PRODUCT MARKET COMPETITION, EFFICIENCY AND AGENCY COSTS: AN EMPIRICAL ANALYSIS

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Abstract

Policy makers in Europe have been concerned that lack of product market competition have led productivity to lag behind the US. Theoretical models are ambiguous about the direction of the effect that product market competition should have on productivity. On the one hand increasing competition lowers firm's profits and thus reduces incentives to exert effort (the Schumpeterian effect), on the other hand it reduces agency costs (or increases the risk of bankruptcy) thus increasing incentives to exert effort. This paper uses panel data on UK establishments over the period 1980-1996 to investigate the relationship between product market competition and productivity levels and growth rates. The introduction of the European Union Single Market Programme (SMP) is used as an instrument for the change in product market competition. The SMP was ex ante expected to affect competition in some industries but not others. It is shown that the Lerner Index fell in the affected industries after the SMP by more than in the non-affected. The results suggest that the increase in product market competition brought about by SMP led to an increase in overall levels of efficiency and growth rates. The sample of firms is then split into those with a principal-agent set up and those without. The increase in efficiency occurred in principal-agent type firms, and not in those where managerial control and ownership were more closely related. These results suggest that product market competition can play an important role in reducing agency costs and may explain some of the poor performance of European economies.

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1 Introduction

Productivity levels and growth rates in many European countries have lagged behind the US and some far eastern economies. Academics and policy makers have focussed attention on the lack of product market competition as one of the main reasons for this poor performance.[1] The idea that competition improves efficiency has a long history in economics. Numerous theoretical models formalise the relationship between product market competition and efficiency with ambiguous predictions.

Empirical work has largely suggested that product market competition is positively correlated with productivity, although this work has been plagued by problems in measuring both the degree of competitiveness and productivity levels or growth rates. In addition, this work has on the whole remained agnostic as to the mechanism through which product market competition affects efficiency.

In this paper the focus is on whether an increase in product market competition had an impact on productivity levels and growth rates, whether it was positive or negative, and whether the increase in competition led to a change in productivity by reducing agency costs. The aim of this paper is to empirically examine these issues. Measuring the degree of product market competition is a notoriously difficult problem. To get around this the implementation of the European Union Single Market Programme (SMP) is used as an exogenous instrument for the level of product market competition.[2] This is shown to be correlated with the Lerner Index, a conventional measure of product market competition. A panel of data on manufacturing establishments in the UK is used. Firms are divided into four categories and measures of efficiency are compared before and after the implementation of the SMP. Firms are categorised by whether or not they are in industries where the SMP was *ex ante* expected to increase product market competition and whether or not they have a principal-agent structure.

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[1] See, inter alia, HM Treasury (1998, 1999, 2000), McKinsey (1997, 1998), Baily and Gersbach (1995), Borshch-Supan (1998) and Januszewski, Koke and Winter (1999).

The layout of the paper is as follows: the next section discusses the theoretical and empirical literature relating product market competition to productivity and efficiency. Section 3 lays out the modelling strategy. Section 4 describes the data, including details of the Single Market Programme, and discusses some econometric and measurement issues. Section 5 presents the empirical results and a final section concludes.

2 Background

There is a large theoretical literature examining the relationship between product market competition and efficiency. Paper in the Schumpeterian tradition suggest that firms' incentives to innovate decrease with competition because there are fewer rents to be shared out. In this paper the main concern is with the impact of product market competition on agency costs. In firms where ownership and management are separated inefficiency arises because managers slack, there is a conflict of interest between owners and managers, and the owners cannot perfectly monitor the managers' effort. How does product market competition affect the managers' incentives to slack? There are a number of models that tackle this question with ambiguous results.

Hart (1983) considers two types of firms: entrepreneurial firms, which are owned and managed by the same person so do not have a principal-agent problem, and managerial firms, in which ownership and management are separated so a principal-agent problem arises. Owners are uncertain about firms' costs so do not know whether bad performance is due to mismanagement or high costs. He shows that, if total and marginal costs are positively correlated across firms (specifically across entrepreneurial and managerial firms) and there are a sufficient number of entrepreneurial firms to affect the market, then managerial firms will have less opportunity to engage in managerial slack. Competition makes the performances of different firms interdependent via prices and thus provides a mechanism for reducing slack. The amount of managerial slack, and the way in which managerial slack responds to changes in product market competition, will be a function

[2] Papers that examine the impact of market integration on the degree of competition include Levinsohn (1993), Sleuwaegen and Yanawaky (1988) and Jaquemin and Sapir (1991).

of how correlated costs are and the size of the entrepreneurial sector relative to the managerial sector. Scharfstein (1988) shows that Hart's result depends on assumptions about managers' utility functions, in particular if the manager's marginal utility from income is strictly positive the opposite result occurs – competition leads to an increase in managerial slack.

Willig (1987) considers a monopoly. In his model competition in the product market makes profits more sensitive to managerial effort. Owners then have incentives to relate managerial remuneration to profits which leads to reductions in X-inefficiency. Competitive pressure is measured in terms of an increase in the price sensitivity of the firm's demand, so price is closer to marginal cost (i.e. lower monopoly rents). The increase in the price elasticity induces managers to expend more effort at the margin.

Vickers (1994) considers a homogeneous goods market with Nash-Cournot competition. There is entry of a lower cost firm and the post-entry equilibrium leads to a ranking of entrants in terms of relative costs. Higher cost (incumbent) firms have incentives to reduce costs. In Holmstrom (1982) and Nalebuff and Stiglitz (1983) the key effect of competition is to increase the information available to the principal (the owner of the firm) in order to enable them to monitor the agent (the manager) more effectively. An increase in the level of product market competition increases the number of firms in the industry and, as long as costs are correlated, this provides additional information to the principal.

