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1992: TRADE AND WELFARE; A GENERAL EQUILIBRIUM MODEL

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ABSTRACT

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This paper investigates the consequences of the completion of the internal market in the EC using a computable general equilibrium model of trade under imperfect competition. The focus of the paper is the welfare consequences of reducing trade barriers and the changes in production and trade flows with the rest of the world. Welfare changes by country are reported and these are decomposed by source of gain. Two sets of results are reported: a 'segmented market' experiment where trade costs are reduced by an amount equal to 2.5% of the value of trade, and an 'integrated market' experiment in which there is the same trade cost reduction plus a switch from a segmented to an integrated market equilibrium. In both cases we find large welfare effects arising from imperfect competition. Intra-EC trade liberalization has pro-competitive effects which make a substantial contribution to the welfare change in the first set of experiments and are the most important component of the welfare change in the second set.

JEL classification: F1, F12, F14, F15, F17

Keywords: economic integration, imperfect competition, European Community, simulation, trade liberalization, general equilibrium, welfare

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NON-TECHNICAL SUMMARY

This paper investigates the consequences of the completion of the internal market in the EC using a computable general equilibrium model of trade under imperfect competition. The focus of the paper is on the welfare consequences of a reduction in trade barriers and on the changes in production and trade flows with the rest of the world. We report two sets of results: a 'segmented market' experiment in which there is a reduction in the costs of trade by an amount equal to 2.5% of the value of trade; and an 'integrated market' experiment in which there is the same trade cost reduction plus a switch to integrated from segmented markets. This means that firms can no longer price discriminate between markets but compete on an EC-wide basis, setting the same producer price in all markets. This experiment implies a much greater pro-competitive effect of trade liberalization as each firm's effective market shares are reduced. Within each of these experiments we consider the short run, where the numbers of firms are held constant, and the long run where there is free entry and exit of firms from any of the EC countries. In both sets of experiments we find large welfare effects from factors associated with imperfect competition. Intra-EC trade liberalization has pro-competitive effects which make a substantial contribution to the welfare change in the first set of experiments and are by far the most important component of the welfare change in the second set of experiments.

The model contains a perfectly competitive composite sector and a number of imperfectly competitive industries. Production uses intermediate goods and five primary factors of production. The imperfectly competitive industries include 13 manufacturing industries, as well as banking and finance. These industries operate under increasing returns to scale and support an equilibrium with intra-industry trade. The changes in trade costs and market structure occur only in the 14 imperfectly competitive industries; the perfectly competitive sector changes in response to changes in other sectors. The model is disaggregated into seven 'countries': France, Germany, Italy, the United Kingdom, 'Other EC North' (Benelux & Denmark), Iberia (Spain and Portugal) and Greece/Ireland.

In the experiments EC output in all imperfectly competitive industries rises. The distribution of the output changes across industries and depends on a number of interdependent factors. These include the relative share of intra-EC trade in production of each industry, the degree of economies of scale, the degree of concentration, the elasticity of demand for the individual product varieties and cost changes due to general equilibrium changes in input prices. The size of the external trade effects are largest in industries where the production increase is large, and where initial imports are relatively small. In most industries quantity changes are larger in the long run. This occurs due to the exit of firms – remaining firms operate on a larger scale, thus giving lower marginal costs and the

consequent increase in production and exports. Moving to an integrated market implies a much more pro-competitive policy and so also magnifies the changes. EC exporters benefit substantially from the integrated market scenario. Some industries greatly increase their sales to the rest of the world and particularly in the long run. It is in those industries which benefit the most from the pro-competitive effect of the trade liberalization that the change in EC exports to the rest of the world is the greatest. There is also a very substantial decline in imports of some goods.

We report welfare changes by country of the various experiments which are decomposed by source of gain. Under segmented markets, welfare gains are comparatively small for most of the EC although rising slightly in the long run. Significantly larger gains are reported in the integrated market experiment in the long run. Except for France and 'Other EC North', all countries experience welfare gains in excess of 1% of GDP; and for Greece/Ireland and Iberia the gains exceed 2% of GDP. It is worth noting that the policy experiment directly affects only the 14 industries, which account for a little less than 40% of GDP.

The decomposition of the welfare gains by industry and by type of gain indicate that the gains largely follow the pattern of the output changes and that the greatest gains arise from the change in consumer and intermediate surpluses arising from the changes in prices. The paper also reports on the decomposition of the welfare gains by looking at the direct cost saving of the policy, at 'distortions' in each industry and at changes in external terms of trade. The pro-competitive effect of the policy accounts for a significant share of the gains in most industries in the long run; whereas in the short run a higher proportion of the welfare gain is generated by the direct effect of the reduction in trade costs.

We undertake two types of sensitivity analysis, rather than assuming a uniform cost reduction of 2.5% of trade costs across all industries, we assess the consequences of a differential experiment that maintains the same overall size of the policy experiment. The aggregate welfare effects are now considerably larger, because the industries in which the trade cost reduction is now greater include some of those with the highest degrees of concentration and economies of scale. Moreover, the changes in the policy effects are not directly proportional to the changes in policy as a consequence of the interplay of general equilibrium effects. The second kind of sensitivity analysis reported is with respect to market structure, where we change the level of disaggregation within each industry i.e. a change in the number of sub-industries.

By modelling intra-EC trade liberalization in a general equilibrium model, we can address several important questions that cannot be treated in a partial equilibrium approach. We find modest effects on factor markets as trade liberalization has differential effects across industries with different factor intensities. General equilibrium effects enter into the accounting of the welfare

effects of the policy change, but not with sufficient force to make the order of magnitude of welfare changes different from those that would be derived from a partial equilibrium approach. We also find quite large effects on the EC's external trade, as intra-EC trade liberalization reduces demand for imports from outside the EC. The analysis suggests that there are potentially large welfare gains from factors associated with imperfect competition and hence confirms the importance of the effects of '1992' on market structure and competition. It should also be stressed, however, that much scope remains for improving our understanding of how to model the interaction between trade policy and industrial organization.

1. INTRODUCTION

The aim of this paper is to investigate the role of general equilibrium effects in European integration. Smith and Venables (1988) used a partial equilibrium approach to investigate the effects of the "1992" programme on intra-industry trade and competition, and hence on prices, output and welfare. The completion of the internal market was found to be a pro-competitive policy, leading to substantial increases in firm scale, and bringing welfare gains from lower prices, and with increasing returns to scale, lower costs.

A partial equilibrium approach to the study of the completion of the internal market is incomplete, and therefore potentially misleading, for two reasons. First, partial equilibrium analysis assumes that resources drawn into the industry under study are available at prices equal to social opportunity cost. If one imperfectly competitive industry's expansion is -- because of overall resource constraints -- another's contraction, then this assumption is invalid, and we may overestimate the welfare gains associated with the policy. Second, partial equilibrium studies assume that input supply curves are horizontal, so that resources are available to the industry at a constant price. If input supply curves to each industry are in fact upward sloping, partial equilibrium studies overestimate the quantity effects of the policy. Input supply considerations affect not only inputs of primary factors, but also inputs of intermediates, which may themselves be produced by imperfectly competitive industries, so generating 'linkages' between industries.

In an earlier paper (Gasiorek, Smith and Venables, 1991) we took a general equilibrium approach to modelling the completion of the internal market. We did not address the welfare implications of the policy, concentrating on modelling inputs to each industry and

investigating the effects of completion of the market on factor demands and factor prices. This paper is based on a richer data set, which allows us to model the country structure of EC markets at a more disaggregated level, and to adopt a slightly more disaggregated treatment of labour markets; and although we report and discuss the implications for factor markets and EC outputs of the policy change, we focus mainly on the welfare effects and on the effects on the rest of the world.

We construct a general equilibrium model in which production uses intermediate goods and five primary factors of production. The model contains a perfectly competitive composite sector, and a number of imperfectly competitive industries. These industries operate under increasing returns to scale and support an equilibrium with intra-industry trade. We consider two kinds of policy experiments: a reduction in intra-EC trade costs for these industries; and the same intra-EC trade cost reduction but now accompanied by a change in market behaviour, from a 'segmented' market quantity equilibrium, to an 'integrated' market quantity equilibrium.

The paper is organised as follows. Section 2 sketches the model (with more detail provided in an Appendix), and section 3 discusses the data used and the calibration of the model to the base data set. Section 4 describes the effects on EC production and external trade of the two main policy experiments undertaken, and section 5 looks at their implications for factor prices. Section 6 describes the effects of the two policy experiments on welfare. Welfare effects are decomposed into parts attributable to the direct effect of the policy, to interaction with distortions, and to terms of trade changes. Section 7 presents sensitivity analyses: both with respect to an alternative policy experiment in which the reduction in trade costs is

not uniform across industries and with respect to the assumptions about market structure used in the calibration of the model.

