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## ABSTRACT

### Trade and Economic Geography: The Impact of EEC Accession on the UK\*

This paper combines establishment level production data with international trade data by port to examine the impact of accession to the EEC on the spatial distribution of UK manufacturing. We use this data to test the predictions from economic geography models of how external trade affects the spatial distribution of employment. Our results suggest that accession changed the country-composition of UK trade and via the port-composition induced an exogenous shock to the economic environment in different locations. In line with theory, we find that better access to export markets and intermediate goods increase employment while increased import competition decreases employment.

JEL Classification: F14, F15 and R12

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## 1. Introduction

Work in international trade has long been concerned with what is produced where. That is, in the distribution of economic activity across countries. In contrast, this paper forms part of a small, but growing literature focusing on the relationship between economic integration and the spatial distribution of economic activities *within* a country. We view UK accession to the European Economic Community as a trade “shock” and use this shock to help identify how trade affects the spatial distribution of activity.

The UK’s accession to the EEC is a good case study for assessing these trade effects. First, as discussed below, that the UK would join was far from certain until less than a year before accession. This means that we can expect firm responses to come after UK accession even if firms are forward looking. Second, accession occurred when tariffs, generally, were at much higher levels than today. The fact that tariff reductions were large means that impacts should be easier to identify. Third, these tariff changes affected most manufacturing sectors at a time when manufacturing was a significant component of the UK economy. As most studies, ours included, focus exclusively on manufacturing, the relative importance of this sector will matter for the magnitude of any general equilibrium effects of liberalisation. Fourth, we are able to use detailed data on individual firms and the ports through which trade flows. This allows us to test the predictions from economic geography models in an original fashion. Finally, the existing literature focuses on the response of developing countries to major trade liberalisations. See, for example, Hanson (1996, 1997, 1998), Pavcnik (2002) and Tybout (2000, 2001). Studying developed countries, however, has one key advantage over looking at developing countries. Frequently, developing country liberalisations form part of a larger package in response to macroeconomic shocks. In contrast, although the early 1970s was a time of significant macroeconomic shocks, accession was *not* a response to these shocks. Thus, we can treat accession as providing a natural experiment in terms of changing trade policy.

The fact that UK accession to the EEC led to a significant re-orientation of trade towards EEC members is well documented elsewhere - see, among many others, Winters (1984), or Begg *et al* (2003). Less well known, is the significant re-orientation in terms of the port through which this trade occurred. We describe this re-orientation in Overman and Winters (2005). In this paper, we argue that because this changing port-composition was a result of accession it induced different *exogenous* shocks to the economic environment in different UK regions. We then examine whether the resulting changes to the spatial distribution of employment are in line with predictions from models of economic geography. To do this, we construct a panel of firms for which we know production sector, employment and the Travel To Work Area (TTWA) where these firms are located. We use data on the volume of trade by port and distance from these ports to different TTWAs to construct measures of the import competition and access to export markets and intermediate goods faced by firms. Using the panel nature of our data to control for unobserved firm specific effects, we then test whether these three access variables have a significant impact on firm employment. Of course, it is possible that changes in firm employment actually drive changes in these variables rather than vice-versa. We argue, however, that the changing country composition of UK trade during this period is driven by accession, not the performance of individual firms and so we can use this changing country composition to instrument for the three access variables.

The rest of the paper is structured as follows. Section 2 provides a summary of the historical background and details the extent of trade liberalisation that occurred when the UK joined the EEC. Section 3 considers theoretical predictions about the possible impact of integration on the spatial distribution of activity. Section 4 details the trade and production data that we use. Section 5 constructs measures of import competition, export market access and intermediate good market access and analyses whether these have the predicted impact on firm employment. Section 6 looks at the extent to which changes in the port composition of trade are determined by the country composition of trade. Section 7 then uses

these findings to construct instruments for the port composition of trade and thus assess whether the effects that we document in section 5 are actually due to the trade liberalisation associated with accession. Section 8 concludes.

## 2. The background

The UK first applied to join the EEC in 1961. This application, and a second in 1967, failed as a result of a French veto. A third application was successful and the UK joined on 1<sup>st</sup> January 1973. For our purposes, it is interesting to note that even without the French veto, UK membership was far from certain. Edward Heath's narrow majority of 30 was sufficient to ensure that parliament accepted the government's accession terms, but the signing of the Treaty of Accession was a much closer run thing. In the end, the government carried the day with a majority of 21. As suggested above, this uncertainty ensures that adjustment to accession is likely to have occurred after entry rather than before, even if firms are forward looking. Moreover, once the need for adjustment has been identified, it is likely to take a while to effect, so we should observe the impact in our data (which start from 1970).

**Table 1: Major Economic Events 1970s**

Year	Month	Event
1971	February	Decimal currency introduced
	August	End of Bretton Woods era; Pound allowed to float
1972	January	Miners begin pay strike
	February	3 day working week begins for most industry to conserve power supplies; miners return to work
	May	Sterling joins the EEC currency snake
	June	Sterling out of the snake
	November	Counter inflation bill – 90 day standstill pay, prices, rents, dividends
1973	January	UK joins EEC; further controls on prices, pay, rents, dividends
	March	Pay Board and Price Commission established
	May	1.6m workers strike against counter-inflation measures
	October	66% price increase light crude oil
	November	25% cut in oil supplies to West; voltage reductions due to power engineers industrial action; petrol ration coupons issued
1974	January	Light crude oil price from \$5 to \$11.5 per barrel; 3 day working week
	February	Miners strike
	March	End of miners strike and return to 5 day working week
	May	Lifting of restrictions on fuel
	July	TUC accept voluntary wage restraint in place of statutory wage controls
1975	August	£6 per week pay rise limit becomes effective
	October	OPEC 10% price increase
	July	Heavy selling of sterling
1976	September	Treasury announces it will seek \$3.9bn loan from IMF
	January	Further \$3bn loan from Bank of International Settlements
1977	July	Abolition of tariffs with EFTA
	December	OPEC announces new 14.5% (staggered) price increases
1978	January	“Winter of Discontent” – series of strikes in public services
1979	May	Price Commission abolished
	June	OPEC announce 15% price increase

Notes: The timeline is an extract from that available at <http://www.bized.ac.uk>

While this uncertainty works in our favour, other macroeconomic uncertainties of the time do not. A number of these uncertainties were global, some were UK specific. Table 1 provides a timeline of major events. These events are likely to have an impact on the composition of overall economic activity. However, our focus is on the impact that integration has on the spatial distribution of economic activity in different sectors *within* the UK taking the level of aggregate sectoral activity as given. It is still possible that these shocks could account for what we observe, but only if they affect locations asymmetrically in a way that is correlated with the trade shocks we identify. Given their macro-economic nature, this seems unlikely, but clearly the possibility cannot be completely ruled out.

We finish this brief background review with a note on the changes in tariffs associated with accession. In the early 1970s tariffs were considerably higher than now, so that the margins of preference generated by accession were, in some cases, quite large. Table 2 reports average UK and EEC tariffs after the Kennedy Round – i.e. applicable from 1972 to 1980 when the Tokyo Round started. In 1972 UK imports from outside the Commonwealth and manufactured imports from EFTA faced the tariffs reported in the ‘UK’ column, with a mean of 7.2% but entries as high as 19%. By 1979 all except those from the EEC, EFTA (manufactures) and the ACP developing countries faced the tariffs in the ‘EEC’ column, with mean of 4.2% and peaks of 14%. The excepted countries faced zero tariffs broadly speaking.

**Table 2: UK/EEC Tariff rates 1972-1979**

Product	UK	EEC		UK	EEC
Mineral products	0.2	0.1	Footwear and headwear	14.7	12.4
Chemical products	8.1	6.9	Stone, ceramic and glass products	10.2	8.0
Rubber products	7.4	2.0	Base metals and metal products	5.2	4.2
Hides, furs, leather products	4.6	1.3	Unwrought, pig iron, scrap	1.1	2.0
Raw hides, skins, fur	N/A	N/A	Basic shapes and forms	8.9	7.0
Articles of leather, fur	13.1	1.3	Steel	9.2	6.7
Wood and cork products	2.3	1.1	Other	7.5	8.7
Wood, natural cork	0.5	0.1	Articles of base metal, misc.	10.0	7.1
Articles of wood, cork	6.8	9.4	Nonelectrical machinery	8.6	6.4
Pulp and paper	7.8	6.9	Electrical machinery	12.4	9.1
Pulp	0.1	2.5	Transportation equipment	9.8	9.3
Paper	13.1	11.1	Precision instruments	13.5	8.4
Textiles	9.1	4.7	Miscellaneous	4.2	2.4
Natural fiber and waste	N/A	0.2			
Yarn and basic fabrics	15.0	11.1			
Special fabrics, apparel, other	19.0	13.9			
			Total	7.2	4.9

Notes: N/A denotes figures not available in the original source. Source: Preeg (1970).

### 3. Theory

What should we expect to be the impact of accession on the spatial distribution of economic activity in the UK? Obviously, theories of comparative advantage help us to understand the changing composition across sectors, and this must play a part in the overall decline in UK manufacturing during this period. It could also clearly help us to understand changes in the distribution of aggregate activity if regions are specialised in sectors that perform differently as the UK adjusts to accession. However, our focus is on how integration affects the spatial distribution of activity *within* particular sectors, on which theories of

comparative advantage are essentially silent. Thus the theoretical foundation that we use comes from the literature that directly considers the impact that integration has on economic geography. These effects have been the focus of the recent ‘New Economic Geography’ (NEG) associated with urban and international economists, see Fujita, Krugman and Venables (1999), Fujita and Thisse (2002), and Baldwin, Forslid, Martin, Ottaviano, Robert-Nicoud (2003) for overviews. The analysis of NEG formalises ideas about the impact of trade from an older literature associated with economic geographers.

This literature argues that the equilibrium spatial distribution of economic activity depends on the balance between agglomeration and dispersion forces. Firms that locate in big markets benefit from being close to their customers and suppliers. That is, they benefit from demand and supply linkages. Offsetting these advantages is the fact that big markets are more crowded which increases product and factor market competition putting downward pressure on prices and upward pressure on wages.<sup>1</sup> The balance of these forces depends on the trade costs between different locations. At higher trade costs, the costs of serving distant customers are so large that they dominate the agglomeration forces and activity is dispersed. At intermediate trade costs, the opposite is true and agglomeration can occur, while at low trade costs, congestion costs are dominant and industry may once again disperse.

What do such models imply for the economic geography of the UK as it opens up to trade with Europe? One possibility is that regions that are close to new trading partners (i.e. “border” regions), benefit disproportionately from the improved market access that comes with accession. Hanson (1996, 1997, 1998) has used regional data from Mexico to test whether changing export market access helps explain the changing economic geography of Mexican regions. He argues that the formation of NAFTA acts as a natural experiment that disproportionately increases the export market access of regions in the north of the country close to the US border. His empirical work tests the prediction that this change should lead activity to relocate from Mexico City to the northern regions driving up employment and wages there. Both of these predictions hold true.<sup>2</sup>

The effect found by Hanson is not the only possibility when a country opens up to trade. While export market access and access to imported intermediate goods rises in border regions, so too does the degree of product market competition felt via imports. Hanson focuses only on export market access and thus argues that the employment share of border regions *must* rise. Once we allow for increased import competition, border regions may suffer if activity relocates from those border regions to other non-border regions. This happens because firms in non-border regions are partly protected from increased competition by the fact that imports incur higher transport costs to reach those regions. This line of reasoning has been formalised by Alonso-Villar (2001), Monfort and Nicolini (2000), Paluzie (2001) and Crozet and Koenig (2002). Brulhart and Koenig (2005) provide related empirical evidence for quite aggregate sectoral data (the 8 sectors of 1 digit NACE) for the CEEC countries.

When we turn to our empirical analysis we view ports as identifying the borders of the UK (i.e. the points through which imports enter and exports leave). We then construct variables that capture all three access effects. We expect activity to rise with better export market access and access to intermediate goods and to fall with increased import competition. The reduced form relationship we estimate is close to, but not exactly, that which could be derived from extending the formal models mentioned above to allow for multiple sectors. As data limitations prevent us from estimating a more structural equation, we see little to be gained from working through a more formal model. Instead, we motivate our approach on the basis of

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<sup>1</sup> In NEG models that rely on Dixit-Stiglitz production functions this is technically a market crowding effect and not a product market competition effect. See Ottaviano and Thisse (2003) for further discussion.

<sup>2</sup> Hanson’s results may also be influenced by the general, non-discriminatory, liberalisation in Mexico which Krugman and Livas (1996) argue should reduce the attractions of the metropolis – Mexico City – relative to other locations.



the informal reasoning and the intuitive predictions that we have drawn out above and refer the interested reader to the references given.

## 4. Data

### 4.1 Production data

Our basic unit of observation will be the employment of UK manufacturing establishments for the period 1970-1992 constructed using production data from the Annual Respondent Database (ARD).<sup>3</sup> The ARD is an extremely rich data set which contains information about all UK manufacturing establishments.<sup>4</sup> Griffith (1999) provides a detailed description of this data.

Establishments provide data on a range of variables, although the data available on any particular establishment in any given year depends on whether it was selected to make a detailed return that year. Selected establishments answer a detailed questionnaire providing data on a range of variables. In contrast data for non-selected establishments is much more basic. As a general rule all larger establishments with more than 100 employees are selected, as are a percentage of establishments with more than 20 but less than 100 employees. Establishments with less than 20 employees are usually exempt (non-selected). The precise rules vary year by year. Table A1 in the Appendix provides details of the sample selection criteria for all years between 1970 and 1992.

