European Integration and Productivity: Exploring the Gains of the Single Market

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Abstract

The European Single Market (SMP) was conceived as the structural response to the "Euro-sclerosis" of the early eighties. The objective of the Program was to eliminate all the remaining non-tariff barriers to the free circulation of goods, services, persons and capital by the end of 1992. The release of these constraints aimed to deliver substantial welfare gains across the Union in terms of higher productivity levels and lower costs, prices and mark-ups. These effects were expected to result from structural changes in volume and location of production and the erosion of protection in previously sheltered industries. Although there exists some evidence that the SMP increased competition in EU, the impact of the Single Market on productivity has received less attention and it is still an open issue. This paper uses a variety of panel data techniques to argue that the SMP significantly increased productivity in a number of European countries. In particular, as a result of the Program, industry productivity increased considerably in 1992 and 1993 in France, Italy, Germany, the Netherlands and in the UK. It is also important to stress that the estimated (short run) SMP gains appear quantitatively important.

1 Introduction

In the early 1980s, the European Union (EU) was suffering severe economic problems, including rising unemployment and moderate growth. Market rigidities were considered the main cause of this poor economic performance: rigidities pervaded all

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European markets, whether relating to products or production factors. Acting against such "Euro-sclerosis" required structural reforms aimed at enhancing market flexibility and reducing barriers to mobility within the EU (European Economy 1996).

In the light of these facts, the EU Commission published the White Paper (1985) on completing the internal market which proposed that Member States abolish all remaining non-tariff barriers to the free circulation of goods, services, persons and capital. By eliminating market fragmentation, the economic aim of the Single Market Program (SMP) was to implement structural changes designed to restore the capacity of the EU to generate growth and employment. More specifically, in the White Paper the Commission proposed 282 specific measures to remove non-tariff barriers - particularly, technical, administrative, and fiscal barriers - by the end of 1992. The opportunities provided by the SMP for the exploitation of economies of scale and the rationalization of production across Europe could have worsened competition in certain sectors as monopoly or oligopoly structures developed. As a result, competition policy was also particularly strengthened in the domain of merger concentration, with the adoption of merger regulation in 1989. Another measure, complementary to SMP, has been a broader use of regional policy, aimed to ensure that the SMP did not adversely affect regional convergence.

As explicitly mentioned in the ex-ante evaluation of the SMP, known as the Cecchini Report (1988), the release of these constraints was expected to deliver substantial welfare gains across the Union. By removing physical, technical and fiscal barriers hindering trade and factor movements within the EU, the SMP aimed to increase productivity and reduce costs, prices, profits and mark-ups. These effects were supposed to result directly from both changes in volume and location of production, and potential shifts in the competitive regime in previously protected industries.

The study of Buigues et al. (1990) ascertained that 40 out of the 120 manufacturing sectors at the NACE three digit level of disaggregation were likely to be especially affected by the SMP. These sectors included those industries in which the main purchaser is the public sector, those where EU trade was hampered by differences in national standards and a variety of industries where principal obstacles to trade were administrative and/or technical controls. At that time, these 40 sectors represented somewhere around 12 to 18% of Community GDP (about 40 to 60% of Member States' value added in manufacturing).

At the end of 1992, just as the Single Market was supposed to become a reality, Member States charged the Commission in Council resolution 1218/92 with reporting on the overall effectiveness and impact of the Program. The ex post evaluation of the SMP reports positive evidence at both micro and macroeconomic level, but it does not provide direct estimates of the impact of the Program on productivity (European Economy 1996). Other empirical work in this area is also relatively limited and is only focused on Italy and the United Kingdom (see Bottasso and Sembenelli 1998 and Griffith 2001).

This paper analyses to what extent the Single Market has increased productivity in the European Union. This is done in three different stages. First, the relationship between market integration, competition and productivity is outlined from a theoretical perspective. Second, the empirical evidence on the effects of the SMP on competition and productivity is reviewed and discussed. Finally, this paper estimates the impact of the SMP on productivity in a number of European countries.

The structure is as follows. Section 2 presents the relationship between market integration, competition and productivity from a theoretical perspective. Section 3 discusses the available empirical evidence on the effects of the Single Market on competition and productivity. Section 4 discusses the econometric specification. Section 5 introduces the data, estimation methods and measurement of the core variables. Section 5 presents the econometric results. Section 6 summarizes the main results and concludes.

2 The theoretical background

It is generally accepted that market integration policies increase productivity. In addition to fuller exploitation of comparative advantages, specialization and economies of scale, market integration may enhance further productivity gains due to an increase of the degree of competition[1]. In a principal-agent setting, a higher number of agents allows the (uninformed) principal to extract information about (unobservable) agents' behavior. As a result, the more competitive environment gives sharper incentives to reduce slackness and sloth within firms. In addition, models of industry evolution suggest that if firms are characterized by different levels of productivity, a higher competitive pressure leads to a fiercer evolutionary process. Efficient firms grow and survive, while inefficient firms decline and exit. As a result, industry productivity increases.

2.1 Competition, incentives and efficiency

Despite the widespread view that competition is important for productive efficiency, it is not so clear how it works in theory. Intuitively, competitive pressure makes organizations internally more efficient by sharpening incentives to avoid sloth and slack. In principle, however, there is no difference between the owners of a monopolistic firm and those of a competitive one. Quoting Nickell (1996), "The owners of monopolistic firms will be just as keen to prevent slacking by managers and workers as the owners of a competitive firms". It can be argued that the owners of a competitive firm, by making comparisons with other agents' performance, are in a better position to evaluate their managers' effort[2]. This type of incentives are analyzed in the works of Holmstrom (1982b), Nalebuff and Stiglitz (1983) and Mookherjee (1984). In particular, Holmstrom (1982b) shows that if agents face some common uncertainties, relative performance evaluation extracts information optimally. As a result, moral hazard being more detectable, agents will reduce their opportunistic behavior and, hence, will supply proper levels of effort.

Agents' effort can also be increased by implicit incentives that arise naturally from market force. Concerning implicit incentives, the model proposed by Hart (1983) for-

[1] Sutton (1991) shows that, other things equal, an enlargement of market size increases the equilibrium number of firms. This can be taken as an intuitive explanation of the increase of competition due to european integration.

[2] This is true under the assumption that managers know more about what is going on than the owners. In case of symmetric information, the highest degree of productive efficiency will be automatically achieved, i.e. no principal-agent problem would exist.

malizes the idea that competition is a source of discipline and, under a set of assumptions, demonstrates how it can reduce the amount of managerial slack. Hart assumes there are two types of firms in a industry, "entrepreneurial" (E), where the owner runs the firm and, "managerial" (M), where managers have goals on their own, in particular effort minimization. Owners cannot monitor managerial effort and are uncertain about their firm's cost, but they can observe the outcome of their effort, i.e. the performance of firm. As a result, there will be managerial slack and, in particular when a firm's costs are low, the manager will be able to engage in discretionary behavior and still fulfill his profit target. All firms face common shocks. Under these assumptions, when (marginal) costs are low entrepreneurial firms will expand. Depending on the proportion of entrepreneurial firms, aggregate supply in product markets will rise and product prices will fall. As a result, managers who must fulfill profit targets will have less opportunity to engage in managerial slack. These effects are stronger when the number of firms (a measure of competition) and their heterogeneity increase. It is worth noting that, in contrast with Holmstrom's (1982b) system of incentives, it is not required to observe other firms' profits. In this approach, the market system makes the actions and utilities of different managers interdependent via prices; i.e. the market mechanism itself acts as a sort of incentive scheme. However, Scharfstein (1988) shows that Hart's result are sensitive to the specification of managerial preferences.