2. THE MODEL

We work with eight countries. Seven represent the EC: France, Germany, Italy, the United Kingdom, Other EC North (Benelux and Denmark), Greece/Ireland, and Iberia (Spain and Portugal). (The anomalous linking of Ireland and Greece reflects our judgment about the quality of the data available on these countries rather than geographical ignorance.) The eighth country is a rather simple representation of the rest of the world. In our 1991 paper, we worked with an alternative level of aggregation, in which Iberia, Other EC North and Greece/Ireland are treated as a single country, the Rest of the EC. Aggregation is not a simple matter of presentation, because the assumption of national market segmentation implies that an aggregation of national markets entails a change in firms' pricing behaviour in these markets, and further because the impact of a reduction in intra-EC trade costs depends on the country structure imposed on the EC. The structure we work with is as disaggregated as data allows and while some intra-EC trade is treated as intra-country rather than inter-country trade, less than 15% of trade is so misclassified.

Each country is endowed with five primary factors of production: capital (factor 1), and labour disaggregated into four skill types. The types of labour are: professional, scientific and related labour (factor 2); managerial, clerical and other non-manual (factor 3); skilled manual labour (factor 4); and unskilled manual labour, (factor 5). We assume that capital is perfectly mobile internationally, and available at a constant price. Other factors are internationally

immobile, so their prices adjust to equate demands to endowments. The commodity structure of the model comprises thirteen manufacturing industries (listed in Table 1 of Section 3) and one financial services sector, all of which are assumed to be imperfectly competitive, and which are modelled in some detail. The remainder of each economy is aggregated into a single perfectly competitive composite, which is tradeable and which we take as the numeraire.

Each industry contains a number of firms, with n_i^k denoting the number of firms in industry k located in country i. For a particular industry and country all firms are symmetric: for each k and each i, the n_i^k firms have the same production and sales patterns. Each of these firms produces a number of varieties of differentiated product, which we denote m_i^k. The output of each industry is used both in final demand, and as an intermediate.

Consider first final demand. p_{ij}^k and x_{ij}^k denote the price and quantity of a single product variety of industry k produced in country i and used (as a final demand) in country j. (There are $n_i^k m_i^k$ such varieties, and, because of symmetry, we do not need to introduce a notation for individual varieties). Consumer preferences are such that the following aggregation procedure is possible. First, varieties within an industry and country of sale are aggregated into a quantity index X_j^k with associated price index P_j^k. This is done by a constant elasticity of substitution aggregator with elasticity of substitution (common to all countries) denoted ε^k. The functional form of this is given in the Appendix. It is important to note that at this level we aggregate over products from all sources of production; so we do not use the Armington assumption of separate nesting of products by geographical source. Second, the quantity and price indices X_j^k, P_j^k are aggregated into utility and expenditure

functions. There is a single representative consumer with homothetic preferences in each country. If u_j is utility, E_j is the unit expenditure function, and M_j is income, then the budget constraint is

$$M_j = u_j E_j(\ldots, P^k_j, \ldots) \tag{1}$$

E_j is assumed to be Cobb-Douglas. The functional form is given in the Appendix. Consumer demands both for the aggregate quantity indices and for individual varieties are derived by partial differentiation of the expenditure function.

The quantity of a single product variety of industry k produced in i and used as an intermediate good in j is denoted y^k_{ij} with price q^k_{ij}. Technology is supposed to be such that the following aggregation procedure is possible. First, varieties within an industry and country of sale are aggregated into a quantity index Y^k_j with associated price index Q^k_j. (Once again, they are not separately nested by geographical source). Second, the quantity and price indices are aggregated into a composite intermediate commodity whose price index in country j is F_j, (see the Appendix). This implies that there is a single composite intermediate commodity, so that the proportions in which each industry uses the products of other industries are assumed to be the same.

The costs of a firm in industry k of country i are given by a cost function c^k_i,

$$c^k_i = m^k_i\left[\, h^k(z^k_i)G^k_i(F_i, w^1_i, w^2_i, w^3_i, w^4_i, w^5_i)\right] \tag{2}$$

$$\text{where} \qquad z^k_i = \sum_j \left\{ x^k_{ij} + y^k_{ij} \right\} \tag{3}$$

z^k_i is the total output per variety of a country i firm in industry k. The function h^k describes the returns to scale in industry k. Increasing returns to scale means that $h^k(z^k_i)/z^k_i$ is decreasing in z^k_i,

and we employ a functional form for h^k that permits decreasing marginal cost as well as decreasing average cost (see the Appendix). Notice that this function is not country specific. Furthermore, there are no economies of scope, since c_i^k is linear in m_i^k, and returns to scale are associated with output per variety, z_i^k. The function G_i^k aggregates input prices into cost per unit h. Its arguments are the intermediate price index, F_i, and the prices of the five primary factors of production, w_i^ℓ. The functions G_i^k differ by country, but only by a scalar, implying Hicks neutral technical differences. Input demands, which in equilibrium equal factor supplies, v_i^ℓ, are partial derivatives of these cost functions so we have

$$v_i^\ell = \sum_k n_i^k m_i^k h^k(z_i^k) \frac{\partial G_i^k(F_i, w_i^1, w_i^2, w_i^3, w_i^4, w_i^5)}{\partial w_i^\ell} \qquad (\ell=1,..,5) \qquad (4)$$

The profits of firms are given by

$$\pi_i^k = m_i^k \sum_j \left\{ p_{ij}^k x_{ij}^k + q_{ij}^k y_{ij}^k \right\} \left\{ 1 - \tau_{ij}^k - t_{ij}^k \right\} - c_i^k \qquad (5)$$

where τ_{ij}^k and t_{ij}^k are respectively the ad valorem tariff and transaction costs of shipping a unit of industry k output from economy i to economy j. (The tariff is non-zero only where j is in the EC and i is the rest of the world, when the value of the tariff is the EC's common external tariff). We assume that all external trade barriers are tariffs, not quantity restrictions.

Two alternative assumptions are made about firms' choice of sales quantities for final goods. The first is to assume that firms act as Cournot competitors in segmented markets. Each firm in industry k and country i then chooses sales in market j, x_{ij}^k, taking as constant the

sales of all its rivals in each market. Optimisation requires the equation of marginal revenue to marginal cost in each market, where the slope of each firm's perceived demand curve depends on the extent of product differentiation, and on the share of the firm in that market. This will be referred to as the segmented market hypothesis. An equation for the equality of marginal revenue to marginal cost is given in the Appendix.

The alternative assumption is that firms choose a total quantity for sale in the seven EC markets combined, taking as constant total EC sales of rival firms; with the distribution of these aggregate quantities between markets in the EC then determined by arbitrage so as to equate the producer prices of the product, making $p^k_{ij}(1 - t^k_{ij}) = p^k_{i\ell}(1 - t^k_{i\ell})$ for all countries j, ℓ, in the EC. This second hypothesis will be referred to as the integrated market hypothesis. Its force is that the slope of firms' perceived demand curves now depends on product differentiation, and on the firm's share in the EC as a whole, rather than in each separate market. Alternative behavioural hypotheses are possible, some of which are discussed in Venables (1990).

Firms' choice of intermediate sales quantities, y^k_{ij}, is less straightforward. It is possible that purchasers of inputs have some monopsony power, to be combined with the monopoly power of sellers. Further, and perhaps more importantly, even if purchasers of intermediates are input price takers, the demand for intermediates is a derived demand, and establishing the elasticity of the derived demand curve is not straightforward. For these reasons we assume that the price of a good sold as an intermediate equals the price of the same good sold to final demand, $q^k_{ij} = p^k_{ij}$. Furthermore, the number of varieties of intermediate goods entering the price indices Q^k_j is held

constant, so abstracting from any variety effects on the users of intermediate goods.

As has been noted above, each firm produces a number of varieties of product, m_i^k. It is assumed throughout this paper that these numbers are constant. Furthermore, it is assumed that, at the base, output per variety, z_i^k, is the same for all firms. m_i^k should therefore be thought of as a scaling device; with different firm sizes in the base data set attributed to differences in the number of varieties firms produce, not differences in output per variety. The effect of this assumption is to ensure that all firms have the same degree of unexploited economies of scale.