For our analysis we work with employment data, rather than wages, because we are confident that employment variables are constructed in a consistent way across time.<sup>5</sup> We then need to decide which of two possible variables to work with. One possibility is the estimate of employment that is used when deciding which establishments are selected to return a full questionnaire.<sup>6</sup> Somewhat confusingly, the ARD refers to this as selected employment. Selected employment should be recorded whether or not an establishment makes a full return (given that it forms the basis for deciding which establishments have to make such a return). Although this is true from 1980-1992, it is not so in the 1970's where employment has been collected, but (accidentally) deleted for non-selected establishments. As a result, we choose only to work with returned employment. For an establishment to be in our sample, we must have returned employment for at least two years during our sample period.<sup>7</sup> Given the sampling frame discussed above, this means that our sample will be composed of a disproportionate number of larger establishments. Below, we present robustness checks that show that this sample selection does not affect our results.

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<sup>3</sup> The availability of trade data restricts us to only study 1970-1992. We discuss this below.

<sup>4</sup> For legal reasons, we exclude Northern Ireland. The smallest unit of observation in the ARD is the local unit ('plants'). Local unit data is not available for the 1970s. In addition, allocating plants to the regions that we use, Travel To Work Areas (TTWA), would be a huge undertaking. Instead we use data for reporting units ('establishments'). Reporting units may consist of several local units. The calculation of access variables is problematic for reporting units with local units in different locations. Given the data problems discussed above, we proceed by assigning all employment to the reporting unit, ignoring redistribution across local units. If anything, this means that we understate the impact of accession if re-allocation across local units is affected in the same way as that across reporting units. Fortunately data from 1997 (when the ARD provides TTWA for local units) show this problem only affects a small percentage (3% in 1997) of reporting units because less than 10% of them have multiple local units and less than a third of these then have local units in different TTWAs. Reporting units may also be part of a larger enterprise group but we ignore any correlation for units that are part of the same group.

<sup>5</sup> In the terminology of Head and Mayer (2004a) we consider the quantity version of the market size and product competition effects rather than the price (or wage) version.

<sup>6</sup> This employment data is obtained from the various predecessors to the Inter Departmental Business Register and the data may have come from a return to another survey or an administrative source such as VAT or PAYE.

<sup>7</sup> We need at least two years to estimate firm specific fixed effects. We also only consider firms that do not change sector.

Given that our unit of observation will be employment by establishment, we need to be able to classify establishments by activity and location. All establishments are classified according to their main economic activity using the Standard Industrial Classification (SIC). During our sample period, the SIC changes from SIC 1968 revision (SIC68) to SIC 1980 revision (SIC80). A preliminary mapping from SIC80 to SIC68 was provided by the ONS and then supplemented using ARD data on individual establishments' sectoral classifications. For compatibility with the trade data, we then map from SIC68 to the Industry/Commodity group classification used in the 1974 IO table (IO sectors). IO sectors are basically defined as, or are aggregations of, 3-digit SIC68 sectors (minimum list headings). Details of the mappings from SIC80 to SIC68 to IO sectors are available from the authors on request. The list of the 80 IO sectors that we work with in the econometric section are given in table A2 of the Appendix.

Establishments can be located using a number of indicators. All establishments can be located in one of 10 UK regions. However, to analyse the impact of integration, we wanted to use a smaller geographical scale that would hopefully provide more cross-section and time series variation with which to identify the effects. After much experimentation, we constructed a consistent set of geographical units across our time period based on 307 UK Travel To Work Areas (TTWA 1998 revision). Allocating establishments to TTWAs is complicated because the location information provided in the ARD varies significantly over time. The three most important sources of location information are the establishment's local employment office, local authority and postcode. Local employment codes are provided at the start of our time period but not the end. The timing is reversed for postcode. Again, detailed information on how establishments are located is available on request.

One issue for estimation arises from the need to reconstruct establishment TTWA from a variety of location variables that are not perfectly nested: Sometimes, establishments close to the boundaries of TTWA may change TTWA even though the establishment has not relocated. Given this, we do not explicitly model establishment re-locations, instead assuming the same establishment level fixed effect independent of any relocation. For establishments that change TTWA due to the imperfect mapping of location variables to TTWA this introduces some noise in the measurement of the access variables, but should not affect results otherwise. Genuine moves should not affect our results either, unless they are driven by changes to establishment fixed effects that are systematically related to the choice of new location (and hence the measure of access variables). This seems unlikely. Similarly, although we allow for establishment births and deaths (i.e. the panel is unbalanced) we do not explicitly model the extent to which accession changed birth and death rates across TTWA.

## 4.2 The International trade data<sup>8</sup>

The main international trade data that underpin our analysis describe UK trade by port and commodity from 1970 to 1992.<sup>9</sup> The dataset was specially constructed from official sources for the present exercise and, to our knowledge, these sources have never been exploited before at this level of detail. They were supplemented by data for the same commodities and time period on the sources of imports and destination of exports, which reflect the re-orientation of UK trade following accession to the EEC.

Data on UK trade by port have been published in a variety of sources since 1970.<sup>10</sup> The source data contain three major omissions: export data for 1983, both export and import data for 1987, and export

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<sup>8</sup> Some of the material in this sub-section is taken from section 4 of Overman and Winters (2005).

<sup>9</sup> Data are not available by port for trade with the EU after 1992 because under the Single Market Programme these flows were treated as internal European trade and were recorded via VAT returns rather than by Customs and Excise at the port.

<sup>10</sup> The Annual Statement of Trade, Vol. V, (HM Customs and Excise), 1970-75; Statistics of Trade through United Kingdom Ports, (HM Customs and Excise), 1976-80; on micro fiche, 1981-87, and then electronically for 1988-92 via the commercial data suppliers, Business Trade Statistics Ltd.

data for HS chapters 84-99 for 1989-90. The structure of the data varies by publication and the classifications evolve from SITC(R) through SITC(2R) and (3R) to the Harmonised System (HS, 1988).<sup>11</sup> We have attempted to correct for these evolutions and to convert the data to a common classification. The latter process requires some approximation, usually based on the structure of UK total trade.

The most disaggregated continuous series that could be constructed was at the Division (2-digit) level of the SITC(R), which distinguishes 56 headings, of which we have to drop one (35, gas and electricity) and combine one pair into a single heading (33 and 52 which become entwined in the later classifications). At this level no volume or deflator data are available, so all data are in value terms. Given the high rates of inflation over much of the period this renders inter-temporal absolute comparisons meaningless, but for our purposes using ports' shares in total UK trade of a commodity is sufficient.

Over the period 1970-92 data are reported for about 120 ports at some point of time. However, the coverage changes through time and there is a fairly continuous process of re-combination of ports into local groups, as the geographical responsibilities of individual customs offices evolved. In most cases we solve these problems by aggregating ports into groups that are invariant over time, but there remain a number of minor inconsistencies.<sup>12</sup> We do not believe that we have introduced any major errors, however. Overall we are able to compile consistent data on 92 ports or local groups of ports over 1970-92.<sup>13</sup>

When we turn to the econometric specifications, it is sometimes useful to group ports into eleven groups, loosely based on those used by Chisholm (1992, 1995) in the only previous analysis we know of that considers the effects of accession on the geography of trade (but not production). The eleven groups, along with the acronyms that we use to refer to them, are defined in table A3 of the appendix. The grouping is more finely disaggregated around the South East, because we expect integration to affect those ports in particular.<sup>14</sup>

### 4.3 Mapping Trade Flows to Industries

The data on trade flows prior to 1977 are available only at Division (2-digit) level of the SITC(R). Thus all subsequent data were converted to this basis. To relate these data to manufacturing establishments we need to develop a concordance between SITC(R) and UK IO sectors. No such converters were published, so we had to proceed indirectly. Aki Kuwahara of UNCTAD kindly supplied us with a 'universal' concordance between eight classifications including the SITC(R) and the International SIC68 from which we generated a mapping from the approximately 1,200 basic SITC(R) 4- and 5-digit headings to 4-digit ISIC headings, of which there are one hundred of relevance for trade in goods.

This mapping was then matched to UK visible export data by SITC(R) collected from the UN Comtrade Database,<sup>15</sup> averaged over 1970-80. In about a dozen cases an SITC heading was mapped to more than one ISIC heading, in which case trade was divided evenly between those headings. In about three dozen

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<sup>11</sup> In addition to classifying goods differently, the classifications also have different coverage of goods. E.g. variations in the treatment of non-monetary gold, tax-free cars, and parcel post.

<sup>12</sup> E.g. Avonmouth was included in Bristol 1970-73, the two ports were separated for 1974-80 and after 1980 Bristol disappears as an explicit entry and we take it implicitly to be included in Avonmouth.

<sup>13</sup> The data have been subject to a number of consistency checks as they have been prepared, including checking against independent sources. Unfortunately a small number of implausibilities remain in the allocation of trade across ports. The most serious remaining mystery is the sharp changes in the share of exports of engineering goods (SITC(R)7) passing through Heathrow in 1991. We have been unable to explain this or to find a plausible way of adjusting the data.

<sup>14</sup> We separate London from THAKE and Felixstowe from HAVEA because the two named ports are major specialist deep-sea ports which may have different trading roles from their regional neighbours. We do not treat Southampton specially, because it entirely dominates its region, nor Liverpool, because we are less interested in the North-West region a priori.

<sup>15</sup> For which, thanks are due to Azita Amjadi of the World Bank.

cases an SITC heading had not been mapped to ISIC. Most of these were UN ‘special’ 4-digit codes ending in zero which are used when official statisticians cannot allocate trade across 4-digit headings but know its 3-digit category. Most of these actually recorded no trade for the UK, and so allocating them to ISIC did not matter, but this was not always the case. In addition, there were about half a dozen ‘genuine’ SITC heading that were unmapped. In these cases we created a mapping from the textual descriptions of the two classifications.<sup>16</sup>

The dataset resulting from these manipulations comprised about 1,200 rows each containing an ISIC heading, a SITC(R) heading and an export flow. This was then aggregated into SITC(R) 2-digit divisions and then into the ISIC headings to create a matrix of trade cross-classified by ISIC and SITC(R) sections. From this the converter matrix  $B^X$  was created by dividing entries by their column sums. Thus  $B^X$  reports how exports of an SITC section flow are derived from ISIC 4-digit headings. A corresponding matrix was created for imports,  $B^M$ , using UK imports data from the same source averaged over 1970-80.

Department of Industry (1980) defines UK Input-Output (IO) sectors in terms of the minimum list headings (MLH) of the UK’s SIC68. There are 91 sectors which potentially could produce tradable goods. CSO (1971) concords the MLHs with ISIC 4-digit categories, noting the many places in which the concordance is less than perfect. Most of these are small enough to ignore or are neutralised when MLHs are aggregated into IO-sectors. Thus the mapping normally maps the whole of an ISIC heading into a single IO-sector. However, thirteen major conflicts between ISIC and SIC are explicitly listed in the introduction to CSO(1971);<sup>17</sup> these were treated individually wherever possible, as were the 26 cases in which an ISIC heading is mapped to more than one IO-sector. In these cases, we reverted to the SITC(R) 4- and 5-digit trade data to divide the ISIC trade aggregate appropriately between IO-sectors, completing separate exercises for exports and imports. The resulting matrices,  $C^X$  and  $C^M$ , report how trade flows by ISIC heading may be allocated across IO-sectors. Once the classification matrices have been derived we apply them to the data on SITC(R) Division trade by port to create series of trade by port, IO sector and year, which we can marry with the establishment data.

## **5. Import competition, access to export markets and the changing economic geography of UK manufacturing**

In an earlier paper (Overman and Winters, 2005), we describe the way that accession re-orientated UK trade towards ports that were close to EEC member countries. Re-orientation did not occur uniformly across sectors. Some sectors showed particularly strong re-orientation while the effect in others was weaker or even went in the opposite direction. In this paper, we use this cross-sector variation to examine whether accession helps to explain changes to the economic geography of UK manufacturing. The hypotheses that we investigate are (i) accession re-oriented UK trade by country of origin/destination and that this caused a re-orientation in terms of the ports used for that trade; (ii) that this changed the degree of import competition, and the ease of access to intermediate goods and export markets faced by establishments in different TTWAs; (iii) these changes in turn affected the economic geography of manufacturing. We proceed in several stages. First, in this section, we describe how we calculate import competition, access to intermediate goods and export market access for TTWAs. We then show that changes in these measures are correlated with changes in establishment employment in a way that is consistent with theory. In the following two sections, we then consider issues of causality.

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<sup>16</sup> Finally, two SITC headings were mapped to a ‘false’ ISIC heading, 9999; that is, for these headings there is no corresponding ISIC heading at all. This ‘false’ heading was treated symmetrically with genuine ISIC headings.

<sup>17</sup> This is in addition to a general note about the different treatment of repair work in the two classifications, which we cannot make allowance for.

Our dependent variable is establishment employment. We know the industrial sector of the establishment and in which TTWA they are located for the time that the establishment exists during the period 1970-1992.<sup>18</sup> We want to explain the evolution in establishment employment in terms of import competition, access to intermediate goods and export markets. We start by using the port trade data to construct proxies for these three access variables.