Other types of implicit incentives arising from exogenous market forces are given by reputation effects (Holmstrom 1982a, Vickers 1995). The basic idea is that while managerial effort does not influence current earnings, it may influence future market-based rewards via its impact on the market's estimate of the manager's ability. While the market can observe managerial output, it cannot distinguish effort or ability components from unobserved productivity shocks. In this setting, competition can provide a basis to separate out the manager's effort or ability from an unobserved productivity shock, which is likely to be correlated across the firms operating in the same industry. With the ability component more distinguishable, the market can use its more precise knowledge of managerial output to estimate the managerial ability. As a result, in order to increase future rewards, managers have incentives to raise their effort early in the career[3]. Nickell (1994) extends these results to N firms and proves that managerial effort increases with the number of firms.

An alternative analysis relies on the possibility that competition may raise the sensitivity of profits to the actions of managers. A model proposed by Willig (1987) investigates the effect of an increase of competition on managerial slack. Competitive pressure is proxied by an increase in the elasticity of demand of a managerial firm, while the internal organization of the firm is modelled according to the principal-agent interaction. In this setting, it is shown that a *ceteris paribus* increase in competitive pressure raises managerial compensation and, hence, the level of effort. Conversely, if the higher sensitivity effect is dominated by the demand reduction, profits will be lower and consequently, competition effects will be reversed. However, this does not appear to be a robust result. For instance, Hart (1987) notes that the competition pressure effect reduces managerial slack only because the manager obtains surplus that the owner cannot get his hand on. If the owner can keep the manager down to his reservation utility level, this effect disappears. By adopting a Cournot-oligopoly framework, Martin (1993) shows that the degree of firm efficiency is inversely related to the number of firms in the market. The greater the degree of competition in the market, the smaller the payoff associated with a marginal increase in firm efficiency and the less it is in the interest of the owner to set a fee schedule that induces the manager to reduce costs. As a result, in equilibrium, marginal cost is an increasing function of the number of firms. Similar results are presented in the study of Horn, Lang and Lundgren (1994).

[3] Vickers (1995) shows that effort increases provided that the correlation of measurement errors in assessing abilities exceeds that the correlation of abilities. Correlation of measurement errors improves the precision with which the market can observe performance and so increases the weight attached to performance in assessing ability. On the other hand, correlation of abilities leads agents to free-ride on each other's efforts. An implication of this argument is that incentives may perform better when agents are in similar environments - in particular, when there is greater correlation of the uncertainties that affect them - than when they are in very different environments.

As well as managerial effort, competition may also influence the effort of workers. This follows naturally from the notion that product market rents can be shared with workers (Smirlock and Marshall (1983), Dickens and Katz (1987), Stewart (1990)). In this framework, since rents can be captured in the form of higher wages or reduced effort, an increase in the degree of competition leads to an increase of workers' effort. By focusing on unionized firms, where firms and unions bargain over both wages and effort, Nickell (1994) shows that an increase of competition may lead to increases in unionized effort.

There are also alternative explanations of the relationship between competition and productivity. For example, the degree of competition could positively provide incentives for R & D expenditure. This argument follows by considering that a competitive firm gains more from innovation than a monopolist can gain (Arrows 1962). However, this is controversial. By innovating, a monopolist can keep the entrant out of the market and retain the monopoly position. The best the potential entrant can do by innovating[4] is to gain admittance to what will then become a duopoly. This will determine a reduction of monopolist's profits. Thus, as Tirole (1989 p. 393) notes, "because competition reduces profits, the monopolist's incentive to remain a monopolist is greater than the entrant's incentive to become a duopolist". In addition, following Shumpeter (1943), it can be argued that monopolistic firms can more readily fund R & D expenditure because they face less market uncertainty and have a larger, more stable cash flow. The consequence of these opposing forces is that, in general, the relationship between competition and R & D expenditure is either positive or negative depending on the specification of the model. Finally, it can be argued that in oligopolistic industries, resources may be spent on deterring rivals, and this can lead directly to production inefficiency. The use of excess capacity to make entry deterrence credible is an example of this.

[4] This argument does not apply in a case of drastic innovation.

2.2 Industry evolution

A higher degree of openness of the market may affect the process of selection and, hence, the evolution of an industry. Efficient firms grow and survive, while inefficient firms decline and exit[5]. Although this process can be seen as an immediate implication of Ricardo's 1817 theory of comparative advantage and specialization, alternative explanations can be obtained from the literature on industry evolution.

Jovanovic (1982) proposes a theory of selection and industry evolution, where the firm's entry-stay-exit decision depends on its predicted cost. In this framework, costs are random, and different among firms. Each firm knows the *distribution* of true costs among them, but no firm knows what *its* true cost is. All firms have the same prior beliefs, and each firm regards itself as a random draw from the population distribution of true costs. This "prior" distribution is then updated as information becomes available. At the start of every period, a firm decides whether to exit or stay based upon its current cost information. If the firm is a low cost firm, it is likely that the evidence will be favorable, and the firm will survive. If its costs are high, then it may not wait long before exiting the industry. The evolution of the economy is then driven by these optimizing agents' learning and selection decisions. Market integration forces domestic firms to compete directly with foreign firms. It is likely that markets integration shifts the critical cost value for the exit decision toward zero[6], implying that a higher number of firms decide to exit[7]. As a result, by inducing a fiercer evolutionary process, market integration increases industry productivity.

Focusing directly on productivity dynamics, Hopenhayn (1992) proposes a model of industry evolution with firm-level heterogeneity and price-taking behavior in a dynamic competitive framework. Firms are subject to a random productivity shock every period and the probability of a future positive shock is increasing in this period productivity.

[5] There is now a growing body of empirical papers which look at relative importance of these effects on productivity growth. See for instance Griliches and Regev (1995) and Levinsohn and Petrin (1999).

[6] That is, for a given confidence level the tails of the new distribution are less thick after markets integrate.

[7] This can happen if the proportion of low-cost competitors differs across countries/industries and takes a higher value after market integration. Different proportions of low-cost firms across country/industries may be well explained by historical and/or accidental factors.

Hence, high productivity firms are more likely to remain high productivity firms. From this basic framework, Hopenhayn shown that in equilibrium low productivity firms are more likely to exit, and that older cohorts of firms will be more productive than younger cohorts. Again, as a direct effect of the SMP, domestic firms have to compete with foreigners in the same marketplace. It is likely that in some industries domestic firms will become (relatively) more productive, while in others they will become (relatively) less efficient. Since the probability of a positive productivity shock is increasing in this period productivity, the next productivity shock will force firms that would have decided to stay in separated markets to exit.

3 Some evidence on the Single Market Program

The evaluation of the effects of the SMP on the level of efficiency is a challenging task for several reasons. First, the period that has elapsed since the beginning of SMP is relatively short, many of the measures were put in place recently, and much of the necessary statistical information is only available up to 1994 or even 1993. Secondly, the SMP has been implemented at varying speeds and intensity in different sectors and different Member States. Lastly, the period of investigation has been an extremely eventful one for the global economy[8]. Nevertheless, the first detailed ex-post analysis of the SMP provides some positive evidence of the impact of the Program on European economies at both micro and macroeconomic level (European Economy 1996).

With reference to the SMP's degree of implementation, and to what extent it has been really effective in removing obstacles to the free circulation of goods, services, persons and capital, the evidence provided is satisfactory. In terms of the White Paper alone[9], nearly 93% of the associated Single Market measures had been transposed into domestic legislation by mid-May 1996[10]. In addition, a survey of 20000 enter-

[8] Europe has also experimented the enlargement of the EU to Spain and Portugal, German reunification in 1990, and the economic transformation in Central and Eastern Europe.

[9] In order to prevent anti-competitive effects led by increases in concentration, competition policy has been particularly strengthened in the domain of merger concentration, with the adoption of merger regulation in 1989. Another Community initiative which complements and affects implementation of SMP is regional policy. In order to ensure that the SMP does not adversely affect regional convergence, structural funds are directed toward particular areas (European Economy, 1996).