All that remains to complete the description of the model is the determination of income. Income accruing to factor ℓ in economy is $w_i^\ell v_i^\ell$. National income is factor income accruing to the five factors, plus the profits of firms and CET revenue:

$$M_i = v_i^1 w_i^1 + v_i^2 w_i^2 + v_i^3 w_i^3 + v_i^4 w_i^4 + v_i^5 w_i^5 + \sum_k n_i^k \pi_i^k + \sum_k n_8^k m_8^k \tau_{8i}^k \left\{ p_{8i}^k x_{8i}^k + q_{8i}^k y_{8i}^k \right\} \qquad (6)$$

where country 8 is the rest of the world. Notice that CET revenue is attributed to the importing country, though in reality it accrues to the EC as a whole.

3. Data and calibration

The modelling exercise requires calibrating the model to a particular data set. The principal data requirements are: first, trade and domestic sales data broken down by industry and by country; and secondly, a range of industry-specific parameters. Numerical specification of the model can then be completed by calculating the

values of remaining parameters and endogenous variables such that the base year observations support an equilibrium. Comprehensive literature reviews were undertaken for a number of the industry-specific parameters required. A complete list of sources is not provided here but is available on request. Key items are referenced in the text.

The overall structure of the model is one of eight economic areas or "countries" (listed in the previous section), fourteen imperfectly competitive industries (listed in Table 1), and one perfectly competitive sector which comprises the rest of the economy.

The industrial structure used is based on the R25 subdivision of the European Community NACE-CLIO classification scheme. The R25 subdivision distinguishes between 13 manufacturing and 12 non-manufacturing sectors. Here the non-manufacturing sectors are aggregated into two sectors, financial services, assumed to be imperfectly competitive, and all of the rest treated as a single perfectly competitive sector; while each of the 13 manufacturing industries is treated as a separate sector.

The base year taken for the calibration is 1985 which is the latest year for which an almost complete set of trade and production data was available. Where the data were incomplete the data set was supplemented from published Eurostat data and adjusted as appropriate.

3.1 Trade and Production: Both trade and production data were obtained from the European Commission: trade data from the VOLIMEX database, and production data from the BDS database. These particular data sources were chosen on the grounds of accuracy and reliability. In each case the database derives from the same source as comparable published Eurostat data, but has been adjusted by the European

Commission to improve the degree of compatibility both between different country returns and between the two databases themselves. Data on international trade in financial services were not available broken down both by country of origin and country of destination, and a matrix of trade data at this level of disaggregation was derived by application of an rAs procedure to the data published in the Eurostat report *International Trade in Services - EUR12 - From 1979 to 1988*

Despite the Commission's attempts to reconcile trade and production data, problems of incompatibility remain. There is the fundamental difficulty that trade data are collected on a commodity basis, while production data are collected on an activity basis. Further, the trade date include re-exports, and therefore tend to exaggerate trade flows.

Production statistics for 1985 were not available on the BDS database for Greece, and, in the case of one industry, for Portugal. Comparable data were therefore obtained from Eurostat *Structure and Activity of Industry, 1985, Main Results, (SAI)*, and scaled as appropriate. For Greece the latest available figures from SAI were for 1983; so these were rescaled to account for Greek growth between 1983 and 1985.

3.2 Industrial Data: The industry specific data required include the share of value added in production; the share of each factor in value added; the elasticity of substitution between different factors of production; the share of final demand in the output of each industry; the degree of returns to scale in each industry; a measure of the number of symmetric firms competing in each industry and each country. Some of the key features of these data are presented in Table 1.

The model distinguishes between five factors of production - capital and four types of labour, professional, scientific and related non-manual (L1), managerial, clerical and other non-manual (L2), skilled manual (L3), and unskilled manual (L4). Both the share of value added in production, and the share of capital in value added were calculated from the BDS database. The shares of the four different types of labour were calculated on the basis of United Kingdom earnings data, and the UK Census of Production. UK shares were taken to apply to all countries. The factor shares in value added are listed in Table 1. The table shows that the most capital intensive industries are metalliferous products and chemical products, and the least capital intensive are electrical goods, office machinery and precision instruments, and agricultural and industrial machinery. The industries most intensive in professional and highly skilled workers are the electrical goods industry, office machinery and precision instruments, and financial services (which are assumed to employ no manual labour). The most manual labour intensive industries are the metal products, rubber and plastic, and textile industries.

The G_i^k component of the cost function is a nested constant elasticity of substitution function. The capital-labour elasticity of substitution is derived from a review of the available literature and is largely based on the estimates in Piggott and Whalley (1985). In the version of the model presented in this paper the same measure of elasticity is then also assumed between the different types of labour.

Central to the model is the interaction between the degree of scale returns and the extent of concentration in each industry. We measure the degree of concentration by computing Herfindahl indices. The reciprocal of this index gives the number of equal sized firms in the industry equivalent to the observed size distribution, and it is

this that we use for firm numbers in the model. For most countries, data for the computation of the Herfindahl indices were obtained from Eurostat. The data source here is the same which is used in compiling Eurostat's *Structure and Activity of Industry, 1985, Results by Size Class*, but with a wider size class breakdown. For the remaining countries data were obtained from the respective national statistical offices, except for Portugal where firm numbers were estimated on the basis of firm sizes in Spain. Unfortunately, primarily for reasons of statistical confidentiality, the largest size class for which data were available was rarely greater than 5,000 employees, and frequently only 1,000 employees. However, where one is interested in establishing the degree of market power firms may have it is precisely in the largest size classes that the most important interactions take place. In order to capture the dispersion of firms in the top size class it was assumed that the size of firms in this class follows a Pareto distribution. The Herfindahl index for each industry and country was then computed on the basis of firms in size classes other than the top class all being of average size for their class; and the size of firms in the top size class following a Pareto distribution.

It is, however, not reasonable to suppose that at this level of aggregation each firm in an industry is competing with all other firms. We have therefore assumed that each industry is divided into sub-industries, with firms competing only at sub-industry level, each firm represented in only one sub-industry, and each sub-industry within any industry having the same number of equal-sized firms. The number of sub-industries in each industry was based on a Herfindahl calculation of the number of equal-sized 3-digit industries in each of the 13 manufacturing industries (using output weights from a sample of EC countries), with judgemental modifications for two industries

(metalliferous products, food products) where the procedure generated an implausible number of sub-industries. The financial services sector was assumed to consist of two sub-industries. The number of sub-industries in each industry is reported in the column "Sub-Ind" of Table 1. When an industry is divided into sub-industries, the relevant measure of concentration is now not the Herfindahl index for the industry, but that for the sub-industry, which is the original index multiplied by the number of sub-industries. Sensitivity analysis with respect to the assumptions about sub-industries is reported in Section 7.

The concentration measure reported in the first column of Table 1 is the Herfindahl index for sub-industries, adjusted to take account of import penetration. The six industries with the highest degree of concentration are (in order) office machinery, transport equipment, electrical goods, chemicals, non-metallic minerals, and metalliferous products. The three industries with the lowest degree of concentration are rubber and plastics, paper, and textiles.

Table 1 also lists the degree of assumed returns to scale (IRS). In each case the percentage figure refers to the increase in costs as a result of a 50% reduction in output. These estimates are engineering estimates for which the primary data source was Pratten (1988), supplemented by an extensive literature review.

The column "FES" of Table 1 lists the proportion, obtained from Eurostat, *National Accounts. Input-Output tables.* 1985 of the output of each industry that is devoted to final expenditure as opposed to being used as an intermediate good.

3.3 Demand and calibration: The price elasticity of demand for the industry aggregates, X^k_j and Y^k_j, with respect to the associated price

indices, are unity, by the Cobb-Douglas assumption. The price elasticities of demand for individual varieties depend on the elasticities of substitution in the CES aggregators. For intermediate products we assume that this elasticity of substitution is the same for all industries, and equal to 5.

For final products we assume that the base data set represents a long run equilibrium in which profits are zero. Technology and firm scale imply a relationship between average cost and marginal cost, and, with the assumption of long run equilibrium, this also gives a relationship between price and marginal cost. This price cost margin is supported at equilibrium by two considerations; product differentiation and market power stemming from the degree of concentration in the industry and the form of interaction between firms. We assume that the base case is a segmented market Cournot equilibrium. The price cost margin then implies a measure of product differentiation, from which we obtain a value of the elasticity of substitution, ϵ^k. Calibrated values of ϵ^k are reported in Table 1. They are to be interpreted as the price elasticity of demand for an individual product variety, holding prices of other varieties and the overall industry price index, P^k_j, constant. These elasticities are very high in food, and textiles; and are relatively low (so products are quite highly differentiated) in industries such as paper, and chemicals. This method of calibration does of course depend on the form of the base equilibrium. Sensitivity analysis over equilibrium concepts is undertaken in Venables (1990).

