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The Effects of European Economic Integration on the Profitability of Industries

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Abstract

This paper examines the effects of intensified international competition on industry profits in six European Union (EU) countries. The paper uses two methods to estimate industry profits. The traditional method uses accounting data to obtain a measure of gross price-average cost margins. The second method directly estimates markups of price over marginal cost using new empirical techniques. Import competition is found to have disciplined market power, regardless of the method used to estimate industry profits. From the analysis of the markups, there is evidence that this is due mainly to intra-EU import competition. The evidence for export discipline is much weaker.

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SUMMARY

This paper empirically examines whether intensified international competition forces industries to price more competitively by examining two-digit International Standard Industrial Classification manufacturing sectors between 1970 and 1994 in six European Union (EU) member countries: Belgium, Denmark, France, Germany, Italy, and the United Kingdom. The paper also explores the implications of the trade bloc for the strength of trade discipline originating from intra-EU trade and extra-EU trade.

Two alternative methods are used to estimate industry profits. The traditional method uses accounting data to obtain a measure of price-cost margins that serves as a proxy of price over average, rather than marginal, cost. The second method directly estimates the markup of price over marginal cost using a modified version of Hall's (1990) method, which imposes no restrictions on returns to scale or the degree of competition in industries. The effects of economic integration on profits are then captured by relating the margins/markups to trade penetration ratios.

Both methods provide evidence that import competition disciplines market power. Export competition is found to have had a negative impact on both the markups and margins, albeit insignificantly in the markups analysis. The markups analysis suggests that intra-EU import competition is the main disciplining effect. The margins analysis suggests that the main disciplining effect arises from extra-EU import and export competition. Therefore, although both methods show evidence of trade discipline, they do not concur on the origins of trade discipline. Greater weight should, however, be attached to the results of the markups analysis, since the profits estimates under the margins analysis could be biased.

I. INTRODUCTION

Tariffs and other restrictions on trade have been widely used to shield domestic industries from international competition. Trade barriers give domestic suppliers greater market power and allow them to increase the markups of price over marginal cost. As a result, profitability is artificially high and incentives to produce efficiently are lower than in the absence of tariffs. A vast body of literature (see, for example, Helpman and Krugman, 1989) argues that this inefficiency can be remedied by liberalization of international trade. Hence, a lowering of trade barriers will lead to a reduction in market power and lower profit margins. Although this argument is theoretically well-established, the empirical evidence to support it is rather limited. Some more recent notable studies on this issue are by Levinsohn (1993) and Harrison (1994).

This paper provides empirical evidence that increased international trade disciplines imperfectly competitive industries by forcing them to price more competitively. The paper makes three contributions to understanding and testing the effects of increased openness of the market for goods and services on the profitability and market power of domestic industries.

First, the paper shows that new empirical methods are needed to examine accurately the effects of intensified international trade. The empirical literature has diverged on the appropriate methodology to estimate industry profit margins. The traditional method of estimating profits utilizes accounting data to measure price-cost margins that are defined as revenues-variable costs/revenues.[1] Therefore, the accounting profits serve as a measure of price over average cost [P-AVC/P] rather than marginal cost. Alternatively, the proponents of the 'new' empirical industrial organization contend that price-cost margins cannot be directly observed but rather must be estimated using structural econometric models. Comparisons of the estimates of the profit margins from the two methods suggest that the gross margins are biased in both directions.

The new empirical method that is used in this paper to examine the response of the profitability of domestic industries to increasing competition from abroad is based on a modified version of the technique developed by Hall (1990). There are several important motivations for utilizing the modified version of Hall's (1990) method rather than the traditional method to measure profits including the following: (1) Under conditions of constant returns to scale, the markup of price over average cost is equal to the markup of price over marginal cost. But if there is an increasing returns to scale cost schedule, marginal cost and average cost will differ, and estimates of the markups of price over marginal cost will be more appropriate indicators of profits than the accounting price-cost margins.[2] The methodology to estimate the markups of price over marginal

[1] This technique is known as the Structure-Conduct-Performance Paradigm (SCPP).
[2] For example, with fixed costs, marginal cost does not equal average cost.

cost makes no assumptions about the degree of returns to scale in the industry nor the degree of competition; (2) The traditional method of measuring profit margins assumes that only capital is a fixed cost and that inputs of labor and material are only variable costs. Overhead labor must be a huge part of any fixed cost and so must "overhead materials" (purchased inputs from other industries, such as advertising). Also, the size of a firm's capital stock certainly increases with its (long run) output, so there must also be a strong variable component to capital. Hence, the measures of the profit margins from the accounting data will be biased and may lead to inaccurate predictions about the disciplining effects of trade.[3]

Second, the paper examines the effects of increased openness over the 1970-94 period using panel data for six manufacturing sectors and for six European Union (EU, formerly known as the European Community) member states (Belgium, Denmark, France, Germany, Italy and the United Kingdom).[4] Hall's technique has only been previously applied to investigate the consequences of trade reform in individual countries (Levinsohn, 1993; and Harrison, 1994). Since this paper estimates the accounting price-cost margins and the markups of price over marginal cost for a panel of countries and industries, it allows us to see how the profit estimates vary within an industry across countries, as well as within a country across industries. Furthermore, studying a group of countries that were among the original members of the EU provides an ideal opportunity to study the effects of intensified competition on market structure for several reasons. First, several new countries had joined the EU and tariff and nontariff barriers and other restrictions to trade between them and the existing EU member countries were gradually being lifted over the 1970-94 period. Second, the free movement of factors of production had gradually been established in the EU by 1993. Third, a cross-country EU group analysis permits us to disaggregate trade flows by their origins, whether intra-EU or extra-EU, and thus to determine how the strength of trade discipline varies by the origin of trade. Finally, a time-series analysis permits us to examine the consequences of the creation of the EU for market structure and trade discipline in a long-run perspective.

In order to examine the effects of increased trade openness for the manufacturing sectors of six EU member nations, the profit margins from both the new and traditional

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[3] Capital intensive industries will have higher margins even though the industry may not be very profitable. Also, industries with large fixed materials or labor costs will have lower margins even though the industry may be profitable.

[4] All of the previous empirical research on the EU has solely adopted the SCPP methodology. Examples include studies by De Ghellinck, Geroski and Jacquemin (1988), Geroski and Jacquemin (1981), Jacquemin and Sapir (1990, 1991), and Sleuwaegen and Yamawaki (1988).

methods are related to import and export penetration ratios.[5] Enhanced imports signify intensified competition and are expected to be negatively related to the industry profit margins. The overall effect of exports on profits is expected to be ambiguous. On the one hand, they can also signify increased competition, in which case they will be negatively related to profit margins. On the other hand, there can be a positive relation between exports and market power if concentrated sellers can discriminate between foreign and domestic markets, or if there is product differentiation.[6]

Third, the paper explores whether the extent of trade discipline varies depending on the origin of the trade. Although, in general, there are no particular *a priori* reasons to expect that imports and exports will have different disciplining effects depending on the country from which they originate, this may not be the case when a trade bloc is formed. Intra-EU and extra-EU trade penetration ratios capture the various effects of trade creation and trade diversion that arise with the coming into effect of the EU. Since many barriers to trade within the Union were eliminated over the 1970-94 period and a common external tariff was set up on imports from outside the Union, it is expected that these measures will divert trade away from countries outside the EU and encourage trade within the EU.