Schmidt (1997) abstracts from the informational effects of product market competition. He derives a model in which the optimal incentive scheme is a function of the degree of product market competition. An increase in competition leads to a reduction in firms' profits. This has two effects. First, the probability of liquidation goes up giving managers incentives to work harder. Secondly, the reduction in profits may change the profitability of a cost reducing activity. This can lead to either a reduction or an increase in managers incentives depending on the direction of change.

A model in which product market competition will have the opposite effect and will increase managerial incentives to slack is Martin (1993) who finds that X-inefficiency

rises with the number of firms in Cournot model. In this model marginal revenue declines as the number of firms increases so the principal has less incentive to pay the agent to reduce costs.

There is also empirical work investigating the relationship between competition and productivity. Nickell (1996) and Nickell et al (1997) are concerned with the impact of competition on the level of productivity and its growth rate. These papers are in the structure, conduct, performance tradition – they assume that market structure is exogenous. They find that product market competition (measured in a number of ways including a survey of managers, market share and ex post measures of rents) has a positive impact on total factor productivity. Hay and Liu (1997) use UK industry level data and show that, for a degree of competition (defined by the behaviour of firms rather than number of firms in the market), a firm with lower relative costs will enjoy higher market share and higher price cost margin. When firms' costs are endogenous managers attempt to lower them and this leads to a positive relationship between product market competition and efficiency.[3]

Another way to motivate the analysis in this paper is to note that within establishment growth accounts for a large part of aggregate growth in labour and total factor productivity in the UK.[4] How much of this within growth can be explained by changes in competitive pressure that affect the effort exerted by managers and workers within the establishment? That is one of the questions this paper addresses.

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[3] A number of other studies find a positive relationship between competition and efficiency including – Caves and Barton (1990), Green and Mayes (1991), Caves et al. (1992) (these show that increasing concentration reduces efficiency) and Haskel (1990), Nickell, Wadhwani and Wall (1992) which find a positive relation between competition on levels and growth of productivity. Klette (1999) finds that Norwegian establishments with higher markups tend to have lower productivity.

[4] Disney, Haskel and Heden (2000) show, using the same data as used in this paper, that around 50% of the increase in the level of labour productivity and TFP is due to growth within incumbent firms or shifts in market share to existing higher productivity firms.

3 Modelling strategy

In order to test these ideas empirically we would ideally like to relate exogenous changes in product market competition to productivity measures. However, there are several difficulties with doing this. First, it is very difficult to measure the degree of competition in a market. Secondly, it is unlikely that these changes in competition would be exogenous. Thirdly, it is difficult to measure productivity differences in the presence of imperfect competition and non-profit maximising behaviour.

Because of these difficulties the approach taken in this paper is to:

- assume that the SMP represents an exogenous increase in the degree of product market competition;
- identify two types of industry: those that were affected by the SMP (where non-tariff barriers to trade were high before the SMP and where the SMP brought them down) and those that were not affected by the SMP (where non-tariff barriers were low pre-SMP);
- identify two types of firms: firms with a principal-agent structure (group or managerial firms) and firms that are not (single or entrepreneurial firms).

Measures of efficiency (or at least measures that are correlated with efficiency) are then compared across these groups to identify the impact of an increase in product market competition on measures of efficiency.

Consider a measure of efficiency, denoted *P*. We can think about making the following comparisons:

(time-diff) the difference over time (before (0) and after (1) the SMP)

$$P_1 - P_0 .$$

This will indicate whether there has been a change in the level of TFP over time. However, the change could be due to reasons other than the implementation of SMP.

Therefore, we look at the difference in *(time-diff)* between similar industries that were (A) and were not affected (B) by SMP,

$$(P_{A1} - P_{A0}) - (P_{B1} - P_{B0}).$$

This controls for other (unobserved) factors that may have led to a change in levels of TFP over time, as long as they are common among similar industries.

We can also look at the difference in *(ind-diff)* between group (M=managerial) and single (E=entrepreneurial) establishments,

$$(P_{T1} - P_{T0})^M - (P_{C1} - P_{C0})^M$$
$$(P_{T1} - P_{T0})^E - (P_{C1} - P_{C0})^E.$$

If we see a change in managerial firms and not entrepreneurial this suggests that the change could be due to a reduction in agency costs. By making the comparison between both types of establishments and affected and non-affected industries other (unobservable) factors that may affect productivity levels in single or group establishments are controlled for.

This identification strategy relies on the following assumptions:

(a) whether or not an industry had high non-tariff barriers prior to SMP is independent of the determinants of firm-level productivity in each industry;[5]

(b) the SMP had no impact on the degree of product market competition in the "unaffected" industries;

[5] The most likely source of endogeneity here is that industries with low relative productivity could be more likely to lobby for protection to trade. This would bias the results towards zero.

(c) that entrepreneurial firms have less of an agency problem than managerial firms (how entrepreneurial firms are identified in the data is discussed in Section 4 below) and that this is the major difference between the two types of firms;

(d) that the control and treatment groups have a common time trend.

3.1 Measuring efficiency

There is now the problem of how to measure efficiency or productivity. The measurement or estimation of TFP has received considerable attention in the economic literature.[6] A simple and straight forward measure is labour productivity – measured by value-added per worker,

$$\ln(LP)_{it} = \ln\left(\frac{VA}{Emp}\right)_{it} \qquad (1)$$

where i indexes firms[7] and t indexes time. One problem is that this measure does not account for differences in capital inputs. The usual way to deal with this is to estimate total (or multi) factor productivity. Traditional methods of measuring total factor productivity either use index number techniques and observed data or estimate the production function.

The simplest approach to measuring TFP is to assume a Cobb-Douglas production function and constant returns to scale

$$Y_{it} = A_{it} K_{it}^{(1-a)} L_{it}^{a}$$

[6] See, inter alia, the recent surveys by Hulten (2000), Griliches (1998).