[10] However, the fact that SMP legislation has, to a great extent, been transposed into Member

prises around the Community by Eurostat on their perceptions of the impact of the SMP, provides generally positive responses, especially in the manufacturing sector. Bearing this in mind, more detailed empirical evidence of the SMP on the increase of competition, productivity levels, and growth will be the subject of the next two subsections.

3.1 Changes in the competitive environment

Regarding the change in competitive environment, the expectation of increased competition as a consequence of the SMP is supported by the available empirical evidence. Nevertheless, some additional robustness tests would be necessary. Along these lines, the study carried by London Economics (1996) on cross-section data from EU 12 reveals a significant negative effect of the SMP on the level of price-cost margins[11] for the period 1980-92. Other things being equal, the estimates indicate that the SMP yields a yearly reduction of 0.20 percentage points in margins as of 1987. The relative decline in margins triggered by the SMP has been particularly important in some of the manufacturing sectors most sensitive to SMP (specifically sectors which had moderate non-tariff barriers before the SMP) but also in sectors which were not particularly affected by the SMP. Conversely, the effects on some of the SMP highly sensitive sectors[12] does not appear to have been significant. This last result casts some doubts about the causality (SMP vs. not SMP) of the estimated fall of price-costs ratios across the European countries.

Detailed evidence is also provided by the analysis of Allen et al. (1998). These authors estimate the impact of the SMP on patterns of consumption and trade arising directly from the lowering of trade barriers (the direct effect) and the resulting im-

States' domestic legislations is not in itself a sufficient condition for the Single Market to actually work. The following new problems are becoming clearer: non-adoption of Single Market measures; legislative inadequacies; ineffective enforcement of the legislation; the emergence of new obstacles (European Economy 1996).

[11] In a Cournot oligopoly with N players, in a symmetric equilibrium, the price-cost margin is given by: $\frac{p-c}{p} = \frac{s}{|\epsilon|}$, where p is the price, c is the marginal cost, s is the (symmetric) market share, and ϵ is the demand elasticity. In the above expression, a reduction in the price-cost margin implies an increase in the number of competitors.

[12] Namely, pharmaceutical products, electrical equipment, etc.

pact on price-cost margins and industrial restructuring (the competition effect). The model is estimated for fifteen sectors in each of four countries of the European Union (France, Germany, Italy and the United Kingdom), chosen on the basis of their ex-ante identification by Buigues et al. (1990) as being particularly sensitive to the SMP. The SMP terms are described by a set of dummy variables for the years 1992-94 included in both the demand and supply equations. As expected, the impact of trade barrier reduction on mark-ups is negative and yields a reduction of 3.9 percentage points on average. In contrast to the London Economics' study, the fall in price-cost margins is reflected in all but one of the sectors studied. However, in order to relate these results to the SMP and not to an eventual common shock, these estimation procedures should be repeated including data from non sensitive sectors. A not significant change of the price-cost margins in the non sensitive industries would be a more robust test in favor of the SMP.

3.2 Impact on productivity

Turning to the expected productivity gains from the Program, some qualitative evidence is reported in European Economy (1996). In first instance, the restructuring phase has taken place mostly through the capital markets via mergers and acquisitions, with a more limited role for entry, exit and the internal growth or decline of existing firms. Concerning the effect of volume and location of production, the increased exploitation of scale economies in the manufacturing industry has been assessed by focusing on the evolution of firm size. The results suggest that this structural characteristic of European manufacturing sector has remained unchanged as a consequence of the SMP. Furthermore, at the sectoral level, the stronger growth in firm size has mainly involved industries that were not SMP-sensitive (European Economy, 1996 p. 124). By comparing different types of industries[13], strong growth of average size has been detected in advertising-intensive industries, in all the four main countries. This confirms that, in these industries, the exploitation of the scale economies is linked to

[13] Namely, exogenous and endogenous fixed (and sunk) costs (Sutton, 1991; Davies, Lyons et al. 1996).

the creation of strong brand names, development of new products and heavy up-front advertising investments. However, this ex-post review of the SMP benefits does not contain direct estimates of the impact of European integration on the level and growth of productivity.

Some empirical evidence on this issue is provided by Bottasso and Sembenelli (1998). They estimate a Solow's residual equation[14] for three sub-samples of Italian manufacturing firms[15], obtained by using the ex-ante information provided by Buigues and al. (1990). By comparing the pre-reform (1982-1987) with the post-reform (1988-1993) performance of the variables of interest across different sub-samples, they estimate the impact of the SMP on market power and productivity. For the sample of the "highly sensitive" firms, the main findings are: 1) market power firms decreases by 50% in the SMP implementation compared to previous years; 2) productivity growth increases during the 1985-1987 period, that is from the announcement of the signature of the White Paper (1985) until the starting of the implementation of the SMP (1987). This is consistent with the idea that sensitive firms anticipate an expected increase in competitive pressure by reducing inefficiencies. The fact that similar patterns are less apparent in other periods, nor for the other sample of firms makes the authors confident about the nature of the shock. Unfortunately, their methodology does not allow to identify productivity shocks related to the Single Market from other shocks affecting the sensitive sectors.

By using panel data at establishment level, Griffith (2001) finds that the Single Market increased competition in the UK and this, in turn, raised productivity. Again the measurement of the Program is based on the sensitive sectors identified by Buiges et al. (1990), while the "after the Program" period is taken as 1993 -1996. Interest-

[14] Their empirical model is

$$\Delta q_{it} = \mu_{it} * PRE * \left(s_{it}^M \Delta m_{it} + s_{it}^L \Delta l_{it}\right) + \mu_{it} * POST * \left(s_{it}^M \Delta m_{it} + s_{it}^L \Delta l_{it}\right) + \gamma_{it} \Delta k_{it} + \Delta a_t + \Delta v_{it}$$

where Δq_{it}, Δl_{it}, Δm_{it} are first differences of (log of) gross output, labour and materials, divided by the net capital stock, Δk_{it} is the first difference of the (log of) net capital stock, μ_{it} is price over marginal cost, s_{it}^M and s_{it}^L are the shares of materials and labour in total revenues, γ_{it} is the local scale elasticity measure minus 1, Δa_t is a time effect, Δv_{it} is a $MA(1)$ random component and PRE ($POST$) is a dummy variable taking value 1 for the years 1982-1987 (1988-1993) and 0 otherwise.

[15] Respectively "highly sensitive firms", "moderate sensitive firms" and "non sensitive firms".

ingly, the results suggest positive effects of the Single Market in those establishments characterized by a principal-agent set up (managerial firms) but not in the others (single or enpreneutrial firms). This provides empirical support for the mechanism that the SMP raised productivity by mitigating agency costs.

However, both these studies do not exploit the fact that the Single Market is a policy change affecting the European Union as a whole. Taking account of the multi-country dimension of the Program should make possible to identify productivity shocks related to the SMP from other (unobservable) country/sectoral shocks.

4 The empirical formulation

This section considers the basic model and estimation, data, and measurement problems.