Thus, because of the policies taking effect during the period examined, it is expected that intra-EU imports and exports will have a stronger disciplining impact over extra-EU imports and exports. In addition, the existence of preferential/differential trade arrangements affects the degree of substitutability between products that are actually traded from different origins. So, for example, absence of barriers to trade on products from within the community implies that homogeneous products can compete one for one and even differentiated products will face greater competition. The proximity of the EU countries implies lower natural trade barriers in terms of transportation costs and differences in tastes among the EU member nations and may contribute to the disciplining effect of intra-EU trade. The evidence from the analysis of the markups of price over marginal cost conform with these expectations.

However, there may also be arguments to support a stronger disciplining impact of extra-EU trade over intra-EU trade. The disciplining impact of intra-EU trade could be limited by the characteristics of market conduct within the EU, such as various horizontal and merger agreements, dominant positions that allow price leadership, and intrafirm

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[5] It would be ideal to also relate the estimates of profits to direct measures of trade barriers such as tariffs and quotas. However, data for tariff and non-tariff barriers are not available in time series form for each country-sector pair.

[6] Exports sales of differentiated products will increase the profit margins if they enlarge the market for a typical firm. Also, the enlarged market can allow the firm to take advantage of economies of scale in production and to spread fixed costs over a larger production volume.

trade (Jacquemin and Sapir, 1990 and 1991). Furthermore, if firms in the different EU member countries collude following liberalization, or if production of goods for the region shifts to countries that are most suited for production, the disciplining effect of imports and exports from within the Union will be dampened. However, it has been observed that the creation of the EU has led to an increase in intraindustry trade among the member states rather than interindustry trade. The existence of similar products implies greater competition and trade discipline than if countries specialized in producing certain goods for the region as a whole, although, as discussed above, in certain situations, the existence of product differentiation could be expected to dampen trade discipline.

The rest of the paper is divided into four sections. Sections II and III analyze the price-cost margins and the price-marginal cost markups respectively. Section II discusses the empirical implementation and results obtained from the analysis of the gross margins. Section III outlines the methodology that is used to estimate price-marginal cost markups and discusses the empirical implementation and presents the results. Section IV presents some conclusions. The description of data sources and variable construction for each methodology is given in the appendix.

II. ECONOMETRIC ANALYSIS OF GROSS PRICE-COST MARGINS

A. Empirical Implementation

Two approaches are adopted to examine the price-cost margins. First, the summary statistics of the price-cost margins (PCM) in each industry and for each country are analyzed. Second, the gross price-cost margins are regressed on the trade penetration ratios. The import penetration ratio (IPR) is defined as imports as a fraction of domestic sales, and the export penetration ratio (EPR) is defined as export sales as a fraction of domestic production. The intra-EU import penetration ratio is defined as the ratio of imports from the 12 EU member nations to domestic sales.[7] The extra-EU import penetration ratio is calculated as the ratio of imports from the world, excluding imports from the 12 EU member nations, to domestic sales. The intra-EU and extra-EU export penetration ratios are defined analogously as the ratio of exports to the 12 EU member nations relative to domestic production, and the ratio of exports to the rest of the world (excluding the EU countries) relative to domestic production respectively. The pooled regressions are estimated using the whole panel of cross-country and cross-sector data. The regression specifications were chosen to be as similar to the markup regression specifications as possible in order to facilitate comparisons between the two methods.

[7] Over the period examined in this paper there were only 12 member nations in the EU. Three more countries have joined since then.

The regressions that are estimated for price-cost margins are given by,

$$\Delta PCM_{cit} = \beta_0 + \beta_1 \Delta[IPR_{cit} - \overline{IPR}_{ci}] + \beta_2 \Delta(\frac{K}{Q})_{cit} + \beta_3 \Delta(\frac{\dot{Q}}{Q})_{cit} + \varepsilon_{cit}. \qquad (1)$$

where c, i, and t denote country, industry, and time period respectively. Equation (1) can be rewritten with IPR replaced by intra-EU/extra-EU IPR, EPR and intra-EU/extra-EU EPR in order to test the effect of each penetration ratio on the price-cost margins. Other variables included in the regression include the capital to output ratio, $\frac{K}{Q}$, and the percent change in the industry sales, $\frac{\dot{Q}}{Q}$. Since the gross return to capital is included in the price-cost margin, the margin is expected to be positively related with the ratio of capital to output. Also, as noted by Esposito and Esposito (1971) high capital requirements reflect a cost disadvantage and serve as a barrier. Thus, high capital requirements which prevent new entrants into the market will be positively related to the level of industry profit rates. Increases in industry demand, as reflected in a high growth rate of industry sales, should also be positively related to industry profits.

The paper tests the hypothesis that the higher the import intensity, the greater is the threat of foreign competition and the closer prices will be to competitive levels. Thus, the price-cost margins will be negatively related to the import intensity variable (or import penetration ratio). However, there is a simultaneity problem in considering price-cost margins and import penetration. Higher margins or profits in an industry will attract foreign firms to enter the market and thus will induce more imports. Therefore, OLS estimates are expected to be inconsistent and biased upwards.

The predicted relationship between the export variable and the price-cost margins is ambiguous. On the one hand, if the exporting industry is small in the world market and cannot price discriminate between domestic and international markets, it will be constrained to a competitive outcome in the same way as import-competing industries. This implies a negative relationship between the price-cost margins and the export variable. On the other hand, with differentiated products, greater exports due to an enlarged market can lead to economies of scale in production and to higher price-cost margins as long as the larger market does not eliminate the scale-economy entry barriers. Also, if the exporting industry can discriminate between domestic and international markets, firms in the industry can elevate the price above international levels. The domestic sellers price-cost margin becomes a weighted average of the margins on domestic and export sales (Pugel, 1980). However, whether discrimination causes the overall weighted price-cost margin to rise or fall is uncertain, because the price-cost margins rise in one market and fall in the other. The effect on the overall weighted price-cost margins depends on the home and foreign demand elasticities and the economies of scale in the industry (Huveneers, 1981). These reasons suggest that the export intensity

variable (or the export penetration ratio) can be positively related to the price-cost margins. It is also important to note that the export variable, like the import variable, is endogenous. High price-cost margins in an industry will attract foreign firms to enter and may reduce exports from a given country. There is thus a negative impact of the price-cost margins on the penetration ratios, and it is expected that the coefficients on OLS estimates will be inconsistent and biased downwards.