[7] Note that in the empirical application the unit of observation is the establishment which roughly equates to a line of business within a firm, i.e. it is all the plants within a single firm under one 4-digit SIC code. The word firm is used here for ease of exposition.

where Y is value-added,[8] A is a Hicks-neutral productivity shift parameter (total factor productivity), K is a vector of capital inputs and L is a vector of compensated labour inputs. Taking logs and rearranging gives

$$\ln A_{it} = TFP_{it} = y_{it} - al_{it} - (1-a)\ k_{it} \qquad (2)$$

where lower case letters denote logs. This says that log TFP is equal to log output minus inputs weighted by the elasticity of output w.r.t. each input. We don't observe these elasticities. However, profit maximising behaviour when firms are price takers in the labour market implies that wages (w_{it}) are set equal to the marginal revenue product of workers

$$w_{it} = ar_{it}\frac{Y_{it}}{L_{it}}$$

where r_{it} is marginal revenue. Perfect competition in the product market implies that price is equal to marginal revenue so we have

$$a = s = \frac{w_{it}}{p_{it}}\frac{L_{it}}{Y_{it}}$$

where p_{it} is the price of output of the *i*th firm at time *t*. We observe both the numerator (the wage bill) and the denominator (the value of output) of this, so the log level of TFP can be measuring using observed data,

$$TFP_{it} = y_{it} - sl_{it} - (1-s)\ k_{it}\,. \qquad (3)$$

Similarly we can define the growth rate in log TFP as

$$\Delta TFP_{it} = \Delta y_{it} - s\Delta l_{it} - (1-s)\Delta k_{it}\,. \qquad (4)$$

[8] For expositional purposes a value-added production function is used here, in the application below TFP is measured using the value of output and intermediate inputs are included on the right hand side. This can matter because the price indices for output and intermediate inputs are different.

These measures are used because they are well known and provide a useful benchmark. However, a problem for the purpose of this paper is that they give inconsistent measures of TFP when product markets are not perfectly competitive. With imperfect competition in the product market $r_{it} = p_{it}\left(1-\frac{1}{e_{it}}\right)$ where e_{it} is the conjectured price and quantity response of competitors (i.e. it is the elasticity of residual demand) which is increasing in competition and $\left(1-\frac{1}{e_{it}}\right)<1$.

Profit maximising behaviour now implies that

$$w_{it} = ap_{it}\left(1-\frac{1}{e_{it}}\right)\frac{Y_{it}}{L_{it}}.$$

This means that the share of labour is over estimated (and the share of capital under estimated)

$$\hat{s} = m_{it}\frac{w_{it}}{p_{it}}\frac{L_{it}}{Y_{it}} > s$$

where $m_{it} = \left(1-\frac{1}{e_{it}}\right)^{-1} > 1$ is the ratio of price to marginal costs. In this case measured TFP (denoted EstTFP) becomes,[9]

$$\begin{aligned} EstTFP_{it} &= y_{it} - \hat{s}l_{it} - (1-\hat{s})\ k_{it} \\ &= y_{it} - m_{it}sl_{it} - (1-m_{it}s)\ k_{it} \\ &= y_{it} - sl_{it} - (1-s)\ k_{it} - (m_{it}-1)\left(s\ln\left(\frac{L}{K}\right)_{it}\right) \end{aligned} \qquad (5)$$

In the presence of imperfect competition our usual measure of TFP (equation (3)) will give a biased estimate of "true technological" TFP. The size of the bias is

$$Bias = -(m_{it} - 1)\left(s \ln\left(\frac{L}{K} \right)_{it} \right). \quad (6)$$

This will be positive since $\ln\left(\frac{L}{K} \right)_{it} < 0$ almost all of the time. How will the bias vary across firms? The bias is increasing with the markup, m_{it}. The bias is also increasing in the capital to labour ratio.

Is there anything that can be done to correct for this bias? If we had an estimate of the markup, $\hat{m}_{it}$, then we could use this to correct the bias

$$\begin{aligned} TFP_{it} &= y_{it} - \frac{\hat{s}}{\hat{m}_{it}} l_{it} - \left(1 - \frac{\hat{s}}{\hat{m}_{it}} \right) k_{it} \\ &= y_{it} - s l_{it} - (1 - s)\, k_{it}. \end{aligned} \quad (8)$$

Note that $m_{it} = \frac{P}{MC}$ and if $AC \approx MC$ this can be approximated using observed data on the value of output and total costs, $\hat{m}_{it} = \frac{P \cdot Q}{AC \cdot Q} \approx \frac{P}{MC}$.

A further problem that may be of concern is systematic variation in the type and quality of inputs across establishments. In particular, the use of different qualities of labour may be of concern (see Table 3 below). We can allow for this by letting the production function take the form

$$Y_{it} = A_{it} K_{it}^{(1-a_s-a_u)} LS_{it}^{a_s} LU_{it}^{a_u}$$

where *LS* is the number of skilled employees and *LU* the number of operatives.

The measure of TFP that controls for both markups and heterogeneous workers is given by

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[9] See Hall (1988) and Klette (1999).

$$TFP_{it} = y_{it} - \frac{\hat{s}_S}{\hat{m}_{it}} ls_{it} - \frac{\hat{s}_U}{\hat{m}_{it}} lu_{it} - \left(1 - \frac{\hat{s}_S + \hat{s}_U}{\hat{m}_{it}}\right) k_{it} \qquad (9)$$

where

$$a_S = s_S = \frac{ws_{it}}{p_{it}} \frac{LS_{it}}{Y_{it}}; \qquad a_U = s_U = \frac{wu_{it}}{p_{it}} \frac{LU_{it}}{Y_{it}}$$

and where *ws* and *wu* are wages of skilled and operatives respectively. A similar correction can be made to the measure of TFP growth shown in equation (4).

4 Data and measurement issues

The main data used in this paper comes from the Annual Census of Production (ACOP) Respondents Database (ARD). ARD is the establishment level data that is collected under the Annual Census of Production in the UK.[10] Information is collected at two levels – the local unit and the establishment.