4.1 The productivity equation

A generalized, Cobb-Douglas production function is used as a framework, although the effects of alternative specifications and/or adjustments to the input measures will also be considered. Denoting countries by $i = 1, ..., N$, manufacturing industries by $j = 1, ..., J$ and time by $t = 1, ..., T$, the basic model has the log-linear form

$$\begin{aligned} y_{ijt} &= \beta_{1i} y_{ijt-1} + \beta_{2i} l_{ijt} + \beta_{3i} k_{ijt} + \beta_{4i} CYCLE_{ijt-2} \\ &\quad + \beta_{5i} TREND_{it} + S_{ijt} + \phi_{ij} + \lambda_t + \epsilon_{ijt} \end{aligned} \quad (1)$$

where y_{ijt} is log real output, l_{ijt} is log employment, k_{ijt} is log capital stock, $CYCLE_{ijt-2}$ is a cyclical component, $TREND_{it}$ is a country-specific linear time trend, S_{ijt} reflects those factors capturing the impact of the Single Market Program on the level of productivity, ϕ_{ij} are country-industry effects, λ_t are time effects, and the coefficients are allowed to vary across countries i. The set of fixed effects cover all unobserved country-industry specific shocks influencing the level of productivity, while λ_t captures macroeconomic shocks which affect the level of productivity in all countries. Finally, ϵ_{ijt} captures all the other shocks to industrial productivity and it is considered to be serially uncorrelated. Absence of serial correlation is assisted by the inclusion of dynamics in the form of a lagged dependent variable. This is a simple way to capture the fact that, whenever factors of production are changed, it typically takes some time for output to reach its new long run level[16]. For example, if new capital goods are purchased, it may take a considerable time before the new machines are fully operational.

4.2 Estimation

As long as the fixed effects (ϕ_{ij}) in equation (1) are uncorrelated with the included variables, consistent estimates of the parameters of interest can still be identified. This is unlikely to be the case, however. The fixed effects reflect unobserved factors such as managerial ability and other technical differences between firms affecting the level of productivity (see, for example, Hoch 1962; Mundlack 1961; Nerlove 1965).

A natural way to eliminate such unobserved heterogeneity is to transform the observed variables by subtracting out the appropriate time series means for each cross-sectional unit, and then to apply the least squares estimator to the transformed data (Within Groups Estimator). This estimator is BLUE with strictly exogenous regressors. While there are reasons to believe that this condition may hold for the SMP_{ijt} variable, the Single Market being a policy measure decided by the European Commission, this is hardly the case for the others. Therefore, weak exogeneity is assumed. This hypothesis would be violated if, for example, firms correctly predict future productivity shocks (e.g. ex post effects of SMP) and this would be reflected in serial correlation of the ϵ_{ijt} term. Therefore, serial correlation tests are presented after the results are shown[17]. In the presence of weakly exogenous regressors, it should be noted that there may be finite sample biases with the Within Group Estimator. The results in Nickell (1981), however, find that the magnitude of this bias diminishes in the length of the time series element of the panel. Since the sample runs for 23 years, the size of

[16] The corresponding long run equilibrium coefficients can be obtained by multiplying the short run coefficients by $1/(1-\beta_{1i})$.

[17] This is a LM statistic which tests for a AR(1) and/or a MA(1) structure in the residuals in a fixed effects context. It is asymptotically distributed as $N(0,1)$ under the null, Baltagi (1995).

this bias is likely to be small.

Finally, additional concerns are given by the potential endogeneity of labour and/or capital. In fact, it should be noted that important components of the error term are those productivity shocks that are directly related to employment or capital intensity. For example, autonomous shocks to effort may induce a rise in output and a possible fall in employment. In order to avoid the corruption of parameter estimates caused by possible correlations between ϵ_{ijt} and l_{ijt} or k_{ijt}, the robustness of the results will also be checked by re-estimating the model with instrumental variables techniques. As long as the basic error, ϵ_{ijt}, is serially uncorrelated, all lags on l and k beyond $t-1$ are valid instruments. It is worth noting that the validity of these instruments depends crucially on the absence of serial correlation in ϵ_{ijt}, which will be investigated using a serial correlation test described in Baltagi (1995).

4.3 Data and measurement issues

4.3.1 Data sources and sample size

The data used in this empirical application comes from OECD industrial databases (see Appendix 1 for details). The main data source is the OECD Stan Industrial Database (1996) which provides information at the three-digit industry level on value added, employment, investments, labour compensation, import and export. To obtain measures of the capital stock, this basic data has been combined with data on capital stock at the two-digit industry level from the OECD International Sectoral Data Base (ISDB). A whole-economy PPP and an investment PPP have been used to convert constant (1990 price) data on value added and capital stock into a common currency (US dollars), also obtained from the ISDB data set.

The sample consists of 30 manufacturing industries in eight OECD countries over the period 1970-1993[18]. For some of the industries, information is also available at the four-digit industry level. When the more disaggregated information is available, it is

[18] Finland, Norway, and Sweden have been excluded from the dataset because they were joining the European Union during the years of the SMP. Denmark has also been excluded because it presents a very heterogeneous mix of sensitive sectors relatively to the other countries.

used. However, information at the three-digit level (ISIC 3832-383X) is used when it allows to obtain longer time series. The distribution of observations across countries and industries, after cleaning and deleting missing values, is displayed in Table 1.

Table 1: Sample size by industry and country

ISIC	Be	Fra	Ger	Ita	Net	UK	Jpn	USA	Total
3130	23	-	24	22	24	23	24	25	165
3140	23	-	24	22	24	23	24	25	165
3210	23	24	24	22	24	23	24	25	189
3220	23	19	24	22	24	23	24	25	184
3230	23	24	24	22	24	23	24	25	189
3240	23	-	24	22	24	23	24	25	165
3310	23	19	24	22	24	23	24	25	184
3320	23	19	24	22	24	23	24	25	165
3410	23	24	24	22	24	23	24	25	189
3420	23	24	24	22	24	23	24	25	189
3522	-	14	17	-	24	23	24	25	127
352X	-	14	17	-	24	23	24	25	127
3550	23	24	24	22	24	23	24	25	189
3560	-	-	24	22	24	23	24	25	142
3610	-	24	24	17	24	23	24	25	161
3620	-	24	24	17	24	23	24	25	161
3690	-	24	24	17	24	23	24	25	161
3710	23	24	24	22	24	23	24	25	189
3720	23	24	24	22	24	23	24	25	189
3810	23	25	25	25	24	23	25	24	194
3820	23	25	25	25	10	25	25	24	182
3829	-	14	24	16	24	23	24	25	150
3832+383X	23	25	25	25	10	25	25	24	182
3841	-	16	23	17	24	23	24	25	152
3842	-	16	16	17	-	17	10	23	99
3843	-	16	16	17	24	23	24	25	145
3844	-	16	16	17	24	17	10	23	123
3845	-	16	23	17	24	17	10	23	130
3849	-	-	16	17	24	17	10	-	84
3850	17	25	25	25	24	23	25	24	188
Total	381	500	676	577	668	670	668	715	4855

NOTE.- 3130 Beverages; 3140 Tobacco; 3210 Textiles; 3220 Wearing Apparel; 3230 Leather & Product; 3240 Footwear; 3310 Wood Products; 3320 Wooden Furniture; 3410 Paper & Products; 3420 Printing & Publishing; 3522 Drugs & Medicines; 352X Other Chemicals; 3550 Rubber Products; 3560 Plastic Products; 3610 Pottery China etc.; 3620 Glass & Products; 3690 Other Non Metallic products; 3710 Iron & Steel; 3720 Non Ferrous Metals; 3810 Metal Products; 3820 Non Electrical Machinery; 3829 Other Machinery & Equipment; 3832+383X Electrical Machinery; 3841 Shipbuilding & Repairing; 3842 Railroad Equipment; 3843 Motor Vehicles; 3844 Motorcycles & Bicycles; 3845 Aircraft; 3849 Other Transport Equipment; 3850 Professional Goods.

4.3.2 Measurement issues

Productivity Following Nickell (1995 and 1996), the basic measure of industrial productivity that is considered here is given by the constant value added (1990 prices).

Cycle measure Business cycle, ($CYCLE_{ijt-2}$) is measured by the rate of growth of output, on a three-digit basis. It is lagged twice, in order to eliminate potential endogeneity or collinearity with the lagged dependent variable.

Import penetration Import penetration is measured by the shares of imports in value added, lagged one period.

