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The microeconomics of international price dispersion

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To my mother, my brother, and Onur

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ABSTRACT

This dissertation investigates the reasons behind international price dispersion. The first essay, “International Price Dispersion and the Direction of Trade”, discusses the importance of trade cost as a determinant of international price dispersion. The importance of trade costs in segmenting product markets can not be captured by considering aggregate prices or in the absence of information on the direction of trade. The first essay, addresses this problem by utilizing product-specific prices along with cross-sectional productivity measures and bilateral trade flows that allow us to identify the probable source of any one product. The empirical approach used in this work is in line with the theoretical framework of Eaton and Kortum (2002) and the variation of this model proposed in Anderson and van Wincoop (2004). The data are shown to be consistent with this framework. In particular, trade costs in the form of transportation and distribution costs are important in determining international price differences and segmenting international markets.

The second essay, “International Price Dispersion and Market Structure” investigates the effect of market structure on absolute price differences. Cheung, Chinn and Fuji (1999) argue that, monopolistic firm’s pricing power is determined by the elasticity of demand which depends on the substitutability among varieties within the industry. Therefore, product differentiation creates more dispersed prices and it can be a sign of market power. In this essay, market structure is controlled by using the product classification proposed by Rauch (1999). Specifically, the data is divided into two separate good categories as homogeneous goods and differentiated goods. The results

presented in this chapter demonstrate that the effect of potential determinants of international price dispersion differs substantially for different product types.

CHAPTER 1

INTRODUCTION

The law-of-one-price (LOP) states that, once the prices expressed in common currency units, identical goods in different countries should have identical prices. Purchasing power parity (PPP) states that LOP should hold on average. The conclusion that prices of the same goods when expressed in the same currency units fail to equalize across locations is considered as a sign that markets are not perfectly integrated (Chen, 2002). This dissertation is a combination of two essays which empirically investigate the reasons behind international price dispersion. Although due to data limitations most empirical work has examined the time-series distribution of international relative prices, Crucini, Telmer and Zachariadis (2005) state that both LOP and PPP are about the cross-sectional distribution, and they propose the use of price level data that enable us to make comparisons across locations. Following the above-mentioned work, I utilize microeconomic price levels in order to infer the reasons behind international price dispersion. The dataset originates from EUROSTAT surveys and contains retail prices for a broad set of goods and services within the EU countries for the years 1975, 1980, 1985 and 1990. The level of detail in this dataset allows exact comparisons across space at a given point in time, hence enabling a through investigation which can go deeper in a disaggregate sense as to the reasons responsible for price dispersion.

The first essay, "International Price Dispersion and the Direction of Trade", is firmly motivated by the theoretical framework discussed in Anderson and van Wincoop (2004). Anderson and van Wincoop (2004) argue that the death of distance is exaggerated and that trade costs are large even between highly integrated economies, suggesting some useful hypotheses for understanding these. According to the authors, direct evidence on trade costs which comes from costs imposed by policy (tariffs, quotas and the like) and costs imposed by the environment (transportation (freight) cost, insurance and time cost) are the first best alternatives to use, but not always feasible due to data limitations and the very large size of the resulting datasets. Therefore indirect sources along with a theoretical approach are necessary and inevitable in order to infer the large portion of trade costs. Prices of goods can provide an indirect source of information about the magnitude of trade costs (Anderson and van Wincoop 2004).

In the theoretical framework established in Anderson and van Wincoop (2004), international price dispersion is determined by trade costs made up of transportation and local distribution costs, differences in taxes, markups and good specific characteristics. I utilize physical distance between countries as a measure for transportation cost and income per-capita and industry-specific real wage rates as a measure for local distribution cost. Heterogeneity across industries in transportation costs and local distribution costs are controlled by industry-specific tradability and the non-traded input share variables, respectively. Tax differences are controlled by good-specific dummies for the group of goods for which we have a-priori information about large tax differences across countries and value added tax (VAT) rates differences.

Finally, according to this model variable markups also affect price differences. Markups depend on factors such as the price elasticity of demand and market share of the producer. Calculation of markups is somewhat problematic since marginal cost of production is an unobservable variable. Campbell and Hopenhayn (2005) argue that larger markets are more competitive, and in more competitive markets producers must recover their fixed costs by selling more at lower markups. Similarly, due to Melitz and Ottaviano (2005), market size affects the toughness of competition. Bigger markets exhibit higher levels of product variety and host more productive firms that set lower markups and lower prices. By following these arguments, we utilize population size differences to capture market size and hence differences in markups.

In order to extract information about trade costs from price data, Anderson and van Wincoop (2004) propose the use of price level data. Moreover, they argue that the natural strategy should be to identify the source country for each product. We use two different approaches in order to identify the most likely source of each product in the data. In our first approach, information on country and industry-specific productivities is used along with the good specific price levels. More specifically, we rank the countries according to their level of productivity for each industry, and compute the product-specific price differences relative to the most productive country in each industry. This approach is consistent with Eaton and Kortum (2001), Eaton and Kortum (2002), and Bernard, Eaton, Jensen and Kortum (2003) where the most productive country for each product is the sole exporter of it to the rest of the world.

As an alternative approach, we consider industry-specific bilateral trade flows and use data from the importer country's real trade partners in order to generate the information as a weighted average of the real trade partners' data for a "hypothetical" source country and for each product in our sample. Utilizing industry-specific bilateral trade information allows us to take into consideration that the same type of good can be exported by more than one country within the sample.

The results in both approaches indicate that identifying the source country makes it possible to consider price comparisons that are relevant to trade costs. Overall, data is consistent with the theoretical model discussed in Anderson and van Wincoop (2004) in which price dispersion is determined by trade costs, good-specific characteristics, taxes and markup differences.

The second essay, “International Price Dispersion and Market Structure” investigates the effect of market structure on absolute price dispersion. Specifically we attempt to distinguish the effect of potential determinants of international price dispersion discussed in Anderson and van Wincoop (2004) on different product types.

According to Cheung, Chinn and Fuji (1999), a monopolistically competitive firm’s pricing decision depends on the elasticity of demand which is in turn determined by the number of close substitutes to the good in the market. Therefore, product differentiation can be a sign of market power.

In order to classify goods in our data, we use the commodity classification proposed by Rauch (1999). In the Rauch classification, internationally traded commodities can be classified as goods traded in organized exchanges, goods that are not traded in organized exchanges nevertheless possess a “reference price”, and finally differentiated goods. Commodities that belong to the first and second groups are homogeneous goods since having a reference price distinguishes homogeneous goods from the differentiated ones (Rauch, 1999).

The first specification in this essay based on the model used by Crucini, Telmer and Zachariadis (2005), and analyzes the effect of market structure on good-by-good price dispersion. According to this model, international price dispersion is determined by the extent to which final goods are traded, and the share of the non-traded input in the total cost. Taxes are controlled by VAT differences and good-specific dummy variables for vices (tobacco products and alcoholic beverages) and large cars. Results confirmed that tradability of good is negatively, and the non-traded input share is positively related with international price dispersion. Moreover, results demonstrate larger impact of both variables for homogeneous goods.

The second model based on the theoretical discussion in Anderson and van Wincoop (2004). As we have already discussed above, according to this model, international prices differ to the extent of trade costs, good characteristics, taxes and finally markup differences. In this essay, we attempt to infer the effects of potential determinants for different commodity types. Results show that homogeneous goods have higher price elasticity of distance and local distribution cost and markup differences have larger impact on differentiated goods. Furthermore, our results support the argument made by Rauch (1999) and Barthelon and Freund (2004): The price elasticity of distance decreases monotonically over the period for differentiated goods, but we do not observe a similar trend for homogeneous goods. So, it can be concluded that, decrease in search costs over the years affects the trade and prices of differentiated goods more than homogeneous goods. In short, our results make it clear that the effect of potential determinants of international price dispersion differs substantially for different product types. Since product differentiation is used in order to control the effect of market structure, these results demonstrate that market structure has an important impact on international price dispersion.

Overall, results presented in this dissertation indicate that international price dispersion is largely determined by transportation cost, local distribution costs, good characteristics, taxes and differences in markups and heterogeneity across different product categories should be considered in future work in this literature

CHAPTER 2

INTERNATIONAL PRICE DISPERSION AND THE DIRECTION OF TRADE

2.1 Introduction

Crucini, Telmer and Zachariadis (2005) (CTZ) make the case that Law-of-One – Price (LOP) and Purchasing Power Parity are essentially about the cross-sectional distribution of international relative prices rather than about the time-series behavior of changes in these relative prices, and that "economic theory places much starker restrictions on LOP deviations than on their changes"; the implication being that the gap between theory and empirics can be bridged through the use of microeconomic price levels that enable exact comparisons across locations. Anderson and van Wincoop (2004) propose the use of price level data that are comparable across locations at a point in time as a promising route for inferring trade cost levels, arguing that "it is hard to see how information can be extracted about the level of trade costs from evidence on changes in relative prices." They go on to suggest that in order to extract information about trade costs from price levels " a natural strategy would be to identify the source country for each product," noting that " unfortunately survey data often do not tell us which country produced the good."