The simultaneity problem between the import and export penetration ratios and the price-cost margins that is alluded to in the discussion above implies that ordinary least squares estimations will yield biased and inconsistent results. To solve the simultaneity problem, the paper uses an instrumental variables (IV) procedure. Appropriate instruments need to be correlated with the penetration ratios and the price-cost margins, but they should not be caused by either the margins or the penetration ratios, nor should they enter the margins equation directly. Hence, the paper uses national tariff rates, national unemployment rates, and transportation cost variables as instruments. Lower tariff rates and transportation costs should induce greater imports and exports. The aggregate unemployment rate captures changes in industry demand. Changes in demand affect the import and export volumes as well as the price-cost margins.

Replacing the import penetration ratio (export penetration ratio) by intra-EU and extra-EU import penetration ratios (export penetration ratios) respectively in equation (1) tests whether the strength of trade discipline depends on the origin of the trade.

B. Results

Table 1 shows that gross price-cost margins tend to be the highest in Italy and the lowest for the United Kingdom. Also, the gross price-cost margins tend to be the highest in the nonmetallic mineral products and chemicals sectors. Separate regressions of the price-cost margins on each of the time, country, and sector dummies reveal that 7 percent of the variation in the margins can be attributed to the year, 22 percent can be explained by the sector, and 40 percent is explained by the country.

Table 2 presents the IV results from estimating variations of equation (1). Only the IV regression results are reported here since the IV estimates correct for the endogeneity of the trade penetration ratios. Table 2a shows that both import and export penetration have significant negative impacts on the price-cost margins. A 10 percent increase in the IPR or EPR relative to their respective averages are estimated to reduce the gross margins by 0.012. As predicted, the coefficient on the capital to output ratio is positive and significant in both of the regressions. The coefficient on the growth rate of industry sales is small and insignificant in both regressions.

Table 2b presents the IV regression results when the intra-EU and extra-EU import (export) penetration ratios are both included in the regression, and Table 2c

presents the IV regression results when the impact of intra-EU and extra-EU import (export) penetration ratios are examined in separate regressions. It is reasonable to expect that intra-EU and extra-EU imports (exports) will be highly collinear. For example, ongoing trade liberalization between the EU member countries diverts trade from outside the EU to trade within the EU, in which case the intra-EU import penetration ratios will be negatively related to the extra-EU import penetration ratios. Alternatively, exchange rate fluctuations simultaneously affect the intra-EU and extra-EU import penetration ratios causing them to move together. One potential remedy for collinearity is to drop one of the explanatory variables. It may, therefore, be preferable to obtain estimates of the impact of changes in the intra-EU IPR and extra-EU IPR on the price-cost margins separately, as in Table 2c.

From Table 2b, it appears that the negative influence of import penetration on price-cost margins is caused by intra-EU import penetration. There is a positive, albeit insignificant, coefficient on the extra-EU IPR. An F test of the null hypothesis that the coefficients on intra-EU imports and extra-EU imports are the same could not be rejected. However, from Table 2c, the effects of both the intra-EU and extra-EU IPRs are negative and significant. The coefficient on extra-EU IPR is larger in magnitude than the coefficient on the intra-EU IPR, suggesting a stronger disciplining effect of extra-EU imports on the margins.

The coefficient on the extra-EU EPR reported in Table 2b is large, negative, and significant, in contrast with the estimated coefficient on intra-EU export penetration. A test of the hypothesis that the coefficients are the same was rejected at the 10 percent level of significance. The evidence from Table 2c confirms that extra-EU exports have a stronger disciplining effect than intra-EU exports. Again, the remaining coefficients on the capital to output ratio and the growth rate of industry sales have the predicted signs in most of the regressions in Table 2, panels b and c.

III. ECONOMETRIC ANALYSIS OF MARKUPS OF PRICE OVER MARGINAL COST

A. Methodology

Unlike the accounting gross price-cost margins, the new empirical methods attempt to directly estimate the markup of price over marginal cost rather than average variable costs. The framework used to estimate price-marginal cost markups is a modified version of the method developed in Hall (1990). The production function for an industry is given by,

$$Y = F(K, L, M, T) \tag{2}$$

where Y is gross output, K is capital, L is labor, M is intermediate inputs of energy and materials, and T is an index of technology or productivity. Taking a first-order Taylor

series approximation of the production function yields the rate of growth of gross output as a weighted function of the growth rates of inputs,

$$dy = \left(\frac{F_L L}{Y}\right)dl + \left(\frac{F_K K}{Y}\right)dk + \left(\frac{F_M M}{Y}\right)dm + \left(\frac{F_T T}{Y}\right)dt \qquad (3)$$

where the lower-case letters represent the logs of their upper case counterparts and the derivatives of F are evaluated at their steady states.

It is assumed that each industry has some degree of monopoly power in the goods market but is assumed to be a price taker in the market for inputs. Under these assumptions, the first-order conditions for profit maximization imply that the elasticity of output with respect to any factor J equals a markup μ multiplied by the share of that factor in output, s_{yJ}:

$$\frac{F_J J}{Y} = \mu \frac{P_J J}{P_y Y} = \mu s_{yJ} \qquad J = L, K, M. \qquad (4)$$

where P_y is the price of gross output, F_J is the marginal product of input J, P_J is the price of input J, and μ is the ratio of price over marginal cost. It is important to note that the price of capital, P_K, is defined as the rental cost of capital. The rental price of capital is the price that one unit of "capital services" would receive in a competitive rental market. It is assumed that all pure economic profits also go to the owners of capital. However, the rental price of capital, P_K, in the first-order conditions derived above depends only on the user (rental) cost of capital. The output elasticities can generally be constructed from observed payments to factors except for the output elasticity of capital. This is because the observed payment to capital includes both the pure rental component and the pure economic profits that go to the owners of capital. To construct the capital elasticity, it is necessary to construct a series for the rental price of capital. From equation (4) it can be seen that under perfect competition, $\mu = 1$, the elasticity of output with respect to each factor is equal to the factor's share in gross output.

Substituting equation (4) into equation (3) for the output elasticities yields the growth rate of gross output as a function of the weighted growth rates of inputs, the markup, and shocks to productivity:

$$dy = \mu[s_{yl}dl + s_{yk}dk + s_{ym}dm] + dt \text{ or } dy = \mu dx + dt \qquad (5)$$

where $dx = [s_{yl}dl + s_{yk}dk]$. Since the derivatives of the production function, F, in equation (3), are evaluated at the steady state, the factor shares, s_{yJ}, in equation (5) are averages over the sample period rather than time-varying. Equation (5) can be employed to estimate the markups of price over marginal cost, μ. This method is robust to increasing returns to scale and market power: the derivation of this equation did not require assumptions about whether the degree of returns to scale in the industry was

increasing, decreasing, or constant, nor about the degree of competition and market structure of the industry.[8]

It is important to note that the production function is defined above in terms of gross output rather than value added as in Hall (1990). Real value added is constructed by taking gross output and subtracting the productive contribution of intermediate inputs. This generates a measure of net output that is independent of intermediate inputs and allows Hall to specify the production function only as a function of capital, labor, and technical change. However, Basu and Fernald (1994a, 1994b) show that the measurement of real value added assumes that the elasticity of output with respect to intermediate inputs equals its revenue share. This is only true if there is perfect competition. In the presence of market power, shifts in the intermediate inputs will be incorrectly attributed to shifts in value added and estimates of the markups will be biased. Thus, the impact of intermediate inputs should be taken into account even if the production function is defined in terms of value added.