The final stage of calibration involves positioning demand curves (i.e., finding parameters of a^k_{ij}, of the aggregators given in the Appendix) such that consumption of products in each country is consistent with the matrix of production and consumption.

4. QUANTITY CHANGES

In this section we focus on the consequences for trade and production of the reduction in trade barriers arising from the completion of the internal market. We report two sets of results: a "segmented market" experiment in which there is a reduction in the costs of trade by an amount equal to 2.5% of the value of trade; and an "integrated market" experiment in which there is the same trade cost reduction plus a switch from segmented market to integrated market equilibrium. Within each of these sets of experiments we consider a short-run case in which firm numbers are held constant and a long-run case in which there is free entry and exit of firms from any of the EC countries. The changes in trade costs and market structure occur only in the 14 imperfectly competitive industries; the perfectly competitive sector is not directly affected by the experiment, but changes in response to changes in other sectors.

4.1 Segmented Markets: Table 4.1 shows the changes in total EC output, EC exports to the rest of the world and EC imports from the rest of the world for both the short run and the long run. EC output in all the imperfectly competitive industries rises by modest amounts. The distribution of the output changes across industries depends on a number of factors, including the relative share of intra-EC trade in production of each industry, the degree of economies of scale in the industry, the degree of concentration in the industry, the elasticity of demand for the individual product varieties, and cost changes due to general equilibrium changes in input prices. The higher the share of trade in production the greater the benefits of the reduction in trade costs; the greater the economies of scale in the industry the

larger will be the cost reductions arising from increasing output; the more concentrated the industry the greater will be the competitive gains arising from the trade liberalisation; the more elastic is demand in the industry the larger the change in output for a given change in costs (and therefore prices); while the effects of input price changes depend on the factor intensity of the industry. The factors are not all independent as the process of calibrating the model chooses the demand elasticity in order to reconcile the assumption about returns to scale with the information about concentration.

In both the short run and the long run the industries that experience the most expansion in this experiment are office machinery and precision instruments, transport equipment, and textiles, clothing and leather. Office machinery and precision instruments is an industry with large economies of scale, high concentration, and a high proportion of output traded within the EC. The largest output effects are in the two most concentrated industries, in which the pro-competitive effect of intra-EC liberalisation will be greatest. The overall expansion of the imperfectly competitive sector occurs partly due to the release of real resources as trade costs are reduced and as firms exploit the advantages of economies of scale, but also due to the contraction of the perfectly competitive sector. In the short run the perfectly competitive sector contracts by 0.56% and in the long run by 0.82%.

Looking at the external trade of the EC we see a decrease in imports and increase in exports. As usual there is a trade diversion effect coming from the decrease in the cost of intra-EC trade, and this reduces extra-EC imports. In a perfectly competitive model this effect would be offset by an increase in EC prices, as industries move

up supply curves. However, in this framework the reduction in imports is reinforced by falls in EC prices as firms move down marginal cost curves, so generating a relatively large reduction in imports. Similarly in a perfectly competitive economy we would expect to see a decrease in exports; however, because of EC cost reductions, extra-EC exports now increase.

The size of the external trade effects are largest in industries where the production increase is large, and where initial imports are relatively small (so the increase is measured against a small base). Of course, changes in the trade position of the imperfectly competitive industries are mirrored in the trade of the perfectly competitive composite sector, since the balance of payments balances.

No account is taken in the model of quantitative restrictions on trade, though in reality EC imports to some industries, notably transport equipment and textiles, are subject to such restrictions. The declines in demand for imports shown in Table 4.1 as reductions in EC imports from the rest of the world might in reality appear in such cases as reductions in the rents gained by constrained exporters rather than in quantities imported.

Comparing the long run and the short run we see that in most, but not all industries, quantity changes are larger in the long run. These are industries in which exit of firms takes place. Remaining firms operate at larger scale, this giving lower marginal costs and the consequent increase in production and exports.

4.2 Integrated Markets: In this section we allow not only for the 2.5% reduction in trade costs but we also assume that EC markets are fully integrated. This means that firms can no longer price discriminate between markets but now compete on an EC-wide basis by

setting the same producer price in all markets. This experiment therefore implies a much greater pro-competitive effect of trade liberalisation as each firm's effective market shares are reduced. Table 4.2 shows the consequences of the same two experiments described previously but this time with the integrated markets assumption.

As can be seen from the first column of the table, output changes, even holding the number of firms fixed, are significantly higher than previously -- in most cases at least twice as high. As in the segmented market case the distribution of these output changes across industries involves office machinery, electrical goods and transport equipment expanding the most. The pro-competitive effect of this policy reduces profits, so exit of firms occurs in the long run. This greatly increases the output expansion and in particular for metalliferous products, non-metallic mineral products, transport equipment and food products. As before these changes take place due to the combination of the initial reduction in trade costs and the change in concentration (exit of firms from the industry) which enables remaining firms to take advantage of economies of scale, together with the relatively high elasticities of demand in these industries. The changes in concentration are larger in this experiment as a result of the integrated market assumption which makes the EC market much more competitive than previously. These changes are also accompanied by changes in output in the perfectly competitive sector which now contracts by 1.69% in the short run and by 4.5% in the long run.

EC exporters benefit substantially from the integrated market scenario, with some industries greatly increasing their sales to the rest of the world (food products +12%; transport equipment +6.7%). The change in the pattern of external trade flows is much more

substantial in the long run. This is particularly true of EC exports to the ROW, which rise by large amounts as scale economies induce changes in costs. It is in those EC industries which benefit the most from the pro-competitive effect of the trade liberalisation that the change in EC exports to the ROW is the greatest. There is also a very substantial decline in imports of some goods.

5. FACTOR PRICES

Tables 5.1 and 5.2 report the implications of the experiments for wages; the price of capital is, by assumption, held constant. The tables permit comparisons of wage changes both across the four types of labour, and across the seven EC countries.

Looking first across types of labour, it is generally the case that the main beneficiaries are type 1 labour-- professional, and scientific and related. This is particularly so in the long run integrated market experiment. In six of the seven countries the largest wage increase is received by this type of labour. Conversely, unskilled labour is the relative loser. In the long run integrated market experiment, for five of the seven EC countries, the smallest wage increase is for unskilled manual labour (labour type 4); and in four countries this is a wage reduction (in terms of the numeraire, although not necessarily in real terms). The reasons for the differential impact of integration across skill types are clear from table 1. All the imperfectly competitive industries are intensive users of type 1 labour as compared to the perfectly competitive sector; and the industries which are the most intensive users of type 1 labour (office machinery and electrical goods) experience relatively large output increases.

Across countries there is some tendency, albeit small, towards

factor price equalisation. The coefficient of variation of the price of the first three kinds of labour across countries shows a slight reduction as a result of the policy experiments; although the coefficient of variation of the wage of the least skilled labour shows a small increase. The tendency towards factor price equalisation, modest though it is, reflects the fact that factor endowment based comparative advantage is being more fully exploited following the trade liberalisations.

6. THE WELFARE CONSEQUENCES OF 1992

Table 6.1 shows the distribution across EC countries of the changes in welfare as a result of all four experiments - segmented and integrated markets in both the short and the long run. Welfare gains are measured by compensating variation, and expressed as a percentage of GDP. Table 6.1 shows that all countries experience a welfare gain from trade liberalisation. However, under the segmented markets hypothesis this welfare gain is comparatively small for most of the EC countries. The welfare gains are highest for Greece/Ireland (+1.1%) and the Iberian countries (+0.6). The welfare gains are a little larger in the long run. Significantly larger gains are reported in the integrated market experiment in the long run. Except for France and the Other EC North all countries experience welfare gains in excess of 1% of GDP and for Greece/Ireland and the Iberian countries the gains exceed 2% of GDP. It is worth noting that the policy experiment directly affects only the 14 industries, which account for a little less than 40% of GDP.

In order to gain a greater understanding of the source of these welfare gains we decompose them both by industry and by source of gain, first for the segmented market experiment and then the

integrated.

6.1 Segmented Markets: The first column of Table 6.1.1 gives the welfare gains generated by each industry in the long run segmented market experiment as a proportion of EC consumption of the industry's product. Two observations can be made. First, the gains are quite small -- exceeding 1% of consumption in only two industries. Second, the distribution of gains across industry follows quite closely the pattern of output changes previously discussed. In particular, we see that the two industries with the largest long run gains (relative to consumption) are transport equipment and office machinery. Gains are smallest in banking and finance and in metal products. This confirms the fact the the gains are greatest in the more concentrated industries.