SMP impact The evaluation of the impact of the SMP on the level of industrial productivity raises a number of problems. These range from the identification of those sectors which are more likely to be affected by the Program to how to separate the effects of SMP from other factors and the timing of such effects. In order to identify those sectors, the structural criteria suggested by the European Commission in the preparatory work on the ex-ante analysis of the SMP effects have been followed (see Buigues et al. (1990)). In that report, industries most directly affected by the Program were identified by authors using the level of non-tariff barriers complemented by other indicators, including the price dispersal between Member States, the level of intra-EU trade and the potential for economies of scale. Out of 120 NACE three-digit manufacturing industries, forty were selected, representing around 12 to 18% of Community GDP (about 40 to 60% of Member States' value added in manufacturing). These "sensitive" industries were further classified into two sub-groups depending on whether the impact of abolition of non-tariff barriers was expected to be "high" (14 industries) or "moderate" (26 industries)[19]. In the first sub-group two types of industries were included: those in which the main purchaser is the public sector and those where different national standards considerably hamper intra EU-trade. The second

[19] This classification was carried out at the EU level. At a second stage, the pertinence of this list was checked with respect to each Member State, taking into account national industrial structures and country specific on tariff barriers.

sub-group covers a variety of manufacturing industries where principal obstacles are administrative and technical controls or differences in standard. However, these are not perceived to have a major negative impact on intra-EU trade. Applying these definitions to our sample, 6 "highly sensitive" industries[20], 9 " moderately sensitive" industries and 15 "non sensitive industries" have been identified. Table 2 shows the full sample, reclassified according to these definitions.

[20] According to the national reviews of the ex-ante effects of SMP by industrial sector, ISIC 3140 and 3690 should also be included among the sensitive industries in Germany and ISIC 3844 in Italy.

Table 2: Sample Classification

ISIC	Industry
Highly Sensitive Sectors	
3130	Beverages
3522	Drugs & Medicines
3832+383X	Electrical Machinery
3841	Shipbuilding & Repairing
3842	Railroad Equipment
3850	Professional Goods
Moderately Sensitive Sectors	
3210	Textiles
3220	Wearing Apparel
3240	Footwear
3550	Rubber Products
3610	Pottery, China, etc.
3620	Glass & Products
3820	Non-Electrical Machinery
3843	Motor Vehicles
3845	Aircraft
Non Sensitive Sectors	
3140*	Tobacco
3230	Leather & Products
3310	Wood Products
3320	Wooden Furniture
3410	Paper & Products
3420	Printing & Publishing
352X	Other Chemical Products
3560	Plastic Products
3690*	Other Non Metallic Products
3710	Iron & Steel
3720	Non Ferrous Metals
3810	Metal Products
3829***	Other Machinery and Equipment
3844**	Motorcycles & Bicycles
3849**	Other Transportation Equipment

NOTE.- A single asterisk denotes additional highly sensitive sectors in Germany; a double asterisk denotes additional highly sensitive sectors in Italy; a triple asterisk denotes additional highly sensitive sectors in the UK; ISIC 3842 is not included among the sensitive sectors in the Netherlands.

With reference to the timing of the Single Market, the Program is based on the hard core of legislative proposals set down in the 1985 White Paper on completing the internal market and the legislative measures actually implemented in the period

1988-93 as a direct result of the White Paper. A positive productivity shock in the sensitive industries during these years can, therefore, provide evidence of the SMP impact[21]. Considering that the implementation of the SMP directives showed a degree of acceleration in the 1992-93 period, a first SMP measure can be obtained by the interaction of a dummy variable taking the value one if the industry belongs to the highly sensitive sectors, and zero otherwise, $(SENS_{ij})$, with time dummies for the years 1992 and 1993, $(SENS_{ij} * 1992 - 93)$. However, the Program could have started producing its effects also during the earlier implementation phase. Therefore, a time dummy for the years 1987-1991 interacted with the sensitive sectors dummy, $(SENS_{ij} * 1987 - 91)$, has also been included. To summarize, the Single Market Program effect on the level of productivity, S_{ijt}, shall be specified as

$$S_{ijt} = \beta_{6it} SENS_{ij} * 1987 - 91 + \beta_{7it} SENS_{ij} * 1992 - 93 \tag{2}$$

Substituting the equation (2) in (1) and including import penetration[22], (IMP_{ijt-1}), as an additional control, the productivity equation is estimated as

$$\begin{aligned} y_{ijt} &= \beta_{1i} y_{ijt-1} + \beta_{2i} l_{ijt} + \beta_{3i} k_{ijt} + \beta_{4i} CYCLE_{ijt-2} + \beta_{5i} TREND_{it} \\ &+ \beta_{6it} SENS_{ij} * 1987 - 91 + \beta_{7it} SENS_{ij} * 1992 - 93 \\ &+ \beta_{8i} IMP_{ijt-1} + \phi_{ij} + \lambda_t + \epsilon_{ijt} \end{aligned} \tag{3}$$

Before beginning the formal analysis of the results, it is worth to examine some simple descriptive statistics reported in Table 3[23].

[21] It should be considered that this definition of the SMP is rather restrictive because it does not capture medium and long run effects of the SMP.

[22] Trade can affect productivity levels through a number of routes (e.g. technology spillovers by the reverse engineering of imported goods, increased product market competition, or larger market size). See, for example, Coe and Helpman (1995), Coe, Helpman and Hoffmaister (1997), and Keller (1997, 1999).

[23] Complementary descriptive statistics are reported in Appendix 2, Table A.1.

Table 3: Means of productivity (levels), investment intensity and import penetration by country and sensitivity to SMP in selected years

	EU			Japan and US		
	70-86	87-91	92-93	70-86	87-91	92-93
Value added per worker						
Sensitive Sectors	10.17	10.51	10.56	10.35	10.68	10.69
Growth rate	-	0.033	0.005	-	0.032	0.001
Other Sectors	10.39	10.76	10.79	10.47	10.89	10.94
Growth rate	-	0.036	0.003	-	0.040	0.005
Investment intensity						
Sensitive Sectors	0.14	0.15	0.13	0.13	0.15	0.15
Growth rate	-	0.071	-0.133	-	0.154	0.000
Other Sectors	0.17	0.18	0.16	0.18	0.18	0.20
Growth rate	-	0.059	-0.111	-	0.000	0.111
Import intensity						
Sensitive Sectors	1.17	1.63	1.98	0.28	0.46	0.48
Growth rate	-	0.393	0.215	-	0.643	0.043
Other Sectors	1.22	1.75	1.90	0.26	0.40	0.40
Growth rate	-	0.434	0.086	-	0.538	0.000

NOTE.- Value added per worker is calculated as the (log of) ratio of value added to employment; investment intensity is calculated as the ratio of investments to value added; import intensity is calculated as the ratio of imports to value added; growth rates are calculated as percentage changes of the means between two subsequent sub-periods; Sensitive Sectors include ISIC 3130, 3522, 3832+383X, 3841, 3842 (excluding the Netherlands), 3850, ISIC 3140 and 3690 for Germany, ISIC 3844 for Italy and ISIC 3849 for the UK; Other Sectors include all the others.

Firstly, it can be noted that, during the SMP years, the average labour productivity grew more in the sensitive sectors than in the other sectors in the EU. On the contrary, Japan and the US exhibit an opposite trend. Although this provides some evidence of the impact of the SMP on labour productivity, caution is suggested because the period of investigation was extremely eventful for the global economy and the magnitude of the differential productivity growth is small. Turning to investment intensity, the sensitive sectors underperformed relatively to the other sectors over the period 1992-93, both inside and outside the EU. However, the figures in Table 3 primarily reflects the severe recession occurred in EU in 1992 and 1993, making difficult to draw any conclusions about the impact of the Program. Table 3 displays the direct effect of the removal of non tariff barriers on the growth of import penetration. The sensitive sectors showed higher growth than the non sensitive sectors in 1992-93, as expected. Although these trends are similar to those in Japan and the US, the magnitude of the effects is larger in the EU. Although this evidence is favorable to the SMP, this conclusion cannot be reached directly from the figures in Table 3, these statistics being constructed on data on imports from anywhere in the world (the only measure available at this level of disaggregation). More reliable evidence should be based on data which provide information on the source of import, accounting trading partners in the EU separately from the rest of the world.