Estimation of equation (5) requires data for real gross output. Since this is not available and to allow comparison with earlier studies which use value added, a relationship between the weighted growth rates of inputs and the markup and the growth rate of real value added is derived which accounts for the impact of shifts in intermediate inputs on value added. Following the analysis developed by Basu and Fernald (1994a, 1994b), the growth rate of the Divisia index of value added is defined as,

$$\frac{dV}{V} = dv = \frac{1}{1-s_{ym}}dy - \frac{s_{ym}}{1-s_{ym}}dm \tag{6}$$

where V is value added, dv is the growth rate of value added, and s_{ym} is the share of materials in revenue, $\frac{P_M M}{P_Y Y}$. Substituting the expression for the growth rate of gross output into the definition of the growth rate of value added yields,

$$dv = \frac{dy - s_{ym}dm}{1-s_{ym}} = \frac{\mu}{1-s_{ym}}[s_{yl}dl + s_{yk}dk] + (\mu - 1)\frac{s_{ym}}{1-s_{ym}}dm + \frac{dt}{1-s_{ym}}. \tag{7}$$

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[8] Hall (1990) argues that it is necessary to estimate factor shares in relation to cost rather than revenue to avoid biased markup estimates. This is because under imperfect competition revenue-based input shares are less than cost-based input shares. The analysis presented above takes Hall's (1990) derivation one step further by using the relationship between cost-based factor shares and revenue-based factor shares derived from homogeneity of the production function and the first order conditions of profit maximization to obtain an expression that is in terms of the markup and that is valid under imperfect competition and increasing returns to scale.

Inserting $1 - s_{ym} = 1 - \frac{P_M M}{P_Y Y} = \frac{P_Y Y - P_M M}{P_Y Y} = \frac{P_V V}{P_Y Y}$ into equation (7) yields,

$$dv = \mu[s_{vl} dl + s_{vk} dk] + (\mu - 1)\frac{s_{ym}}{1 - s_{ym}} dm + \frac{dt}{1 - s_{ym}} \text{ or } dq = \mu[dx^*] + \frac{dt}{1 - s_{ym}} \qquad (8)$$

where $dq = dv + \frac{s_{ym}}{1 - s_{ym}} dm$, $dx^* = [s_{vl} dl + s_{vk} dk + \frac{s_{ym}}{1 - s_{ym}} dm]$ and s_{vJ} is the share of each actor in value added, or $s_{vJ} = \frac{P_J J}{P_V V}$. Since data for all of the variables can be obtained, regressions of equation (8) can be estimated to obtain the markup estimates.[9]

The theory developed here assumes that firms are moving along their production functions. However, in the short run movements of inputs and outputs do not look like movements along the production function. Because of labor hoarding or capacity utilization, firms may maintain a larger labor force or stock of capital than is necessary owing to adjustment costs. If the true quantities of capital and labor input can be assumed, the right adjustment to deal with this issue is to use time-varying elasticities based on shadow costs to weight input growth. Alternatively, the fact that there is labor hoarding and capital utilization can be taken to imply that there are unobserved variations in the inputs of capital and labor that are omitted from the regressions. For example, changes in the degree of effort per hour worked, or changes in the length of the workday of capital from adding extra shifts, could potentially be included in the regressions.

The theory assumes that there is perfect competition in the market for inputs, but there may be labor market imperfections, which will influence the weights attributed to the growth rates of labor and capital in the regressions. For example, a monopsony in the labor market will lower both wages and employment levels below the competitive level. Thus, labor's share in value added will be lower and a smaller weight will be attributed to the growth rate of labor than capital in the regressions. Alternatively, it is difficult to determine the effect that a monopoly union will have on overall labor compensation. Furthermore, it is difficult to predict how these imperfections will in turn affect the regression estimates of market power.

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[9] Omitting the materials term in equation (8) yields the relationship between the markup, the growth rate of value added, and the weighted growth rates of the inputs of labor and capital (where the weights are the shares of the factors in value added) if the impact of shifts in materials use is not accounted for as in Hall (1990). A comparison of the markup estimates when the materials term is omitted with the estimates when it is included reveal upward biased markup estimates, as predicted by Basu and Fernald, because materials use is positively correlated with the use of other inputs.

B. Empirical Implementation

In order to see how changes in import penetration (or export penetration) affected the price-marginal cost markup, dx^* is interacted with the import penetration ratios -IPRs (export penetration ratios -EPRs). The hypothesis to be tested is that higher degrees of import/export penetration induced by the trade reform will increase the degree of competition and reduce markups. However, following the discussion of the relationship between export penetration and price-cost margins, it is possible that the export penetration ratios could be positively related to the price-marginal cost markups in the cases of differentiated products or if oligopolistic sellers can discriminate between foreign and domestic markets. The regression estimated is given by:

$$dq_{cit} = B_0 + B_{1ci}dx^*_{cit} + B_2[IPR_{cit} - \overline{IPR}_{ci}]dx^*_{cit} + B_{3ci} + u_{cit} \qquad (9)$$

where $B_{1ci} = \mu_{ci}$ is the markup for each country c and sector i, and B_3 is the fixed effect that interacts country with sector. There is an equivalent regression that replaces IPR with EPR. The coefficient B_2 on the interaction term will be negative if changes in trade flows increase competition and cause the industry markups to decline.[10] A regression of this form allows the markup to vary across country and sector but the effect of the import penetration ratios (export penetration ratios) is constrained to be the same for each country and sector. The constant term, B_0, reflects the average rate of productivity growth.

In addition, the import/export penetration ratios are replaced by intra-EU and extra-EU import/export penetration ratios respectively in equation (9). This will allow us to determine whether imports/exports from within the EU exert a stronger disciplinary effect on markups than imports/exports from outside the EU.

C. Results

The results from estimating regressions of the form of equation (9) to determine the effects of changes in the import penetration ratios on the markups are reported in Table 3. The first column presents the OLS estimates. The signs and sizes of the markup estimates are what one would expect. The cases where the markup estimates are significantly different from 1 are denoted by asterisks. The coefficient on dx^* interacted with the import penetration ratio is negative in the OLS regression but insignificant. The OLS estimates, however, are likely to be biased because decisions to alter production and input usage are naturally made simultaneously. For example, a positive technology shock will generally cause an industry to raise both production and input usage (although this is not definite, particularly in the presence of imperfect competition).