The local unit is the smallest entity reported in ARD, it is effectively a plant (a single address). The ARD contains basic information on the population of production plants in the UK (there are around 100,000 to 400,000 reported per year). This includes information on employment and on the location and ownership of the plant (i.e. whether plants are commonly owned, the nationality of owner, region, postcode, etc.).

An establishment can be a single local unit or a group of local units that are commonly owned and operate in the same 4-digit industry. Detailed information on output and inputs is provided at the establishment level on all establishments with over 100 employees and a sample of establishments below this size. Only production establishments are surveyed. This is called the selected data.

Each local unit (plant) has three identifier codes –

[10] See Griffith (1999) for more details.

(1) a unique identifier that is tied to that address (cso_ref), this does not change when ownership changes, but would change if the plant was disassembled and moved to a different location;

(2) an establishment identifier (cso_ref2), this links local units that are owned by the same firm and operate within the same 4-digit industry;

(3) an enterprise (firm) identifier (egrp_ref), this links local units and establishments that are under common ownership.

There is a code (acp_stat) which indicates the legal status of the local unit (incorporated, partnership, government body, charity etc.). There is no information on non-production activities (including head office) or activities located in foreign countries. When collecting the data the ONS asks that all non-production activities undertaken within the production establishments be excluded. There is a country code (fo_code) that identifies the nationality of the ultimate parent company.[11]

One aim of this paper is to look separately at establishments where a principal-agent problem is more or less likely to occur and see how a change in product market competition affects the two groups differently. Four types of plants/establishments can be identified in the data:

Single (or entrepreneurial) establishments: these are independent single plant establishments that are not foreign owned, they include sole proprietors and partnerships;

Group (or managerial) establishments: these are plants that have subsidiary plants, have sibling plants or are foreign owned;

Government or public corporations, central government or local authority bodies;

Other: includes non-profits and undefined.

[11] This information is collected from another survey, the definition of ownership is the same as used for defining foreign direct investment (holding of 25% or more).

Government and Other are dropped from the analysis here (they represent a small proportion of activity in almost all time periods and industries with a few obvious exceptions such as the utilities before privatisation).

It is argued here that in single establishments the manager and owner are more likely to be the same person (or to be closely linked, e.g. through a family connection), while in managerial establishments there is likely to be a separation of managerial control and ownership which makes it more likely that agency costs are higher. Two indicators of this that are available in the ARD data are the number of "working proprietors (excluding salaried directors)" and establishments that are categorised as partnerships. The proportion of establishments of each type are shown in Table 1. Establishments that have at least one working proprietor, or are partnerships represent 17% of singles and 5% of group establishments.

Table 1: Indicators of principal agent structure

	Single		Group	
	Not affected by SMP SENS=0	Affected by SMP SENS=1	Not affected by SMP SENS=0	Affected by SMP SENS=1
Working proprietor	13.58	14.58	3.76	3.97
Partnership	0.84	0.74	0.25	0.22
Working proprietor and partnership	2.15	1.76	0.60	0.28
Neither working proprietor nor partnership	83.44	82.93	95.39	95.52
	100.00	100.00	100.00	100.00

There is then the difficulty of how to treat establishments that switch type. For the purposes of the empirical exercise undertaken in the next section establishments are identified by their initial type (their type in the first year they exist or 1980, which ever is earlier). This is assumed to be exogenously determined.

Column 1 of Table 2 shows the number and proportion of observations in the population of establishments that are single, group or switch between the two types over the period 1980-1996. The vast majority (84%) of observations in the population are single establishments, however a large proportion of these only have a very small number of employees. The second column shows the distribution of observations by type in the

population of establishments which are observed at least two times and which have at least five employees – 66% are single, 20% group and the remainder switch some time during the period. The distribution of establishments observed at least five times with twenty or more employees is shown in column 3.

Table 2: Distribution of observations by type (1980-1996)

Type	Population			Selected		
	all	*at least 2 obs. and 5 or more employees*	*at least 5 obs. and 20 or more employees*	*all*	*at least 2 obs. and 5 or more employees*	*at least 5 obs. and 20 or more employees*
Single	2,335,418	735,579	418,391	52,435	41,515	14,952
	84.27	*66.47*	*57.86*	*27.81*	*24.29*	*14.45*
Group	263,137	215,996	162,653	91,861	87,446	63,220
	9.50	*19.52*	*22.50*	*48.73*	*51.16*	*61.12*
Single to Group	118,283	104,489	96,108	28,242	26,666	16,004
	4.27	*9.44*	*13.29*	*14.98*	*15.60*	*15.47*
Group to Single	54,366	50,501	45,900	15,988	15,292	9,267
	1.96	*4.56*	*6.35*	*8.48*	*8.95*	*8.96*
Total	2,771,204	1,106,565	*723052*	188,526	170,919	103,443
	100.00	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*

Source: Author's calculations using the ARD. Number of establishments 1980-1996 with % in italics, government and other establishments are not included. Only incorporated establishments (acp_stat=1), those with at least one employee and those in manufacturing industries are included. There were 61,567 (2%) observations in establishments that changed type more than once, these were dropped from the population. The selected data has also been cleaned as describe in the Data Appendix.

Only a subset of establishments are sent detailed forms by the ONS, these are called the selected establishments. In the right hand side of the table the same description of the distribution is given for those firms that were selected. These are the establishments which will be used in the analysis below as they are the ones on which detailed data on output and inputs is available. Looking at all selected establishments, 28% are single and almost 50% are group with the rest switching. The fourth column shows the distribution of observations in the selected data that are observed in at least two years and that have five or more employees and the final column those establishments observed at least five times in the selected data with five or more employees.