Although we have trade data by ports, we do not have information on the UK origin of exports and the UK destination of imports. One possibility is to assume that imports and exports occur only through the closest port. That is, assume that ports have well defined ‘hinterlands’ and ‘forelands’. Evidence presented in Hoare (1977, 1985, 1986, 1988) and Chisholm (1992) argues against this. Chisholm reports Hoare’s results as showing that “if we take the standard region as the geographical unit of analysis, then in 1964, the tonnage of [firm] exports routed through a port in the same standard region accounted for 63% of the total; by 1978 the proportion had fallen to 48%” [Chisholm 1992, p563]. Chisholm’s results suggest that “the rapid reduction in the strength of local linkages seems to have abated in the period 1978-86” [Chisholm 1992, p563]. Given that on average establishments are not only linked to their closest port we instead assume that distance from *all* ports and the volume of trade through those ports are the key determinants of the access variables. Thus, we assume that establishments in TTWAs that are close to ports with large amounts of imports face more import competition than those in TTWAs a long way from these ports. Similarly for intermediate goods and export market access.

It is important to note that such a formulation is consistent with NEG theory where love of variety means that consumers purchase all varieties of differentiated manufactured goods, while establishments supply their differentiated goods to all markets. Given that different ports tend to trade with different foreign markets (something we consider empirically below), the idea that distance to all ports matters is consistent with the underlying theory.

Using this assumption, we construct a measure of import competition faced by an establishment in a given sector located in a given TTWA as:

$$IMP_{jlt} = \sum_p \frac{m_{jpt}}{d_{lp}}$$

where  $m_{jpt}$  is the share of imports for sector  $j$  coming in through port  $p$  at time  $t$  and  $d_{lp}$  is the distance in kilometres between port  $p$  and TTWA  $l$ . To implement this equation, we map trade flows to IO sectors as described in section 4.3. Distances are calculated as straight line distances using data on the eastings and northings of the port and the centre of the TTWA. For the moment, we weight port trade flows by the simple inverse of distance, but we discuss other alternatives in section 7.2 below.

We calculate export market access equivalently:

$$EXP_{jlt} = \sum_p \frac{x_{jpt}}{d_{lp}}$$

using the share of exports ( $x_{jpt}$ ) that leave the UK through each port. To calculate intermediate market access we weight the imports in different sectors coming in at each port by industries use of that sectors good in production. That is, our measure of intermediate good market access is:

$$INT_{jlt} = \sum_k \sum_p \frac{a_{jk} m_{kpt}}{d_{lp}}$$

where  $a_{jk}$  is industry  $j$ ’s use of intermediate  $k$ .<sup>19</sup>

<sup>18</sup> As discussed in the data section, we only consider firms that do not change TTWA or IO sector during the life of the firm.

<sup>19</sup> Industry  $j$ ’s use of intermediate  $k$  is taken from Department of Industry (1980).

Using these measures of import competition, intermediate good and export market access, we run the following regression for each sector for the panel of employment by establishment.

$$\ln(e_{it}) = \beta_{0j} + \beta_{1j} \ln(IMP_{jlt}) + \beta_{2j} \ln(EXP_{jlt}) + \beta_{3j} \ln(INT_{jlt}) + c_i + \varepsilon_{it}$$

where  $e_{it}$  is employment in establishment  $i$ ,  $c_i$  is an establishment specific fixed effect,  $\varepsilon_{it}$  is an idiosyncratic shock;  $IMP_{jlt}$  is the measure of import competition for sector  $j$  (the main economic activity of establishment  $i$ ) in TTWA  $l$  (where establishment  $i$  is located) at time  $t$ , with intermediate good and export market access defined similarly. The betas are coefficients to be estimated. We estimate the specification by sector (so that coefficients vary across sector) using data from 1970 to 1992. We exclude data from 1983 (no export data) and 1987 (no export or import data). We include, but do not report results for, a set of year dummies. Theory predicts a negative coefficient on import competition ( $\beta_{1i} < 0$ ), and positive coefficients on intermediate good and export market access ( $\beta_{2i} > 0$  and  $\beta_{3i} > 0$ ).

A few comments are in order. First, we observe no additional information at the establishment level so all we can do is use the panel dimension of our data to control for the unobserved establishment specific fixed effect. Second, the only explanatory variables we can measure at the TTWA level over this period are the access variables included in the specification. Third, the flow of trade through different ports may be partly driven by changes in the spatial distribution of UK manufacturing. To control for these problems we will present instrumental variable results in section 7, once we have considered the extent to which the direction of trade determines the port composition. Instrumenting controls for the problem of the endogeneity of the included TTWA variables. Providing that other TTWA level or establishment level variables are uncorrelated with the country re-orientation of trade (which seems reasonable) this should also control for other omitted variables that might be correlated with the access variables.

For the moment, table 3 reports results from estimating the specification using the within estimator, ignoring these three problems.<sup>20</sup> We get the clearest results on export market access. 21 coefficients are positive and significant at the 5% level or higher, with only 10 negative and significant and the rest insignificant. Results on import competition and intermediate good access are more mixed. For import competition, 16 coefficients are negative and significant in line with theory, while 13 are significantly positive. For intermediate access, 16 coefficients are positive, in line with theory with 12 negative. Part of the problem here is that the diagonal coefficients on the input output table are often large at the two digit level so these two variables are quite highly correlated. On balance, we would argue that our initial results are more with the theory than against it, but we postpone further discussion until we have dealt with the three problems highlighted above. This is the issue to which we now turn using the fact that UK accession acts as a natural experiment which changes the direction of trade independent of changes to UK economic geography and thus provides a way to construct a variable to instrument the economic geography variables. Details of how we construct the instrument are given in section 6, while section 7 considers results when we use these instruments in our basic panel specification.

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<sup>20</sup> There are insufficient observations for sector 61 (other vehicles). No industry is classified in sector 74 (textile finishing). It is not clear why this is the case, but this is true in the raw data and is not a result of our processing of the data.

**Table 3: Estimates of effect of economic geography variables on establishment employment**

IO	IMP	EXP	INT	N	IO	IMP	EXP	INT	N
10	-0.18	0.36	-0.14	40	50	0.31	-0.19	0.06	215
11	0.49*	0.15**	-0.55**	130	51	-0.20**	0.14*	0.10	926
12	-0.20*	0.02	0.17*	149	52	16.04**	1.73**	-18.06**	223
13	0.03	0.03	-0.06	1258	53	0.61**	0.06	-0.70**	308
14	-0.71**	0.09	0.72**	1031	54	-0.72**	0.21*	0.67**	529
15	-0.09	0.04	0.16	512	55	-0.11	0.04	0.12	252
16	-4.33	0.30**	4.23	39	56	0.00	0.12	-0.07	746
17	-0.01	-0.13**	0.02	215	57	-0.18**	0.31**	-0.04	825
18	-0.01	-0.12**	0.23**	375	58	0.13	-0.03	0.32	59
19	-0.01	-0.04	0.10	121	59	0.00	-0.13**	0.06	1529
20	0.34**	0.06	-0.31**	798	60	-0.01	0.08	-0.03	579
21	0.00	0.09	0.07	326	62	-0.04	0.04	0.00	1083
22	0.04	-0.10**	0.22**	337	63	-0.40	0.18*	0.26	492
23	0.50**	-0.18*	-0.35**	32	64	-0.53**	0.25*	0.42**	321
24	0.03	0.12**	0.04	609	65	0.03	0.02	0.06	348
25	-0.08	0.10	0.04	290	66	0.26*	-0.23*	0.13	138
26	0.09	-0.08	-0.08	161	67	0.06*	0.03	-0.05*	4840
27	0.02	0.01	0.01	213	68	0.00	0.09	-0.16	56
28	-0.38**	0.45**	0.27*	111	69	-0.76**	0.01	1.02**	713
29	0.12	-0.27**	0.21**	422	70	0.08	0.05	-0.21*	808
30	-0.25	-0.01	0.11	75	71	0.40	0.20*	-0.36	1030
31	-0.07	0.19	-0.04	67	72	0.50*	-0.08	-0.62**	166
32	-0.09	0.09	0.03	434	73	0.13	-0.19	-0.10	275
33	0.10*	0.12*	-0.07	673	75	-0.33*	-0.31*	0.58**	165
34	0.07	0.03	0.00	751	76	0.03	0.04	-0.02	733
35	-0.35	0.00	0.64*	418	77	0.11**	0.00	-0.13**	3918
36	0.04	0.16**	-0.07	492	78	0.13*	-0.02	-0.01	535
37	0.45*	0.01	0.03	229	79	-0.12	0.20**	-0.10	437
38	0.02	-0.11	0.17	628	80	-0.13*	0.13*	0.13	679
39	-0.10*	0.04	0.09*	591	81	-0.01	-0.17	-0.27	31
40	-0.75**	0.14	0.85**	97	82	-0.04	-0.01	0.11**	1353
41	-0.22	0.53**	-0.23	244	83	-0.06	0.09*	0.07**	1650
42	0.02	-0.11*	0.08	877	84	0.50	-0.02	-0.46	3220
43	0.97	0.10	-1.27	102	85	0.65	0.22**	-0.82	324
44	-0.09**	0.01	0.05	2269	86	-0.13	0.04	0.12	843
45	-0.10**	0.24**	-0.08*	1770	87	-0.08	0.02	0.02	830
46	0.01	-0.05	0.09**	2347	88	0.04	-0.09**	0.00	4979
47	-0.19**	0.20**	0.04	1655	89	0.00	0.07	0.00	535
48	0.04	0.00	-0.11**	941	90	-0.07	-0.02	0.03	2155
49	-0.30*	0.80**	-0.16**	171	91	0.10*	-0.12	-0.01	1323

Notes: The dependent variable is returned employment at the establishment level. IO gives the IO sector number, see table A2 in the appendix for sector names. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs. N gives the number of unique establishments used to calculate the within estimator. \* denotes significant at 5%, \*\* significant at 1%. All specifications include establishment fixed effects and time dummies. Data is for 1970-1992 (excluding 1983 and 1987). Source: Authors own calculations using ARD data and trade data described in Section 4.

## 6. Explaining the Port-Composition of UK Trade

Our basic hypothesis assumes that the direction of trade partly determines the port-composition of trade and that the direction of trade is exogenously shifted by UK accession. This section considers this hypothesis, first for the sake of its intrinsic interest, but second in order to use the direction of trade as an instrument for the port-composition in our estimating equation. We are not arguing that direction is the only factor behind the port-composition of trade. Clearly factors such as port-facilities, internal transportation links and traditional shipping lines also matter. However, even the most casual reflection on shipping routes suggests the likelihood of some link – for example, roll-on, roll-off ferries for France leave mainly from South-East England, while those for Ireland leave from equivalent facilities in Wales, North-West England and West Scotland.

We explore the substantive question using data for 11 port-regions and 54 commodities.<sup>21</sup> The hypothesis concerns the ‘behaviour’ of ports and hence we treat ports as the basic observational units and estimate, for each, a panel of 54 commodities with 21 years of data for exports and 22 for imports. We are interested in the shares of each commodity entering/leaving via specific ports which is convenient, since by converting everything to shares we avoid the need to allow for inflation.

The basic equation is:

$$S_{pgt} = \sum_d^D b_{pd} T_{gdt}$$

where subscripts are  $p$  for port group,  $g$  for commodity,  $t$  for time and  $d$  ( $d=1, \dots, D$ ) for destination of exports (or source for imports).  $S$  is the share of the port group  $p$  in total trade in good  $g$  in year  $t$ , and  $T$  the share of destination  $d$  in that trade. Because the shares sum to unity over  $d$  (i.e.  $\sum_d T_{gdt} = 1$ , all  $g$  and  $t$ ), the equation is rewritten in the form:

$$S_{pgt} = \sum_d^{D-1} b_{pd} (T_{gdt} - T_{gDt}) + b_{gD}$$

where  $D$  refers to the  $D^{\text{th}}$  destination. Further, because the shares all sum to unity over ports ( $\sum_p S_{pgt} = 1$ , all  $g$  and  $t$ ), the  $b_{gd}$  sum to zero over  $p$  and the  $b_{gD}$  to unity. Provided that all equations contain the same regressors and no observations are omitted, these conditions are automatically satisfied by linear regressions run on each port separately. In addition we include a time trend in the equations to capture slowly evolving factors affecting ports (allowed to vary over port-regions and over commodities), and a dummy variable taking the value of unity from 1980 onwards to represent the abolition of the National Docks Labour Scheme. This highly restrictive labour agreement applied in around half of UK ports, and is widely regarded as having curtailed their productivity and growth relative to non-Scheme ports. The coefficients of these variables also sum to zero over port groups.

We are interested in trade with Western Europe as a factor in UK economic geography, and also note that for very distant partners (e.g. China) the choice of UK port is likely to depend very little, if at all, on its closeness to that partner. Hence given the likely difficulties of identifying very many country effects, we distinguish the following countries, or groups of countries as sources for imports and markets for exports: France; Germany; Benelux ;Scandinavia; Italy; Austria and Switzerland; Other Western Europe, and Rest of the World (which is the omitted category,  $D$ , in the estimating equation above.)<sup>22</sup> Given that our

<sup>21</sup> Given that we do not have a full model of the port composition of trade we do not try to explain the small number of zero-flows for regions. Rather we take them as data, omitting them from the sample, and omitting all observations for a region-commodity pair if it can muster fewer than five observations exceeding 0.000001 over the sample period.