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[10] Although as mentioned before this may not be the case for an exporting industry consisting of differentiated products or of concentrated sellers that can price discriminate between domestic and international markets.

Also, for some industries, particularly since the paper examines industries at a highly aggregated level, a substantial amount of materials are also the output produced by the same industry. Thus, to the extent that the error term reflects shocks to industry technology, it will be strongly correlated with materials use. Furthermore, because data on intermediate input use are lacking, a measure of real materials was constructed that involved deflating nominal materials use by an industry-specific deflator. The industry-specific deflator, itself, is also likely to be very sensitive to input changes or technology changes, and hence the error term in the regressions.

To correct for this problem, two sets of IV regressions are estimated. In the first set (IV1), a nonlinear combination of the current growth rates in the real world price of oil and the growth rates of real government spending in each country are used as instruments. To be legitimate instruments, fluctuations in the world price of oil and increases in government purchases should not cause shifts in productivity and should not be caused by productivity shifts. If changes in the price of oil or increases in government purchases shift the production function at all, the shift will consequently lead to variations in productivity, in which case it is possible that these instruments are correlated with the error term. Following Hall (1988, 1990), the paper justifies using the world price of oil as an instrument on the basis that changes in the price of oil do not shift the production function in the short run.

The second set of IV regressions (IV2) use a nonlinear combination of a dummy variable that is set equal to 1 if the year is 1993 and is 0 otherwise, and the growth rate of manufacturing employment in each country as instruments along with real government spending by each country and the growth rates of world prices of oil. The dummy variable would be the most persuasive instrument, since it reflects the entry into effect of the single European Market, enabling the free movement, not only of goods, but also of persons, services, and capital on January 1, 1993. Thus, the dummy variable will be directly related to factor supplies but unrelated to fluctuations in productivity. The identifying assumption for using the growth rate of manufacturing employment as an instrument is that there are no aggregate technology shocks (as in Hall, 1986).

The parameter estimates from instrumenting are very similar to the OLS estimates although the results from the IV analysis reveal that the OLS markup estimates may be slightly biased upwards. However, the markups of price over marginal cost continued to be significantly large in a few cases, such as Italy's paper, printing and publishing industry and Germany's machinery and equipment industry. In several other cases the markup estimates were moderate and ranged from 5 to 15 percent, which is similar to the findings by Basu and Fernald for the U.S. manufacturing sector (1994a, 1994b).

The coefficient on dx^* interacted with the import penetration ratio is a larger negative number and significant in the IV regressions than in the OLS regression. The

coefficient is -0.32 (0.168) in the first IV regression, -0.25 (0.14) in the second IV regression and -0.05 (0.066) in the OLS regression (standard errors are in parentheses). Papers by Nelson and Startz (1990a and 1990b) and Bound, Jaeger, and Baker (1993) show that in finite samples, IV estimates are biased in the same direction as the OLS estimates, with the size of the bias approaching that of the OLS bias, as the R^2 between the instrument and the endogenous explanatory variable approaches zero.

To determine the quality of the IV estimates, the study conducts F tests for the joint significance of the exogenous instruments in the first stage regressions (those that are excluded in the second stage regressions) for the endogenous variables. From the F tests it is evident that the instruments are mostly jointly significant for the endogenous variables in both of the IV regressions. However, there are a few cases in the first IV regression specification where the remaining instruments are only weakly correlated with the endogenous variables. In those cases following Bound, Jaeger, and Baker (1993), a small correlation between the instrument and the error terms could lead the IV estimates to be more inconsistent than the OLS estimates. However, all of the instruments in the second IV regression specification are jointly significant.

A comparison of averages of the gross price-cost margins for the period 1970-94 for each country sector-pair with the implied margin estimates from the Hall method (Table 4) reveal that the gross price-cost margins tended to fall in a narrower range than the implied margin estimates from the Hall method. The implied Hall margins reveal that some sectors have lower margins than is suggested by the gross margins, while others have higher implied margins than suggested by the gross margins.

The remaining analysis in this section focuses on the findings presented in Table 5. The table reports the results from estimating IV regressions in the form of equation (8) that examine the effects on the markups of the IPRs, EPRs and intra-EU and extra-EU IPRs/EPRs. Since the markup estimates reported in Table 3 are representative for all of the regressions, only the coefficient estimates on the penetration ratios are reported in Table 5.

From Table 5 it is evident that the import penetration ratios had a negative and significant influence on the markup estimates. The magnitude of this coefficient is larger than in the analysis of the gross margins. A 10 percent increase in the import penetration ratio will lead an estimated implied margin of 0.237 (a markup of 1.31) in Italy's machinery and equipment sector to drop to 0.217 (a markup of 1.278) in the first IV regression and to 0.222 (a markup of 1.285) in the second IV regression. Under the margins analysis, a 10 percent increase in the import penetration ratio is estimated to lead a margin of 0.237 to drop to 0.225. Therefore, the estimated impact of changes in import penetration ratios on the margins is slightly larger in the markup analysis. The EPR is also found to have a negative influence on the markup estimates, but it is not significant in contrast to the traditional price-cost margin method.

Two sets of regressions that include intra-EU and extra-EU penetration ratios are estimated and reported in Table 5. In the first set both intra-EU and extra-EU imports (exports) are included in the regressions. In the second set, intra-EU imports/exports are included, omitting extra-EU imports (exports) and vice versa. Since the intra-EU imports (exports) and extra-EU imports (exports) may be collinear, it may be better to examine their effects on the markups from separate regressions. The regressions estimated with the intra-EU and extra-EU penetration ratios reveal that intra-EU imports have a strong negative and significant influence on the markups (regardless of whether both intra-EU and extra-EU IPRs are included in the regression or if the effect of each on the markups is tested in separate regressions). A test of the hypothesis that the intra-EU and extra-EU IPRs have equal effects in the regression where they are both included was rejected at the 5 percent level of significance. In contrast in the price-cost margins analysis, extra-EU imports were found to have a stronger disciplining effect than the intra-EU imports.

In the regressions that test the effects of intra-EU and extra-EU import penetration ratios separately, only the coefficient on intra-EU imports is negative and significant in the markup analysis. The estimated magnitude of the effect of the intra-EU import penetration ratio is almost the same as that estimated from the price-cost margin analysis. However, in the price-cost margin analysis, the estimated effect of extra-EU imports is significant and larger in magnitude than the effect of intra-EU imports.

In the markup analysis, the coefficients on the intra-EU and extra-EU export penetration ratios are smaller in magnitude than the coefficients on the intra-EU and extra-EU import penetration ratios, and were insignificant in all of the relevant regressions. In contrast extra-EU exports are found to have a negative and significant influence on the margins in the price-cost margin analysis.