In this paper, we consider microeconomic price levels along with the information on productivity of each country in each industry which we use in order to identify the most likely source for each product. This is consistent with the models of Eaton and Kortum (2001), Eaton and Kortum (2002), and Bernard, Eaton, Jensen, and Kortum

(2003) where the most productive country for any one product is the sole source of that product to the rest of the world. As an alternative identification strategy, we consider industry-specific bilateral trade flows in order to determine the price of the product in the hypothetical source as a weighted average of the prices of an importing country's actual trading partners. Utilizing trade flows, allows us to consider price comparisons for each product consumed in the importing country relative to countries that are likely to be a source for that product.

We consider a variation of the Eaton and Kortum (2002) model proposed in Anderson and van Wincoop (2004). In this framework, international price dispersion is determined by transport costs, local trade (distribution) costs, taxes, good-specific characteristics, and differences in markups. We use geographic distance as a measure of transport costs and also allow for industry variation in these. We account for local trade costs through income per capita differences as in Crucini, Telmer, and Zachariadis (2004), and also consider industry-specific features of local costs as captured by the non-traded factor input content measure used in CTZ and by country-industry-specific real wage rates. Differences in taxes across goods are captured by group-specific dummies for classes of goods that are likely to face higher taxes and, where broadly available, by considering VAT levels for different goods and countries. Finally, we assume that the larger markets tend to be more competitive so that demand elasticities are higher and markups lower there, and utilize population size to capture market size as an approximate inverse measure of the markup.

Transport costs and broader trade costs are of central importance in many macroeconomic models.[1] However, assessing these costs at the macroeconomic level has proved to be problematic. Anderson and van Wincoop (2004) argue persuasively that "average price dispersion measures are not very informative about trade costs." In general, the impact of trade costs in segmenting individual product markets will be underestimated while considering aggregate prices or the average (over products) of price deviations. When aggregate prices or mean price deviations are considered, it is likely that countries both export and import to and from each other some of the goods that go into the construction of the composite price. As a result, the impact of trade costs on price differences could wash out on average even if trade costs were important in segmenting markets as determinants of international price deviations for individual products. This is the "averaging-out property" put forth by Crucini, Telmer, and Zachariadis (2004).

Trade costs will again be mismeasured in the absence of information regarding the source of the product being compared across locations. Even when internationally comparable prices of individual products are available, the lack of information about the source of particular products makes it difficult to infer trade costs.[2] For instance, transport costs would be mismeasured since the distance between the two countries does not necessarily capture distance between exporter and importer. If trade between two countries does not occur for a certain product, then that price difference shall lie between

[1] For instance, Atkeson and Burstein (2004) consider a theoretical model where trade costs are essential in explaining the time series relation between international relative prices of tradable goods and the real exchange rate.

[2] This might be behind the finding in Anderson and Smith (2004) and elsewhere of a small or non-existent average impact of transport costs, captured by physical distance, on deviations from LOP.

the no-arbitrage bounds and will be less than the trade cost.[3] On the other hand, if both countries export the product to each other, the overall impact of trade cost on that product's price difference between these two countries can be zero even if these costs are positive and large for each country. A bilateral price difference truly reflects the size of trade costs when only one of the countries being compared is the source of that product to the other.

In this paper, we aim to resolve the abovementioned problems by utilizing product-specific international price differences along with cross-sectional productivity indices and bilateral trade flows between countries to identify the likely source of any one product. Utilizing the unique –in terms of breadth of the goods covered and their exact comparability across locations- microeconomic dataset of absolute prices across the European Union from CTZ along with information on the direction of trade, we identify economically meaningful measures of trade costs in general, and transport costs in particular through their estimated impact on product-specific retail price differences between importing and source countries.[4]

We find that country-specific aspects of transport costs measured by geographic distance, and distribution costs measured by real income per capita, are important in explaining deviations from the law of one price and absolute price dispersion. In addition,

[3] Since the average trade cost between countries that do not trade with each other is likely to be greater than between those that do, the price gap is likely to be greater between locations that do not trade even though this falls within the bounds determined by trade costs.

[4] Trade across these European countries is less likely to be characterized by high policy-related and other unidentified trade barriers, enabling us to better capture transport costs via a geographic distance measure. However, to the extend that transport costs across these countries are relatively less important, our estimates of these are a lower bound for average transport costs characterizing world trade.

industry-specific transport costs as measured by the local cost content of final products are shown to be important in determining absolute price dispersion across countries. Overall, the data are consistent with models where transport costs and differences in distribution costs, retail taxes, and market size play important roles in the determination of international retail price differences.

The importance of trade costs in relation to international quantity flows and international price dispersion has been emphasized in the recent work of Anderson and van Wincoop (2004) and Hummels (1999). However, there is little in terms of empirical work that examines price dispersion and the direction of trade within a unified framework.[5] Heterogeneity in trade costs and productivity and the interaction between these are central to the quantity and price implications of a number of recent papers. For example, in the model of Bergin, Glick, and Taylor (forthcoming), heterogeneity in trade costs and productivity across goods may reverse the usual Balassa-Samuelson effect if the productivity advantage relates to goods with high trade costs. Benigno and Thoenissen (2003) consider the impact of total factor productivity (TFP) shocks in a theoretical environment that allows for home bias and market segmentation, where productivity advantage is consistent with lower domestic price level since domestically produced goods comprise a larger fraction of domestic consumption than foreign consumption. Here we allow for and utilize productivity heterogeneity across industries.

[5] The model in Eaton and Kortum (2002) has implications for both international price dispersion and quantity flows but has not been fully explored empirically. Bergin and Glick (2005) consider a model of firm heterogeneity in per unit costs of trade where reductions in fixed cost of trade or per unit tariffs have differential effects on price dispersion. They then use this model to explain the apparently contradictory observations that “while quantities of trade have increased significantly, especially for previously non-traded goods, “there has been limited or negative price convergence.”

Our identification strategy is consistent with lower product prices in countries that have higher productivity in that industry. Finally, we explore the issue of industry heterogeneity in transport costs and show that our estimates of the latter are consistent with common measures of tradability.

The remainder of the paper is organized as follows. Section 2.2 describes the unique dataset of microeconomic prices from CTZ and the construction of cross-sectional TFP indices and trade-weighted relative prices. Section 2.3 offers the theoretical motivation behind our empirical application pursued here. Section 2.4 briefly concludes.

2.2 Data Description

Let's denote p_{ij} as the local currency price of good I in country j, p_{ik} as the local price of the same good in country k, and e_{jk} as the nominal exchange rate of country j in terms of currency units of country k. then we can define law-of-one price deviations as

$$\ln q_{ijk} = \ln\left(e_{jk}\, p_{ij} / p_{ik}\right) \tag{2.1}$$

We use the same retail price data as CTZ.[6] A detailed description of the data is provided in the latter paper.[7] These data originates from Eurostat surveys conducted in different European cities sampled at five year intervals between 1975 and 1990. The level of detail often goes down to the level of the same brand sampled across locations and enables exact comparisons across space at a given point in time. The price data for each cross-section is collected in a sequence of surveys where the same group of goods is

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[6] We take from CTZ the common currency prices with the outliers having being removed. CTZ remove the price entry for a good in a certain country when the price in that country differs by a factor of five from the average common currency price for that good across countries.

[7] A comprehensive list of the goods is available at http://bertha.tepper.cmu.edu/eurostat

collected within the same period for all countries.[8] The Eurostat survey covers nine countries for 658 goods in 1975, 12 countries for 1090 goods in 1980, and 13 countries for 1805 and 1896 goods respectively for 1985 and 1990. The nine EU countries in the 1975 survey are Belgium, Denmark, France, Germany, Ireland, Italy, Luxembourg, The Netherlands, and the UK. Greece, Portugal and Spain are added in 1980 and Austria in 1985.

Each good was assigned to a three-digit industry to be mapped into the industry-specific measures of the non-traded input share, tradability, and the real wage rate, as well as to TFP and bilateral import flows the construction of which is discussed in the next few paragraphs. The non-traded input share of the good is the ratio of non-traded input costs to total cost for each industry. Non-traded inputs are assumed to include: utilities, construction, distribution, hotels, catering, railways, road transport, sea transport, air transport, transport services, telecommunications, banking, finance, insurance, business services, education, health and other services. This measure is taken directly from CTZ who compute it using the 1988 input-output tables of the UK. The tradeability for each industry is measured as the ratio of total industry trade between countries in the sample divided by total output of that industry across the same countries, as in CTZ.[9] We use three-year averages of tradeability using two preceding years along with the cross-sections sampling years in order to limit measurement error issues.