<sup>22</sup> Trade data aim to identify the ultimate destination of exports and the actual producer of imports rather than country to or from which they are immediately transported. Thus some trade recorded as bound to or from a country may actually travel via European entrepôts, (e.g. Rotterdam or Antwerp) and hence all trade may have a bias towards South-East ports. This could



sample ends in 1992, trade with the Soviet bloc was very small so we do not break it out separately. Thus our working hypothesis is that while Europe is sufficiently close to the UK that it could be of material importance which UK ports were used for trading with it, the rest of the world is sufficiently distant that port choice will hardly be influenced by the geographical composition of trade within the bloc.

Table 4 presents two sets of results for exports and imports of manufactures (SITC 5 – 8).<sup>23</sup> For each port group we report the coefficients of interest, the probability levels for Wald tests of the null hypothesis that the country breakdown explains none of the port-composition of trade, the within-R<sup>2</sup> for the panels (across commodities) and the sample size. The time trend terms are frequently statistically significant individually and always strongly so collectively. The fit is mostly quite high and the direction of trade variables are often highly significant although not always entirely in line with our maintained hypothesis about the European bias of the Southern and Eastern ports. This is not surprising given the complexity of logistical optimisation. Nonetheless, the overall results are quite strongly supportive of the model.

The results are reported with the ports ordered according to the extent to which we expect the port to be tied to European trade.<sup>24</sup> The constant, also labelled RW to remind us of its role as the comparator region (D) in the equation, is difficult to interpret because the RW data also appears in all the other independent data. The remaining country coefficients describe the effects on a port-region's share of exports of a commodity of an increase in the share of that country accompanied by an equal fall in the share of the RW in exports of the commodity.

Starting at the far right of table 4, it is plain that the Thames and Kent region is strongly, positively influenced by trade with France. Germany is important for exports, not imports (vice-versa for Italy) Correspondingly, it has a bias against trade with Scandinavia and Other Western Europe. London, in contrast, shows much less dependence on neighbouring European markets, presumably reflecting its traditions as a national deep-sea port. It has a strong trend decline in importance (not reported in the table) even allowing for its 'unfavourable' country profile. Haven/East Anglia shows less response to French, German and Italian trade and more to Scandinavian trade (i.e. its focus is more north-easterly, like its location). Felixstowe, which is reputedly more international than the rest of its region, nonetheless shows strong connections to Scandinavia.

Moving south-westwards, Sussex and Hampshire shows positive effects for France and Belgium. For the South-South West and Cornwall, North East and East Scotland, results are somewhat mixed. The rest of ports region – the whole of Britain's west coast – shows the predicted (relative) negative dependence on North West European trade (with surprise positives for Benelux manufactured trade) and positive effects from Other Western Europe and the Rest of the World. Air transportation may also experience some of the geographical influences we postulate and the results of the combined tests on direction suggest that this is so. However, the individual coefficients do not lend themselves to easy interpretation.

This discussion leaves the strong impression that the country-composition of trade does have a role in explaining its port composition. The degrees of explanation are quite high, given the simplicity of the model, and the statistical tests quite clear in their inference. It is also notable that, as predicted, the precision with which the effects can be identified declines as we move away from the South East. We do not advance these results as a comprehensive theory of port-use, but they are quite sufficient to suggest the plausibility of our hypothesis and the use of country-composition as instruments for port composition.

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slightly distort our estimates but does not overturn the basic idea that as trade with Western Europe increases, ports in the South and East are likely to benefit most.

<sup>23</sup> Results for primary exports and imports (SITC 0 – 4) are available on request.

<sup>24</sup> Thus the first column refers to 'other airports', which are scattered about the country, the second to the London airports (Heathrow, Gatwick and Southend) and the remainder to sea ports roughly in order of increasing proximity to Western Europe.

**Table 4: The Port Composition of Trade given the Country Composition**

MANUFACTURED EXPORTS											
	AIROT	AIRLO	RESTP	ESCOT	NEHUM	SSWCO	SUHAM	FELIX	HAVEA	LONDN	THAKE
Dock Labour	-0.01**	0.01	-0.01*	0.00	0.01**	0.00	-0.03**	0.01**	0.01**	0.02**	-0.01**
France	-0.11**	0.10	-0.42**	-0.04**	0.38**	0.04	0.02	-0.04	0.00	-0.29**	0.36**
Germany	0.04	0.09	-0.14	-0.03	-0.03	0.03	-0.05	-0.12**	0.04	-0.17	0.34**
Benelux	-0.03	-0.29**	0.25**	0.04**	0.01	0.04*	-0.05	-0.01	-0.05	0.09	0.01
Italy	-0.14*	0.46**	0.12	0.03	-0.23*	-0.13**	0.01	-0.17*	-0.01	0.05	0.01
Scandinavia	0.09**	0.04	-0.29**	0.02	0.07	0.06*	0.03	0.21**	0.09	-0.04	-0.27**
Oth. W. Eur.	0.10	-1.08**	0.59**	-0.01	0.00	-0.05	0.06	-0.07	0.06	0.83**	-0.43**
Austria/Switz	0.02	0.69**	-0.12**	-0.01	-0.10**	0.01	-0.03	0.02	-0.08**	-0.45**	0.04
Constant RW	0.01	0.17**	0.19**	0.01**	0.15**	0.01	0.08**	0.01	0.09**	0.12**	0.18**
R <sup>2</sup> (within)	0.28	0.59	0.81	0.50	0.51	0.49	0.41	0.82	0.59	0.81	0.91
p(direcn = 0)	0.00	0.00	0.00	0.01	0.00	0.01	0.12	0.00	0.00	0.00	0.00
N	564	567	567	567	567	554	567	567	567	567	567
MANUFACTURED IMPORTS											
	AIROT	AIRLO	RESTP	ESCOT	NEHUM	SSWCO	SUHAM	FELIX	HAVEA	LONDN	THAKE
Dock Labour	-0.01**	-0.01	-0.01	0.00	0.01**	0.01**	-0.04**	0.02**	0.01**	0.01*	0.01
France	-0.09**	-0.05	-0.19**	-0.05	0.04	-0.02	0.28**	-0.16**	0.17**	-0.22**	0.30**
Germany	0.00	-0.16**	-0.06	0.02	0.04	-0.01	0.03	0.00	-0.05	0.12*	0.06
Benelux	0.01	-0.11	0.15**	-0.09**	-0.09**	-0.03	0.12**	0.00	0.04	-0.08	0.08
Italy	-0.03	0.02	-0.13*	0.02	-0.09*	0.18**	-0.13	-0.09	-0.21	-0.12	0.58**
Scandinavia	0.00	-0.42**	0.03	-0.06*	0.09**	-0.05**	-0.09	0.26**	0.28**	0.28**	-0.31**
Oth. W. Eur.	0.10*	-0.03	0.14	0.02	-0.07	-0.01	0.01	0.04	-0.01	0.07	-0.27**
Austria/Switz	0.01	0.82**	-0.03	0.08**	0.05	-0.02	-0.19**	-0.09*	-0.12**	-0.18**	-0.34**
Constant RW	0.05**	0.18**	0.09**	0.00	0.10**	0.03**	0.10**	0.09**	0.12**	0.04**	0.20**
R <sup>2</sup> (within)	0.32	0.59	0.80	0.54	0.49	0.52	0.27	0.68	0.65	0.68	0.86
p(direcn = 0)	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	591	593	594	594	594	593	594	594	594	594	594

Notes: Coefficients from regression of port regions shares on dummy for Dock Labour Scheme, country shares and time dummies (not reported); \* denotes significant at 5%, \*\* significant at 1%. R<sup>2</sup> (within) reports the within R-squared. p(direcn = 0) reports the probability levels for Wald tests of the null hypothesis that the country breakdown explains none of the port-composition of trade. N reports the sample size. Source: Authors own calculations using trade data described in Section 4.

Given this, we estimate the same model on the individual port data in order to generate instrumental estimates of exports and imports. The port data are noisier and subject to many more zeros and small values. For some ports we have too few observations to estimate a panel at all and for many we have to omit some commodities. As before, we take the zeros as exogenous to the country-composition of trade and estimate only on share observations exceeding 0.000001 (1/10,000<sup>th</sup> of a percent) where there are at least five of them for a particular port/commodity combination over the sample. Some of the predicted values from these equations, the instrumental estimates, are negative, but they are very small and correspond to very small flows in the data. Thus, we carry them forward to the next stage. Before being used as instruments, the estimates are put through the SITC-IO converter, and many of them are absorbed into other positive values at this stage. Then, before use, the results by port are combined with distance data to calculate the distances of the TTWAs from the mean bundle of imports or exports, and at this stage they are entirely dominated by the larger positive values for the larger ports. From the results it is clear that the estimates for the larger individual ports are well defined and plausible (as for the regional data) so all told we do not believe that the negative predictions play any material role in the final results.

## 7. The UK's accession to the EEC and the changing economic geography of UK manufacturing

### 7.1 Instrumental variable results

To construct our instruments, we simply replace actual port trade shares with predicted port trade shares when calculating our measures of import competition, intermediate good and export market access. Table 5 presents results when we instrument all three access variables using these measures based on predicted shares and all other exogenous variables as instruments. Table 6 summarises these results in the row marked “core results”. It also provides, for comparison, results when we do not instrument as well as results for a number of robustness checks to which we will shortly turn.

The instrumental variable results are actually more supportive of the theoretical priors. Once again, let us start by considering the coefficient on instrumented export market access. 24 coefficients are positive and significant at the 5% level, 11 are negative significant (compared to 21 positive and 10 negative without instrumenting). For import competition, 22 coefficients are now negative significant, in line with theory and only 9 positive significant (compared to 16 negative, 13 positive before instrumenting). Finally, for intermediate good access, 20 coefficients are now positive significant, in line with theory, while only 9 are negative (compared to 16 positive, 12 negative before instrumenting).

### 7.2 Robustness checks

Before discussing our results further, we report a range of robustness checks. As the number of tables of estimated coefficients soon becomes overwhelming, table 6 reports results comparing the number of positive and negative coefficients that are significant, while the detailed tables are relegated to the appendix.

The results in table 5 are based on reported (or “returned”) employment. As discussed in the data section this is only available if a establishment has been selected in a given year and so the sample tends to favour larger establishments. When an establishment is not selected, we only have estimated (or “selected”) employment that is used to decide whether a establishment has to make a return. Using both selected and returned employment significantly increases the number of firms (particularly small firms) that we are able to use to identify the effects but as table A4 and the third row of table 6 show, this does not change the core results.<sup>25</sup> Given this, and the fact that we have no selected employment in the 1970's, we continue to restrict our attention to the set of firms for which we have returned (i.e. actual) rather than selected (i.e. estimated) employment.

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<sup>25</sup> To be precise, we know set establishment employment equal to returned employment when that is available and selected employment otherwise.

**Table 5: Instrumental variable estimates of effect of economic geography variables on establishment employment**

IO	IMP	EXP	INT	N	IO	IMP	EXP	INT	N
10	-0.18	-0.25	0.41	40	50	0.26	-0.33	0.27	215
11	-1.76*	-0.45*	2.43**	130	51	-0.54**	0.25*	0.29**	926
12	-0.27	-0.05	0.31**	149	52	17.42**	1.72**	-19.45**	223
13	0.05	0.00	-0.05	1258	53	0.60	0.37	-0.99	308
14	-0.66*	0.12	0.65*	1030	54	-0.74**	0.27*	0.64	529
15	-0.15	0.23*	0.08	512	55	-0.25*	0.33*	-0.07	252
16	3.29	0.56**	-3.84	39	56	0.00	0.09	-0.03	746
17	0.08	-0.25**	0.04	215	57	-0.50**	0.67**	-0.17	825
18	-0.04	-0.19*	0.32**	375	58	-0.09	-0.12	1.61**	59
19	0.04	0.12	-0.09	121	59	0.06	-0.42**	0.35**	1529
20	-0.17	0.48**	-0.24*	798	60	-0.36	0.04	0.33	579
21	0.13	0.03	0.01	326	62	-0.08	0.16	-0.09	1083
22	-0.11	-0.07	0.27**	337	63	-0.23	0.62**	-0.37	492
23	0.66**	-0.19*	-0.69**	32	64	-0.97**	0.35	0.84**	321
24	-0.12	0.18**	0.15	609	65	0.08	-0.15	0.23*	348
25	-0.06	0.04	0.10	290	66	0.44*	-0.42*	0.37**	138
26	0.06	-0.07	-0.07	161	67	0.07	0.11*	-0.16**	4840
27	-0.25	-0.03	0.21	213	68	-0.05	0.16	-0.22	56
28	-0.50**	0.48**	0.38*	111	69	-1.50**	-0.23	2.03**	713
29	-0.04	-0.24**	0.37**	422	70	0.44	-0.46	-0.16	808
30	-0.59	0.18	0.14	75	71	0.28	-0.30	0.25	1030
31	-0.06	0.08	0.09	67	72	0.41	-0.53	-0.15	166
32	0.03	-0.06	0.09	434	73	0.86*	-0.50*	-0.53	275
33	0.36**	-0.06	-0.09	673	75	-0.61*	-0.45*	1.00**	165
34	-0.07	0.25**	-0.09	751	76	0.02	0.02	0.01	733
35	0.06	-0.14	0.34	418	77	0.13**	0.02	-0.19**	3918
36	0.10	0.26*	-0.18	492	78	0.22**	-0.12*	0.02	535
37	0.14	0.30	-0.08	229	79	-0.04	0.32*	-0.25	437
38	-0.05	-0.09	0.23	628	80	-0.26**	0.25*	0.16	679
39	-0.22**	0.06	0.18*	591	81	-0.17	-0.19	-0.15	31
40	-0.69**	0.46	0.52	97	82	-0.04	-0.01	0.13**	1353
41	-1.67*	1.27**	0.15	244	83	-0.22**	0.26**	0.06	1650
42	0.01	-0.04	0.01	877	84	1.81**	0.06	-1.85**	3220
43	-0.51	-0.77	1.06	102	85	1.43	0.46**	-1.82*	324
44	-0.14**	-0.11	0.21**	2269	86	-0.55*	0.13*	0.47*	843
45	-0.31**	0.61**	-0.30**	1770	87	0.01	0.01	-0.06	830
46	-0.03	-0.20**	0.28**	2347	88	0.01	-0.06	0.00	4979
47	-0.23**	0.36**	-0.08	1655	89	-0.04	0.21*	-0.09	535
48	-0.20*	0.08	-0.03	941	90	-0.12*	0.06	-0.03	2155
49	-0.42*	1.04**	-0.30**	171	91	0.22*	-0.22	-0.02	1323

Notes: The dependent variable is returned employment at the establishment level. IO gives the IO sector number, see table A2 in the appendix for sector names. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs. N gives the number of unique establishments used to calculate the within estimator. \* denotes significant at 5%, \*\* significant at 1%. All specifications include establishment fixed effects and time dummies. Data is for 1970-1992 (excluding 1983 and 1987).