The remaining columns of table 6.1.1 decompose the gains in each industry into six components. The unit is the percentage of the total gain in the industry attributable to each component (and elements may exceed 100% if other components are negative). The first two, DCSp and DCSn, are changes in consumer surplus. Changes in prices of individual products, p_{ij}^k, and the number of products available, n_i^k, change the price indices for each industry in each country P_i^k, and hence the value of the expenditure function and consumers' surplus. The first two columns give these effects, split into the price effect (DCSp, attributable to changes in p_{ij}^k), and the variety effect (DCSn, attributable to changes in n_i^k). The latter is positive in industries in which the number of firms has increased and negative if there has been a decrease (and would be zero in a short-run experiment, of course). The third column, DIS, gives the analogous effect for intermediates. Changes in intermediate prices, q_{ij}^k, change the

intermediate price indices, Q_j^k and P_j, and the value of this change is reported as the change in intermediate surplus produced by each industry which supplies intermediates. The fourth column, DGR, gives the change in external tariff revenue, and the fifth, DPR, the change in profits of firms in the industry. In the long-run experiment shown in Table 6.1.1, the profit effect is necessarily zero. The sixth column, GE, shows what we call the general equilibrium effect: the change in industry costs due to changes in input prices. The need for this to be accounted for is most easily seen by supposing that wages have fallen. This would raise profits, but not, of itself, raise welfare, being simply a redistribution from labour to profits. The change in costs shown in the GE column would in this case be equal and opposite to the effect shown in the DPR column. Similarly, if profits rose only because of a fall in intermediate prices, the benefits of this would have been accounted for in DIS, and to avoid double counting an equal and opposite cost effect would be recorded in the general equilibrium column. In a partial equilibrium model such general equilibrium effects would of course be absent.

From table 6.1.1 it can readily be seen that the greatest gains arise from the change in surpluses arising from the changes in prices - change in consumer surplus + the change in intermediate surplus. The distribution of these gains between consumer surplus and intermediate surplus follows closely the final expenditure share of each industry (for example, metalliferous products has a very low final expenditure share, and conversely a high intermediate share).

The change in welfare due to the variety effect will depend on whether there is entry or exit in the industry. A large negative change is reported for transport equipment and food products, which are those industries earlier identified as experiencing the greatest

declines in firm numbers. The change in government revenue measures trade diversion, and is in all cases negative (it is zero for the banking and finance sector as there is no CET), which reflects the decline in ROW imports to the EC. The pattern of these changes follows closely the pattern of the external trade flows.

Table 6.1.2 presents a different way of decomposing the welfare gains for each industry by looking at the direct cost saving of the policy, at "distortions" in each industry, and at changes in external terms of trade. The distortions term is relevant because quantity changes have welfare effects if marginal costs differ from marginal social valuations. We identify these effects by first order approximations. This is why the first column of Table 6.1.2, giving welfare gain generated by each industry as a percentage of consumption, is different from the first column in table 6.1.1. Again, the remaining columns in this table give the percentage of the total welfare gain in that industry which is attributable to each component.

The first component of the welfare gain (direct) gives the direct cost saving due to the assumed reduction in the cost of trade. The second, (competition), measures welfare changes associated with the fact that firms set prices above marginal cost. The approximation we use to get this effect is the sum of changes in outputs produced of each good times the price marginal cost margin on that good. Denoting changes by Δ, this is

$$\sum_i n_i^k \, m_i^k \sum_j \left[\left\{ p_{ij}^k \left(1 - t_{ij}^k \right) - \frac{\partial c_i^k}{\partial z_i^k} \right\} \Delta x_{ij}^k + \left\{ q_{ij}^k \left(1 - t_{ij}^k \right) - \frac{\partial c_i^k}{\partial z_i^k} \right\} \Delta y_{ij}^k \right]$$

It should be noted that since price marginal cost margins are

generally higher on home sales than on export sales, and the policy increases trade volumes, it is quite possible that this effect could be negative.

The next effect (differentiation) gives the value of the distortion associated with the changes in the number of firms. Since firms are unable to capture the entire consumer surplus associated with the introduction of a new product, introducing a product will give a welfare gain. With preferences of the type used here the net welfare gain is $1/(\varepsilon-1)$ times the revenue (and costs) generated by the product. The differentiation effect is therefore:

$$\sum_{i} m_i^k \sum_{j} p_{ij}^k x_{ij}^k \frac{\Delta n_i^k}{(\varepsilon^k-1)}$$

Column 4 gives trade diversion: the change in the volume of imports from the rest of the world times the common external tariff. Columns 5 and 6 give the value of changes in external terms of trade. With intra-industry trade these can be reported separately for exports and for imports.

The first thing we learn from Table 6.1.2 is the high proportion of the welfare gain that is generated by the direct effect of the policy, the assumed reduction in trade costs. In the short run, not shown in the Table, this exceeds 100% of the total gains in four industries, implying that the other induced effects are, in total, negative. The proportion of gains attributable to the direct effect is reduced considerably in the long run, though there is still one case in which the direct effect exceeds 100%. The competition effect brings a significant share of the gains in most industries, as exit of firms brings increased firm scale. The value of the distortion associated with changes in the number of firms is negative where there

is exit from the industry and positive where there is entry. These effects are generally quite small.

Trade diversion creates a welfare cost, and the share of this depends on the size of the increase in imports, the level of the CET, and the overall gain in the industry. The terms of trade changes indicate that, in all industries, there is a fall in both export prices and import prices. The fall in import prices arises as importers cut price in response to increased competition in the EC. The deterioration of the export terms of trade is a consequence of lower marginal costs of firms in the EC, and is largest in the most concentrated industries, for example office machinery and precision instruments, and transport equipment. It should be noted that the rest of the world gains from the net terms of trade changes reported here. In a perfectly competitive model economic integration would generally improve the terms of trade of the EC, and worsen it for the rest of the world; here, the supply side improvements in the EC are, in part, exported, so giving welfare gains for the rest of the world.

6.2 Integrated markets. Tables 6.2.1 and 6.2.2 provide the same two types of breakdown of the welfare consequences of trade liberalisation but this time for the integrated market scenario. Looking across industries we see much larger gains in this case than in the segmented case (comparing tables 6.1.1 and 6.2.1). However, the relative performance of industries is similar, with transport equipment and office machinery giving the largest gains.

Looking at the decomposition of gains in table 6.2.1 we see the pro-competitive nature of the integration experiment leading (through short-run profit changes, not shown in the Table) to a considerable amount of exit, as indicated by the welfare loss associated with the

variety effect.

Table 6.2.2 decomposes the welfare gain by direct effect, distortion, and terms of trade. As would be expected, the proportion of the gain attributable to the direct effect of the policy is now much reduced. Most of the welfare gains are attributable to the competition effect -- the expansion of production by firms operating with price in excess of marginal cost. Again, this is partially offset by loss of variety, by trade diversion, and by deterioration in the export terms of trade as some of the benefits of lower marginal costs are passed to ROW consumers.

The results reported in this section can be compared with the partial equilibrium results of Smith and Venables (1988), where the long run welfare effects of the segmented market experiment ranged from 0.29% to 1.31% of base consumption (excluding a single good for which the effects were much less), while in the integrated market experiment, the effects ranged from 0.40% to 5.57% of base consumption. The range of numbers reported in the first columns of Tables 6.1.1 and 6.2.1 are therefore quite comparable with the earlier partial equilibrium results. The welfare changes by country shown in Table 6.1 seem much smaller, but recall that the Table shows the welfare change as a fraction of GDP for a policy experiment that is assumed to affect directly a little less than 40% of the economy.

7. ALTERNATIVE EXPERIMENTS AND ASSUMPTIONS

The experiments described in the preceding sections all assume that "1992" brings a cost reduction of 2.5% of trade costs uniformly across all fourteen industries; but the policy impact of "1992" will surely not be so uniform. The Commission of the European Communities (1989) have attempted to identify goods for which the impact will be

greatest, and on the basis of their work, and judgements about the possible impact of "1992" in financial services, we have run an alternative set of policy experiments in which the trade cost reduction is increased to 5% in four industries: office machinery, electrical products, transport equipment, and food production; and raised to 10% in banking and finance. So that the overall size of the policy experiment is comparable to that investigated in earlier sections, we have reduced the trade cost reduction in the other nine industries to 0.566%, a level that ensures that the overall cost reduction on intra-EC trade is the same in both sets of experiments. The aim of this exercise is as much to explore the sensitivity of the model to changes in the size of policy changes as to provide a more accurate model of the inter-sectoral impact of "1992"

Table 7.1 compares the long run effect of the two sets of experiments. One striking result is that the aggregate welfare effect of the differential trade cost reduction is considerably greater than that of the uniform trade cost reduction. This is easy to understand in the light of the earlier discussion about the industrial characteristics which lead to large policy effects. The industries in which we are now assuming the trade cost reduction will be greater include some of the industries with the highest degrees of concentration and economies of scale. Secondly, it should be noted that the changes in the policy effects are not directly proportional to the changes in policy: as the trade cost reduction is doubled in transport equipment, for example, the welfare gain in that sector more than doubles in the segmented market experiment, and less than doubles in the integrated market case. This is the natural consequence of general equilibrium effects which imply that policy changes originating in one sector have effects that are not confined to that

sector. The general equilibrium effects seem to be more visible in the integrated market experiment.