Table 3 gives some descriptive statistics on establishments of different types split into those industries that were affected by the SMP (the treatment group) and those that were not (the control) in the selected data. Single establishments are much smaller than group

establishments in both sets of industries. Average output and capital stock are around one-tenth the size and employment around one-fifth. They use lower levels of capital per worker and a lower share of skilled (administrative, technical and clerical) workers. Single establishments also pay operatives less. Output over variable costs (a proxy for the markup) are similar across types, and if anything higher in single establishments. These differences may, of course, reflect differences in industry composition as well as differences within industries.

Table 3: Descriptive statistics of selected establishments, 1980-1996

	Single		Group	
	Not affected by SMP SENS=0	Affected by SMP SENS=1	Not affected by SMP SENS=0	Affected by SMP SENS=1
Observations	17,754	13,202	38,363	34,124
Mean real output (1980 £,000)	3,849	4,161	15,100	20,500
Mean real capital stock (1980 £,000)	1,773	1,910	6,027	10,300
Mean employment	129	137	375	519
Capital over labour	12,909	12,557	17,131	18,631
Labour share	0.30	0.31	0.29	0.30
Intermediate share	0.53	0.52	0.53	0.53
Share ATC workers	0.25	0.28	0.32	0.35
Wages (skilled), (1980 £)	4,547	4,526	4,377	4,500
Wages (operatives), (1980 £)	2,956	2,912	3,460	3,315
Output/variables costs	17.9	19.3	17.6	17.4

Source: Author's calculations using the ARD. Government and other establishments are not included.

One concern that arises from these differences in observable characteristics is whether there is common support, that is whether the size distribution of each category of establishment overlaps. Table 4 shows the distribution by size (measured by real output), and we can see that there is support from around the 10 percentile of the single establishments to around the 90^{th} percentile of group establishments.

Table 4: Distribution of size (real output) by establishment type

	Single		Group	
	Control SENS=0	Treatment SENS=1	Control SENS=0	Treatment SENS=1
Mean	3848	4161	15124	20542
SD	6421	10637	51103	72841
1%	289	254	504	469
5%	464	415	952	965
10%	613	557	1398	1434
25%	1017	953	2647	2799
50%	1936	1853	5848	6281
75%	3934	3875	13295	15635
90%	8141	8598	28210	39293
95%	12794	14252	46297	70565
99%	37037	36266	163174	255048

The various measures of efficiency discussed above are calculated using these data. They are implemented using the value of gross output and labour, capital and intermediate goods as inputs (see Data Appendix for details). The factor shares are allowed to vary across 2-digit industries and over time. The mean measure is shown by establishment and industry type in Table 5.

Table 5: Efficiency measures, 1980-1996

	Single		Group	
Observations	SENS=0	SENS=1	SENS=0	SENS=1
Mean labour productivity (real value-added over number employed), (1980 £)	10,479	10,768	13,211	13,279
Level of TFP	3.48	3.52	3.53	3.53
Level of TFP, adjusted for markup	3.00	3.01	3.05	3.06
Level of TFP, adjusted for markup and skills	3.18	3.20	3.23	3.24
Growth of TFP	0.37	0.50	0.46	0.57
Growth of TFP, adjusted for markup	0.32	0.75	0.44	0.73
Growth of TFP, adjusted for markup and skills	0.66	0.82	0.57	0.75

While labour productivity varies across types of establishment , the level of TFP is remarkably similar, even after adjusting for establishment level variation in markups and skills levels. The growth in TFP is considerably more varied.

4.1 EU Single Market Programme (SMP)

The EU Single Market Programme (SMP) is used as an exogenous change in the degree of product market competition. The aims of the SMP were to bring down internal barriers to the free movement of goods, services, capital and labour. The European Commission's White Paper (1985) outlined around three hundred specific measures which were designed to achieve this.

Mayes and Hart (1994) summarise these measures into six main areas of action: (1) unified market in goods and services, (2) unified factor market, (3) promotion of competition, (4) monetary integration, (5) social protection, and (6) united response to external challenges. The measures included harmonising indirect taxes, standards, border controls, lowering the barriers which enable firms to segment markets, thus increasing both the size of the markets and the intensity of competition (e.g. remove nationality requirements, common competition policy, removal of other non-tariff barriers); removal of public sector discrimination in favour of its own firms; reducing the cost of capital and labour by permitting free flow across countries and to assist the process of structural change by investing in infrastructure, technology and human skills (see Burridge and Mayes (1992)).

The measures that were aimed at promoting competition include instituting common rules on regulation, takeovers, state assistance to industry, patents and copyrights, company accounting and disclosure of information, opening up of public procurement to competitive tender and reducing intervention in agriculture. This wide range of measures impacted upon different industries differentially. How can the impact of these measures be quantified?

The Cecchini report attempted to quantify the size of non-tariff barriers in existence before the SMP was implemented. They use a series of surveys and technical papers to assign numerical values to the size of non-tariff barriers in each industry before the SMP.

Industries are divided into three categories by the Cecchini report, those in which

(i) barriers were low pre-SMP so the impact of the SMP was expected to be low, (ii) those with an intermediate level of barriers pre-SMP and where the measures undertaken as part of the SMP were expected to significantly reduce them, and (iii) those where there were high level of barriers pre-SMP and the SMP was expected to significantly reduce them. Categories (ii) and (iii) are considered "sensitive" to the SMP. The classification used here is from Mayes and Hart (1994, p53) of 3-digit industries that were likely to be affected by the SMP.[12] See the data appendix for a list of industries that were classed as "sensitive", the numbers of firms in these industries and the distribution by firm type.

The approach taken in this paper is to use the SMP as an exogenous shock to product market competition and to use a difference in differences estimator to look at the impact of that shock on productivity. Establishments in "sensitive" industries are identified as the "treated" group and compared to the establishments in non-sensitive industries (i.e. the "control" group).