Source: Authors own calculations using ARD data and trade data described in Section 4.

**Table 6: Comparison of results from various specifications**

	Sign	IMP	EXP	INT	No. IO
Core results (not instrumented)	+	13	<b>21</b>	<b>16</b>	80
	-	<b>16</b>	10	12	
Core results (instrumented)	+	9	<b>24</b>	<b>20</b>	80
	-	<b>22</b>	11	9	
Selected and returned employment	+	13	<b>28</b>	<b>21</b>	80
	-	<b>24</b>	12	15	
Distance decay ( $\rho$ )=0.5	+	8	<b>24</b>	<b>24</b>	80
	-	<b>25</b>	9	11	
Distance decay ( $\rho$ )=1.5	+	7	<b>21</b>	<b>18</b>	80
	-	<b>16</b>	8	12	
INT defined ignoring own intermediates	+	10	<b>25</b>	<b>21</b>	80
	-	<b>25</b>	13	9	
Heteroscedastic robust errors	+	8	<b>18</b>	<b>17</b>	80
	-	<b>18</b>	6	9	
Clustered errors	+	1	<b>8</b>	<b>6</b>	76
	-	<b>3</b>	3	3	
First differencing	+	3	<b>7</b>	<b>5</b>	80
	-	<b>9</b>	4	3	
Long differences	+	2	<b>9</b>	<b>5</b>	77
	-	<b>9</b>	0	2	

Notes: The table reports the number of significant coefficients that are positive or negative in each of a variety of specifications. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs. No. IO reports the number of sectors for which the specification has been run (we drop sectors with less than 10 unique observations) Bold text highlights the coefficients that are consistent with theory (negative for IMP; positive for EXP and INT).

The next variation that we consider is to allow for different distance decay effects when constructing our measures of import competition, export market and intermediate good access. To see what this entails, redefine import competition for sector  $j$  in TTWA  $l$  as

$$IMP_{jlt} = \sum_p \frac{m_{jpt}}{(d_{lp})^\rho}$$

where, as before,  $m_{jpt}$  is the share of imports for sector  $j$  coming in through port  $p$  at time  $t$  and  $d_{lp}$  is the distance in kilometres between port  $p$  and TTWA  $l$ . The coefficient  $\rho$  now allows us to vary the distance decay effect: the higher  $\rho$  the more import competition declines with distance from the port where the imports enter. The other two geography variables can be defined similarly. Ideally, we would like to be able to estimate the coefficient on distance using our data, but computational considerations make this infeasible.<sup>26</sup> Instead, we have experimented with two different values ( $\rho=0.5$  and  $\rho=1.5$ ) chosen after consulting Head and Disdier (2005) which provides a meta-analysis of results on the distance decay coefficient in the standard gravity model.<sup>27</sup> Detailed results are reported in tables A5 and A6 while, again, table 6 provides a summary. Results with a distance decay parameter of 0.5 are, if anything, a little stronger. Those with  $\rho$  set equal to 1.5 are a little weaker, particularly for import competition and intermediate goods access. This is not particularly surprising, as  $\rho=1.5$  is a fairly strong distance decay and gives much less time series variation from which to estimate the effects. Separating out the effects of

<sup>26</sup> For 81 sectors, with 93 ports and 287 TTWAs each iteration requires a minimum of  $3 \times 2,161,971$  calculations.

<sup>27</sup> In particular, examination of figure 1 suggests that these values are at roughly two standard deviations below and above the mean estimate.

import competition from intermediate good market access then becomes more difficult because large diagonal elements on the input-output matrix mean that these two variables can be quite highly correlated.<sup>28</sup>

The existence of large diagonal elements in the input-output matrix suggests that we might be able to get stronger results if ignore own intermediate inputs when defining our measure of intermediate good access. In other words, we could re-define intermediate good market access as:

$$INT_{jlt} = \sum_{k \neq j} \sum_p \frac{a_{jk} m_{kp}}{d_{lp}}$$

where, as before,  $a_{jk}$  is industry  $j$ 's use of intermediate  $k$ . Of course, this now means that the sign on the import competition variable could theoretically be positive if access to own intermediate goods is sufficiently important so as to outweigh the competition effect. This seems unlikely a priori, and the results reported in table A7 and summarised in table 6 show that the effect of the import competition variable is much as before. In fact, this redefinition of intermediate input access does little to change the results and so we pursue it no further.

Two final issues before we turn to the interpretation of our core results. First, we examine what happens if we allow for a more general error structure on the idiosyncratic errors. Results reported in table A8 and summarised in table 6, show that little changes if we allow for arbitrary heteroscedasticity at the establishment level. Even more general, we could allow for the idiosyncratic errors of establishments in the same TTWA to be arbitrarily correlated. This is problematic in our context because, as discussed in section 4, the way that we locate establishments means that they may shift around neighbouring TTWAs, while clustering the errors in the fixed effect regression requires us to restrict individual establishments to belong to only one cluster.<sup>29</sup> We could restrict attention to establishments that are only ever recorded in one TTWA, but this makes sample sizes too small in a number of industries (particularly as we also lose observations when only one establishment is present in a particular TTWA). Instead, to get some feeling for whether the pattern of results persists after clustering the errors we cluster establishments by their mode TTWA.<sup>30</sup> Given these sample size problems, we take the results reported in table A9 and summarised in table 6 as encouraging. Unsurprisingly we lose a few sectors and get less significant coefficients overall but the ratio of numbers of coefficients consistent with theory to those inconsistent with theory is almost identical to those of our core results. Given the smaller sample sizes and the conservative error structure one is tempted to look at coefficients that are significant at the 10% level in addition to 5% and above. This does not do much for the results on import competition and intermediate good access (we now find 6 import coefficients negative to 3 positive; 6 intermediate access coefficients positive to 4 negative). Results on export access are strengthened, however, with 12 coefficients now positive and 3 negative as before.

As a final robustness check, we try an alternative estimation strategy switching from fixed effects estimation to time differencing. First differencing to remove the unobserved establishment specific effect results in significantly smaller sample sizes because we need establishments to report employment in at least two consecutive periods. Aside from the sampling frame, this condition has additional bite because we are missing two years of export data and one year of import data. On average, as table A10 shows, the instrumented first difference results are based on sample sizes that are 25% smaller than those presented in table 5 so, not unsurprisingly, we get less significant coefficients. However, as with other robustness checks, the overall pattern of the significant coefficients is roughly unchanged as table 6 shows. Again,

<sup>28</sup> On a couple of occasions large coefficients on import competition are matched by equally large coefficients of opposite sign on intermediate good access suggesting this is a particular problem for that sector. See, e.g., sector 52 in table 4.

<sup>29</sup> See the implementation of clustered regressors in the stata module xtivreg2 for further discussion.

<sup>30</sup> We drop firms where there is more than one mode TTWA.

considering significance at 10% gives us slightly more theoretically consistent significant coefficients, particularly on intermediates where the number of positive significant coefficients increases by 5 (with only 1 additional negative) and exports where the overall number of positive significant coefficients is 12 versus 7 negative.

Instead of first differences, one particularly natural strategy is to restrict our focus to a long difference that defines pre-accession as the first period. The issue then is to choose the second period and hence the length of the difference. Attrition means that taking long differences across the whole of our time period is out of the question. An alternative which has a nice economic interpretation is to define a final period in the mid-1980s pre-single market.<sup>31</sup> Given that we do not have trade data for 1983, this suggests sometime 1984-1986. After investigating the possibilities, attrition coupled with the fact that all establishments are not sampled in a given year, forced us to take time averages for the 1970-72 period and 1984-1986 period as our establishment level observations.<sup>32</sup> As table A11 shows the resulting sample sizes can still be quite small so again, unsurprisingly, the summary in table 6 shows that we have less significant coefficients overall. However, as with the clustered errors the ratio of numbers of coefficients consistent with theory to those inconsistent is, if anything, better than those of our core results. These ratios are virtually unchanged if we consider 10% significance levels.

In summary, we have presented coefficients for a number of robustness checks that suggest that our core results are robust to different definitions of employment, to different distance decay coefficients; to alternative definitions of the access to intermediate goods and to allowing for arbitrary heteroscedasticity at the establishment level. The overall number of significant coefficients is smaller if we cluster errors at the TTWA (i.e. allow arbitrary correlation across establishments within the same TTWA) because of the problem of uniquely allocating firms to the same TTWA across time. First differencing and long differencing also give smaller numbers of coefficients but for a different reason – the much smaller sample sizes that are available for estimating these specifications. Despite these difficulties the ratio of coefficients consistent with theory to those inconsistent is, if anything, larger for these last three specifications.

### 7.3 Discussion of results

Overall, the series of checks that we have presented makes us confident that the core results that we presented in table 5 are fairly robust. Before concluding it is interesting to try to relate the pattern of coefficients across sectors to the characteristics of those sectors. To begin, we can consider how the pattern of coefficients relates to the changes in tariffs that occurred as a result of the UK's accession to the EEC. We expect changes to UK tariffs to be one component determining the extent to which import competition changes as a result of UK accession. We can then get a rough measure of the extent of tariff changes that drive import competition by noting that internal EEC tariffs on most goods go to zero while UK tariffs remain in place from the rest of the world. Thus, the size of the UK tariffs on non-EEC countries give us some idea of the decrease in tariff experienced by the UK's new EEC partners. We would expect this to be positively related to the increase in import competition in any given sector. Similarly, EEC tariffs will apply to non-EEC members post accession, but will no longer apply to the UK as a member of the EEC. Thus, the size of EEC tariffs give us some idea of the decrease in tariffs faced by UK exporters to the EEC and we would expect this to be positively associated with the change in export access experienced by a sector.

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<sup>31</sup> The Single European act was signed in 1986.

<sup>32</sup> We take the maximum of one, two or three year averages depending on the availability of data.

Clearly changing tariffs as the result of accession are one of several components that determine import competition and export market access, although other factors (such as trade-ability, which we consider below, will also matter). Referring back to the tariff information that we have available in table 2 it is obvious that we cannot do this in a particularly precise way because of the paucity of information on tariffs and the imperfect matching from available data on tariffs to sectors. We are able to match 64 sectors in to the tariff data by excluding agricultural related sectors (IO 12-23) and four miscellaneous sectors (IO 83, 88, 90 & 91). The magnitude of the coefficients is not particularly informative, but we can try and relate the sign of significant coefficients to the change in import tariffs or the tariffs faced by exporters. For import competition, we have 26 coefficients which are significant and can be mapped to one of the tariffs reported in table 2. Of these, 19 are positive, 7 negative. Creating a dummy variable that takes value 1 if the coefficient is positive and zero if negative, we then regress this dummy on the change in import tariffs. We can proceed similarly for the sign on export market access (reversing the coding of the dummy so that 1 always implies consistent with theory). Regressions of these two dummies on the changes in tariffs give positive, but insignificant coefficients and small R-squared.

We do better if we try to relate the signs of coefficients to the openness of a sector. We rank sectors according to the direct exports of goods and services per mille of net output and, as before, define dummy variables for all three coefficients that take value 1 when the coefficient is consistent with theory, zero if inconsistent. The coefficient on openness for the import market dummy is positive, significant and the regression has an R-squared of 0.15. The coefficient on openness for the export access dummy is positive, but insignificant. The results for intermediates sit between these two extremes. Again, the coefficient on openness is positive, it is just insignificant (at 12%) and the overall R-squared is 0.08.

Overall, the results here on the type of sectors that show effects consistent with theory are not particularly strong. However, many factors determine the way in which access variables change over this period for different sectors and nothing that we report here goes against our key finding that the signs of coefficients on the variables of interest are, on balance, broadly supportive of the theoretical priors.

## **8. Conclusion**

This paper has offered a detailed investigation of the effects of the UK's accession to the EEC on the spatial distribution of her industry. We are interested in this firstly per se but secondly as a test of the predictions of the 'New Economic Geography'. We have undertaken two major data construction exercises, one on the employment and location of establishments and one on the allocation of UK international trade between British ports, to explore the question with a finer geographical and commodity disaggregation than ever before.