[8] In what CTZ call "1985", for instance, the prices of most services were collected in September-October 1985, while prices of most clothing items were collected in December of 1984. The nominal exchange rate data with which prices were converted into a common currency takes explicit account of this timing, taking the form of averages of daily data over the relevant time intervals,

[9] Both shares are listed in detail in tables A1 and A2 in the data appendix in CTZ (2005).

The distance measure utilized here is the greatest circle distance between the airports of the capital cities and is measured in kilometers. The capital city of each country is the sampling location of the price data for all countries but Germany for which the reported prices are an average from a number of cities within that country. Thus, for Germany, we use distance relative top Frankfurt, a geographic and economic center. Population and real GDP per capita are obtained from PWT 6.1 for each of the cross-sections. The latter measure is the constant price chain series GDP per capita with the code name rgdpch.

We also use data on VAT rates for 23 different categories of goods and services for all countries in our sample in 1990. For 1975, 1980 and 1985 VAT is not observed for Greece, which entered the European Community (EC) in 1980, and for Portugal, and Spain which entered the EC in 1985. This is the same VAT data as in CTZ, assembled from the European commission publication “VAT rates applied in the member states of the European Community” (2002), the OECD publication “Taxing Consumption, and the Ernst and Young publication “VAT and Sales Taxes Worldwide: A Guide to Practice and Procedures in 61 Countries” (1996).

Data required for TFP calculation come from two World Bank sources: the Trade and Production Database on investment and Capital for Agriculture and Manufacturing.

The Trade and Production Database collects production and trade information for 67 developing and developed countries from different sources and merges them into a common classification. The main sources for production data are the UNIDO and OECD joint collection program. We obtained from this database value added in current dollars and fixed capital formation, as well as wages and salaries and the number of employees for 28 three digit manufacturing industries. Depending on the country, the coverage of data is from the late '70s to late '90s. Value added in current dollars is deflated to obtain value added in constant dollars using price deflators from the OECD STAN database.[10] Wages in current dollars were deflated using the same price deflators from the OECD STAN database to obtain wages in constant dollars. The real wage utilized in the regressions was constructed as wages and salaries in constant dollars over the number of employees.

The Database of Investment and Capital for Agriculture and Manufacturing reports the total capital stock for the manufacturing sector. Using capital formation data for 28 manufacturing industries from the Trade and Production Database, we also obtained total manufacturing sector investment. We then obtained each industry's share of total manufacturing for each country. Finally, we assume that the share of investment in the industry in total manufacturing for a specific year is equal to its share of the capital stock and then use observed industry share and total manufacturing capital stock to calculate capital stock for each manufacturing industry. The data appendix provides additional details on the construction of the capital stock.

With the data at hand and, following Harrigan (1997), under the assumption of a Cobb-Douglas production function, total factor productivity (TFP) between countries j

[10] We obtain volumes expressed in US dollars as $vol_{US} = (VALUK * VALU_{95})/100$, where VALUK is the volume index for value added, and $VALUE_{95}$ is the base year figure for the current price variable. We then obtain the value added deflator as $VALU / vol_{US}$. Since 1990 is the base tear for the capital stock of the manufacturing sector, we use the value added deflator for 1990.

and k for industry h can be described as

$$TFP_{hjk} = \left(Y_{hj} / Y_{hk}\right)\left(L_{hk} / L_{hj}\right)^{s}\left(K_{hk} / K_{hj}\right)^{1-s} \qquad (2.2)$$

where Y denotes real value added, L is the number of employees, K is the capital stock for each industry and s is the average share of labor in total cost between j and k. In calculating TFP, we use three-year averages of the variables using the two preceding years along with each cross-section's sampling year. The data for constructing TFP is not available to us for 1975 and is only available for five of the above countries in 1980 limiting our ability to identify the source country. This is the reason we initially utilize price data for 1985 and 1990 for which TFP is available for an identical sample of eight countries: Austria, Denmark, Germany, Greece, Ireland, Italy, Portugal, and the United Kingdom (UK). Moreover, throughout the paper, we consider manufacturing goods prices since we could not obtain the data for constructing TFP for services at a disaggregate level and because we are primarily interested in trade costs faced by traded goods.[11] The availability of the TFP measure across industries is reported in table A1 in the data appendix.

We utilize bilateral trade flows from the OECD International Trade by Commodity Statistics (ITCS) database, in order to identify the probability-weighted source for each good sold in each country of the Eurostat price dataset. We are now able to use the full sample of countries and years allowed by the CTZ price data, with the exception of Luxembourg, as the data requirements of TFP construction no longer

[11] Arbitrage models as in Lee (2004) show that price differences across countries will equal the trade costs for products that are traded while endowment or productivity differences will determine the exact degree of deviations from the LOP for products that are not traded in equilibrium.

constrain us. Utilizing this broader sample of countries is desirable since it also enhances our ability to assess the probable source for each product among a broader group of possible source countries.

The ITCS database includes annual bilateral flows in current $US between 269 international locations for 2581 goods categories for the period 1960-2000. We inspected this list of traded goods and categories and came up with a list of 68 product categories chosen to best relate to the products from the Eurostat price data. These 68 categories which are described in the first column of the table A2 in the appendix, were then aggregated by ISIC code into 42 separate four-digit categories of the manufacturing sector, shown in the second column of Table A2, that are finally mapped onto the disaggregated product prices from the Eurostat data.[12] We end up with imports for each of 42 industries of each country in our sample from each other.[13] That is, we consider imports of country j from each other countries in our Eurostat price data for each industry h. for each importer j and industry h, the probability-weighted source price for a specific product is defined as the weighted average of the prices of exporters of that product with weights calculated using bilateral trade flows for each cross-section.

[12] There is a many-to-one mapping from goods for which we have prices to the four-digit categories in the trade data. Ideally, future work should focus on more disaggregated trade data that can be closely matched to the products in the price surveys. However, this labor intensive task would face two inherent problems. First, for disaggregated products, the problem of "empty cells" is a greater concern. Second, the measurement error is greater for highly disaggregated product categories relative to aggregates.

[13] As we are constrained by the number of countries for which we have price data, we actually use eight countries for 1985, 11 for 1980, and 12 for 1985 and 1990. we note that, while in the price data, Belgium and Luxembourg prices are given separately, the bilateral flows dataset includes the aggregate of Belgium and Luxembourg reducing the number of countries we can consider by one for each cross-sections.

Denoting im_{jkt}^{h} as imports of country j from country k for industry h in cross-section t, the weight of exporter country k for importer j in industry h is defined as $w_{jkt}^{h} = im_{jkt}^{h} / \sum_{k=1}^{n-1} im_{jkt}^{h}$, where n is the number of countries in the sample. However some exporting countries have missing prices for some goods so that the sum of the above weights would not add up to one in these cases. To cope with this, we re-scale the weights.[14] The price in the probability-weighted origin is then simply given by the weighted sum of exporting countries' observed prices:

$$p_{j\kappa t}^{h} = \sum_{k=1}^{n-1} w\_new_{jkt}^{h} * p_{kt}^{h} \qquad (2.3)$$

where we have one probability-weighted source, κ, for each importer j in each industry h. We can then compare the price of each product sold in the importing location relative to this probability-weighted source. The same weights are used in order to construct the real GDP per capita, the real wage rate, population and distance variables of the probability-weighted origin relative to which we compare the respective variables of the importing country.

Finally, we add the effect of domestic production of the importer country into the analysis. Domestically consumed production of country i for industry h is defined as the difference between total output and exports of country i for that industry. Total output and exports data were obtained from the Trade and Production Database as the three-digit level of the manufacturing sector. We treat domestically consumed production for country j for industry h in cross-section t as an import from itself and re-define the weight

[14] For each good, we consider only imports from countries for which the price is observed so that the new weights are given by multiplying w_{jkt}^{h} by $\sum_{k=1}^{n-1} im_{jkt}^{h}$ over the new imports sum.

of exporter country k for importer j in industry h as $w^h_{jkt} = im^h_{jkt} / \sum_{k=1}^{n} im^h_{jkt}$, where n is the number of countries in sample including the importer country j itself. We then re-scale the weights as explained in the previous paragraph. The price in the probability-weighted origin is again given by the weighted sum of exporting countries' prices: $p^h_{j\kappa t} = \sum_{k=1}^{n} w\_new^h_{jkt} * p^h_{kt}$, where the price of the importing country itself is now included in this calculation. Again, real GDP per capita, the real wage rate, population, and distance for the probabilistic exporter are calculated by using these same weights. These weighted variables are then used to construct log differences relative to the importing country. To facilitate the construction of relative distance, distance from the importing country is defined as $dist_{jj} = \left(A_j / \pi\right)^{1/2}$ where A_j is the surface area of importer country j in squared kilometers.