The second kind of sensitivity analysis we conduct is with respect to market structure. Evidently, each industry contains many different product types. Our model contains two ways of handling the disaggregation from the industry to the product. One is the division of each industry into sub-industries; the other is by product differentiation within each sub-industry. The results reported so far are based on the division of industries into sub-industries, as reported in table 1, with the corresponding (calibrated) measures of product differentiation, ε. How are results changed if we handle the disaggregation differently? The model was recalibrated and experiments rerun with the assumption that each industry consists of a single sub-industry. Making this change means that calibrated elasticities are now lower, as reported in table 1 as ε'. Lower ε corresponds to a greater degree of product differentiation; as would be expected, not using sub-industries to capture heterogeneity within the industry puts more weight on product differentiation between individual varieties.

This change influences results in two ways. First, lower demand elasticities mean that quantity changes become somewhat smaller. Second, industries are less concentrated (since firms are not divided between sub-industries), so the pro-competitive effects of policy are smaller. Table 7.2 reports welfare changes in this case. We see that welfare gains in the short run segmented market experiment are now slightly larger. This is because the increase in trade volumes, with associated trade costs, is slightly less. However, in all other cases gains are reduced. As argued above, gains come from the pro-competitive effects of policy. Shifting competition from the

sub-industry to the industry level makes the equilibrium more competitive, reducing the scope for these gains. This appears most significantly in the long run integrated market experiment, in which gains are reduced by around 40%.

8. CONCLUDING COMMENTS

We have modelled "1992" in two ways in this paper: first as a fairly modest change in intra-EC trade barriers, and second as a change in trade barriers accompanied by a significant change in the behaviour of firms. In both sets of experiments we find large welfare effects from factors associated with imperfect competition. Intra-EC trade liberalisation has pro-competitive effects which make a substantial contribution to the welfare change in the first set of experiments and are by far the most important component of the welfare change in the second set of experiments.

By modelling intra-EC trade liberalisation in a general equilibrium model, we can address several important questions that cannot be treated in a partial equilibrium approach. We find modest effects on factor markets as trade liberalisation has differential effects across industries with different factor intensities. General equilibrium effects enter into the accounting of the welfare effects of the policy change, but not with sufficient force to make the order of magnitude of welfare changes different from those that would be derived from a partial equilibrium approach. We also find quite large effects on the EC's external trade, as intra-EC trade liberalisation reduces demand for imports from outside the EC.

Policy simulation in numerically calibrated models should always have health warnings attached. The results are based on a theoretical model that is, at best, a very crude approximation to the real world

and on a modest amount of imperfect data. In this exercise there are at least three areas of particular concern.

The first is that the rest of the world is modelled in a fairly rudimentary fashion, so that results on external trade effects should be treated with caution.

Secondly, it is the effects on competition of trade policy changes that dominate our results, but market structure is probably the area in which the interpretation of our data is most problematic. The analysis we have undertaken of the sensitivity of our results to changing the modelling of competition within the industry shows that while the general shape of the results is broadly unchanged the size of welfare effects of policy is fairly sensitive to the modelling of competition.

Thirdly, there is a considerable degree of uncertainty about what "1992" will actually mean. We have addressed this uncertainty first by undertaking two kinds of policy experiment: a segmented market experiment in which firms' behaviour remains unchanged, and an integrated market experiment in which firms behaviour become significantly more competitive as a result of the creation of a single European market. As in our earlier partial equilibrium work, we find that the effects of "1992" differ quite markedly between these two interpretations of what "1992" means. We have also investigated the sensitivity of our results to changes in the inter-industry distribution of the effects of policy, and find only a moderate degree of sensitivity here.

In short, our analysis confirms the central importance of the effects of "1992" on market structure and competition, while suggesting that there remains much scope for improving our understanding of how to model the interaction between trade policy and

industrial organisation.

Appendix:

Consumers in country j, j = 1...J, consume products which are produced in each country, so the number of product types available for consumption is $\Sigma_{i=1}^{J} n_i m_i$. Demands in each country are derived from a Dixit and Stiglitz (1977) type welfare function, i.e., there is a CES aggregator of the form,

$$X_j^k = \left[\sum_{i=1}^{J} n_i^k m_i^k a_{ij}^k (1/\varepsilon^k) x_{ij}^k (\varepsilon^k - 1)/\varepsilon^k \right]^{\varepsilon^k/(\varepsilon^k - 1)} \qquad j=1,\ldots,J. \qquad (A1)$$

where a_{ij}^k are demand parameters describing the preferences for of a consumer in country j for product produced in country i. X_j^k can be regarded as a quantity index of aggregate consumption of the industry output. Dual to the quantity index is a price index, P_j^k, taking the form,

$$P_j^k = \left[\sum_{i=1}^{I} n_i^k m_i^k a_{ij}^k p_{ij}^{k(1-\varepsilon^k)} \right]^{1/(1-\varepsilon^k)} \qquad j=1,\ldots,J, \qquad (A2)$$

and representing the price of the aggregate product, where the p_{ij}^k are the prices of the individual varieties. The unit expenditure function is Cobb-Douglas, so

$$E_j = \prod_k (P_j^k)^{\beta_j^k} \qquad j = 1,\ldots,J, \qquad \sum_I \beta_j^k = 1. \qquad (A3)$$

where the β_j^k give the share of industry k in country j expenditure.

Construction of the intermediate aggregators, Y_j^k, Q_j^k and F_j is exactly analogous.

Profits of firms are given by equation (5) of the text with cost

function (2). The function G^k is nested CES. The function h^k takes the form,

$$h^k(z_i^k) = \left[c_0^k + c_1^k z_i^k + c_2^k (z_i^k)^{c_3^k} \right] \qquad \text{(A4)}$$

Returns to scale depend on the parameters $c_0^k \ldots c_3^k$. Thus, $c_0^k > 0$ is a fixed cost; $c_2^k > 0$, $c_3^k < 1$ implies decreasing marginal cost. Under the segmented market hypothesis firms choose the quantity they supply to each market, given sales of other firms in that market. The first order condition for profit maximisation takes the form,

$$p_{ij}^k (1 - t_{ij}^k)\left(1 - \frac{1}{e_{ij}^k}\right) = \frac{1}{m_i^k} \frac{\partial c_i^k}{\partial z_i^k} \qquad i,j=1\ldots J. \qquad \text{(A5)}$$

where e_{ij} is the perceived elasticity of demand and is given by

$$\frac{1}{e_{ij}^k} = \frac{1}{\varepsilon^k} + \left(1 - \frac{1}{\varepsilon^k}\right) s_{ij}^k, \qquad i,j=1\ldots J. \qquad \text{(A6)}$$

s_{ij}^k is the share of a single firm from country i in the country j market for industry k.