To recap, UK accession changed the country composition of trade. These changes to the country composition of trade changed the ports through which trade entered and exited the UK with the result that import competition, export and intermediate market access changed differently for firms located in different TTWA. Firm employment responded to these changes in the way that theory predicts in roughly one quarter to one third of UK sectors. In a small number of sectors, the changes went against theory while for the remainder we can detect no significant effect. Attempting to explain which sectors were consistent with theory by looking at the changes in tariffs or the degree of openness does not provide a particularly strong story, but of course many other factors may have driven changes in access variables during this period.

Our approach provides a new test of theories of economic geography that uses UK accession to help us identify the causal effect of changing import competition, export market access and intermediate good



market access on economic geography. Overall, we find that changes in the spatial distribution of UK manufacturing are broadly consistent with the predictions of theory.

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## Appendix

Table A1: Sampling frame for selected firms in ARD source data 1970-1992

Census year	Employment size band	Sampling fraction	Comments
1970-1971	<25 25 or more	0 (exempt) All	In some industries < 11 In some industries 11 was lower limit
1972-1977	<20 20 or more	0 (exempt) All	
1978-1979	<20 20-49 50 or more 20 or more	0 (exempt)* 0.5 All All	All industries In 68 industries In 68 industries In all other industries
1980-1983	<20 20-49 50-99 100 or more	0 (exempt) 0.25 0.5 All	All industries In most industries In most industries All industries
1984	<20 20-49 50 or more	0 (exempt) 0.5 All	All industries England only 20 or more outside England
1985-1988	<20 20-49 50-99 100 or more	0 (exempt) 0.25 0.5 All	All industries In most industries In most industries All industries
1989	<20 20-49 50 or more	0 (exempt) 0.5 All	All industries England only 20 or more outside England
1990-1992	<20 20-49 50-99 100 or more	0 (exempt) 0.25 0.5 All	All industries In most industries In most industries All industries

\* In 1978 a small sample of establishments employing less than 20 was also drawn  
Source: Oulton (1997) and Barnes and Martin (2002)

Table A2: IO sectors

Code	Industry name	Code	Industry name
10	Coke ovens and manufactured fuel	51	Radio and electronics components
11	Mineral oil refining, lubricating oils, etc.	52	Television, radio and sound reproducing equipment
12	Grain milling	53	Electronic computers
13	Bread and flour confectionery and biscuits	54	Radio, radar and electronic capital goods
14	Meat and fish products	55	Domestic electrical appliances
15	Milk and milk products	56	Other electrical goods
16	Sugar	57	Shipbuilding and marine engineering
17	Cocoa, chocolate and sugar confectionery	58	Wheeled tractors
18	Animal and poultry foods	59	Motor vehicles
19	Oils and fats	60	Aerospace equipment
20	Other food	61	Other vehicles
21	Soft drinks	62	Engineers' small tools
22	Alcoholic drink	63	Cutlery etc., jewelry and precious metals
23	Tobacco	64	Bolts, nuts, screws, etc.
24	General chemicals	65	Wire and wire manufactures
25	Pharmaceutical chemicals and preparations	66	Cans and metal boxes
26	Toilet preparations	67	Other metal goods
27	Paints	68	Production of man-made fibers
28	Soap and detergents	69	Cotton, etc. spinning and weaving
29	Synthetic resins, etc. and synthetic rubber	70	Woollen and worsted
30	Dyestuffs and pigments	71	Hosiery and knitted goods
31	Fertilizers	72	Carpets
32	Other chemical industries	73	Household textiles and handkerchiefs
33	Iron castings etc.	74	Textile finishing
34	Other iron and steel	75	Other textiles
35	Aluminum and aluminum alloys	76	Leather, leather goods and fur
36	Other non-ferrous metals	77	Clothing
37	Agricultural machinery	78	Footwear
38	Machine tools	79	Bricks, fireclay and refractory goods
39	Pumps, valves and compressors	80	Pottery and glass
40	Industrial engines	81	Cement
41	Textile machinery	82	Other building materials, etc.
42	Construction and mechanical handling equipment	83	Furniture and bedding, etc.
43	Office machinery	84	Timber and miscellaneous wood manufactures
44	Other non-electrical machinery	85	Paper and board
45	Industrial plant and steelwork	86	Packaging products of paper, board, etc.
46	Other mechanical engineering	87	Other paper and board products
47	Instrument engineering	88	Printing and publishing
48	Electrical machinery	89	Rubber
49	Insulated wires and cables	90	Plastics products n.e.s.
50	Telegraph and telephone equipment	91	Other manufacturing

Table A3: Definition of port groups

<b>AIROT</b> OTHER AIRPORTS	ALL OTHER AIRPORTS	<b>ESCOT</b> East Scotland	ABERDEEN	
	BELFAST AIRPORT		DUNDEE	
	GLASGOW AIRPORT		FRASERBURGH	
	MANCHESTER AIRPORT		GRANGEMOUTH	
	PRESTWICK AIRPORT		KIRKCALDY	
<b>AIRLO</b> London Airports	GATWICK AIRPORT		KIRKWALL	
	HEATHROW AIRPORT		LEITH	
	SOUTHEND AIRPORT		MONTROSE	
<b>RESTP</b> Rest of ports	ARDROSSAN		<b>NEHUM</b> North East and Humber	PETERHEAD
	AVONMOUTH			BLYTH
	AYR	BOSTON		
	BARROW-IN-FURNESS	GOOLE		
	BELFAST	GRIMSBY		
	CARDIFF	HARTLEPOOL		
	COLERAINE	HULL		
	DOUGLAS	IMMINGHAM		
	ELLESMERE PORT	MIDDLESBROUGH		
	FISHGUARD	SCARBOROUGH		
	FLEETWOOD	SUNDERLAND		
	GLASGOW	TYNE		
	GREENOCK	WHITBY		
	HEYSHAM	<b>SSWCO</b> South West and Cornwall	EXETER	
	HOLYHEAD		FALMOUTH	
	INVERNESS		FOWEY	
	IRISH LAND BOUNDARY		GUERNSEY	
	IRVINE		JERSEY	
	LERWICK		PAR	
	LIVERPOOL		PENZANCE	
	LONDONDERRY		PLYMOUTH	
	MANCHESTER		POOLE	
	MILFORD		TEIGNMOUTH	
	MOSTYN	WEYMOUTH		
	NEWPORT	<b>SUHAM</b> Sussex and Hampshire	COWES	
	PORT TALBOT		NEWHAVEN	
	RUNCORN		PORTSMOUTH	
	SHARPNESS		SHOREHAM	
	SILLOTH		SOUTHAMPTON	
	STORNOWAY	<b>HAVEA</b> Haven and East Anglia	COLCHESTER	
SWANSEA	GREAT YARMOUTH			
WATCHET	HARWICH			
WHITEHAVEN	IPSWICH			
WORKINGTON	KINGS LYNN			
<b>LONDON</b>	LONDON		LOWESTOFT	
<b>FELIX</b>	FELIXSTOWE		WISBECH	
		<b>THAKE</b> Thames and Kent	DOVER	
			LONDON	
			MEDWAY	
			RAMSGATE	
			WHITSTABLE	

Table A4: Results using both selected and returned employment

IO	IMP	EXP	INT	N	IO	IMP	EXP	INT	N
10	-0.13	-0.12	0.27	66	50	-0.36	0.16	0.04	1796
11	-0.34	-0.32*	0.85	493	51	-0.69**	0.44**	0.24**	5370
12	-0.22	-0.10	0.37**	483	52	8.07**	0.86**	-9.05**	2869
13	-0.10	0.23	-0.12	13020	53	-1.97**	-0.27	2.08**	4249
14	-0.25	0.19	0.18	4606	54	-0.30	0.25*	0.12	3355
15	-0.29*	0.12	0.20	2514	55	-0.32**	0.41*	-0.05	2001
16	0.97	0.58**	-1.49	49	56	-0.01	0.16*	-0.14	10421
17	0.12	-0.30**	0.08	1155	57	-0.42**	0.56**	-0.19**	25926
18	-0.01	-0.33**	0.35**	1519	58	-0.33	0.05	0.91*	155
19	0.02	0.20*	-0.16	472	59	0.14*	0.07	-0.16	7399
20	0.46*	-0.14	-0.27*	6514	60	-0.08	0.16*	-0.07	2445
21	-0.19	0.17*	0.10	993	62	-0.18	0.52**	-0.31**	5724
22	-0.21**	-0.01	0.23**	1152	63	2.77**	0.42**	-3.19**	8824
23	0.57**	-0.26*	-0.61**	101	64	-0.42*	-0.01	0.55**	2721
24	-0.04	0.18**	0.05	2738	65	0.15	-0.08	0.10	1395
25	-0.02	0.22**	-0.21	1254	66	0.32	-0.48**	0.44**	1477
26	0.39**	0.02	-0.42**	1046	67	0.09*	0.19**	-0.23**	40679
27	-0.19	-0.15	0.25*	1121	68	-0.44	-1.02	1.17	81
28	-0.33*	0.36**	0.27*	757	69	-0.71*	-0.18	1.15**	1719
29	0.06	-0.20*	0.23**	2378	70	0.91**	-1.69**	0.61**	2678
30	-1.52**	0.99**	0.26	253	71	0.10	0.10	0.01	6104
31	0.06	0.31*	-0.21	397	72	-0.29	0.10	0.04	1496
32	-0.01	-0.06	0.11	2605	73	0.64	-0.09	-0.62	2030
33	-0.07*	0.57	-0.41*	1975	75	-0.20	-0.59**	0.77**	2719
34	-0.18	0.33**	-0.10	1802	76	0.23**	-0.17	-0.06	6008
35	-0.11	-0.22**	0.51	1899	77	0.38**	-0.04	-0.22**	40448
36	-0.01	0.29*	-0.14	1934	78	0.14	-0.22**	0.16	2886
37	0.19	-0.30	0.32**	3258	79	-0.09	0.15	-0.09	1396
38	-0.31**	-0.01	0.37**	7864	80	0.06	0.11	-0.08	5696
39	-0.18**	0.13	0.06	3410	81	-0.07	-0.45	0.05	548
40	-0.78**	-0.55	1.47**	1031	82	-0.11*	0.05	0.13**	5344
41	-1.53**	0.90**	0.44	1611	83	0.10*	-0.06	0.06*	23402
42	0.06	-0.16*	0.13	5869	84	2.82**	0.14**	-2.90**	32357
43	1.85	0.83	-2.63	604	85	1.47	0.66**	-2.03	1293
44	-0.12**	-0.01	0.09	11773	86	0.04	-0.04	0.05	4102
45	-0.22*	0.43**	-0.21**	10895	87	0.57	-0.07	-0.49	4548
46	-0.12**	-0.14**	0.31**	16238	88	0.05	-0.07	0.05**	69075
47	-0.12*	0.35**	-0.19*	10462	89	-0.23**	0.41**	-0.11	1862
48	-0.15*	0.40**	-0.31**	9349	90	-0.13**	0.03	0.01	14585
49	-0.41*	0.78**	-0.38**	1059	91	0.17**	-0.08	-0.08	25334

Notes: The dependent variable is returned or selected employment at the establishment level. IO gives the IO sector number, see table A2 in the appendix for sector names. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs. N gives the number of unique establishments used to calculate the within estimator. \* denotes significant at 5%, \*\* significant at 1%. All specifications include establishment fixed effects and time dummies. Data is for 1970-1992 (excluding 1983 and 1987).

Source: Authors own calculations using ARD data and trade data described in Section 4.

Table A5: Results using distance decay  $\rho=0.5$ 

IO	IMP	EXP	INT	N	IO	IMP	EXP	INT	N
10	-0.44	-1.25	1.46*	40	50	0.64	-0.76	0.78	215
11	-1.51	-0.31	2.39	130	51	-1.44**	0.67**	0.77**	926
12	-0.85	-0.09	0.80**	149	52	42.91**	3.91**	-48.43**	223
13	0.00	0.14	-0.16	1258	53	-1.78	0.56	0.99	308
14	-3.02**	0.00	3.22**	1031	54	-1.57*	0.84**	1.18	529
15	-0.13	0.60**	-0.15	512	55	-0.56*	0.92*	-0.30	252
16	-10.24	0.74*	10.07	39	56	0.12	0.07	-0.02	746
17	0.02	-0.43**	0.14	215	57	-1.42**	1.75**	-0.51	825
18	-0.19	-0.31	0.73**	375	58	-6.90*	4.38*	5.42**	59
19	0.15	0.26	-0.15	121	59	0.26	-0.90**	0.67*	1529
20	-0.58	1.00**	-0.23	798	60	-1.14	0.09	1.05	579
21	0.35	0.21	-0.12	326	62	-0.18	0.40	-0.23	1083
22	-0.27	-0.12	0.69**	337	63	-0.19	0.68**	-0.36	492
23	1.70**	-0.30	-2.15**	32	64	-1.95**	0.95	1.53**	321
24	0.03	0.37**	0.26	609	65	0.07	-0.08	0.55*	348
25	-0.27	0.28	0.16	290	66	1.17	-0.82	0.68*	138
26	0.02	-0.16	0.00	161	67	-0.02	0.41**	-0.36**	4840
27	-0.42	0.09	0.36	213	68	0.09	0.59	-1.05	56
28	-1.04**	1.30**	1.08*	111	69	-3.89**	-0.44	5.22**	713
29	0.11	-1.06**	1.58**	422	70	1.30	-0.74	-1.05*	808
30	-1.70**	0.64	0.15	75	71	1.01	-0.33	-0.08	1030
31	-0.06	0.25	-0.04	67	72	0.89	1.43	-3.26**	166
32	0.19	-0.63*	0.68**	434	73	0.85	-1.11	-0.01	275
33	0.80*	0.06	-0.31	673	75	-1.89**	-0.79	2.27**	165
34	0.09	0.57**	-0.28*	751	76	0.22	-0.43	0.17	733
35	0.73	-0.68*	0.45	418	77	0.52**	-0.16	-0.59**	3918
36	0.31	0.57**	-0.38	492	78	0.41*	-0.48**	0.20	535
37	0.23	1.05	-0.33	229	79	-0.54**	0.37	0.08	437
38	-0.30	-0.66*	1.21**	628	80	-0.53**	0.65**	0.19	679
39	-0.53**	0.00	0.56**	591	81	0.50	-0.50	-1.18	31
40	-1.38**	1.11	1.11	97	82	-0.18	0.00	0.42**	1353
41	-4.05*	4.25**	-1.15	244	83	-0.82**	0.76**	0.26**	1650
42	0.02	-0.33	0.23	877	84	6.22**	0.11	-6.30**	3220
43	0.16	-1.11	0.32	102	85	9.76**	1.33**	-11.06**	324
44	-0.36**	-0.15	0.44*	2269	86	-2.16**	0.74**	1.54**	843
45	-1.06**	1.73**	-0.89**	1770	87	-1.86**	0.64**	1.20*	830
46	-0.06	-0.23	0.48**	2347	88	0.22	-0.37**	0.04	4979
47	-0.62**	0.94**	-0.19	1655	89	-0.22	0.33	0.05	535
48	-0.53**	0.34	-0.23	941	90	-0.27*	0.04	0.00	2155
49	-1.02**	2.31**	-0.46*	171	91	0.56*	-0.65*	0.09	1323

Notes: The dependent variable is returned employment at the establishment level. IO gives the IO sector number, see table A2 in the appendix for sector names. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs (all calculated with distance coefficient  $\rho=0.5$ ). N gives the number of unique establishments used to calculate the within estimator. \* denotes significant at 5%, \*\* significant at 1%. All specifications include establishment fixed effects and time dummies. Data is for 1970-1992 (excluding 1983 and 1987).