The initial SMP programme was announced in 1986 and implementation was scheduled to take place starting in 1988 and be completed by 1992 (although not all proposals had been implemented by 1992). Thus three time periods are considered:

PRE 1980-1987, pre-SMP
DUR 1988-1992, during implementation of SMP
AFT 1993-1996, after SMP implemented

What impact do we expect the SMP to have on the degree of product market competition? Where the impact of the SMP was to open up previously uncompetitive domestic markets then we expect to see an increase in competition. Where domestic markets were already competitive (e.g. part of an international market) then SMP will either have no effect, or could lead to an increase in the volume of trade. There may also

[12] Buigues et al (1991) identified the sectors within the EU and within each EU country (respectively) which would be most affected. They use three features of the industries – the height of non-tariff barriers to be removed, the degree of price dispersion across EU countries and the degree to which the industry was already exposed to foreign trade. Burridge and Mayes (1993) repeated this exercise for the UK.

be gains from economies of scale, or an increase in the market power of successful domestic firms, since now they may be dominant in a larger market.

Therefore, before turning to look at the impact of SMP on measures of efficiency it is important to first look at the impact of the SMP on some indicators of product market competition. The main indicator used is an establishment specific Lerner Index. Under the assumption that average variable cost provides a good approximation to marginal cost these can be measured as output minus the wage bill and the cost of intermediate inputs, divided by output. Note that output equals $P_{it}Q_{it}$, and the wage bill plus the cost of intermediate inputs equals average variable cost times quantity ($AVC_{it}Q_{it}$). Thus the establishment specific Lerner Index is,

$$Lerner_{it} = \frac{P_{it}Q_{it} - AVC_{it}Q_{it}}{AVC_{it}Q_{it}} = \frac{P_{it} - AVC_{it}}{AVC_{it}}.$$

The first three columns of Table 6 show how the Lerner index changed over time in sensitive industries (relative to non-sensitive). In the first column this is estimated using the sample of all establishments. The markup above (average) variable cost was on average around 18%, and fell by almost 1% more in sensitive industries than in non-sensitive ones (the year dummies, not shown, indicate that it fell in all industries over this time period). These estimates are in line with other empirical estimates of the level of markups in the UK.[13] In the second column the same exercise is repeated on just single establishments. A similar pictures arises, the average markup over (average) variable cost is around 19% and it fell by around 1% after SMP. The third columns looks at group establishments. The average markup above (average) variable costs is lower for this group, around 18%, and fell by just under 1%. This shows that the SMP led to an increase in product market competition, and that the effect was similar across types of establishment.

[13] See, inter alia, Martins et al (1996) who estimate markups for the UK using industry level data of around 16% on average.

In the final two columns the change over time of industry level output and input price indices are compared across sensitive and non-sensitive industries. Overall the output price index rises, but not by as much in sensitive industries. There is no statistical difference in the rise in input prices across industries. This is interesting, because it suggests that an alternative interpretation – that the affect of the SMP was to reduce the cost of inputs and thus impact on measured productivity through an alternative route – is not supported by the data.

Table 6: Impact of SMP on product market competition

	Establishment Lerner Index			4-digit SIC output price	4-digit SIC input price
	All	Single	Group		
observations	103,443	30,956	72,487	2855	2762
AFT*SENS	-0.008	-0.009	-0.007	-0.051	0.003
	(0.002)	*(0.003)*	*(0.002)*	*(.029)*	*0.019*
AFT	-	-	-	0.584	0.383
				(0.021)	*(0.013)*
SENS	-	-	-	-0.095	-0.023
				(.019)	*(0.011)*
Establishment effects	yes	yes	yes		
Year effects	yes	yes	yes		
Industry effects	-			yes	yes

5 Empirical Results

In this section the impact of product market competition on efficiency is estimated, using the SMP as an instrument. Estimates of the impact *(ind-diff)* are obtained from regressions of the form

$$\ln(eff)_{it} = bAFT_t * SENS_i + t_t + h_i + e_{it}$$

where *eff* is one of the measures of efficiency discussed above, SENS=1 if non-tariff barriers were medium or high pre-SMP and (AFT=1) after the implementation of the

SMP was completed. b captures the difference in *eff* due to the SMP (under the assumptions discussed above). This estimator of the impact of SMP controls for other (unobserved) factors that may have led to a change in levels of TFP over time, as long as they are common across the "treated" and "control" establishments.

To identify whether this effect was due to a reduction in agency costs *(type-diff)* the sample is split by type of establishment. This controls for other (unobservable) factors that may have affected efficiency differently in different types of establishments (single or group).

We start in Table 7 by comparing the three "unadjusted" measures of efficiency given by equations (1), (3) and (4). The first is labour productivity (value-added per worker). The second is the conventional Cobb-Douglas index for the level of TFP. The third is the growth in TFP. In the first column all establishments are included. We see that labour productivity went up after the implementation of SMP in establishments in "sensitive" industries by around 2% more than in the other establishments. The level of TFP went up by almost 1% more and the growth in TFP was also nearly 1% higher.

In the second and third columns we split the sample by single and group. In column 2 we see that there were no statistical differences between single establishments in sensitive and non-sensitive industries on any of the three measures. Column 3 shows that there were significant and positive effects for group establishments in sensitive industries. Labour productivity went up by almost 3%, the level of TFP by around one and a half percent and the growth in TFP by just over 1%.

These results provide strong evidence to suggest that product market competition had a positive impact on productivity levels and growth rates and that it did so by reducing agency costs (under the assumption that the main difference between the two groups is agency costs). But what about our concerns over the measurement of productivity. In Table 8 we look at the adjusted measures, and in all but one case a similar picture arises. The level of TFP goes up around 2.7% after adjusting for the markup and skills composition and the growth in TFP goes up by around 1.5%. The only exception is the level of TFP adjusted for the markup only.