Under the integrated market hypothesis firms choose total sales to the seven EC markets, given total sales of their rivals. In this optimisation problem they anticipate that the allocation of all firms sales between all markets will be such as to equate producer prices of a particular product in all markets, i.e., to satisfy the following equation.

$$p_{ij}^k (1 - t_{ij}^k) = p_{i\ell}^k (1 - t_{i\ell}^k), \qquad i,j,\ell=1\ldots J. \qquad \text{(A7)}$$

Table 1: Industry data:

Industry	Factor Shares in VA (%)				
	K	L1	L2	L3	L4
Metalliferous products	0.424	0.111	0.119	0.086	0.258
Non-metallic mineral prod's	0.304	0.127	0.153	0.101	0.314
Chemical products	0.322	0.226	0.167	0.072	0.212
Metal products	0.192	0.156	0.158	0.198	0.295
Agric. and ind. machinery	0.161	0.222	0.156	0.268	0.193
Office mach'y & prec.inst.	0.158	0.330	0.209	0.133	0.170
Electrical goods	0.151	0.253	0.162	0.162	0.271
Transport equipment	0.227	0.166	0.138	0.207	0.260
Food products	0.287	0.149	0.162	0.080	0.321
Textiles, clothing, Leather	0.189	0.139	0.162	0.108	0.401
Paper & printing prod's	0.236	0.183	0.153	0.178	0.249
Rubber & plastic prod's	0.164	0.156	0.169	0.217	0.295
Timber & other n.e.s	0.231	0.166	0.149	0.079	0.375
Banking and insurance	0.176	0.202	0.621	0.000	0.000
Perfectly comptve sector	0.406	0.094	0.172	0.093	0.233

Industry	Conc	Sub-Ind	IRS	FES	ε	ε'
Metalliferous products	.021	1	6	0.09	17.79	17.8
Non-metallic mineral prod's	.025	4	8	0.18	14.33	10.7
Chemical products	.032	3	15	0.28	8.16	7.1
Metal products	.009	5	7	0.35	16.52	14.7
Agric. and ind. machinery	.012	5	7	0.64	12.88	12.1
Office mach'y & prec.inst.	.078	3	15	0.64	13.42	7.9
Electrical goods	.037	6	10	0.54	11.15	8.7
Transport equipment	.057	1	7	0.68	26.12	26.1
Food products	.008	3	4	0.65	28.50	22.7
Textiles, clothing, Leather	.003	4	3	0.62	31.25	28.4
Paper & printing prod's	.005	3	13	0.21	6.94	6.6
Rubber & plastic prod's	.005	3	5	0.20	17.47	16.9
Timber & other n.e.s	.013	2	5	0.54	21.22	18.6
Financial services	.008	2	5	0.21	21.88	18.8

Table 4.1: Segmented Markets - % Change in Production and External Trade

Industry	EC Production		EC Exports to ROW		EC Imports from ROW	
	SR	LR	SR	LR	SR	LR
Metallif. products	1.9	3.5	1.4	3.3	-4.2	-4.4
Non-met. min. prod.	0.8	2.2	0.5	2.3	-2.9	-3.2
Chemical products	1.5	1.4	0.4	0.3	-4.4	-4.4
Metal products	0.4	0.6	0.2	0.2	-2.5	-2.3
Agric. & ind. mach.	1.6	1.7	0.5	0.5	-7.1	-7.0
Office machinery	3.6	3.8	0.3	0.3	-6.8	-6.7
Electrical goods	1.8	2.5	0.6	1.3	-5.0	-4.9
Transport	5.5	9.7	2.0	8.4	-19.6	-20.2
Food products	1.1	2.6	5.6	7.7	-11.6	-11.5
Textiles...	3.1	3.8	2.2	3.0	-16.1	-16.0
Paper & printing	0.6	0.6	0.5	0.2	-1.4	-1.1
Timber & other n.e.s.	2.2	2.0	1.2	0.9	-6.5	-6.4
Rubber & plastic	0.8	2.2	0.5	2.1	-4.1	-4.2
Banking & finance	0.3	0.7	-0.4	0.1	-1.0	-0.8

Table 4.2: Integrated Markets - % Change in Production and External Trade

Industry	EC Production		EC Exports to ROW		EC Imports from ROW	
	SR	LR	SR	LR	SR	LR
Metallif. products	4.9	28.0	3.8	30.5	-10.7	-13.9
Non-met. min. prod.	3.6	29.5	2.0	35.7	-11.4	-17.8
Chemical products	4.0	6.9	1.3	2.5	-9.2	-7.4
Metal products	1.3	5.3	0.7	2.7	-7.5	-5.4
Agric. & ind. mach.	2.6	5.6	1.0	3.0	-10.4	-9.4
Office machinery	9.7	10.6	0.9	-0.2	-16.9	-13.9
Electrical goods	6.0	15.9	2.1	11.5	-15.3	-15.2
Transport	11.4	25.5	6.7	25.7	-36.5	-39.4
Food products	3.8	17.4	12.1	32.7	-25.2	-27.5
Textiles...	4.8	10.2	5.5	12.0	-20.9	-22.1
Paper & printing	1.9	5.8	1.6	5.0	-4.0	-3.9
Timber & other n.e.s.	3.8	7.3	2.8	5.6	-9.4	-9.1
Rubber & plastic	2.3	19.1	1.5	19.7	-8.1	-9.7
Banking & finance	1.5	13.5	-1.1	9.5	-6.4	-3.2

Table 5.1: % Change in Factor Prices - Segmented Markets

Country	SR (Firm nos. fixed)				LR (Firm nos. flexible)			
	L1	L2	L3	L4	L1	L2	L3	L4
France	0.57	0.13	0.40	0.24	0.74	0.12	0.47	0.22
Germany	0.34	0.15	0.19	0.11	0.44	0.14	0.31	0.08
Italy	0.59	-0.02	0.60	0.25	0.70	0.03	0.61	0.23
UK	0.54	0.32	0.28	0.12	0.63	0.33	0.34	0.11
EC North	0.46	0.34	0.21	0.52	0.63	0.30	0.34	0.49
Gr/Ire	1.07	0.74	1.10	0.90	1.60	1.03	0.88	0.77
Iberia	0.92	-0.05	1.38	0.22	1.00	-0.08	1.43	0.27

Table 5.2: % Change in Factor Prices - Integrated Markets

Country	SR (Firm nos. fixed)				LR (Firm nos. flexible)			
	L1	L2	L3	L4	L1	L2	L3	L4
France	1.80	0.36	1.33	0.59	3.44	0.90	1.41	0.29
Germany	0.78	0.84	0.34	0.37	2.34	2.61	-0.06	-0.78
Italy	1.81	0.67	1.41	0.65	3.90	2.60	0.78	-0.27
UK	2.46	0.89	1.78	0.61	4.36	3.01	0.77	-0.82
EC North	0.22	0.57	0.42	0.63	1.49	0.83	0.47	0.50
Gr/Ire	2.27	1.32	2.05	1.02	5.28	4.58	0.20	-0.42
Iberia	1.87	0.91	1.53	1.12	3.43	1.23	1.78	1.40

Table 6.1: Welfare Changes with Equal Sized Policy Experiment

	Segmented				Integrated			
	CV (ecuM)		Change in CV as % GDP		CV (EcuM)		Change in CV as % GDP	
Country	SR	LR	SR	LR	SR	LR	SR	LR
France	2077	2835	0.3	0.4	4316	9651	0.7	1.5
Germany	2030	2423	0.2	0.3	2127	8375	0.2	0.9
Italy	1716	2266	0.3	0.4	3604	9282	0.7	1.8
UK	1652	2372	0.3	0.4	4091	11068	0.7	1.9
EC North	1731	2014	0.4	0.5	1244	3190	0.3	0.8
Gr/Ire	589	726	1.1	1.4	850	1536	1.6	2.9
Iberia	1151	1344	0.6	0.7	1747	4337	0.9	2.2

Table 6.1.1: Breakdown of Welfare Gains (A) as a % of Total Welfare Gains in each Industry with Free Entry - Segmented Markets

Nace	Industry	Tot as % of EC cons.	DCSp	DCSn	DIS	DGR	DPR	GE
13	Metlfp.	0.9	13.5	-0.9	122.1	-4.7	0.0	-30.1
15	Minp.	0.6	22.5	-2.8	96.2	-1.4	0.0	-14.4
17	Chemp.	0.9	35.8	2.0	89.0	-6.3	0.0	-20.6
19	Metp.	0.3	45.1	-0.7	73.5	-1.8	0.0	-16.0
21	Machv.	0.9	72.1	-0.4	37.3	-6.8	0.0	-2.3
23	Offmach.	1.1	78.2	0.3	40.9	-14.5	0.0	-4.9
25	Elecp.	0.9	63.2	-5.7	51.0	-10.0	0.0	1.4
28	Transp.	1.6	91.3	-15.9	39.5	-9.4	0.0	-5.5
36	Foodp.	0.4	140.6	-20.8	64.9	-27.1	0.0	-57.8
42	Text	0.6	116.0	-3.7	57.2	-51.5	0.0	-17.9
47	Pap	0.3	27.5	3.4	97.7	-3.3	0.0	-25.3
48	Timbp.	0.6	71.0	3.9	51.8	-14.9	0.0	-11.8
49	Rubp	0.6	26.1	-2.5	95.4	-3.7	0.0	-15.4
69	B&F	0.1	16.3	-2.0	48.5	0.0	0.0	37.2

Table 6.1.2: Breakdown of Welfare Gains (B) as a % of Total Welfare Gains in each Industry with Free Entry - Segmented Markets

