Holloware Organisation
566: Handle Manufacturers' Agreement
609: Guild of Metal Perforators
639, 2321: Dustbin Manufacturers' Association
683: Gedges Drawbar Hook Manufacturers' Association
834: British Metal Window Manufacturers' Association

835: Metal Window Association Ltd.
957: Bus Seat Frame Association
1132: Spring & Interior Springing Association
1251: Bedstead Fittings Association
1321: Heavy Coil Spring Association
1355: Screw Stopper Makers' Association
1636: Stockless Anchor Association
2259: Steel Hinge Makers' Association
2506: Hook & Band Manufacturers' Association

411: Manmade Fibres

1448: Stockinette Manufacturers' Association

412: Cotton Spinning & Doubling

422: Linen Sewing Thread Manufacturers' Association
1137: Rayon Staple Spinners and Doublers' Association
1221: Soft Hemp & Taw Spinners' Association

413: Weaving of Cotton, Linen & Manmade Fibres

244: Silk Trade Employers' Association
1138: Rayon Weaving Association
1637: Silk & Rayon Trade Protection Society

414: Woollen & Worsted

1176, 1177: Commission Re-combers' Association
1534: British Paper Machine Felt Association

416: Rope, Twine & Net

622: Synthetic Cordage Manufacturers' Association
865: Combined Wire & Fibre Rope Agreement
1140: National Association of Rope & Twine Merchants
1231: Plaited Cordage Manufacturers' Association
1563, 1797: Twine Manufacturers' Association

418: Lace

430: Madras Manufacturers' Association

419: Carpets

253: British Mat & Matting Manufacturers' Association
557: Association of Mohair & Pile Floor Rugs & Mats

421: Narrow Fabrics

143: British Elastic Braid Manufacturers' Association

422: Made-Up Textiles

31: Cotton Canvas Manufacturers' Association
560: Canvas Hose Manufacturers' Association
1315: Furnishing Fabric Manufacturers' Association
1568: Flannelette Association

423: Textile Finishing

75: Bleaching Trade Advisory Board
367: Warp & Milanese Fabric Dyers' Association
838: Midland Hosiery Dyers' & Finishers' Association
942: Association of Co-Licensees
1533: Dyers' Manmade Fabrics Federation

1535: Association of Dyers for Rubber Proofing
1567: Finishers' Association
1606: Lace Curtain Dyers' & Finishers' Association
1800: Association of Drill Dyers
1801: Association of Piece Dyers
2212: Employers' Federation of Cotton Yarn Bleachers
2600: R Group

432: Leather Goods

898, 899, 1371: Council of Leather and Grindery Merchants' Association of Great Britain

449: Dress Industries, n.e.s

1006: Umbrella Components Association

450: Footwear

168: Shoe Tip Association
757, 758: CIMA Ltd
1825: National Association of Cut Sole Manufacturers

461: Bricks & Fireclay

194: Clay Block Association
254: British Sanitary Earthenware Manufacturers' Association
342: National Silica Brickmakers' Association
343: Fireclay Grate Back Association
377: British Ball Clay Producers' Federation Ltd.
765: British Federation of Plumbers' Merchants
791: The Group (Earthenware)
792: Vitreous Enamellers' Association
877, 1808: National Clayware Federation
1277: Pressed Brickmakers' Association Ltd.
1446: British Sanitary Fireclay Association

462: Pottery

68: National Horticultural Pottery Manufacturers' Association
520: Kiln Owners' Association
642: Enamel Association
765: British Federation of Plumbers' Merchants
894: British Teapot Manufacturers' Association
956: British Electro-Ceramic Manufacturers' Association

463: Glass

836: Patent Glazing Conference
1064: National Sheet Glass Merchants' Association

464: Cement

559: Glazed Cement Manufacturers' Association Ltd.

469: Building Materials

181: Association of Constructional Floor Specialists
205: Western Vale Society
216: Asphalt Roads Association
305: Federation of Building Block Manufacturers

371: Quartzite Association
376: National Federation of Terrazzo Specialists
386: Granite Kerb Conference
539: Southern Cast Concrete Association
540: Associated Paving & Kerb Manufacturers
578: National Employers' Federation of Mastic Asphalt Industry
643: National Association of Putty Manufacturers
841: Built Up Roofing Council
952: Asphaltic Roadways Ltd.
1007: Amalgamated Roadstone Corporation Ltd.
1148: Felt Roofing Contractors' Advisory Board
1259: British Whiting Federation
1260: Building Industry Distributors
1671: North Eastern Guild (Kerbs & Flags)
1717: Roadstone Producers' Advisory Council

471: Timber

1844: Home Timber Merchants' Association

472: Furniture & Upholstery

670: Furniture Trade Agreement
671: National Association of Upholstery Fibre Producers