2.3 Motivation and Estimation

2.3.1 Theoretical Motivation

Anderson and van Wincoop (2004) propose the use of actual price data across locations at a point in time as promising route of extracting information about trade cost levels. They consider a framework where the price of final good is determined by production costs, trade costs, markup, and taxes. Abstracting from markups and taxes they are able to impose arbitrage constraints and derive an inequality that constraints international relative prices. The assumption here is that if country i buys from country κ, then $p_i = c_\kappa \tau_{i\kappa}$, where c_κ is the cost of production in κ, and $\tau_{i\kappa}$ is the trade cost of transporting the good from κ to i. Moreover, country i will buy from κ if $c_\kappa \tau_{i\kappa}$ is the lowest among all potential sources. The inequality thus derived is $\frac{c_{z_i}\tau_{iz_i}}{c_{z_i}\tau_{jz_i}} \leq \frac{p_i}{p_j} \leq \frac{c_{z_j}\tau_{iz_j}}{c_{z_j}\tau_{jz_j}}$ or $\frac{\tau_{iz_i}}{\tau_{jz_i}} \leq \frac{p_i}{p_j} \leq \frac{\tau_{iz_j}}{\tau_{jz_j}}$, where p_i and p_j are retail prices in country i and j, and z_i and z_j are the optimal sources for country i and j respectively. When countries i and j purchase the good from the same source, κ, then the above inequality is reduced to $\frac{p_i}{p_j} = \frac{\tau_{i\kappa}}{\tau_{j\kappa}}$, with the relative price now tied down by trade barriers. Finally, they conclude that "in the specific case where κ is one of the two countries, the relative price captures exactly what we intend to measure." That is, once we identify the probable source country then we can capture the exact level of trade costs.[15]

This treatment is in line with what we do in this paper. Specifically, we use independent information on the productivity of each country in each industry to identify the most likely source for each product. Utilizing productivity to identify the source is consistent with the above framework where a country buys from the cheapest source, and with the models of Eaton and Kortum (2001), Eaton and Kortum (2002), and Bernard, Eaton, Jensen and Kortum (2003), where the most productive country for any one product is the sole source of that product. Alternatively, we consider actual trade flows to construct the price in the source, κ, as a weighted average of each country's within-sample trading partners.

[15] Given the absence of product-specific source information, our aim is necessarily less ambitious. We estimate an improved measure of the relative importance of two components of broadly defined trade costs: transport costs and distribution costs, while controlling for other potential determinants of international relative prices.

Under the maintained assumptions above, the relative price thus obtained could be attributed to trade costs. However, controlling for a number of additional potentially important determinants of international price differences is necessary in practice if we are to best isolate the impact of trade costs. Our point of departure is the framework outlined in Anderson and van Wincoop (2004), where final good prices might differ internationally to the extent that transport costs, and local trade costs, taxes, and markups exhibit variation across countries and goods.

Given the absence of direct measures of transportation costs for broad cross-sections of goods and countries and the problems associated with cif/fob ratios in levels as discussed in Hummels and Lugovskyy (2003), we follow the usual practice of using physical distance between the capital cities of the countries in our sample to capture transportation costs. That is, once we identify the probable source for each product, we identify the size of transport costs by estimated coefficient of distance from the source country. In addition, as suggested in Anderson and van Wincoop (2004), we allow for industry-specific differences in transport costs, first through a measure of tradeability[16] as in CTZ and following that, through the use of industry-specific distance interaction effects.

We also account for the presence of local distribution costs through income per capita differences and by considering industry-specific features of these local costs as

[16] Since this industry-specific measure is based on realized trade flows, it might partly capture industry-specific trade costs other than transport cost. Moreover, industry-specific measures can only be considered as determinants of absolute price deviations, since actual price deviations are related to the direction of trade across countries and can only be explained by factors that have variation across countries.

captured by the non-traded factor input content of each good.[17] Industry-specific features of local costs are also captured by domestic real wage rate rates. Differences in taxes across goods are captured by group-specific dummies for classes of goods that are likely to face higher taxes and where broadly available, by VAT differences across goods and countries.

Finally, we assume that larger markets are more competitive so that demand elasticities are higher and markups lower there, and use population size to capture market size. Larger markets are likely to have a greater number of exporters serving them –in the presence of some fixed cost component in trade cost- and are also more likely to have domestic production of close substitutes for imports –in the presence of some fixed cost component to production inducing economies of scale-both factors leading to a more elastic perceived demand for imports and lower prices in larger markets. It might also be that potentially price discriminating exporters' value large foreign markets more than smaller ones thus exhibiting greater risk aversion for losing large markets and are less likely to charge higher prices there in the presence of demand uncertainty. On the other hand, population size might capture scale economies that simply lower the average domestic cost of production leading to lower domestic prices. However, the scale of domestic production also depends on exports so that population size is less likely to capture scale economies from the production side and more likely to capture scale economies in the domestic distribution or retail sector. In any case, given the difficulty of capturing variations in markups across countries, an alternative starting assumption

[17] We fallow Anderson and van Wincoop (2004) in classifying transport costs and distribution costs as two categories of trade costs, the second of which is related to the local cost component of final prices.

would be that markups exist but are similar across countries so that they do not impact on international price differences. This assumption is imposed in Crucini, Telmer and Zachariadis (2004) and discussed in Anderson and van Wincoop (2004). In that case, the coefficients of population size differences would be interpreted instead as measures of scale economies across industries and specific to countries.

2.3.2 Estimation and Results

Based on the above, we expect that the price difference between the importing location and the source country for a particular final product would be largely determined by transport costs and international differences in local distribution costs, taxes and markups. Thus, we attempt to infer the estimates of the impact of each potential determinant of international price differences by utilizing physical distance as a measure of the importance of transport costs, income per capita or domestic industry-specific real wage rates as measures of the local cost component comprising the price of final goods, and population size as capturing differences in markups, also allowing where possible for VAT differences across industries and countries. In addition, for the absolute price differences specifications we are able to consider product category-specific differences in taxes and industry-specific measures of tradeability and the non-traded factor input content to capture the importance of industry-specific transport costs and local distribution costs respectively.

2.3.2.1 All Unique Bilateral Comparisons

As a first step, we consider the following regression equation for all possible unique bilateral price comparisons j-k

$$q_{ijk} = \alpha_0 + \alpha_1 Dist_{jk} + \alpha_2 y_{jk} + \alpha_3 Pop_{jk} + \varepsilon_{ijk} \qquad (2.4)$$

where q_{ijk} is the log deviation from the Law-of-One-Price (LOP) for good i between countries j and k, α_0 is a constant term[18], and ε_{ijk} is a random error[19]. $Dist_{jk}$ is the (log) distance separating the capital cities of the two countries and is meant as a proxy for transportation costs impeding trade and maintaining price differentials across j and k. The variable y_{jk} is the log difference in real GDP per capita between j and k and captures the local cost component suggested by the theoretical framework from CTZ and Anderson and van Wincoop (2004). That is, GDP per capita captures a "wage effect" whereby richer countries will have higher non-traded sector labor costs.[20] In this sense, GDP per capita is a measure of the local distribution costs discussed above. Finally, Pop_{jk} is the log difference in population size in 000's between countries j and k and is meant to capture the effect of domestic market size. The inclusion of population size is also consistent with gravity models used to assess international quantity flows.

In considering all possible unique bilateral comparisons j-k, we compare each pair of countries once with each bilateral comparison made based on alphabetical order rather than relative to countries more likely to be a source for the product. This is then an

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[18] All explanatory variables are demeaned so that the constant can be interpreted as the price deviation relative to source k at average levels of distance, real GDP per capita, and population size in the sample.

[19] As shown in Crucini, Telmer and Zachariadis (2000), it is necessary to correct the standard errors for heteroskedasticity in this specific context, where we use the aggregative values of the explanatory variables to explain a highly disaggregated dependent variable. This creates a heteroskedastic pattern in the variance of the regression term as shown in the earlier paper. This type of aggregation also makes goodness of fit measures difficult to interpret, so that the low R^2's reported here should be taken with caution.

[20] Crucini, Telmer and Zachariadis (2004) explore the relation between distribution costs and GDP per capita.

arbitrary comparison using no information regarding the source of each product and renders the coefficient of geographic distance proxying for transport cost meaningless. This case will be a reference point with which to compare trade cost estimates obtained utilizing information on the probable source of each product.