IV. CONCLUSIONS

This paper investigates the strength of trade discipline on the manufacturing sectors of six EU member countries over the 1970-94 period. This period is particularly interesting because it captures the effects of the creation of the EU on competition. During this period, additional countries were allowed to join the EU and trade barriers among member countries were gradually removed, leading to the establishment of the single European Market by the end of 1992.

The study compares the results of using two different empirical methods to estimate industry profits. It conducts an econometric analysis of accounting price-cost margins and examines estimates of industry markups of price over marginal cost. The main conclusions are summarized below.

The range of the implied margins from the markups of price over marginal cost is broader than in the analysis of the gross margins: the implied margins from the markup

analysis (based on IV2 in Table 3) range from 0 to 0.3 (a markup range of 0 to 40 percent) while the margins range from 0 to 0.2 (a markup range of 0 to 25 percent). Comparisons between the gross margins and the implied margins from the analysis of the markups suggest that the gross margins are biased in both directions.

The effects of trade policy changes on the margins and markups across countries and sectors were captured by the import and export penetration ratios. Import competition was found to discipline market power. Import penetration had a significant and negative influence on both the margins and the price-marginal cost markups using the IV estimation procedures. The estimated magnitude of the impact on the profit margins is slightly greater in the markup analysis, which is not surprising considering the broader range of implied margin estimates.

A decomposition of the import penetration ratios reveals that intra-EU import penetration is an important disciplining factor, regardless of the method used. The main reason behind this finding is the ongoing removal of barriers to trade between the EU members, while barriers to trade vis-à-vis countries outside the EU were maintained. Other factors could also be contributing to this effect. For example, the EU members produce more similar goods, the implication being that as the countries become more open to trade, their goods will compete one for one. Also, lower transport costs within the EU, in part owing to their proximity, will lead to a greater disciplining impact of intra-EU imports over extra-EU imports.

The evidence for export discipline is weaker. Although, the estimated impact of export penetration on the markups is negative, it is not significant in the analysis of markups. Also, the coefficients on the intra-EU and extra-EU export penetration ratios are not significant. In contrast, the IV regressions of the price-cost margins reveal a significant negative impact of export penetration, which is mainly attributed to extra-EU export penetration.

Although the estimated impact of the import and export penetration ratios on the markups and the margins were roughly the same, the same relationship did not hold up in the analysis of the origin of the trade discipline. Since the margins are simply proxies for markups of price over marginal cost and are biased, the estimated relationship between the margins and the intra-EU and extra-EU penetration ratios could also be biased. This gives credence to the conclusion from the analysis of the markups of price over marginal cost that the main disciplining effect arises from intra-EU import competition.

Table 1. Average Gross Margins Over The 1970-94 Period

Sector	Country					
	Germany	France	U.K.	Italy	Belgium	Denmark
Food, Beverages, and Tobacco	0.17	0.13	0.09	0.17	0.10	0.09
	(0.02)	(0.01)	(0.01)	(0.03)	(0.01)	(0.02)
Textiles	0.10	0.11	0.08	0.16	0.08	0.10
	(0.02)	(0.01)	(0.03)	(0.03)	(0.02)	(0.01)
Paper, Printing, and Publishing	0.13	0.12	0.10	0.14	0.08	0.09
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Chemicals	0.17	0.20	0.10	0.14	0.08	0.12
	(0.03)	(0.04)	(0.02)	(0.02)	(0.03)	(0.03)
Non-metallic Mineral Products	0.16	0.19	0.08	0.21	0.18	0.15
	(0.03)	(0.02)	(0.02)	(0.03)	(0.05)	(0.04)
Machinery and Equipment	0.10	0.11	0.05	0.14	0.07	0.09
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)

Notes: Standard deviations are in parentheses.

Table 2. Pooled Cross-Section First-Differenced IV Regressions: Analysis of Gross Margins

Dependent Variable: PCM

Panel (a): Import and Export Penetration Ratios

IPR	*EPR*	*Growth of Ind. sales*	*K/Q*
-0.121		0.002	0.055
(0.067)		(0.006)	(0.026)
	-0.117	-0.002	0.061
	(0.069)	(0.007)	(0.027)

Panel (b): Regressions Include both of the intra-EC and Extra-EU Penetration Ratios

Intra-EU IPR/EPR	*Extra-EU*	*Growth of Ind. sales*	*K/Q*
IPR			
-0.331	0.179	-0.0004	0.059
(0.322)	(0.519)	(0.008)	(0.029)
EPR			
0.977	-2.786	-0.042	0.097
(0.607)	(1.445)	(0.029)	(0.076)

Panel (c): Separate regressions including each of the Intra-EU and Extra-EU Penetration Ratios

Intra-EU IPR/EPR	*Extra-EU*	*Growth of Ind. sales*	*K/Q*
IPR			
-0.227		0.001	0.057
(0.112)		(0.007)	(0.027)
	-0.324	0.003	0.051
	(0.174)	(0.006)	(0.025)
EPR			
-0.097		0.001	0.052
(0.092)		(0.006)	(0.026)
	-0.722	-0.014	0.081
	(0.285)	(0.011)	(0.035)

Notes: The instruments for the import (export) penetration ratios in these regressions are the aggregate unemployment rate, changes in tariff rates and transportation costs on imports (exports).

Table 3. Pooled Cross-Country and Cross-Sector Regressions: Analysis of Markups of Price-Marginal Cost

	OLS	IV1	IV2
Effects of import penetration ratios on markups			
dx*ipr	-0.05	-0.32 ##	-0.25 #
	(0.07)	(0.17)	(0.14)
R-square	0.971	0.921	0.943