Table 7: Impact of SMP on efficiency (unadjusted)

Type of establishment:	All	Single	Group
Labour Productivity			
observations	*103,443*	*30,956*	*72,487*
AFT*SENS	0.023 **	0.010	0.027 **
	(0.006)	*(0.010)*	*(0.007)*
Establishment effects	yes	yes	yes
Year effects	yes	yes	yes
Level of TFP			
observations	*103,443*	*30,956*	*72,487*
AFT*SENS	0.007 *	-0.006	0.014 **
	(0.003)	*(0.006)*	*(0.004)*
Establishment effects	yes	yes	yes
Year effects	yes	yes	yes
Growth of TFP			
observations	*91,972*	*26,968*	*65,004*
AFT*SENS	0.008 *	0.003	0.012 *
	(0.004)	*(0.007)*	*(0.004)*
Establishment effects	yes	yes	yes
Year effects	yes	yes	yes

*Notes: numbers in italics are robust standard errors. ** indicates significant at the 1% level, * indicates significant at the 5% level.*

Table 8: Impact of SMP on efficiency (adjusted)

Type of establishment:	All	Single	Group
Level of TFP, adjusted for mark up			
observations	*103,443*	*30,956*	*72,487*
AFT*SENS	0.038 **	0.035 **	0.038 **
	(0.005)	*(0.009)*	*(0.007)*
Establishment effects	yes	yes	yes
Year effects	yes	yes	yes
Level of TFP, adjusted for mark up and skills			
observations	*97,686*	*29,185*	*68,501*
AFT*SENS	0.026 *	0.019	0.027 **
	(0.007)	*(0.011)*	*(0.008)*
Establishment effects	yes	yes	yes
Year effects	yes	yes	yes
Growth of TFP, adjusted for mark up			
observations	*91,972*	*26,968*	*65,004*
AFT*SENS	0.012 **	0.007	0.015 **
	(0.004)	*(0.009)*	*(0.005)*
Establishment effects	yes	yes	yes
Year effects	yes	yes	yes
Growth of TFP, adjusted for mark up and skills			
observations	*86,198*	*25,197*	*61,001*
AFT*SENS	0.010 *	0.003	0.014 *
	(0.005)	*(0.010)*	*(0.006)*
Establishment effects	yes	yes	yes
Year effects	yes	yes	yes

*Notes: numbers in italics are robust standard errors. ** indicates significant at the 1% level, * indicates significant at the 5% level.*

6 Summary and conclusions

Theoretical models are ambiguous about the impact of product market competition on efficiency. Despite its popular appeal there is little empirical support for this idea. This paper has used a panel of data on UK establishments over the period 1980-1996 to investigate how changes in product market competition affected productivity and whether it differentially affected firms that had a principal-agent set up (managerial firms) to those that didn't (single or entrepreneurial firms). The introduction of the European Union Single Market Programme (SMP) was used as an instrument for the change in product market competition. It was shown that the SMP led to a decrease in the Lerner Index in industries that were *ex ante* expected to be affected by the SMP. This lends support to the assertion that the SMP increased the degree of product market competition in these industries in the UK.

The difference in productivity before and after the SMP between type of establishments was compared across industries that were and were not sensitive to the SMP. Careful attention was paid to how productivity was measured. The results suggest that the increase in product market competition was associated with an increase in productivity. This increase was not present in establishments that did not have a principal-agent set up, but was in establishments that did. This provides strong empirical support for the idea that increases in product market competition raise productivity by mitigating agency costs.

Data Appendix

The data used in empirical application is described in more detail in Griffith and Simpson (2001) and Griffith (1999).

The industries affected by the SMP were:

High non-tariff barriers	
256	Specialised chemical
257	Pharmaceutical products
325	Mining and construct
326	Power transmission e
328	Other machinery
330	Manufacture of office
341	Insulated wires
342	Basic electrical equipment
344	Telecomm equipment
345	Other electronic equipment
361	Shipbuilding
362	Railway and tramway
371	Precision instrument
372	Medical equipment
373	Optical instruments
421	Ice cream chocolate
491	Jewellery
494	Toys and games

Moderate non-tariff barriers	
247	Glass
248	Refractory and ceramic
251	Basic industrial chemical
321	Agricultural machine
322	Metal-worked machine
323	Textile machinery
324	Processing machinery
327	Machinery for wood
346	Domestic electric appliances
347	Electric lamps
350	Motor vehicles and p
427	Brewing and malting
428	Soft drinks
431	Woollen
432	Cotton and silk
438	Carpets
451	Footwear
453	Clothing
455	Household textiles
481	Rubber

Low non-tariff barriers

210	Extract metal ores
220	Metal manufacture
221	Iron and steel
222	Steel tubes
223	Metal forming
224	Non-ferrous metals
230	Extraction of other
231	Extraction stone, clay
233	Extraction salt
239	Extraction other minerals
240	Manufacture non-metal
241	Structural clay products
242	Cement, lime, plaster
243	Building products
244	Asbestos goods
245	Working of stone
246	Abrasive products
250	Chemical industry
255	Paint and ink
258	Soap and cosmetics
259	Specialised chemical
260	Production of man-made
310	Manufacture of other
311	Foundries
312	Forging, pressing
313	Bolts, nuts etc.
314	Metal doors
316	Finished metal goods
320	Mechanical engineering
329	Ordnance, small arms
340	Electrical and electronic
343	Electrical equipment
350	Motor vehicles and parts
360	Manufacture of transport
363	Motor and pedal cycles
364	Aerospace equipment
365	Other vehicles
370	Instrument engineering
374	Clocks and timing devices
410	Food, drink and tobacco
411	Organic Oils
412	Slaughterhouses
413	Milk products
414	Fruit and vegetables
415	Fish processing
416	Grain milling
418	Starch
419	Bread biscuits confection
420	Sugar and its by-products
422	Animal feeds
423	Misc. foods
424	Spirit distilling
426	Wines, cider, perry
429	Tobacco industry
430	Textiles
433	Continuous filament
434	Spinning and weaving
435	Jute and polypropylene
436	Warp knitted fabrics
437	Textiles finishing
439	Lace Rope etc.
440	Leather
441	Leather tanning
442	Leather goods
450	Footwear and clothing
456	Fur goods
460	Timber and wood
461	Saw milling
462	Semi-finished wood
463	Builders carpentry
464	Wood containers
465	Other wooden article
466	Brushes and brooms
467	Wood furniture
470	Paper and paper products
471	Pulp and paper
472	Paper products
475	Newspapers books periodicals
480	Rubber and plastic
482	Retreading
483	Plastic
490	Other manufacturing
492	Musical instruments
493	Photographic
495	Other manufacturing