To what extent these findings are robust with respect to further econometric controls is the subject of the next section.

5 Empirical results

The main results for all EU countries are displayed in Table 4. A sequence of estimated equations investigate the robustness of the key results, with regard to changes in the equation specification. All the variables included in the production functions show a pattern of signs consistent with our expectations. In column (1) estimates of the baseline equation (3) are reported. The SMP term ($SENS_{ij} * 1992 - 93$) enters positively and is significant at conventional levels, indicating that the EU SMP has generated a positive productivity shock in EU countries during the years 1992-93. In Column (2) a term which controls for a previous impact of SMP during the years 1987-91 ($SENS_{ij} * 1987 - 91$) is also included. This variable captures the impact of the expectations of a tougher competitive regime induced by the SMP on productivity before the "bulk implementation" of the Program. However, this is not supported by the empirical evidence. Column (3) re-estimates the basic specification instrumenting the labour and capital terms (with l_{ijt-1} and k_{ijt-1})[24]. Treating these terms as

[24] This is valid in the absence of serial correlation. The LM statistic at the bottom of the table confirms that there is no evidence of serial correlation in this column. Column (3) also shows that, being labour characterized by a low persistence, lagged levels of employment produce valid but weak

endogenous leads to a decrease of both the capital and the labour coefficients. The SMP term enters positively, as expected, but it is less precisely determined. In column (4) the Cobb-Douglas restriction is relaxed, allowing a more general transcendental logarithmic (translog) specification[25]. The fact that the coefficients of lagged output, labour and capital are fairly close to those obtained earlier and the translog model is rejected against the Cobb-Douglas, $F(6, 2802) = 1.37$, suggest that the chosen baseline specification (Cobb-Douglas) is appropriate[26]. Furthermore, the SMP term remains significant at conventional levels.

In columns (5) and (6) the labour input is adjusted to take account of differences in worked hours and skills levels respectively. The way in which these adjustments are made is described in Appendix 2. The basic model is remarkably robust to all these changes. In particular, column (5) controls for differences in hours worked across countries and column (6) controls also for differences in skills levels. The SMP variable is correctly signed and its coefficient remain significant in both cases. Finally, the cycle term enters negatively[27] and is significant at conventional critical values.

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instruments for the equation in levels (the opposite is true for the capital stock). This is consistent with the findings of Blundell and Bond (1999).

[25] This model differs from the Cobb-Douglas model in that it relaxes the Cobb-Douglas's assumption of unitary elasticity of substitution. The translog model exhibits a number of desirable properties, above all it provides a second order approximation to an arbitrary technology. See, for example, Christensen, Jorgenson and Lau (1973) and Caves Christensen and Diewert (1982).

[26] In column (4) only some estimated coefficients of the translog model are reported. The full structure of the model is shown in Appendix 3.

[27] This counter-intuitive result may be a consequence of the fact that a measure of the past business cycle is considered.

Table 4: Estimates of Production Function, EU Countries.

y_{ijt} Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
y_{ijt-1}	0.813	0.814	0.841	0.817	0.810	0.809
	(35.07)	(35.25)	(37.18)	(53.34)	(34.59)	(34.39)
l_{ijt}	0.05	0.048	0.007	0.058	0.056	0.057
	(3.59)	(3.54)	(0.48)	(4.25)	(3.97)	(4.09)
k_{ijt}	0.069	0.071	0.049	0.064	0.068	0.068
	(4.56)	(4.62)	(3.25)	(4.77)	(4.54)	(4.51)
$SENS_{ij} * 1987-91$	-	-0.009	-	-	-	-
	-	(-1.18)	-	-	-	-
$SENS_{ij} * 1992-93$	0.022	0.019	0.020	0.023	0.023	0.022
	(2.24)	(1.89)	(1.98)	(2.32)	(2.29)	(2.23)
IMP_{ijt-1}	0.00	0.00	0.00	-0.002	0.00	0.00
	(0.037)	(0.037)	(-0.37)	(-0.93)	(0.056)	(0.06)
$CYCLE_{ijt-2}$	-0.026	-0.027	-0.023	-0.026	-0.026	-0.027
	(-3.41)	(-3.46)	(-3.04)	(-3.44)	(-3.44)	(-3.45)
Year dummies	yes	yes	yes	yes	yes	yes
Within Groups	yes	yes	yes	yes	yes	yes
IV			yes			
Serial Correlation	0.00	0.00	0.00	0.00	0.00	0.00
p-value	0.50	0.50	0.50	0.50	0.50	0.50
Adjustments:						
Hours					yes	yes
Skills						yes
Obs.	2998	2998	2998	2998	2998	2998
Fixed effects	158	158	158	158	158	158
Years	1973-93	1973-93	1973-93	1973-93	1973-93	1973-93

NOTE.- All equations include both country-industry fixed effects, country-specific linear time trends and time effects; numbers in brackets below the coefficients are t-statistics; standard errors robust to heteroskedasticity of general form are used to compute t-ratios; instruments for l_{ijt} and k_{ijt} in column (3) are given by their lags (l_{ijt-1}, k_{ijt-1}); serial correlation is a LM test (Baltagi 1995).

These results are open to the criticism that the included SMP variables might not identify effects of the Single Market. In particular, the included SMP variables could pick up an eventual worldwide technological change that occurred in the sensitive industries during the years 1992-93. To address this issue, the basic fixed effects equations have been re-estimated on additional data from the Japan and United States.

In columns (1) and (2) of Table 5, the basic production functions shown in Table 4 are repeated for reference. Column (3) and (4) report estimates of identically specified models for Japan and the US. The core result is that the SMP term ($SENS_{ij} * 1992-93$) is negatively signed and statistically insignificant. In Column (4), by contrast, evidence of a positive productivity shock in Japan and USA, during the years 1987-91 is reported. This could raise doubt about the interpretation of previous SMP effects (1987-91), but this seems not to be case for the core SMP term. The model has also been re-estimated only for the US, as Japan was affected by a severe recession in early 1990s following the end of the "bubble" years. No significant differences arose in the core results.

With regard to the estimated coefficients of IMP_{ijt-1}, and $CYCLE_{ijt-2}$, they are consistent with those reported in Table 4 and, therefore, the same considerations apply.

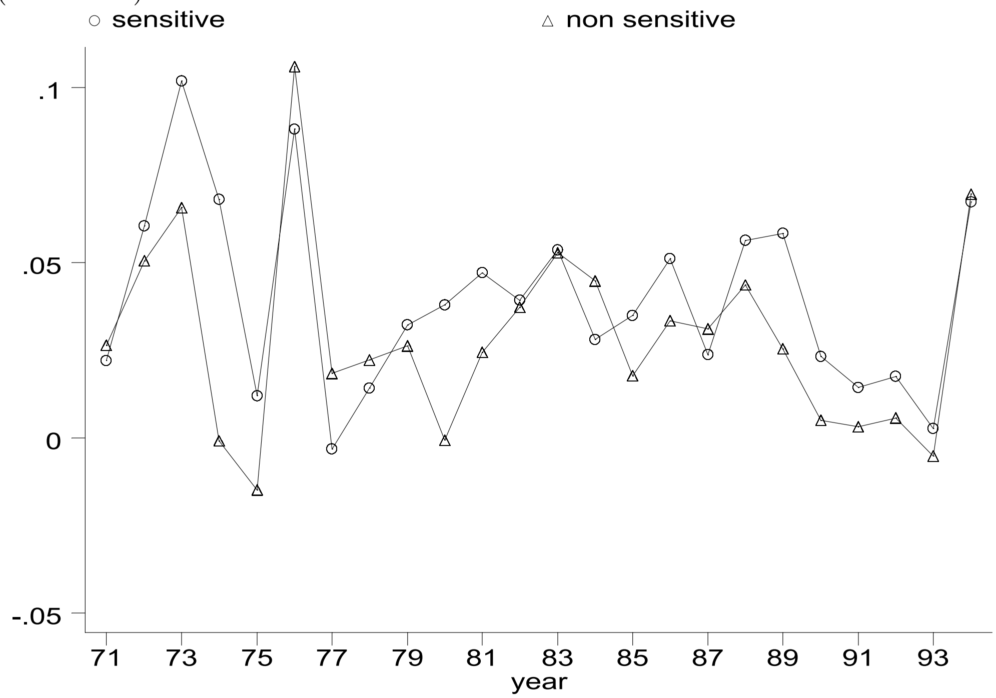
Table 5: Estimates of Production Function, Japan and USA