Markup Estimates

	Germany			Denmark			France			Belgium			United Kingdom			Italy		
	OLS	IV1	IV2	OLS	IV1	IV2	OLS	IV1	IV2	OLS	IV1	IV2	OLS	IV1	IV2	OLS	IV1	IV2
Food, beverages & tobacco	1.116 **	1.084	1.084	1.045	0.974	0.986	1.074	0.927	0.929	1.008	0.968	0.992	0.982	0.969	0.968	1.038	1.027	1.028
	(0.06)	(0.11)	(0.09)	(0.04)	(0.12)	(0.09)	(0.12)	(0.28)	(0.25)	(0.04)	(0.19)	(0.07)	(0.04)	(0.06)	(0.05)	(0.03)	(0.10)	(0.09)
Textiles	1.083	1.069	1.148	1.218 **	1.597 **	1.189 **	1.144 **	1.148	1.153	1.108 **	1.345	1.060	1.037	0.843	0.850	1.130 **	1.122	1.124
	(0.08)	(0.43)	(0.21)	(0.05)	(0.17)	(0.07)	(0.08)	(0.15)	(0.13)	(0.04)	(0.32)	(0.08)	(0.04)	(0.12)	(0.11)	(0.05)	(0.15)	(0.13)
Paper, printing & publishing	1.088	0.852	1.068	1.150	1.205	1.172	1.171 **	1.129	1.129	1.280 **	1.227	1.080	1.131 **	1.046	1.046	1.328 **	1.409 **	1.409 **
	(0.10)	(0.38)	(0.21)	(0.10)	(0.32)	(0.13)	(0.08)	(0.16)	(0.14)	(0.08)	(0.28)	(0.15)	(0.05)	(0.07)	(0.06)	(0.04)	(0.09)	(0.08)
Chemicals	1.023	0.944	0.947	1.020	0.967	0.971	1.040	1.006	1.009	1.047 **	0.974	0.988	1.027	0.992	0.995	1.096 *	1.006	1.010
	(0.05)	(0.08)	(0.07)	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.02)	(0.10)	(0.04)	(0.02)	(0.03)	(0.02)	(0.04)	(0.07)	(0.06)
Non-metallic mineral product	1.270 **	0.996	1.004	1.118	0.543	0.970	1.231 **	1.009	1.010	1.433 **	0.978	1.278	1.047	0.907	0.908	1.257 **	1.135	1.136
	(0.10)	(0.31)	(0.27)	(0.09)	(0.30)	(0.15)	(0.10)	(0.19)	(0.17)	(0.11)	(0.35)	(0.20)	(0.05)	(0.09)	(0.08)	(0.08)	(0.14)	(0.12)
Machinery & equipment	1.295 **	1.184	1.400 *	1.090	1.704 **	1.052	1.047	0.848	0.852	1.129 **	1.177 *	1.182 **	1.065	1.027	1.033	1.271 **	1.305 **	1.309 **
	(0.10)	(0.58)	(0.19)	(0.07)	(0.33)	(0.10)	(0.12)	(0.22)	(0.20)	(0.04)	(0.10)	(0.09)	(0.04)	(0.07)	(0.06)	(0.06)	(0.16)	(0.14)
averages	1.15	1.02	1.11	1.11	1.17	1.06	1.12	1.01	1.01	1.17	1.11	1.10	1.05	0.96	0.97	1.19	1.17	1.17

Notes: IV1 uses nonlinear combinations of the growth rates of the world price of oil and the growth rates of real government spending in each country as instruments.
The instruments used in IV2 are nonlinear combinations of the growth rates of the world price of oil, the growth rates of real government spending in each country, the dummy variable capturing the establishment of the single European Market in 1993, and the growth rates of manufacturing employment in each country.
The standard errors are reported in parentheses.
A # sign tests the null hypothesis that the coefficient is significantly different from zero. An asterisk tests the null hypothesis that the coefficient is significantly different from one. Two asterisks or two ## signs indicate estimates that are significant at the 5% level. One asterisk or # sign indicate estimates that are significant at the 10% level.
F tests for joint significance of the slope coefficients (i.e. that each country and sector has a different markup estimate) are significant.
Country interacted with sector dummies are included in the regressions. F tests for the joint significance of the fixed effects are significant.

Table 4. Average Margins over the 1970-94 period
and Implied Margins from the Markup Estimates

Sector	Country					
	Germany	France	U.K.	Italy	Belgium	Denmark
Food, Beverages, and Tobacco						
Gross Margins	0.174	0.134	0.093	0.168	0.100	0.087
Implied Margins: IV1	0.078	-0.079	-0.032	0.027	-0.033	-0.026
Implied Margins: IV2	0.077	-0.077	-0.033	0.027	-0.008	-0.014
Textiles						
Gross Margins	0.104	0.110	0.079	0.160	0.076	0.101
Implied Margins: IV1	0.065	0.129	-0.186	0.108	0.256	0.374
Implied Margins: IV2	0.129	0.133	-0.177	0.110	0.056	0.159
Paper, Printing, and Publishing						
Gross Margins	0.127	0.123	0.102	0.144	0.082	0.085
Implied Margins: IV1	-0.174	0.114	0.044	0.290	0.185	0.170
Implied Margins: IV2	0.063	0.114	0.044	0.290	0.074	0.146
Chemicals						
Gross Margins	0.169	0.198	0.097	0.136	0.085	0.121
Implied Margins: IV1	-0.060	0.006	-0.008	0.006	-0.027	-0.034
Implied Margins: IV2	-0.056	0.009	-0.005	0.010	-0.012	-0.030
Non-metallic Mineral Products						
Gross Margins	0.164	0.186	0.077	0.212	0.176	0.152
Implied Margins: IV1	-0.004	0.009	-0.102	0.119	-0.023	-0.842
Implied Margins: IV2	0.004	0.010	-0.101	0.119	0.217	-0.031
Machinery and Equipment						
Gross Margins	0.101	0.108	0.050	0.141	0.069	0.090
Implied Margins: IV1	0.155	-0.180	0.026	0.234	0.151	0.413
Implied Margins: IV2	0.286	-0.174	0.032	0.236	0.154	0.049

Notes: IV1 uses nonlinear combinations of the growth rates of the world price of oil and the growth rates of real government spending in each country as instruments. The instruments used in IV2 are nonlinear combinations of the growth rates of the world price of oil, the growth rates of real government spending in each country, the dummy variable capturing the establishment of the single European Market in 1993, and the growth rates of manufacturing employment in each country.

Table 5. Pooled Cross-Country and Cross-Sector Regressions:
Effects of Penetration Ratios on Markups of Price-Marginal Cost

	IV1	IV2
Separate regressions including each of the penetration ratios		
dx*[IPR-IPR*]	-0.323 **	-0.250 *
	(0.168)	(0.142)
dx*[EPR-EPR*]	-0.271	-0.106
	(0.170)	(0.135)
Regression Includes both of the Intra-EU & Extra-EU Penetration Ratios		
Intra-EU IPR	-1.299 **	-1.031 **
	(0.547)	(0.351)
Extra-EU IPR	2.792 *	1.983 **
	(1.689)	(0.943)
Regression Includes both of the Intra-EU & Extra-EU Penetration Ratios		
Intra-EU EPR	-0.227	-0.234
	(0.865)	(0.559)
Extra-EU EPR	-0.220	0.197
	(2.286)	(1.396)
Separate regressions including each of the Intra-EU & Extra-EU penetration ratios		
Intra-EU IPR	-0.466 **	-0.400 **
	(0.220)	(0.188)
Extra-EU IPR	0.004	0.259
	(0.830)	(0.551)
Intra-EU EPR	-0.312	-0.186
	(0.225)	(0.189)
Extra-EU EPR	-0.412	0.016
	(0.650)	(0.493)

Notes: IV1 uses nonlinear combinations of the growth rates of the world price of oil and the growth rates of real government spending in each country as instruments.
The instruments used in IV2 are a nonlinear combination of the growth rates of the world price of oil, the growth rates of real government spending in each country, the dummy variable capturing the establishment of the single European Market in 1993, and the growth rates of manufacturing employment in each country.
Two asterisks denote estimates that are significant at the 5% level. One asterisk denotes estimates that are significant at the 10% level.
Country interacted with sector fixed effects are included in the regressions.
F tests for the joint significance of the slope coefficients (i.e. each country and sector has a different markup estimate) are significant.