Source: Authors own calculations using ARD data and trade data described in Section 4.

Table A6: Results using distance decay  $\rho=1.5$ 

IO	IMP	EXP	INT	N	IO	IMP	EXP	INT	N
10	-0.10	-0.09	0.20	40	50	0.30	-0.21	0.01	214
11	-0.99	-0.40	1.54*	129	51	-0.23	0.03	0.22**	926
12	-0.16	0.00	0.17**	149	52	5.10**	0.56*	-5.74**	223
13	0.02	0.02	-0.05	1243	53	0.01	0.21	-0.25	308
14	-0.16	0.14*	0.11	1027	54	-0.45*	0.14	0.40	529
15	-0.13	0.10*	0.10	512	55	-0.15	0.31*	-0.17	252
16	3.52	0.18	-3.98	39	56	0.04	0.11	-0.13*	741
17	0.06	-0.18**	0.02	215	57	-0.23**	0.35**	-0.10	822
18	-0.02	-0.10*	0.16**	372	58	1.40*	-1.17*	0.70**	59
19	0.05	0.04	-0.08	121	59	-0.03	-0.22**	0.22**	1528
20	-0.12	0.35**	-0.19**	795	60	-0.20	0.04	0.17	579
21	0.08	0.01	0.01	324	62	-0.05	0.12*	-0.08*	1082
22	-0.06	-0.02	0.10*	335	63	-0.17	0.67**	-0.51	491
23	0.36**	-0.10	-0.26*	30	64	-0.90**	0.30**	0.71**	319
24	-0.16*	0.14**	0.12	608	65	0.14	-0.20	0.14*	348
25	0.05	0.02	-0.04	289	66	0.09	-0.12	0.18**	135
26	-0.04	0.01	0.01	161	67	0.09**	0.03	-0.11**	4832
27	-0.31	-0.04	0.28	212	68	-0.46	-0.26	0.74	56
28	-0.46**	0.21*	0.39**	111	69	-0.89**	-0.13	1.19**	713
29	0.06	-0.10*	0.05	422	70	0.12	-0.16	-0.02	808
30	-0.15	-0.04	0.09	75	71	-0.41	-0.28	0.79*	1029
31	-0.08	0.08	0.08	67	72	0.24	-0.56**	0.16	166
32	-0.01	0.04	0.00	434	73	0.83**	-0.15	-0.79**	275
33	0.11	-0.02	0.01	669	75	-0.25	-0.30**	0.54**	165
34	-0.12*	0.16*	-0.01	751	76	0.03	0.10	-0.08*	731
35	0.11	-0.08	0.11	418	77	0.07*	0.01	-0.09**	3914
36	0.09	0.02	-0.03	492	78	0.15*	-0.01	-0.07	534
37	-0.14	0.41*	-0.14	229	79	-0.38*	0.13	0.17	437
38	-0.03	0.08	0.00	627	80	-0.19*	0.12	0.16*	679
39	-0.17**	0.02	0.16**	587	81	-0.15	-0.17	0.03	31
40	-0.49**	0.41*	0.25	97	82	-0.07	0.07	0.05	1352
41	-0.70	0.58	0.07	244	83	-0.18**	0.23**	0.00	1650
42	-0.01	-0.02	0.03	877	84	0.67	0.02	-0.68	3220
43	0.22	-0.45	0.13	102	85	0.30	0.25**	-0.53	321
44	-0.09**	-0.06	0.12**	2269	86	0.17	0.06	-0.20	837
45	-0.10	0.29**	-0.16**	1770	87	-0.08	0.07	0.01	821
46	-0.03	-0.13**	0.18**	2342	88	-0.02	-0.01	-0.01	4964
47	-0.10*	0.17**	-0.03	1655	89	-0.06	0.21**	-0.12*	535
48	-0.22**	0.17*	-0.05	936	90	-0.08**	0.07	-0.05	2155
49	-0.19	0.69**	-0.32**	171	91	0.16	-0.12	-0.05	1323

Notes: The dependent variable is returned employment at the establishment level. IO gives the IO sector number, see table A2 in the appendix for sector names. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs (all calculated with distance coefficient  $\rho=1.5$ ). N gives the number of unique establishments used to calculate the within estimator. \* denotes significant at 5%, \*\* significant at 1%. All specifications include establishment fixed effects and time dummies. Data is for 1970-1992 (excluding 1983 and 1987).

Source: Authors own calculations using ARD data and trade data described in Section 4.



Table A7: Intermediate access variable constructed ignoring own intermediates

IO	IMP	EXP	INT	N	IO	IMP	EXP	INT	N
10	-0.18	-0.25	0.41	40	50	0.27	-0.34	0.27	215
11	-1.72*	-0.45*	2.39**	130	51	-0.43**	0.28**	0.14*	926
12	-0.27	-0.05	0.31**	149	52	15.78**	1.73**	-17.83**	223
13	0.05	0.00	-0.05	1258	53	0.43	0.37*	-0.82	308
14	-0.25**	0.07	0.30**	1030	54	-0.73**	0.26*	0.64	529
15	-0.09	0.27*	-0.04	512	55	-0.25*	0.32*	-0.06	252
16	-0.45*	0.55**	-0.08	39	56	0.00	0.08	-0.02	746
17	0.08	-0.25**	0.04	215	57	-0.51**	0.71**	-0.21*	825
18	-0.04	-0.19*	0.32**	375	58	0.03	-0.12	1.53**	59
19	0.02	0.13	-0.08	121	59	0.20**	-0.39**	0.19*	1529
20	-0.22	0.47**	-0.18*	798	60	-0.11	0.05	0.06	579
21	0.13	0.04	0.00	326	62	-0.08	0.16	-0.09	1083
22	-0.11	-0.07	0.26**	337	63	-0.58**	0.66**	-0.09	492
23	0.66**	-0.19*	-0.69**	32	64	-0.97**	0.35	0.84**	321
24	-0.08	0.15**	0.14	609	65	0.08	-0.15	0.22*	348
25	-0.02	0.10	-0.03	290	66	0.44*	-0.42*	0.37**	138
26	0.06	-0.07	-0.07	161	67	0.06	0.11*	-0.16**	4840
27	-0.25	-0.03	0.21	213	68	-0.05	0.15	-0.21	56
28	-0.50**	0.48**	0.38*	111	69	-0.46**	-0.22	0.98**	713
29	0.00	-0.24**	0.35**	422	70	0.44	-0.46	-0.15	808
30	-0.59	0.18	0.13	75	71	0.28	-0.30	0.25	1030
31	-0.06	0.08	0.09	67	72	0.41	-0.53	-0.15	166
32	0.04	-0.09	0.10	434	73	0.86*	-0.50*	-0.53	275
33	0.36**	-0.06	-0.09	673	75	-0.50*	-0.44*	0.89**	165
34	-0.09	0.25**	-0.07	751	76	0.03	0.02	0.00	733
35	0.17	-0.16*	0.27	418	77	0.12**	0.02	-0.17**	3918
36	-0.01	0.25*	-0.06	492	78	0.22**	-0.12*	0.02	535
37	0.14	0.30	-0.08	229	79	-0.04	0.32*	-0.25	437
38	-0.02	-0.10	0.20	628	80	-0.24**	0.23*	0.17*	679
39	-0.21**	0.06	0.16*	591	81	-0.17	-0.19	-0.15	31
40	-0.68**	0.46	0.51	97	82	-0.04	-0.01	0.12**	1353
41	-1.81**	1.25**	0.28	244	83	-0.22**	0.26**	0.06	1650
42	0.01	-0.04	0.01	877	84	0.09**	0.06	-0.13**	3220
43	-0.27	-0.72	0.77	102	85	-0.23**	0.47**	-0.19	324
44	-0.09**	-0.12	0.17**	2269	86	-0.55*	0.13*	0.47*	843
45	-0.33**	0.62**	-0.29**	1770	87	0.01	0.01	-0.06	830
46	0.02	-0.22**	0.27**	2347	88	0.01	-0.06	0.00	4979
47	-0.26**	0.33**	-0.02	1655	89	-0.04	0.21*	-0.10	535
48	-0.22**	0.07	0.00	941	90	-0.12**	0.05	-0.03	2155
49	-0.42*	1.04**	-0.30**	171	91	0.26*	-0.28*	0.02	1323

Notes: The dependent variable is returned employment at the establishment level. IO gives the IO sector number, see table A2 in the appendix for sector names. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs. IMP and EXP constructed as for table 5. INT constructed ignoring own intermediates. N gives the number of unique establishments used to calculate the within estimator. \* denotes significant at 5%, \*\* significant at 1%. All specifications include establishment fixed effects and time dummies. Data is for 1970-1992 (excluding 1983 and 1987). Source: Authors own calculations using ARD data and trade data described in Section 4.

Table A8: Robust errors

IO	IMP	EXP	INT	N	IO	IMP	EXP	INT	N
10	-0.18	-0.25	0.41	39	50	0.26	-0.33	0.27	142
11	-1.81*	-0.45	2.47*	114	51	-0.54**	0.25	0.29*	640
12	-0.27	-0.05	0.31**	119	52	17.43**	1.72**	-19.47**	146
13	0.07	0.01	-0.08	865	53	1.16	0.48*	-1.66*	194
14	-0.66	0.13	0.66	769	54	-0.73	0.27	0.63	393
15	-0.16	0.23*	0.09	390	55	-0.27*	0.38	-0.10	198
16	-3.59	0.67**	3.06	18	56	0.01	0.07	-0.01	526
17	0.08	-0.25**	0.03	175	57	-0.53**	0.70**	-0.16	534
18	-0.02	-0.20*	0.33**	307	58	-0.09	-0.12	1.61**	42
19	0.04	0.13	-0.10	92	59	0.06	-0.42**	0.35*	1168
20	-0.17	0.48**	-0.24	571	60	-0.40	0.05	0.35	435
21	0.18	0.06	-0.08	254	62	-0.06	0.13	-0.07	820
22	-0.11	-0.07	0.27**	288	63	-0.23	0.63**	-0.37	376
23	0.66**	-0.19	-0.69**	25	64	-0.82**	0.29	0.73**	244
24	-0.09	0.19*	0.13	482	65	0.08	-0.15	0.23*	279
25	-0.09	0.03	0.17	204	66	0.44	-0.42	0.37**	106
26	0.06	-0.06	-0.08	123	67	0.07	0.11	-0.16**	3576
27	-0.26	-0.03	0.23	169	68	-0.03	0.16	-0.24	42
28	-0.50**	0.49**	0.38	87	69	-1.50**	-0.23	2.02**	522
29	-0.04	-0.25*	0.39**	294	70	0.39	-0.39	-0.15	636
30	-0.67	0.20	0.17	65	71	0.31	-0.32	0.26	787
31	0.04	0.18	0.04	60	72	0.41	-0.53	-0.15	127
32	0.02	-0.04	0.09	334	73	0.86	-0.50*	-0.53	193
33	0.36*	-0.06	-0.09	553	75	-0.62*	-0.44	1.00**	128
34	-0.07	0.25**	-0.09	614	76	0.02	0.02	0.01	533
35	0.03	-0.18	0.44	299	77	0.13*	0.02	-0.18**	2771
36	0.11	0.25*	-0.18	398	78	0.22*	-0.12	0.02	400
37	-0.11	0.35	-0.02	159	79	-0.04	0.35	-0.26	346
38	-0.05	-0.09	0.23	430	80	-0.26	0.28	0.11	482
39	-0.20**	0.06	0.16	466	81	-0.17	-0.18	-0.16	21
40	-0.69**	0.46	0.52	65	82	-0.05	0.00	0.13*	1028
41	-1.76	1.31**	0.17	190	83	-0.22*	0.25*	0.06	1183
42	0.01	-0.05	-0.01	651	84	1.86**	0.06	-1.89**	2066
43	-0.44	-0.76	0.98	68	85	1.55*	0.47**	-1.96*	260
44	-0.13**	-0.10	0.21*	1669	86	-0.67*	0.16*	0.57*	683
45	-0.31*	0.61**	-0.30**	1279	87	0.05	-0.01	-0.09	669
46	-0.02	-0.20*	0.28**	1669	88	-0.01	-0.05	0.00	3129
47	-0.23**	0.36**	-0.07	1212	89	-0.03	0.20	-0.08	426
48	-0.22*	0.10	-0.04	696	90	-0.15*	0.06	-0.02	1535
49	-0.42*	1.04**	-0.30*	129	91	0.23*	-0.22	-0.02	964

Notes: The dependent variable is returned employment at the establishment level. IO gives the IO sector number, see table A2 in the appendix for sector names. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs. N gives the number of unique establishments used to calculate the within estimator. Standard errors are robust to arbitrary heteroscedasticity. \* denotes significant at 5%, \*\* significant at 1%. All specifications include establishment fixed effects and time dummies. Data is for 1970-1992 (excluding 1983 and 1987). Source: Authors own calculations using ARD data and trade data described in Section 4.