Estimates and t-statistics from estimating the above specification (Model 1) with OLS and correcting standard errors for the inherent heteroskedasticity are presented in Table 2.1. The distance coefficient is estimated to be negative and statistically indistinguishable from zero for 1985 and equal to 5.5 percent and significant in 1990. Considering all possible bilateral comparisons tends to average out around zero the impact of transportation costs on prices producing unreliable estimates. The estimated coefficient of distance is perhaps devoid of meaning here as distance between two arbitrary countries does not necessarily capture distance between exporter and importer. If trade between two countries does not occur for that product, then that price difference will lie between the no-arbitrage bounds and will be less than the trade costs. Moreover, when comparing two countries it is possible that both export some of the same products to each other. To the extent that this is the case, the final price for these products will incorporate a similar transportation costs in both countries so that there might be a little or no impact of transportation costs on the price difference for these products between the two countries.[21] In general, in the absence of some information regarding the source of

[21] It is also possible that k is the main exporter to j for some product i and does not import this product from j, and j is the main exporter to k for some product i' and does not import this product from k. In that case, this would induce the distance coefficient to be positive as transport costs increase the price in country j relative to k while in the second case the distance coefficient would be negative. The overall result is a possible washing out of the average effect of transport costs across goods. This is related to the "averaging-out" property discussed in Crucini, Telmer and Zachariadis (2004) and can be addressed by considering

each product and the direction of trade, the distance coefficient will not capture transport costs well in the context of "directional regressions" such as the one in Model 1.

GDP per-capita and population enter in expected ways in Model 1. Per -capita GDP shows a strong positive relation with price differences between countries. The price elasticity of real GDP per-capita is 29.5 percent for 1985, and 28.3 percent for 1990, exhibiting remarkable stability over this five year period. Moreover, higher population is associated with lower prices in a country suggesting a potential role for markup differences across countries due to differences in demand elasticities that are positively related to the market size. In this case, the markup would be lower in larger markets as evident in the negative estimated coefficients for population size. Alternatively, scale economies in distribution related to the domestic size of the market might be behind this finding.

Model 2 describes the relation between absolute price differences and the absolute values of the variables that are included in Model 1 as well as additional industry-specific variables like tradeability and local factor input content of goods in each industry. Taking absolute values of the price differences serves three purposes. First, it allows us to use distance as a meaningful determinant of (absolute) price dispersion even in the absence of source country information. This is the case since it resolves the "averaging-out" problem, as pointed out by Crucini, Telmer and Zachariadis (2004). Secondly, it allows us to consider the two industry-specific variables from CTZ which are closely related to a theoretical model where final goods are produced by combining local inputs with traded

absolute price differences for each product across countries or an appropriate variance measure. We pursue this in Model 2 below.

inputs. We would expect goods characterized by a higher degree of tradeability to have smaller absolute price dispersion, and goods with higher local input content to have a higher degree of absolute price dispersion. In our empirical specification, these industry-specific variables enter along with the country-specific measures of transport costs and local distribution costs, where separate impact of industry and country-specific factors would suggest that these trade exhibit heterogeneity across both industries and countries. Finally, we can now introduce two dummy variables related to characteristics of categories of goods. These are intended to control for the degree of tax differences present for certain products where we have some a priori evidence (but no good-specific data) regarding particularly high differences across countries. We would expect such goods to be characterized by a higher degree of absolute price dispersion.

Thus, we estimate the following regression equation for Model 2:

$$\left|q_{ijk}\right| = \alpha_0 + \alpha_1 Dist_{jk} + \alpha_2 \left|y_{jk}\right| + \alpha_3 \left|Pop_{jk}\right| + \alpha_4 X_h + \varepsilon_{ijk} \qquad (2.5)$$

where X_h is a vector of industry-specific and category-specific variables capturing product characteristics as described above. The remaining variables are defined as in regression equation 2.3. The constant α_0 now captures price dispersion at mean distance, real GDP per capita and population size in the sample. The results for Model 2 indicate that as distance between countries increases so does absolute price dispersion. For example, based on the 1985 estimates, doubling in distance increases absolute price dispersion by 10 percent. We also see that price differences are lower for goods that belong to more highly tradeable industries. To the extent that more tradeable goods face determining absolute price dispersion. Thus, both bilateral distance and industry specific

Table 2.1 All Unique Bilateral Comparisons With GDP per-capita

	1985			1990		
	Model1	Model2	Model3	Model1	Model2	Model3
Population	-.066* (-22.54)	.006** (1.96)	.003 (0.29)	-.049* (-17.14)	.007** (2.51)	.011 (1.34)
GDP per-capita	.295* (19.02)	.036** (2.46)	.036 (0.76)	.283* (17.20)	.047* (2.91)	.132** (2.60)
Distance	-.009 (-0.98)	.100* (15.79)	.116* (5.69)	.055* (6.40)	.075* (11.97)	.095* (4.58)
Tradability		-.057* (-7.24)	-.089* (-5.36)		-.087* (-11.46)	-.076* (-4.22)
Non-traded input share		.010* (9.12)	.011* (3.94)		.003* (2.63)	.007* (2.66)
Large cars		.255* (6.95)			.143* (7.67)	
Vices		.227* (13.51)	.172* (4.99)		.218* (12.83)	.194* (5.69)
Constant	.076* (18.65)	.274* (21.78)	.311* (8.93)	.097* (24.00)	.359* (29.29)	.314* (8.54)
R^2(in percentage)	4.1	5.8	16.9	3.5	6.3	23.2
Observations	13995	13995	530	12315	12315	473
Countries	8	8	8	8	8	8

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. In Model 2 we take absolute values for all variables. In Model 3 we use the mean of absolute LOP deviations. The eight countries considered here are: Austria, Denmark, Germany, Greece, Ireland, Portugal, and the UK.

lower effective transportation costs this result suggest a role for transport costs in aspects of transport costs (tradeability) matter –about equally- for absolute price dispersion. Furthermore, higher local input share implies higher absolute price dispersion as the model discussed earlier would predict. Moreover, income per-capita differences enter as a positive determinant of price dispersion, suggesting that both country specific and industry specific aspects of distribution costs matter for absolute price dispersion. However, the estimated impact of income on absolute relative prices across countries in many times smaller than its impact on the actual level of relative prices. By considering absolute price differences we might be underestimating the importance of the local cost component in determining price levels. In this case, the gains made in terms of estimating the transport cost component of trade costs using absolute price dispersion in Model 2 would appear to be a loss in terms of our ability to estimate the distribution costs component of trade costs.

Finally, population coefficient estimates suggest absolute price dispersion increases with differences in population size, indicating a possible role for markup differences as determinants of international price dispersion. The dummies for large cars and vices also have positive and significant effects on absolute price deviations. If a good belongs to the classified by one of these dummies, its price difference between countries will be larger, suggesting a role for tax differences in determining international price dispersion.

For Models 1 and 2, goodness-of-fit measures (R^2) are very low. Price data are more disaggregated than explanatory variables; therefore the R^2 is not meaningful for these models. As explained in CTZ, this type of aggregation makes goodness-of-fit measures difficult to interpret s that the low R^2 here reported here should be taken with caution. In order to alleviate the problem, we follow CTZ and aggregate the data. Specifically we use mean absolute price differences for each bilateral pair of countries in each three-digit industry and then run Model 2 again on the same explanatory variables as before. This is Model 3 for which results are reported in Table 2.1. The goodness-of-fit increases substantially for both cross sections. The coefficient estimates for most of the variables are similar qualitatively to those reported for Model 2. The estimated coefficient for the distance is positive and significant in both cross sections for Model 3 as was the case in Model 2, while the estimated coefficients for local costs are generally higher than in Model 2. The estimated coefficient for category-specific taxes is about the same as in Model 2 in the case of vices. However, since in Model 3 we aggregate according to 3 digit ISIC category, the dummy for "large cars" has not been included in this regression since this product category is one of several in category 384 which includes all transport equipment;.

As a robustness check and to account for broader local costs (including production costs), we re-estimate Models 1, 2 and 3 utilizing information on industry-level real wage rates across countries. Since countries with higher GDP per-capita will typically have higher wage rates, we do not include both measures to avoid the inherent collinearity problem for these two variables. Industry-level real wage rates capture the local cost component attributed to labor but specific to each industry. The fact that our wage measure captures variation across both industries and countries is an advantage relative to country specific measures of real GDP per-capita. The exercise also offers a robustness check for our coefficient estimates on distance, tradeability, and industry-specific local input costs. We report results utilizing wage rates in Table 2.2. We can see that real wage rate has positive impact on price differences in Model 1, and on absolute price differences on Models 2 and 3. The wage impact on prices is about half the GDP impact for Model 1 but larger than the GDP impact for Model 2 and more robust than the GDP impact for Model 3. We also see that the coefficient estimates for the industry specific measures of tradeability and the local factor input content are virtually unchanged. Finally, the estimates for the distance coefficient are qualitatively similar but smaller across the board for all three models and both years relative to the specifications that include GDP per-capita in Table 2.1. This might suggest that real wage rates capture an aspect of local production costs that would otherwise be in part attributed to transport costs.