y_{ijt}	(1)	(2)	(3)	(4)
	EU		**Japan and the US**	
Independent Variable				
y_{ijt-1}	0.813	0.814	0.886	0.882
	(35.07)	(35.25)	(34.95)	(35.0)
l_{ijt}	0.05	0.048	0.073	0.083
	(3.59)	(3.54)	(2.7)	(3.13)
k_{ijt}	0.069	0.071	0.017	0.012
	(4.56)	(4.62)	(0.64)	(0.44)
$SENS_{ij} * 1987 - 91$	-	-0.009	-	0.034
	-	(-1.19)	-	(2.0)
$SENS_{ij} * 1992 - 93$	0.022	0.019	-0.003	0.009
	(2.24)	(1.89)	(-0.139)	(0.39)
IMP_{ijt-1}	0.00	0.00	0.011	0.013
	(0.037)	(0.037)	(0.86)	(1.01)
$CYCLE_{ijt-2}$	-0.026	-0.027	-0.014	-0.013
	(-3.41)	(-3.46)	(-0.74)	(-0.71)
Year dummies	yes	yes	yes	yes
Within Groups	yes	yes	yes	yes
Serial Correlation	0.00	0.00	0.00	0.00
p-value	0.50	0.50	0.50	0.50
Obs.	2998	2998	1206	1206
Fixed effects	158	158	59	59
Years	1973-93	1973-93	1973-93	1973-93

NOTE.- All equations include both country-industry fixed effects, country-specific linear time trends and time effects; numbers in brackets below the coefficients are t-statistics; standard errors robust to heteroskedasticity of general form are used to compute t-ratios; serial correlation is a LM test (Baltagi 1995).

These findings are also consistent with the patterns of productivity arising from Figure 1. Figure 1 shows the average labour productivity growth rate for both the sensitive and the other sectors in the EU. In contrast to previous years, the sensitive sectors performed better than the other sectors in every year of the SMP (1988-93). This provides further evidence of the benefits of the Single Market.

Figure 1: Labour Productivity Growth: Sensitive vs. Other Sectors, European countries (1971-1994)



Finally, it is considered the possibility of heterogeneity in the coefficients across the EU countries. Table 6 reports the results from specifications which allow the coefficients to vary across the EU countries. In columns (1)-(6) estimates of country-specific coefficients for Belgium, France, Germany, Italy, the Netherlands and the United Kingdom are reported, respectively. The country-specific elasticities of the production function are relatively similar to the pooled estimates and show a moderate heterogeneity across countries. With reference to the Single Market, the results are qualitatively similar to the overall sample, except for Belgium. The core SMP term, ($SENS_{ij} * 1992-93$) enters positively and is significant at conventional critical values[28], but, compared to the pooled sample, its coefficient is larger in size (column 2, Table 4).

[28] Since there have been various shocks in the European countries that we are unable to control for, caution is suggested in the interpretation of these results. For example, the captured SMP effects in Germany might be a consequence of the restructuring process and relocation due to re-unification. In the UK, these estimates could simply reflect the impact of the path of privatisation launched in the eighties.

Table 6: Estimates of Production Function, individual EU countries.

y_{ijt}	(1)	(2)	(3)	(4)	(5)	(6)
	FRA	UK	ITA	NET	GER	BEL
Independent Variable						
y_{ijt-1}	0.694	0.175	0.056	0.142	0.153	0.062
	(16.14)	(3.49)	(0.60)	(2.91)	(2.89)	(1.03)
l_{ijt}	0.142	-0.114	-0.122	-0.144	-0.025	-0.04
	(3.29)	(-2.40)	(-2.36)	(-3.07)	(-0.47)	(-0.52)
k_{ijt}	0.102	-0.068	-0.001	-0.046	-0.075	-0.004
	(2.70)	(-1.43)	(-0.02)	(-1.06)	(-1.49)	(-0.07)
$SENS_{ij} * 1987 - 91$	0.014	-0.002	-0.005	-0.035	-0.018	-0.089
	(0.71)	(-0.09)	(-0.18)	(-1.26)	(-0.79)	(-3.05)
$SENS_{ij} * 1992 - 93$	0.034	-0.001	-0.002	0.018	-0.034	-0.087
	(1.67)	(-0.034)	(-0.05)	(0.66)	(-1.41)	(-2.17)
IMP_{ijt-1}	0.025	-0.014	-0.024	-0.027	-0.03	-0.026
	(1.08)	(-0.54)	(-0.63)	(-1.15)	(-1.17)	(-1.11)
$CYCLE_{ijt-2}$	-0.044	-0.011	0.025	0.051	0.047	-0.014
	(-1.64)	(-0.35)	(0.82)	(1.70)	(1.33)	(-0.39)

NOTE.- This table re-estimates the model in column (2) of Table 4 including a full set of country-specific interactions, country-industry fixed effects and common time effects; column (1) reports estimates of coefficients for France (baseline country); columns (2)-(6) report country-specific differences of coefficients from the baseline country; numbers in brackets below the coefficients are t-statistics; standard errors robust to heteroskedasticity of general form are used to compute t-ratios.

6 Conclusions

This paper has produced econometric evidence on the impact of the Single Market on industrial productivity in a panel of industries across 8 OECD countries. Theoretical models posit two different mechanisms through which market integration policies may increase productivity. The first focuses on productivity gains arising from the exploitation of comparative advantages, specialization and scale economies. The second explores the benefits of changes in product market competition in previously protected industries due to market integration. These effects were confirmed by the empirical results.

In addition to statistical significance, these effects are quantitatively important. Due to the Single Market, sensitive sectors' productivity increased by approximately 2% in 1992 and 1993. Single countries estimates are qualitatively consistent with the overall sample, but they reveal SMP coefficients larger in magnitude.

From a methodological point of view, measuring the SMP by means of time/sector dummies is not very attractive because it captures all factors affecting productivity. In other words, one cannot be certain if and to what extent they capture SMP effects. However, since the main results have been confirmed for a number of EU countries, they can be considered quite robust. In addition, these estimates are robust to a variety of tests including econometric techniques, alternative specifications and measuring inputs in different ways.

A Appendix

A.1 Data sources

The data set has been constructed by combining several sources.

OECD Structural Analysis (STAN): data on real value added, nominal gross fixed capital formation, employment, labour compensation and trade flows. These data are available for 22 countries and 49 manufacturing industries. The industrial classification used is the International Standard Industrial Classification (ISIC). Information is available for the period 1970-1995. However, missing values for a number of countries and/or industries during the final two years mean that the regression sample is constrained to 1970-93.

OECD International Sectoral Database (ISDB): data on real value added, real capital stock, employment, worked hours, and share of labour compensation in value added. These data are available for the 12 OECD countries and 15 industries. The same ISIC classification is used as in the STAN data. Information is available for the period 1970-1996. However, missing values for a number of countries during the final two years mean that the regression sample is constrained to 1970-92.