474: Shop & Office Fitting

463: Shopfront Moulding Manufacturers' Association

475: Wooden Containers

2304: Shive Manufacturers' Association

479: Miscellaneous Wood & Cork Manufactures

102: Home Timber Merchants' Association of England & Wales

481: Paper & Board

497: Alex Cowan & Sons Ltd.
498, 1501: Bowaters UK Pulp & Paper Mills Ltd.
499: Association of Wood Free Press
501, 924: Association of Board Makers
506: Association of Makers of Kraft Paper
507: Association of Makers of Imitation Kraft Paper
1149: National Association of Paper Merchants
1193: Clyde Paper Co. Ltd.
1237: Association of Makers of Manilla Papers
1238: Association of Makers of Strawpaper & Fourdrinier Chipboard
1241: Association of Makers of Tissue Paper
1267, 1366: Coated Paper & Board Makers' Association
1328: Imperial Papermills Ltd.
1367: Blackhouse & Coppock Ltd.
1456: Association of Waterproof Paper Manufacturers
1747: Kraft Paper Distribution Association

482: Packaging Products

183: Federation of Paper Tube Manufacturers
556: Association of Corrugated Paper Makers

1235: British Paper Bag Federation
1369: Royal Hands & Grocery Bags Association

483: Manufactured Stationery

987: Envelope Makers & Manufactured Stationers' Association
988: Stationers' Association of Great Britain and Ireland
1239: Association of Makers of MG Envelope Papers

484: Paper & Board, n.e.s

201: Wallpaper Manufacturers' & Employers' Association
495: Association of Lace Paper Makers
496: Association of Makers of Paper Serviettes
502: Association of Makers of Genuine Vegetable Parchment
503: Association of Makers of Esparto Featherweight Papers
504: Association of Makers of Machine-Glazed Poster Paper
923: Association of Makers of Waxing Bleached Imitation Parchment
924: Association of Board Makers
978: Waxed Paper Makers Association
1240: Association of Machine-Glazed Sulphite Paper
1268: Rag Blotting Paper Group
1364: Association of Makers of Esparto Papers
1365: Leatherette Paper Agreement
2595: Wallpaper & Paint Retailers' Association

485-486: Newspapers & Periodicals

850, 851, 852: Wholesale Newspaper Distributors
2001: Associated Newspapers Ltd.

489: Printing & Publishing

73: British Cinema & Theatre Printers' Association
372: Photo-Litho Reproducers' Association
526: National Association of Engravers & Diestampers
1160: Federation of Engravers
1282: Mechanical Printings Group
1333: British Federation of Master Printers
1445: Society of Photo Printers
1929: Small Offset Association

493: Brushes & Brooms

551: British Brushwood Turners' Association

495: Miscellaneous Stationers' Goods

1426: Pencilmakers' Export Group

499: Miscellaneous Manufacturing

537: Reed Manufacturers' Association

Source: as Table 3.

Table A2. Price-fixing Agreements Without Detailed Lists by MLH Industry

212: Bread & Flour Confectionery
844: Soft Flour Committee
2469: Federation of Wholesale & Multiple Bakers
214: Bacon Curing, Meat, Fish
1635: Association of Fish Meal Manufacturers
1962: British Turkey Federation Ltd.
2750: British Bacon Agents' Association
231: Brewing & Malting
1589: Brewers' Society
232: Soft Drinks
577: National Association of Soft Drinks Manufacturers
240: Tobacco
1611: National Union of Retail Tobacconists
271: General Chemicals
134: British Sulphate of Copper Association
274: Paint
385: Building Paints Advisory Council
787: National Association of Wholesale Paint Merchants
1896: National Federation of Associated Paint, Colour & Varnish Manufacturers of the UK
1920: Society of British Paint Manufacturers Ltd.
279(5): Ink
1376: Society of British Printing Ink Manufacturers
311: Iron & Steel
380: British Wrought Iron Association
1030: Railway Cast Bearings Association
1103: Light Rolled Steel Products Conference
312: Steel Tubes
1029: British Hot Finished Tube Conference
313: Iron Castings
474: Foundry Pig Iron Producers' Association
1672: National & Midland Ironfounders' Association
321: Aluminium
419: Light Metal Founders' Association
323: Other Base Metals
410: British Non-Ferrous Metals Association
419: Light Metal Founders' Association
331: Agricultural Machinery
1714: Milking Machine Manufacturers' Association
333: Pumps, Valves & Compressors
232: Hydraulic Association
425, 1418: British Pump Manufacturers' Association
426: Pump Notification Sheme