2.3.2.2 Utilizing Information on Relative Productivity

Overall the results for models 2 and 3 summarized in Table 2.1 indicate that there is a positive and significant relation between distance and absolute price dispersion. However, the interpretation of the coefficients related to transport costs can be problematic for the reasons outlined in the previous section and in the introduction. Moreover, as shown in Table 2.1 for Model 1, the effect of distance on price differences is estimated to be statistically indistinguishable from zero for 1985 for instance, perhaps pointing to the argument put forth by Anderson and van Wincoop (2004). That is, without knowing the potential source for a good, we can not estimate the precise role of transportation costs in determining differences in the price levels for that good between countries.[22]

One way to address the problem is to assume that the more productive among any

[22] One approach would be just assuming one of the countries to be the main exporter using a-priori information. This is unsatisfactory conceptually for obvious reasons and, as one would expect, this approach does not give reliable results. Table in the appendix reports the estimation results for Germany and the U.K. used as a reference countries in each case. The sign and the significance of the distance coefficients are not robust across periods or reference countries.

Table 2.2 All Unique Bilateral Comparisons With Real Wage Rate

	1985			1990		
	Model1	Model2	Model3	Model1	Model2	Model3
Population	-.043* (-16.39)	.007** (2.50)	.005 (0.58)	-.041* (-15.58)	.009* (3.39)	.015*** (1.91)
Real Wage Rate	.098* (13.14)	.055* (7.49)	.082* (3.78)	.148* (20.05)	.061* (7.41)	.106* (4.50)
Distance	-.005 (-0.54)	.075* (11.10)	.075* (3.52)	.035* (4.04)	.056* (8.76)	.068* (3.28)
Tradability		-.058* (-7.39)	-.092* (-5.75)		-.088* (-11.62)	-.077* (-4.28)
Non-traded input share		.010* (9.14)	.010* (4.07)		.003* (2.73)	.007* (2.72)
Large cars		.259* (7.00)			.150* (8.07)	
Vices		.224* (13.39)	.167* (4.94)		.219* (12.97)	.196* (5.86)
Constant	.076* (18.53)	.274* (21.91)	.318* (9.38)	.098* (24.25)	.358* (29.32)	.314* (8.78)
R^2(in percentage)	2.9	6.2	19.1	4.6	6.8	25.6
Observations	13995	13995	530	12315	12315	473
Countries	8	8	8	8	8	8

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. In Model 2 we take absolute values for all variables. In Model 3 we use the mean of absolute LOP deviations. The eight countries considered here are: Austria, Denmark, Germany, Greece, Ireland, Portugal, and the UK.

two countries being compared will export the good to the other country.[23] A problem with this approach would be that given the measurement error associated with TFP construction, comparing countries with similar productivity is likely to often give the

[23] Thus one could consider adding to Model 1 an interaction term between the inverse of the productivity differences and distance across any two countries. This would capture the idea that for each bilateral comparison, the less productive country will be importing product from the more productive country and thus have higher prices than the latter country according to the extent of transportation costs present.

wrong ordering, simply because of measurement error. A related and preferable method is to consider price comparisons only relative to the most productive country in the data, to avoid an ordering based on comparisons among countries that are closer together in terms of productivity.

Thus, we first rank countries according to their productivity in each industry and then denote the most productive country to be the source or reference country for that specific industry. Under the assumption that the most productive country for a certain industry will be the main exporter of goods of that industry, we can then construct the good-specific log relative prices between each country j relative to the main exporter country κ for each industry h.

Admittedly, this approach does not fully resolve the problem of identifying the source country for each good in our price sample since our measure of productivity is at the three-digit level and suffers from an obvious aggregation bias. Moreover, for each destination country there might be more than one main exporter of goods in a certain industry and this exporter might or might not be among the countries in our sample. We begin to address the problems in the next section where we use bilateral imports among the countries in our sample to obtain the probability that a good sold in a certain location was imported from any of the countries in the sample, and by making use of the share of imports from non-EU countries to restrict the sample to goods that are more likely to be imported from the EU countries in our sample. However, as we show next, the current

Implementing this, we obtain consistently positive but small estimated coefficients for this measure, with relatively large standard errors.

methodology goes some distance into identifying the source country and thus providing a meaningful measure of transport costs.

Before turning to estimation using price differences relative to the most productive country, we attempt to evaluate the hypothesis that the productivity is inversely related to prices, consistent with productivity being a determinant of the direction of trade. We consider a specification similar to (2.3) adding now a term for productivity differences across countries:

1985: $$q_{ijk} = \underset{\underset{(18.60)^*}{[.076]}}{\alpha_0} + \underset{\underset{(-0.90)}{[-.008]}}{\alpha_1} Dist_{jk} + \underset{\underset{(19.56)^*}{[.318]}}{\alpha_2} y_{jk} + \underset{\underset{(-23.02)^*}{[-.068]}}{\alpha_3} Pop_{jk} + \underset{\underset{(-3.48)^*}{[-.035]}}{\alpha_4} TFP_{hjk} + \varepsilon_{ijk}$$

1990: $$q_{ijk} = \underset{\underset{(6.49)^*}{[.098]}}{\alpha_0} + \underset{\underset{(6.63)^*}{[.057]}}{\alpha_1} Dist_{jk} + \underset{\underset{(17.78)^*}{[.325]}}{\alpha_2} y_{jk} + \underset{\underset{(-17.84)^*}{[-.051]}}{\alpha_3} Pop_{jk} + \underset{\underset{(-4.40)^*}{[-.042]}}{\alpha_4} TFP_{hjk} + \varepsilon_{ijk}$$

TFP_{hjk} is the difference in total factor productivity across countries j and k for industry h, where industry h is a three digit classification with a one-to-many mapping into individual goods i. Above, we report the estimates and t-statistics for the variables in the regression for 1985 and 1990. The estimates for TFP suggest a negative impact on prices. These estimates suggest the relevance of productivity in determining the direction of international trade and as a result international price differences. The negative impact of TFP is also consistent with the theoretical model of Benigno and Thoenissen (2003) and parameterizations of the model in Bergin, Glick and Taylor (forthcoming).

Given that TFP is a determinant of the direction of price differences across countries, we now go ahead to consider the following regression equation:

$$q_{ijk} = \alpha_0 + \alpha_1 Dist_{j\kappa} + \alpha_2 y_{j\kappa} + \alpha_3 Pop_{j\kappa} + \varepsilon_{ij\kappa} \qquad (2.6)$$

where $q_{ij\kappa}$ is the log deviation from the Law-of-One-Price (LOP) for good i between countries j and κ, the most productive country in industry h assumed to be the main source for product i in country j. To estimate equation (2.6) we utilize the industry-specific country ranking implied by cross-sectional TFP levels in constructing the dependent variable of prices relative to the most productive location. Again, $Pop_{j\kappa}$ and $y_{j\kappa}$ are the population and real GDP per-capita log differences between countries j and κ respectively, $Dist_{j\kappa}$ denotes the log distance between source κ and destination j, and ε_{ijk} is a random error. As the explanatory variables demeaned, the constant α_0 captures the price deviation relative to source κ at average levels of distance, real GDP per-capita, and population size in the sample. Regression equation (2.6) incorporates information regarding the direction of trade and can thus assist in inferring the overall level of trade costs and the level of transport costs component of trade costs as the estimated coefficient for physical distance. Results from this estimation framework are summarized in Table 2.3.

Model 1, the first specification of Table 2.3, indicates that distance has a positive and significant impact on international price differences, suggesting a role for transportation costs as a determinant of these. Based on the 1990 estimates, a doubling in distance would lead to an increase in prices of 9 percent, substantially greater than the 5.5 percent increase for the specification with all unique bilateral price comparisons in Table 2.1. The improvement in terms of the estimated distance coefficient is even more striking for 1985. Comparing Model 1 across Tables 2.1 and 2.3, we see that the estimated coefficient of distance changes sign becoming positive and strongly significant once we account for the probable source of the traded products. When the most productive country for each industry is chosen as the reference location, distance consistently has a positive and significant effect on relative price levels. As the distance between source and destination country increases, transportation costs go up and so does the price of the good in the destination country. We conclude that our approach goes some distance in capturing the likely source country for each industry, even if the existence of multiple products within any industry creates aggregation bias that might still wash out the impact of distance and transport costs to a considerable degree. In addition, local costs are captured by real GDP per-capita appear to have a strong effect on price differences with elasticities equal to 28 percent for 1985 and 42 percent for 1990. Moreover, according to our estimate of the constant term, the importing country typically had prices which were 4.7 percent higher than the source at mean levels of the explanatory variables in 1990. Finally, population size has a negative effect on price differences with an estimated price elasticity of minus 5.6 percent in 1985 and minus 5 percent in 1990. This would suggest that markups are about 5 percent lower in larger countries.