DATA SOURCES AND VARIABLE CONSTRUCTION

A. Analysis of Gross Price-Cost Margins

The data to estimate the price-cost margins for the European manufacturing sector is mainly obtained from the Structural Analysis (STAN) industrial database provided by the OECD. The STAN database contains a complete series for six EU countries: Belgium, Denmark, Germany, France, Italy, and the United Kingdom. For each country, the series are for two-digit ISIC manufacturing industries. The industries are food, beverages, and tobacco (31); textiles (32); paper, printing, and publishing (34); chemicals (35); nonmetallic mineral products (36); and machinery and equipment (36). The database spans the period from 1970 to 1994.

The accounting price-cost margins are calculated by subtracting labor compensation from value added and dividing by the value of sales. The value added is current price, national-accounts-compatible value added and represents the contribution of each industry to national GDP. This is obtained from the International Sectoral Database provided by OECD. The measure for labor compensation is current-price, national-accounts-compatible labor cost, which includes wages as well as the costs of supplements, such as employer's compulsory pension and medical payments. The measure for value of sales is national-accounts-compatible production (gross output) in current prices.

The source for the data on imports, exports, and domestic production to calculate the import and export penetration ratios is the STAN industrial database. The data to calculate the intra-EU and extra-EU penetration ratios is obtained from the Bilateral Trade data section of the STAN database. The data to calculate the ratio of the capital stock to output is taken from the ISDB as well as the STAN database. The series for the gross capital stock is available in the ISDB in constant 1990 prices in U.S. dollar equivalences. It is converted to gross capital stock in constant 1990 national prices by multiplying by the 1990 purchasing power parities for each country. From this the value of the capital stock in current prices is obtained by multiplying the capital stock in constant 1990 prices by the rental price of capital. The construction of the rental price of capital is described in detail in Section B of this appendix. The ratio of capital to output is then obtained by dividing the capital stock by nominal gross output obtained from the STAN database. The growth rate of industry sales is given as the growth rate of nominal gross output.

The instruments for the price-cost margin regressions are constructed as outlined below. Measures of national tariffs are calculated for each country and each year as the ratio of customs and import duties to the value of imports. The data to measure tariffs come from two OECD sources respectively, the *Revenue Statistics of OECD Member Countries*, and the *National Accounts*. Proxies for transportation costs on imports/exports

are the distances between the capital of a country and the national capitals of its top 20 exporters/importers (Jong-Wha Lee, 1993). The distances are weighted by the bilateral import/export values in 1986. Since the regressions are for pooled time-series, cross-section data, it is necessary to introduce time-series variation into the instruments. This is done by interacting the import/export-weighted distance measures with the world price of fuel.[11] The bilateral import and export data come from the IMF's *Direction of Trade Statistics.* Data for the world price of fuel and the percent unemployed in each country comes from various issues of the United Nation's *Statistical Yearbook.*

B. Analysis of Markups of Price Over Marginal Cost

The series used to estimate the price-marginal cost markups are obtained from the International Sectoral Database (ISDB) provided by OECD. The ISDB contains data for the same six EU member countries and two digit ISIC manufacturing sectors as the STAN database. Thus, the regressions to estimate the markups of price-marginal cost include the same countries and sectors as those used in the regressions of the price-cost margins. Although the ISDB data span the 1970-96 period, the time-series for all of the variables is incomplete. Hence, the period of study was restricted to 1970-94 as in the STAN database.

Value added is measured as GDP in constant 1990 prices. This variable is obtained on a national accounts basis and corresponds to sector aggregates in accordance with the ISIC. The measure for labor is the total number of individuals employed. The labor input variable should ideally be effective labor hours. Because of procyclicality, labor hours vary more than the number of workers employed. However, data limitations dictate that the total number of employees be used instead.[12] Labor's share in value added is calculated by dividing the compensation of employees in current prices by value added in current prices. The growth rate of capital is calculated from the gross capital stock, in constant 1990 prices in U.S. dollar equivalences. Capital's share of value added is calculated by multiplying the constructed rental price of capital by the gross capital stock and dividing by value added. The variables that are used to calculate capital's share of value added are all denominated in the national currency prices. The rental price of capital P_K is constructed using the method originated by Hall and Jorgenson (1967) as,

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[11] Higher prices of fuel imply that the transportation costs involved with importing or exporting goods will be greater in the same way that greater distances between one country and another imply higher transportation costs.

[12] Since the labor hours are positively correlated with the number of individuals employed, the markups estimated when the number of employees is used to measure labor may be biased upwards. Sensitivity tests revealed that although the markup estimates are in fact biased upwards slightly when the number of individuals employed is used to measure labor input, the evidence for the existence of markups that are significantly greater than one and for trade discipline is not eliminated.

$$P_K = F_K = (r + \delta)P_I \tag{10}$$

where r is the real interest rate, δ is the depreciation rate, and P_I is the price of the investment good. The real interest rate is given by Fisher's equation where the real interest rate is equal to the nominal interest rate minus the rate of inflation. Thus, the real interest rate can be calculated from the government bond yield and the change in the CPI index (both from the *International Financial Statistics*) as in Caballero and Lyons (1990). Also, like Caballero and Lyons, a depreciation rate of 10 percent was used to calculate the rental price of capital. Data for gross fixed capital formation (in the ISDB) are used to obtain a measure of the price of the investment good, P_I.

The derivation of the rental price of capital depends on the assumption that inputs are instantaneously adjusted to their desired levels. If there are adjustment costs for capital, then the rental rate is no longer given by the formula in equation (10) but rather by $P_K = (r + \delta)q - \frac{dq}{dt}$, where q is the shadow price of a unit of installed capital and is equal to P_I only in the steady state. However, since a Taylor series approximation of the production function is taken in equation (3), the derivatives of F are evaluated at the steady state and q is equal to P_I. Thus, for the purposes of this paper, equation (10) is a valid way to measure the rental price of capital. Also, the factor share used as a weight for the growth rate of each respective factor is an average over the sample period rather than varying from period to period.

Nominal materials use is calculated by subtracting nominal value added (from the ISDB) from nominal gross output (from the STAN database). From this, the share of materials in revenue, s_{ym}, is calculated as the ratio of nominal materials to nominal gross output. The growth rate of real materials is obtained by deflating the measure of the nominal materials by an industry-specific deflator (the ratio of nominal to real value added from the ISDB). The trade penetration ratios are calculated in the same way as described earlier in the paper.

The instruments for the IV analysis are obtained as follows: the growth rate of the world price of oil comes from the latest issue of the IMF's *International Financial Statistics Yearbook*; current government spending by each country is obtained from various issues of the IMF's *Government Financial Statistics Yearbooks* and deflated to obtain real government spending; and the growth rate of manufacturing employment for each country is calculated from the manufacturing employment data in the ISDB.

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