United Nations General Industrial Statistics Database (UNISD): data on the numbers and wage bills of non-production and production workers 1970-90. This is a crude distinction, but is the only available consistently across a large range of industries and countries over time. It has been analyzed extensively by other authors (e.g. Berman, Bound and Machin, 1998) who have found the occupational split highly correlated with alternative measures of human capital (such as education). The industrial classification is again the ISIC as in the STAN/ISDB data. Information is available for the following countries: Canada, Denmark, Finland, Japan, Sweden, United Kingdom, and the United States. For all other countries, the mean employment and wage bill shares across countries in a particular industry and year are used.

A.2 Input measurement

Capital When not available from the ISDB, capital stock was computed from the investment data, by applying a perpetual inventory procedure with a depreciation of 6% per annum for all years following the first year for which data were available:

$$P_t^I K_t = (1-\delta) P_{t-1}^I K_{t-1} \left(\frac{P_t^I}{P_{t-1}^I} \right) + P_t^I I_t$$

where K_t denotes capital stock, P_t^I denotes price of investment goods, I_t real investment and δ depreciation rate. Initial year stocks assumed a presample investment growth rate of 5 %. Data are National Accounts compatible where available, otherwise OECD estimates are made.

Employment The measure of labour input in the empirical analysis has been corrected in various ways. The baseline measure is given by numbers employed in industry j in country i. This is then adjusted by average annual hours actually worked per person in employment (from the ISDB). This is an economy-wide adjustment. The third measure of labour input controls for differences in the quality of labour inputs. Employment in each country-industry-year is sub-divided into the number of production and non-production workers using the UN data on the proportion of each category of worker. Following Harrigan (1998), aggregate labour input can be expressed as a translog index of the two types of labour,

$$L_{ijt} = (h_{ijt})^{s_{ijt}} \, . \, (u_{ijt})^{1-s_{ijt}}$$

where h_{ijt} denotes the number of non-production workers, u_{ijt} denotes the number of production workers, and s_{ijt} is the share of non-production workers in the wage bill. In making this adjustment, country-industry data on h_{ijt} and s_{ijt} are used where available (Canada, Denmark, Finland, Japan, Sweden, United Kingdom, and the United States) and mean values of h_{ijt} and s_{ijt} across these countries in each industry where not available. In addition, data after 1991 are obtained as extrapolations forward in time.

Some descriptive statistics of the variables used in estimation over the period 1970-93 are shown in Table A1.

Table A1: Mean annual growth rates of value added, employment and capital by country and sensitivity to SMP in selected years

	EU			**Japan and USA**		
	70-86	87-91	92-93	70-86	87-91	92-93
Value Added						
Sensitive Sectors	21.39	21.55	21.55	23.04	23.15	23.15
	1.50	*1.55*	*1.61*	*1.24*	*1.50*	*1.53*
Other Sectors	22.75	22.89	22.96	24.07	24.49	24.54
	1.44	*1.40*	*1.51*	*1.34*	*1.33*	*1.33*
Employment						
Sensitive Sectors	11.22	11.04	11.0	12.69	12.47	12.46
	1.46	*1.49*	*1.56*	*1.23*	*1.45*	*1.44*
Other Sectors	12.36	12.19	12.17	13.6	13.60	13.60
	1.58	*1.58*	*1.63*	*1.43*	*1.48*	*1.47*
Capital						
Sensitive Sectors	21.57	21.84	21.99	23.22	23.44	23.57
	1.61	*1.63*	*1.68*	*1.46*	*1.67*	*1.69*
Other Sectors	23.39	23.58	23.82	24.64	25.14	25.29
	1.49	*1.41*	*1.46*	*1.35*	*1.26*	*1.27*

NOTE.- All variables are expressed in logs; Sensitive Sectors include ISIC 3130, 3522, 3832+383X, 3841, 3842 (excluding the Netherlands), 3850, ISIC 3140 and 3690 for Germany, ISIC 3844 for Italy and ISIC 3849 for the UK; Other Sectors include all the others; standard deviations in italics below means.

A.3 Transcendental logarithmic production functions

The transcendental logarithmic production function (translog) can be interpreted as a second order approximation to an unknown functional form[29]. Starting from a generic functional form $\ln Y = f(\ln X_1, ..., \ln X_k)$, it can be derived by expanding this function in a second-order Taylor series around the point $\mathbf{x} = [1, 1, ..., 1]'$ so that at the expansion point, the log of each variable is a convenient zero. Then,

$$\begin{aligned} \ln Y &= f(0) + \sum_{k=1}^{K} \left[\partial f(.)/\partial \ln X_k\right]_{|\ln x=0} \ln X_k \\ &+ \frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{K} \left[\partial^2 f(.)/\partial \ln X_l \partial \ln X_k\right]_{|\ln x=0} \ln X_k \ln X_l + \epsilon. \end{aligned} \tag{A1}$$

The disturbance ϵ in this model is assumed to embody the familiar factors and the error of approximation to the unknown function. Since the function and its derivatives evaluated at the fixed value $\mathbf{0}$ are all constants, they can be interpreted as the coefficients,

$$\ln y = \beta_0 + \sum_{k=1}^{K} \beta_k \ln X_k + \frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{K} \gamma_{kl} \ln X_k \ln X_l + \epsilon. \tag{A2}$$

Among the interesting features of this formulation is that the log-linear model is a special case, $\gamma_{kl} = 0$. Then, the model estimated in column 4 of Table 4 takes the form

$$\begin{aligned} \ln Y_{ijt} &= \beta_0 + \beta_1 \ln Y_{ijt-1} + \beta_2 \ln L_{ijt} + \beta_3 \ln K_{ijt} \\ &+ \beta_4 (\ln Y_{ijt-1})^2/2 + \beta_5 (\ln L_{ijt})^2/2 + \beta_6 (\ln K_{ijt})^2/2 \\ &+ \beta_7 \ln Y_{ijt-1} \ln L_{ijt} + \beta_8 \ln Y_{ijt-1} \ln K_{ijt} \\ &+ \beta_9 \ln K_{ijt} \ln L_{ijt} + \mathbf{X}_t \boldsymbol{\delta} + \epsilon_{ijt}. \end{aligned} \tag{A3}$$

In the translog model the estimated output elasticities with respect to lagged output, labour and capital are, omitting the subscripts, respectively,

$$\begin{aligned} \frac{\partial \ln Y}{\partial \ln Y_{-1}} &= \beta_1 + \beta_4 \ln Y_{-1} + \beta_7 \ln L + \beta_8 \ln K \\ \frac{\partial \ln Y}{\partial \ln L} &= \beta_2 + \beta_5 \ln L + \beta_7 \ln Y_{-1} + \beta_9 \ln K \\ \frac{\partial \ln Y}{\partial \ln K} &= \beta_3 + \beta_6 \ln K + \beta_8 \ln Y_{-1} + \beta_9 \ln L \end{aligned}$$

where these functions can be evaluated at the mean values for $\ln Y_{-1}$, $\ln L$ and $\ln K$ (this is the procedure followed in Table 4, column 4).The estimated variance-covariance

[29] See Berndt and Christensen (1973).

matrix of these linear combinations of the within group estimates can be computed, as

$$\mathbf{W}\left(Est.\ Var\left[\mathbf{b}\right]\right)\mathbf{W}' \tag{A4}$$

where the weight matrix $\mathbf{W}$ is given by

$$\begin{bmatrix} 1 & 0 & 0 & \ln Y_{-1} & 0 & 0 & \ln L & \ln K & 0 \\ 0 & 1 & 0 & 0 & \ln L & 0 & \ln Y_{-1} & 0 & \ln K \\ 0 & 0 & 1 & 0 & 0 & \ln K & 0 & \ln Y_{-1} & \ln L \end{bmatrix}.$$

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