Next, we utilize absolute law-of-one-price deviations relative to the most productive country to estimate a specification similar to (2.5) this formulation allows us to consider the impact of good-specific variables that are common across countries and which help explain overall price dispersion. Specifically, we consider tradeability and the non-traded factor component of goods as Crucini, Telmer and Zachariadis (2004).

Table 2.3 Price Differentials Relative to Most Productive Country for Each Industry (with GDP per-capita)

	1985			1990		
	Model1	Model2	Model3	Model1	Model2	Model3
Population	-.056* (-13.91)	-.001 (-0.28)	.015 (1.27)	-.050* (-11.14)	-.010*** (-1.90)	-.0003 (-0.02)
GDP per-capita	.280* (11.84)	.027 (1.05)	-.104 (-1.20)	.422* (12.33)	-.048 (-1.18)	-.009 (-0.08)
Distance	.041* (2.98)	.100* (10.00)	.130* (3.94)	.090* (6.61)	.064* (6.13)	.093** (2.08)
Tradability		-.046* (-3.04)	-.063** (-2.13)		-.061* (-3.86)	-.034 (-0.93)
Non-traded input share		.010* (4.74)	.005 (1.14)		.008* (3.49)	.006 (1.47)
Large cars		.147* (2.70)			.084* (2.97)	
Vices		.162* (5.99)	.089** (2.19)		.187* (5.96)	.151* (2.88)
Constant	.016** (2.25)	.228* (9.83)	.311* (5.87)	.047* (6.54)	.255* (10.85)	.290* (4.92)
R^2(in percentage)	5.4	5.7	17.6	4.8	5.0	15.7
Observations	3373	3373	132	3186	3186	123
Countries	8	8	8	8	8	8

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. In Model 2 we take absolute values for all variables. In Model 3 we use the mean of absolute LOP deviations. The eight countries considered here are: Austria, Denmark, Germany, Greece, Ireland, Portugal, and the UK.

This also allows aggregation into mean absolute price differences (Model 3) which allows us to obtain more meaningful measures of the goodness-of-fit. We plot the bivariate relation between mean absolute price differences and distance for 1985 and 1990 in Figure 2.1 and Figure 2.2 respectively. The visual evidence supports a positive relation between these two variables.

The estimates for Models 2 and 3 are reported in Table 2.3. The distance coefficient always has a positive significant impact on absolute price differences.

However, for Models 2 and 3 there appears to be little gain in terms of the effect of distance on absolute price differences relative to the estimates utilizing all unique

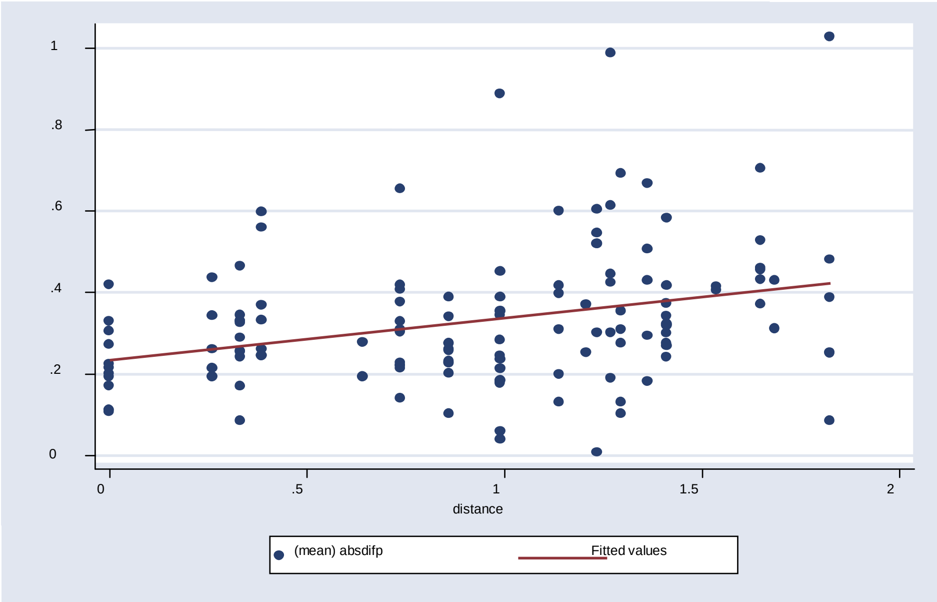

Figure 2.1 Most Productive Country Comparison-1985

bilateral price comparisons reported in Table 2.1. This is in contrast to the significant gains achieved when we utilize the productivity information to identify the source in Model 1.

Accounting for industry-specific productivity resolves some of the problems associated with the lack of information on the source of each product, so that considering absolute price deviations in Models 2 and 3 does not have as much of an additional impact on the distance coefficient in addition to the gains achieved in Model 1. The remaining parameter estimates are for the most part similar to those for the Models 2 and 3 in Table 2.1, with the exception of population which is now estimated to have a small

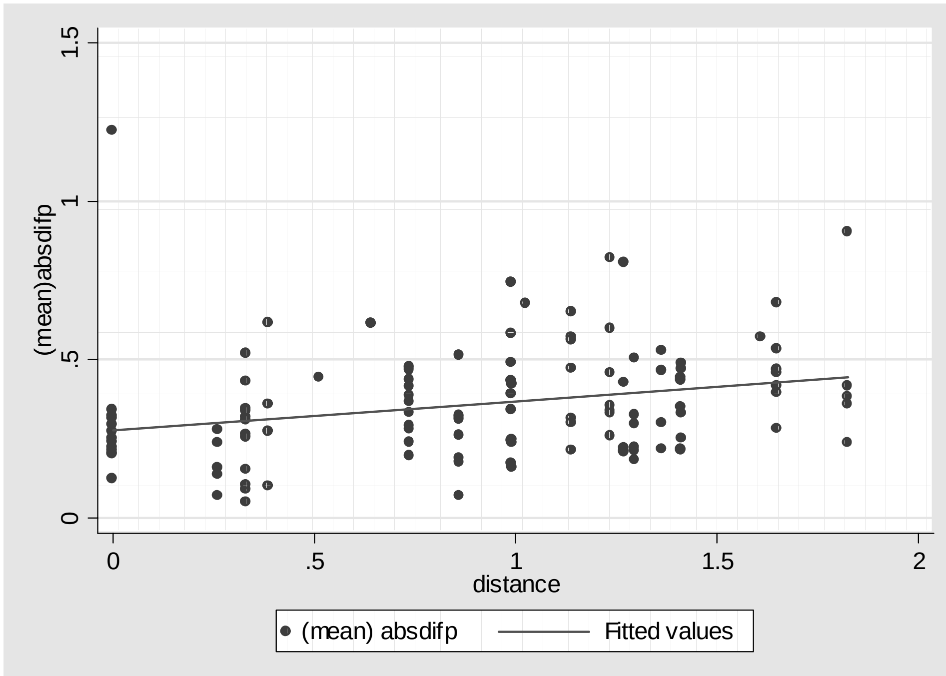

Figure 2.2 Most Productive Country Comparison-1990

negative impact on absolute price dispersion in Model 2 for 1990, and GDP per-capita that is now statistically indistinguishable from zero for both models and both cross-sections. The latter finding suggests that once we consider comparisons relative to the most productive country, higher income differences are no longer associated with higher price dispersion. That is, while richer countries tend to have substantially higher prices as shown in Model 1, it is not the case that absolute price dispersion increases as the income gap across two countries become wider.[24]

[24] The small sample of relatively similar income countries considered here and the resulting small variation in income for these data might be the reason behind the latter finding.

Finally, the constant α_0 captures the price dispersion relative to the source with average levels of distance, real GDP per-capita, and population size in the sample. This is equal to 31 percent in 1985 and 29 percent in 1990.

In Table 2.4, we re-estimate Models 1, 2, and 3 replacing GDP per-capita by wage rates that vary both across industries and countries. In Model 1, wage differences are positively associated with price differences with price elasticities of 15 percent for 1985 and 20.9 percent for 1990. Moreover, according to the estimate of the constant term in Model 1, the importing country typically had prices were 4.8 percent higher than the source at mean levels of the explanatory variables in 1990. The estimated coefficient for distance is now bigger than the coefficients estimated when GDP per-capita is included instead of wage rates.

The distance coefficient is now estimated to be 10 percent for 1990 and 7 percent for 1985, compared to 9 percent and 4 percent respectively in the estimations presented in Table 2.3 utilizing GDP per-capita. Comparing these estimates of distance with the ones obtained using all unique bilateral comparisons in Table 2.2, we see that these are now considerably larger. For 1990, the distance coefficient point estimate was equal to 3.5 percent while for 1985 this was negative and statistically indistinguishable than zero. The improvement in terms of estimating the distance coefficient using the most productive country comparisons is thus even more pronounced when we include wage rates instead of GDP per-capita. Estimates of the variables in Model 2 and 3 in Table 2.4 are qualitatively similar to those in Table 2.3. Again the population size coefficient is estimated to have the wrong negative sign in Model 2 for 1990. The coefficient estimates for the industry-specific measures of tradeability and local factor input content are virtually unchanged relative to those reported in Table 2.3.