334: Industrial Engines
686: W. H. Allen & Co. Ltd.
1493: British Internal Combustion Engine Manufacturers' Association
336: Construction & Earthmoving Equipment
83: Excavator Makers' Association
337: Mechanical Handling Equipment
699: Electrically Driven Winding Engine Notification Agreement
700: Hydraulic Machinery Agreement
339(1): Mining Machinery
1824: Skip Plant Association
339(4): Space-Heating Machinery
849: Association of Heating, Ventilating & Domestic Engineering Employers
339(9): Miscellaneous Other Machinery
712: Electrically Driven Rolling Mill Agreement
341: Industrial Plant & Steelwork
509: Water-Tube Boilermakers' Association
819: Electric Melting Furnace Agreement
1348: British Constructional Steework Association
353: Surgical Appliances
1054: Association of British Dental Traders
361: Electrical Machinery
692: Turbine Reduction Gear Price Agreement
695: Switch Gear Agreement
705: Small Turbine Price Agreement
706: Heavy Reduction Gear Agreement
728: Associated Plant Manufacturers
1560: British Electrical and Allied Manufacturers' Association
1842: Adamson, Daniel & Co. Ltd.
1843: W. H. Allen & Sons Ltd.
362: Insulated Wires & Cables
667: Association of Manufacturers of Electric Wiring Accessories
798: British Insulated Cables Ltd.
1685: Telephone Cable Makers' Association
363: Telegraph & Telephone
32: Chadburns & Robinson & Co.
1135, 1452: Automatic Telephone & Electric Co. Ltd.
364: Radio & Electronic Components
1748, 1750-1761, 1764, 1768, 1770-2, 1776: British Radio Valve Manufacturers' Association
365: Broadcasting Receiving & Sound Reproducing
1927: Radio & TV Retailers' Association
367: Radio, Radar & Electronic Capital Goods
117: Electro Medical Trade Association
368: Domestic Electrical Appliances
107: Association of Manufacturers of Domestic Electrical Appliances
384: Locomotives & Railtrack

805, 1827, 1829: Locomotive & Allied Manufacturers' Association of Great Britain

391: Hand Tools & Implements

121: Association of UK Plier Manufacturers
518: Hand-Tool Wholesale Factors Association

393: Bolts, Nuts, Screws & Rivets

1468: Heat Treated Bolt Association
1839: National Association of Bolt & Nut Stockholders
1840: Bright Bolt & Nut Manufacturers' Association

394: Wire & Wire Manufactures

635: Florists' Wires Manufacturers' Association

399: Metal Industries, n.e.s

114, 115: National Association of Drop Forgers & Stampers
119: British Lock & Latch Manufacturers Association
204: British Aluminium Holloware Manufacturers' Association
263: Hearth Furniture & Art Metalware Manufacturers' Association

413: Weaving of Cotton, Linen & Manmade Fibres

403: Ventile Fabrics Association of Great Britain

414: Woollen & Worsted

802: Woollens & Worsted Trade Terms Organisation Ltd.
1569: Worsted Spinners' Federation Ltd.
1926: Branded Knitting Wool Association Ltd.

415: Jute

1400: UK Jute Goods Association

419: Carpets

1831: Association of Manufacturers of Mohair & Pile Floor Rugs & Mats
2078: Federation of British Carpet Manufacturers

431: Leather

255: Hide & Allied Trades Improvement Society

432: Leather Goods

2323: Wholesale Leather & Grindery Merchants of Great Britain

433: Fur

1183: British Hatters' Fur Manufacturers

449: Dress Industries, n.e.s

542: Corset Trade Association

461: Bricks & Fireclay

112: National Tile Fireplace Makers' Association
341: National Firebrick Conference

462: Pottery

574: Glazed & Floor Tile Manufacturers' Association
829: Home Trade Earthenware Association
1785: English China Manufacturers' Association

463: Glass

374: British Chemical Ware Manufacturers' Association
654: British Laboratory Ware Association Ltd.
1681, 1682: British Bottle Association

469: Building Materials
293-295: Architectural Granite Association
398: Society of Builders' Merchants
1192: General Asphalte Co. Ltd.
472: Furniture & Upholstery
651: Wholesale Furnishing Textile Association
473: Bedding
51: Kapok Processors' Association
651: Wholesale Furnishing Textile Association
475: Wooden Containers
1261: Colmore Register
479: Miscellaneous Wood & Cork Manufactures
191: English Joinery Manufacturers' Association
481: Paper & Board
879: Thomas Owen & Co. Ltd.
1368: Association of Makers of Fine Glazed Paper
1370: National Association of Packing & Wrapping Paper Makers
482: Packaging Products
1404: British Carton Association
1406: British Paper Box Association
483: Manufactured Stationery
1225: Law Stationers' Association
485-6: Newspapers & Periodicals
2002, 2004: Daily Telegraph Ltd.
2386: Times Publishing Co. Ltd.
489: Printing & Publishing
2283: Bemrose & Sons Ltd.
491: Rubber
965: Tyre Trade Register
966: Tyre Trade Joint Committee
967: Tyre Manufacturers' Conference Ltd.
968: Rubber Trade Association of London

Source: as Table 3.