Table A9: Clustered robust errors

IO	IMP	EXP	INT	N	IO	IMP	EXP	INT	N
10					50	0.26	-0.33	0.27	142
11	-1.81	-0.45	2.47	114	51	-0.54	0.25	0.29	640
12	-0.27	-0.05	0.31	119	52	17.43*	1.72**	-19.47*	146
13	0.07	0.01	-0.08	865	53	1.16	0.48*	-1.66	194
14	-0.66	0.13	0.66	769	54	-0.73	0.27	0.63	393
15	-0.16	0.23	0.09	390	55	-0.27	0.38	-0.10	198
16					56	0.01	0.07	-0.01	526
17	0.08	-0.25*	0.03	175	57	-0.53**	0.70**	-0.16	534
18	-0.02	-0.20	0.33	307	58	-0.09	-0.12	1.61**	42
19	0.04	0.13	-0.10	92	59	0.06	-0.42*	0.35	1168
20	-0.17	0.48*	-0.24	571	60	-0.40	0.05	0.35	435
21	0.18	0.06	-0.08	254	62	-0.06	0.13	-0.07	820
22	-0.11	-0.07	0.27	288	63	-0.23	0.63**	-0.37	376
23					64	-0.82	0.29	0.73*	244
24	-0.09	0.19	0.13	482	65	0.08	-0.15	0.23	279
25	-0.09	0.03	0.17	204	66	0.44	-0.42	0.37*	106
26	0.06	-0.06	-0.08	123	67	0.07	0.11	-0.16*	3576
27	-0.26	-0.03	0.23	169	68	-0.03	0.16	-0.24	42
28	-0.50	0.49	0.38	87	69	-1.50*	-0.23	2.02**	522
29	-0.04	-0.25	0.39	294	70	0.39	-0.39	-0.15	636
30	-0.67	0.20	0.17	65	71	0.31	-0.32	0.26	787
31	0.04	0.18	0.04	60	72	0.41	-0.53	-0.15	127
32	0.02	-0.04	0.09	334	73	0.86	-0.50	-0.53	193
33	0.36	-0.06	-0.09	553	75	-0.62	-0.44	1.00**	128
34	-0.07	0.25	-0.09	614	76	0.02	0.02	0.01	533
35	0.03	-0.18	0.44	299	77	0.13	0.02	-0.18*	2771
36	0.11	0.25	-0.18	398	78	0.22	-0.12	0.02	400
37	-0.11	0.35	-0.02	159	79	-0.04	0.35	-0.26	346
38	-0.05	-0.09	0.23	430	80	-0.26	0.28	0.11	482
39	-0.20	0.06	0.16	466	81				
40	-0.69**	0.46	0.52	65	82	-0.05	0.00	0.13	1028
41	-1.76	1.31	0.17	190	83	-0.22	0.25	0.06	1183
42	0.01	-0.05	-0.01	651	84	1.86	0.06	-1.89	2066
43	-0.44	-0.76	0.98	68	85	1.55	0.47	-1.96	260
44	-0.13	-0.10	0.21	1669	86	-0.67	0.16	0.57	683
45	-0.31	0.61*	-0.30	1279	87	0.05	-0.01	-0.09	669
46	-0.02	-0.20*	0.28**	1669	88	-0.01	-0.05	0.00	3129
47	-0.23	0.36*	-0.07	1212	89	-0.03	0.20	-0.08	426
48	-0.22	0.10	-0.04	696	90	-0.15	0.06	-0.02	1535
49	-0.42	1.04**	-0.30	129	91	0.23	-0.22	-0.02	964

Notes: The dependent variable is returned employment at the establishment level. IO gives the IO sector number, see table A2 in the appendix for sector names. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs. N gives the number of unique establishments used to calculate the within estimator. Standard errors are robust to arbitrary heteroscedasticity and allow for arbitrary within TTWA correlation. \* denotes significant at 5%, \*\* significant at 1%. All specifications include establishment fixed effects and time dummies. Data is for 1970-1992 (excluding 1983 and 1987). Source: Authors own calculations using ARD data and trade data described in Section 4.

Table A10: First difference estimator

IO	IMP	EXP	INT	N	IO	IMP	EXP	INT	N
10	0.51	-0.76	0.25	39	50	-0.08	0.04	0.10	142
11	-4.70	-3.47	7.20	114	51	-0.29*	0.23	0.10	640
12	-0.05	0.04	0.05	119	52	6.26*	0.02	-6.44*	146
13	-0.07	0.26*	-0.16	865	53	1.28	0.08	-1.24	194
14	-0.66	-0.04	0.69	769	54	0.40	0.08	-0.49	393
15	0.10	0.11	-0.32	390	55	-0.11	0.48	-0.44	198
16	-1.35	0.11	1.24	18	56	-0.08	0.57**	-0.60**	526
17	0.27	-0.24*	-0.02	175	57	-0.14	0.09	0.10	534
18	-0.10	0.12	0.04	307	58	-0.03	-0.20	0.76	42
19	-0.07	0.11	0.00	92	59	0.23**	0.24*	-0.48**	1168
20	-0.22	0.12	0.11	571	60	-0.67*	-0.06	0.73*	435
21	0.23	-0.12	-0.03	254	62	0.01	-0.03	0.05	820
22	-0.47**	0.06	0.26**	288	63	-0.44	1.24	-0.84	376
23	0.15	-0.12	-0.02	25	64	-0.11	0.38	-0.04	244
24	-0.49**	0.30**	0.27**	482	65	-0.05	-0.24	0.31	279
25	0.14	-0.19	0.07	204	66	1.83	-2.01	0.89	106
26	-0.02	0.15	-0.16	123	67	0.07	-0.05	0.06	3576
27	-0.88*	-0.40**	0.97*	169	68	0.98	1.64	-2.75	42
28	-0.37	-0.01	0.28	87	69	-0.54	-0.02	0.67	522
29	-0.19	0.21	-0.06	294	70	0.06	0.04	-0.06	636
30	-0.30	-0.18	0.29	65	71	-0.30	-0.96*	1.09	787
31	-0.85	-0.19	0.88	60	72	0.76	-0.29	-0.43	127
32	-0.13*	0.22	-0.14	334	73	-1.56**	0.52	0.77**	193
33	-0.03	0.29	-0.19	553	75	0.04	-0.06	0.05	128
34	-0.15*	0.19**	-0.06	614	76	-0.43	0.34	0.07	533
35	1.02	-0.27	-0.61	299	77	0.08	-0.08	0.01	2771
36	0.53	-0.70	0.07	398	78	0.06	0.28	-0.31	400
37	-0.03	-0.06	0.16	159	79	-0.44	1.29	-0.87	346
38	0.01	-0.11	0.07	430	80	-0.26	0.31	-0.03	482
39	-0.03	0.02	-0.01	466	81	-1.43	-1.33	2.70	21
40	-0.07	-0.13	0.22	65	82	0.03	-0.07	0.06	1028
41	0.51	0.30	-0.92	190	83	-0.08	0.10	-0.04	1183
42	0.00	-0.11	0.07	651	84	0.10	0.02	-0.09	2066
43	2.12	0.89	-2.98	68	85	-0.85	-0.23	1.10	260
44	0.03	-0.06	0.01	1669	86	-0.52	0.04	0.50	683
45	-0.09	0.21	-0.18	1279	87	0.44	-0.11	-0.34	669
46	0.00	0.03	-0.05	1669	88	-0.01	0.00	-0.01	3129
47	-0.06	0.14*	-0.07	1212	89	0.10	-0.02	-0.02	426
48	-0.04	-0.05	0.11	696	90	0.03	-0.09	0.07	1535
49	-0.46**	0.57*	-0.10	129	91	0.44**	-0.52*	0.16	964

Notes: The dependent variable is returned employment at the establishment level. IO gives the IO sector number, see table A2 in the appendix for sector names. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs. N gives the number of unique establishments used to calculate the first difference estimator. \* denotes significant at 5%, \*\* significant at 1%. All specifications include establishment fixed effects and time dummies. Data is for 1970-1992 (excluding 1983 and 1987). Source: Authors own calculations using ARD data and trade data described in Section 4.

Table A11: Long differences

IO	IMP	EXP	INT	N	IO	IMP	EXP	INT	N
10	-0.11	0.78	-0.21	18	50	-0.22	-0.54	0.96*	30
11	-0.19	-0.05	1.01	41	51	0.00	0.08	0.02	144
12	0.02	-0.21	0.14	40	52	-2.07	2.53	-0.99	16
13	0.03	0.06	-0.07	204	53	0.64	1.36	-2.00	15
14	-0.11	0.11	0.14	142	54	0.01	-0.10	0.21	101
15	-1.11*	0.41	0.97	117	55	0.08	-0.05	0.20	57
16					56	0.08	-0.04	0.02	106
17	0.03	-0.10	-0.18	73	57	-0.13	0.03	0.33	98
18	0.16	-0.08	0.26	97	58	-0.81	0.85	0.69	13
19	-0.14	0.10	0.18	24	59	-0.06	-0.08	0.12	303
20	-0.06	-0.03	0.17	134	60	-0.33	0.25	0.14	141
21	0.26	0.05	-0.18	70	62	-0.08	0.04	0.07	192
22	-0.04	0.07	0.18	126	63	0.11	-0.04	-0.09	104
23					64	-0.47	0.29	0.38	58
24	-0.02	0.03	0.27	160	65	0.23	-0.18	0.18	101
25	0.01	0.45	-0.31	64	66	0.25	-0.50	0.63*	32
26	-0.06	-0.11	-0.02	35	67	0.02	-0.01	0.03	798
27	-0.24	0.36	-0.20	63					
28	-1.07**	1.39**	0.18	31	69	-0.07	0.53	-0.15	114
29	0.14	-0.29	0.44	76	70	-0.56	0.80	-0.57	181
30	-0.39	0.53	-0.10	24	71	0.07	0.22	0.11	211
31	0.39	0.45	-0.28	17	72	0.85	0.43	-1.49*	35
32	-0.02	-0.02	0.14	99	73	0.30	-0.42	-0.33	38
33	0.46	-0.44	0.06	137	75	-0.15	-0.32	0.60*	32
34	0.11	-0.10	0.14	179	76	0.56**	-0.43	-0.32**	139
35	-0.01	-0.03	0.15	90	77	0.02	0.04	-0.02	541
36	-0.07	0.08	0.12	111	78	0.33	0.00	-0.22	151
37	-0.91	1.09	0.02	29	79	-0.61*	0.77**	0.21	81
38	0.46	-0.47	-0.03	107	80	-1.31**	1.22**	0.10	148
39	-0.20	0.06	0.17	166	81	0.26	-0.84	-0.50	11
40	-0.95*	1.69**	-0.30	18	82	-0.72*	0.72*	0.03	236
41	-1.06	1.25	-0.21	39	83	-0.16	0.15	0.24*	257
42	0.15	-0.08	-0.17	164	84	-0.04	-0.04	0.16	517
43	0.30	0.27	-1.06	15	85	0.40**	-0.29	-0.25	95
44	-0.25**	0.21*	0.03	411	86	0.03	-0.08	0.07	262
45	-0.24**	0.30**	0.06	255	87	-0.03	-0.06	0.02	210
46	-0.08	0.13	-0.03	311	88	0.04	-0.10	-0.01	890
47	-0.13	0.08	0.16	306	89	0.16	0.07	-0.02	135
48	-0.08	0.15	-0.19	171	90	-0.05	-0.05	0.00	330
49	-0.54	1.16*	-0.17	32	91	-0.07	-0.06	0.04	216

Notes: The dependent variable is returned or selected employment at the establishment level. IO gives the IO sector number, see table A2 in the appendix for sector names. IMP reports the coefficient on import competition, EXP the coefficient on export market access and INT the coefficient on access to intermediate inputs. N gives the number of unique establishments used to calculate the long difference estimator (long differences are the based on average employment 1984-1986 minus average employment 1970-1972). \* denotes significant at 5%, \*\* significant at 1%. All specifications include establishment fixed effects and time dummies. Data is for 1970-1992 (excluding 1983 and 1987). Source: Authors own calculations using ARD data and trade data described in Section 4.