Nace	Industry	Tot as % of EC cons.	Direct	Comp.	Diffn.	Div.	Export T of T	Import T of T
13	Metlfp.	0.8	67.1	48.6	-0.9	-4.2	-11.3	0.7
15	Minp.	0.5	51.5	59.4	-3.0	-1.2	-6.7	0.1
17	Chemp.	0.8	94.9	12.7	2.2	-5.1	-5.5	0.8
19	Metp.	0.2	87.1	17.3	-0.9	-1.7	-1.7	0.0
21	Machv.	0.8	90.7	21.5	-0.6	-6.2	-5.8	0.3
23	Offmach.	1.0	83.9	24.7	-0.2	-12.2	-1.0	4.8
25	Elecp.	0.8	73.2	48.0	-6.2	-8.3	-7.7	1.0
28	Transp.	1.5	47.8	89.2	-16.4	-8.2	-14.2	1.9
36	Foodp.	0.3	80.9	78.3	-25.2	-24.8	-9.3	0.1
42	Text	0.5	124.8	39.6	-4.9	-52.7	-7.2	0.4
47	Pap	0.3	83.0	18.0	3.8	-2.6	-2.2	0.0
48	Timbp.	0.5	98.1	18.3	4.6	-14.9	-6.4	0.3
49	Rubp	0.5	66.3	43.6	-2.7	-3.1	-4.2	0.1
69	B&F	0.1	59.5	42.5	-2.3	0.0	0.3	0.0

Table 6.2.1 Breakdown of Welfare Gains (A) as a % of Total Welfare Gains in each Industry with Free Entry - Integrated Markets

Nace	Industry	Tot as % of EC cons.	DCSp	DCSn	DIS	DGR	DPR	GE
13	Metlfp.	3.2	13.9	-3.1	129.0	-4.0	0.0	-35.9
15	Minp.	4.3	21.7	-6.6	96.3	-1.1	0.0	-10.4
17	Chemp.	2.1	38.9	-3.4	98.6	-4.5	0.0	-29.7
19	Metp.	0.7	52.8	-11.1	94.1	-1.5	0.0	-34.4
21	Machy.	1.4	87.3	-17.8	46.9	-5.8	0.0	-10.6
23	Offmach.	4.8	76.5	-1.5	32.7	-7.1	0.0	-0.6
25	Elecp.	3.5	70.7	-21.2	57.3	-7.7	0.0	1.0
28	Transp.	4.5	93.9	-16.4	40.1	-6.7	0.0	-10.9
36	Foodp.	1.2	158.7	-50.7	81.3	-19.8	0.0	-69.5
42	Text	0.8	159.8	-19.6	86.4	-56.5	0.0	-70.1
47	Pap	1.3	28.7	-4.6	103.2	-2.5	0.0	-24.8
48	Timbp.	0.9	92.1	-10.1	72.1	-13.4	0.0	-40.7
49	Rubp	2.1	26.2	-7.0	103.8	-2.2	0.0	-20.7
69	B&F	1.6	9.4	-7.5	33.6	0.0	0.0	64.5

Table 6.2.2: Breakdown of Welfare Gains (B) as a % of Total Welfare Gains in each Industry - Integrated Markets

Nace	Industry	Tot as % of EC cons.	Direct	Comp.	Diffn.	Div.	Export T of T	Import T of T
13	Metlfp.	3.7	14.0	104.0	-2.2	-2.8	-13.5	0.4
15	Minp.	4.9	5.6	107.8	-5.1	-0.7	-7.7	0.1
17	Chemp.	2.0	36.5	75.3	-3.4	-3.3	-6.2	1.1
19	Metp.	0.7	25.8	89.2	-10.9	-1.2	-3.0	0.0
21	Machy.	1.3	52.5	89.2	-17.8	-4.9	-19.4	0.4
23	Offmach.	3.0	28.7	79.9	-3.1	-8.7	0.0	3.2
25	Elecp.	3.6	16.2	119.6	-17.8	-5.6	-13.2	0.8
28	Transp.	4.6	15.6	115.3	-13.2	-5.2	-13.9	1.4
36	Foodp.	1.6	14.9	134.6	-31.6	-10.9	-7.1	0.0
42	Text	0.8	76.6	100.7	-16.3	-44.7	-16.9	0.5
47	Pap	1.3	16.5	93.7	-4.4	-1.8	-3.9	0.0
48	Timbp.	0.9	53.3	86.1	-9.5	-11.6	-19.0	0.6
49	Rubp	2.3	13.9	98.9	-5.5	-1.5	-5.9	0.1
69	B&F	1.7	4.6	102.4	-6.8	0.0	-0.3	0.0

Table 7.1: Distribution of Welfare gains by Industry in the long run

		Uniform Experiment				Differential Experiment			
		Segmented		Integrated		Segmented		Integrated	
		EcuM	%	EcuM	%	EcuM	%	EcuM	%
Nace	Industry								
13	Metlfp.	1314	9	4963	11	224	1	3931	8
15	Minp.	487	4	3575	8	107	1	3062	6
17	Chemp.	1798	13	4276	9	375	2	2951	6
19	Metp.	350	3	1020	2	77	0	725	1
21	Machy.	1194	9	1879	4	256	1	1007	2
23	Offmach.	619	4	2638	6	1397	7	3309	6
25	Elecp.	1208	9	4777	10	2635	13	5953	11
28	Transp.	2871	21	7864	17	7337	36	11868	23
36	Foodp.	1421	10	4637	10	4130	20	6797	13
42	Text	948	7	1194	3	120	1	416	1
47	Pap	397	3	1774	4	107	1	1450	3
48	Timbp.	421	3	670	1	79	0	336	1
49	Rubp	384	3	1468	3	80	0	1140	2
69	B&F	479	3	5414	12	3360	17	9264	18
Total		13889	100	46147	100	20283	100	52209	100

Table 7.2: Welfare Changes with Differential Policy Experiment and with Sub-industries = 1

	Change in CV as a prop. of GDP							
	Differential Experiment				Sub-inds = 1			
	Segmented		Integrated		Segmented		Integrated	
Country	SR	LR	SR	LR	SR	LR	SR	LR
Fra.	0.4	0.6	0.7	1.6	0.3	0.4	0.5	0.9
Germ.	0.2	0.4	0.2	1.0	0.2	0.2	0.2	0.6
Italy	0.4	0.7	0.7	2.0	0.3	0.4	0.6	1.1
UK	0.4	0.6	0.8	2.1	0.3	0.4	0.5	1.1
EC N.	0.5	0.7	0.4	0.9	0.5	0.5	0.4	0.6
Gr/Ire	1.5	1.9	2.0	3.2	1.2	1.3	1.5	2.1
Iberia	1.2	1.0	1.4	2.8	0.6	0.6	0.8	1.6

REFERENCES:

Commission of the European Communities (1989), *The Impact of the Internal Market by Industrial Sector: the Challenge for the Member States* Directorate General for Economic and Financial Affairs, Brussels

Department of Employment (1985), *New Earnings Survey*, 1985.

Dixit, A. & Stiglitz, J.E., (1977), *Monopolistic Competition and Optimum Product Diversity*, American Economic Review, 67, 297-308.

Eurostat (1986), *National Accounts ESA. Input-Output Tables 1980.*

Eurostat (1989), *Structure and Activity of Industry, Annual Inquiry 1985, Main Results 1984/85.*

Eurostat (1989), *Structure and Activity of Industry, Annual Inquiry, Data by size of Enterprise, 1984.*

Gasiorek, M. , Smith, A., and Venables, A.J. (1991), Completing the internal market in the EC. factor demand and comparative advantage, chapter 2 in Winters, L.A. and Venables, A.J., European Integration: Trade and Industry, Cambridge University Press, 9-33

Office of Population and Census Surveys, (1984), *Census 1981, Economic Activity, Great Britain.*

Piggott, J. & Whalley, J. (1985), *U.K.* Tax Policies and applied *General Equilibrium Appraisal*, Cambridge University Press.

Pratten, C. (1988), *A Survey of the Economies of Scale.* in Research on the "Costs of Non-Europe", Basic Findings, Vol.2., Commission of the European Communities, 1988.

Smith, A & Venables, A.J. (1988), *Completing the Internal Market in the European Community: Some industry simulations*, European Economic Review, 32, 1501-1525.

Venables, A.J. (1990), Trade policy under imperfect competition: a numerical assessment, in Krugman, P., and Smith, A., *Empirical Studies of Strategic Trade Policy* (University of Chicago Press for NBER, forthcoming)