Table 9: Distribution of observations in population, by type within industry

sic80		single	group	single to group	group to single	Total
21	Extract metal ores	298	75	13	6	392
		76.02	*19.13*	*3.32*	*1.53*	*100.00*
22	Metal manufacture	15653	6733	1733	1110	25229
		62.04	*26.69*	*6.87*	*4.40*	*100.00*
23	Extraction of other	4235	4903	571	203	9912
		42.73	*49.47*	*5.76*	*2.05*	*100.00*
24	Manufacture non-meta	63938	19699	4562	1922	90121
		70.95	*21.86*	*5.06*	*2.13*	*100.00*
25	Chemical industry	37265	13493	4610	1626	56994
		65.38	*23.67*	*8.09*	*2.85*	*100.00*
26	Production of man-ma	202	202	57	20	481
		42.00	*42.00*	*11.85*	*4.16*	*100.00*
31	Manufacture of other	385695	27123	12715	7473	433006
		89.07	*6.26*	*2.94*	*1.73*	*100.00*
32	Mechanical engineering	373201	38776	18109	10296	440382
		84.74	*8.81*	*4.11*	*2.34*	*100.00*
33	Manufacture of office	15041	1852	975	308	18176
		82.75	*10.19*	*5.36*	*1.69*	*100.00*
34	Electrical and elect	243299	21449	8612	4223	277583
		87.65	*7.73*	*3.10*	*1.52*	*100.00*
35	Motor vehicles and p	26870	5950	2210	1650	36680
		73.26	*16.22*	*6.03*	*4.50*	*100.00*
36	Manufacture of trans	30368	4601	2284	660	37913
		80.10	*12.14*	*6.02*	*1.74*	*100.00*
37	Instrument engineering	37869	5877	3008	1819	48573
		77.96	*12.10*	*6.19*	*3.74*	*100.00*
41	Food, drink, tobacco	78240	12158	8539	1610	100547
		77.81	*12.09*	*8.49*	*1.60*	*100.00*
42	Sugar and its by-pro	30680	8647	3011	1015	43353
		70.77	*19.95*	*6.95*	*2.34*	*100.00*
43	Textiles	54596	11912	3841	2395	72744
		75.05	*16.38*	*5.28*	*3.29*	*100.00*
44	Leather	16432	1772	744	420	19368
		84.84	*9.15*	*3.84*	*2.17*	*100.00*
45	Footwear and clothing	149572	11844	5861	3204	170481
		87.74	*6.95*	*3.44*	*1.88*	*100.00*
46	Timber and wood	243953	14070	8986	3767	270776
		90.09	*5.20*	*3.32*	*1.39*	*100.00*
47	Paper and paper prod	301384	32777	17081	6083	357325
		84.34	*9.17*	*4.78*	*1.70*	*100.00*
48	Rubber and plastic	61512	13058	7120	3033	84723
		72.60	*15.41*	*8.40*	*3.58*	*100.00*
49	Other manufacturing	165115	6166	3641	1523	176445
		93.58	*3.49*	*2.06*	*0.86*	*100.00*
Total		2335418	263137	118283	54366	2771204
		84.27	*9.50*	*4.27*	*1.96*	*100.00*

Table 10: Distribution of observations in population, by sensitivity to SMP

		Observations in 3-digit industry with pre-SMP non-tariff barriers that were:			
sic80		Low	Med	High	Total
21	Extract metal ores	392	0	0	392
		100.00			*100.00*
22	Metal manufacture	25229	0	0	25229
		100.00			*100.00*
23	Extraction of other	9912	0	0	9912
		100.00			*100.00*
24	Manufacture non-meta	49564	40557	0	90121
		55.00	*45.00*		*100.00*
25	Chemical industry	17859	18548	20587	56994
		31.33	*32.54*	*36.12*	*100.00*
26	Production of man-ma	481	0	0	481
		100.00			*100.00*
31	Manufacture of other	433006	0	0	433006
		100.00			*100.00*
32	Mechanical engineering	41934	114230	284218	440382
		9.52	*25.94*	*64.54*	*100.00*
33	Manufacture of office	0	0	18176	18176
				100.00	*100.00*
34	Electrical and elect	25222	26119	226242	277583
		9.09	*9.41*	*81.50*	*100.00*
35	Motor vehicles and p	0	36680	0	36680
			100.00		*100.00*
36	Manufacture of trans	11309	0	26604	37913
		29.83		*70.17*	*100.00*
37	Instrument engineering	2991	0	45582	48573
		6.16		*93.84*	*100.00*
41	Food, drink, tobacco	100547	0	0	100547
		100.00			*100.00*
42	Sugar and its by-pro	26890	7626	8837	43353
		62.03	*17.59*	*20.38*	*100.00*
43	Textiles	50745	21999	0	72744
		69.76	*30.24*		*100.00*
44	Leather	19368	0	0	19368
		100.00			*100.00*
45	Footwear and clothing	2819	167662	0	170481
		1.65	*98.35*		*100.00*
46	Timber and wood	270776	0	0	270776
		100.00			*100.00*
47	Paper and paper prod	357325	0	0	357325
		100.00			*100.00*
48	Rubber and plastic	74290	10433	0	84723
		87.69	*12.31*	*0.00*	*100.00*
49	Other manufacturing	130154	0	46291	176445
		73.76		*26.24*	*100.00*
Total		1650813	443854	676537	2771204
		59.57	*16.02*	*24.41*	*100.00*

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