However, for these absolute price comparisons the coefficient estimates for distance become smaller relative to the specification with GDP per-capita. Finally, price dispersion relative to the source at average levels of distance, real GDP per-capita, and population size in the sample is equal to 31.7 percent in 1985, and 27.6 percent in 1990 for Model 3, almost identical to the estimates of the constant term in Table 2.3

Finally, for 1990 for which we have VAT data for all countries in our sample, we reconsider Models 1 to 3 for the specification with all bilateral price differences and the one relative to the most productive country, adding now VAT log differences as an explanatory variable on the RHS. VAT is not observed for Greece, Portugal and Spain except in the 1990 sample. For this reason, we do not consider VAT for 1985 since this would reduce our small sample to just five countries, and further limit our ability to "guess" the probable source and destination countries for each industry.[25] We report results in Tables 2.5 and 2.6 utilizing GDP per capita and wage rates respectively. For Model 1, the estimated coefficient for VAT differences is positive, very high, and strongly significant. The remaining estimates we obtain are for the most part similar to those in Tables 2.1 to 2.4. For the specification using all bilateral comparisons, the coefficients for Model 1 are virtually unchanged at 5.2 and 3.4 percent relative to 5.5 and 3.5 percent in the specifications without the VAT variable reported in Tables 1.1 and 1.2 for the specifications with GDP and wages respectively. However, the estimated distance

[25] Ideally, we would like the maximum possible number of countries so that the most productive country in our sample will be more likely to be the source in the actual trade data.

Table 2.4 Price Differentials Relative to Most Productive Country for Each Industry (with Real Wage Rate)

	1985			1990		
	Model1	Model2	Model3	Model1	Model2	Model3
Population	-.031* (-9.05)	.001 (0.27)	.009 (0.86)	-.027* (-7.46)	-.012** (-2.55)	-.002 (-0.15)
Real Wage Rate	.150* (8.31)	.054* (3.71)	.046 (1.15)	.209* (12.06)	.034*** (1.66)	.096*** (1.96)
Distance	.070* (4.60)	.081* (7.63)	.097* (2.71)	.101* (7.21)	.046* (3.98)	.049 (1.24)
Tradability		-.051* (-3.36)	-.073** (-2.46)		-.063* (-3.92)	-.030 (-0.82)
Non-traded input share		.010* (4.87)	.005 (1.21)		.008* (3.55)	.007*** (1.70)
Large cars		.152* (2.81)			.088* (3.17)	
Vices		.157* (5.83)	.088** (2.24)		.186* (6.00)	.151* (3.06)
Constant	.014*** (1.87)	.229* (9.86)	.317* (5.95)	.048* (6.68)	.254* (10.78)	.276* (4.78)
R^2(in percentage)	4.3	6.2	17.4	5.3	5.0	17.8
Observations	3373	3373	132	3186	3186	123
Countries	8	8	8	8	8	8

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. In Model 2 we take absolute values for all variables. In Model 3 we use the mean of absolute LOP deviations. The eight countries considered here are: Austria, Denmark, Germany, Greece, Ireland, Portugal, and the UK.

coefficient in Model 1 for the specification using price comparisons relative to the most productive country now falls to 6.4 percent in Table 2.5 and to 7.7 percent in Table 2.6., relative to 9.0 and 10.1 percent in Tables 2.3 and 2.4. Although lower than prior to the inclusion of VAT differences, these estimates are still higher than those obtained using all bilateral comparisons. Finally, for Models 2 and 3, the distance coefficients before and after the inclusion of VAT differences are nearly unchanged and so are the coefficient estimates for tradeability and the local input content, while population size is again estimated to have the wrong negative sign for Model 2 in 1990.

2.3.2.3 Utilizing Trade Flows

Assuming the most productive country in an industry to be the sole exporter of goods of that industry to the countries in our sample does not completely resolve the problem of identifying the source. It is possible that a similar product is exported by more than one country. To cope with this, we use information about industry-specific bilateral trade flows across countries in our sample so as to take into consideration that the same type of good can be exported by more than one country within the sample. However, the goods could also be imports from countries other than the EU sample we have price data for. To the extend that this is the case, our within-sample import weights will not reflect the true probability that a good sold in one location is imported from an other location in the sample. For instance, in 1990, the share of imports from European Union (EU) countries, for our sample is 84 percent for “furniture except metal industries”, but only 51 percent for “tobacco and tobacco products industries”.Moreover, the import share from the EU varies between countries for the same industry. For example, in 1990 the share of EU imports for France, Italy and Greece in “tobacco and tobacco products industries” is higher than 90 percent, whereas the share for Denmark is 11 percent and for Spain only 8 percent. This tells us that, for some countries and industries, important exporters are outside the EU sample we have price data for. In order to alleviate this problem, we consider 50 percent as a cutoff point for the fraction of imports form the EU by each county in each industry.

Table 2.5 1990 with VAT (with GDP per-capita)

	All Unique Bilateral Comparisons			Most Productive Country		
	Model1	Model2	Model3	Model1	Model2	Model3
Population	-.029* (-9.01)	.005*** (1.78)	.010 (1.17)	-.034* (-6.74)	-.008 (-1.52)	-.003 (-0.21)
GDP per-capita	.210* (12.37)	.053* (3.31)	.133* (2.63)	.336* (9.47)	-.062 (-1.56)	.002 (0.01)
Distance	.052* (6.14)	.074* (11.86)	.095* (4.60)	.064* (4.74)	.062* (5.99)	.091** (2.01)
VAT	1.02* (15.38)	.440* (7.46)	.173 (0.80)	.735* (6.44)	.395* (3.77)	.214 (0.58)
Tradability		-.080* (-10.50)	-.076* (-4.17)		-.052* (-3.33)	-.034 (-0.92)
Non-traded input share		.003* (2.71)	.007* (2.64)		.008* (3.48)	.006 (1.45)
Large cars		.127* (6.76)			.075* (2.61)	
Vices		.228* (13.41)	.195* (5.71)		.200* (6.34)	.153* (2.88)
Constant	.099* (24.57)	.354* (28.82)	.316* (8.57)	.047* (6.57)	.251* (10.65)	.293* (4.96)
R^2(in percentage)	5.5	6.8	23.3	6.0	5.4	15.8
Observations	12315	12315	473	3186	3186	123
Countries	8	8	8	8	8	8

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. In Model 2 we take absolute values for all variables. In Model 3 we use the mean of absolute LOP deviations. The eight countries considered here are: Austria, Denmark, Germany, Greece, Ireland, Portugal, and the UK.

That is, for each importer and industry, the ratio of imports from the EU over total imports is constructed and if this is lowers than 50 percent cutoff point, the goods belonging to that industry is dropped from the dataset. This approach increases the likelihood that a certain good we consider in the price comparisons is actually imported

Table 2.6 1990 with VAT (with real wage rate)

	All Unique Bilateral Comparisons			Most Productive Country		
	Model1	Model2	Model3	Model1	Model2	Model3
Population	-.024* (-8.56)	.007* (2.65)	.013 (1.61)	-.016* (-4.10)	-.010** (-2.20)	-.007 (-0.54)
Real Wage Rate	.124* (16.56)	.072* (8.63)	.109* (4.67)	.178* (10.09)	.055** (2.54)	.113** (2.14)
Distance	.034* (4.01)	.052* (7.99)	.067* (3.23)	.077* (5.39)	.035* (2.85)	.042 (1.02)
VAT	1.01* (15.72)	.516* (8.64)	.310 (1.47)	.820* (7.32)	.454* (4.07)	.503 (1.34)
Tradability		-.080* (-10.53)	-.077* (-4.22)		-.054* (-3.43)	-.029 (-0.78)
Non-traded input share		.003* (2.84)	.007* (2.68)		.008* (3.60)	.007*** (1.72)
Large cars		.134* (7.10)			.080* (2.86)	
Vices		.232* (13.68)	.198* (5.95)		.200* (6.41)	.155* (3.09)
Constant	.099* (24.83)	.352* (28.80)	.318* (8.83)	.048* (6.70)	.248* (10.50)	.281* (4.88)
R^2(in percentage)	6.7	7.4	25.9	6.9	5.6	18.5
Observations	12315	12315	473	3186	3186	123
Countries	8	8	8	8	8	8

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. In Model 2 we take absolute values for all variables. In Model 3 we use the mean of absolute LOP deviations. The eight countries considered here are: Austria, Denmark, Germany, Greece, Ireland, Portugal, and the UK.

form an EU country. The advantage of this approach is that for these goods we can better identify the source and thus estimate more precisely transport costs relevant to our sample countries.This point onward we proceed to utilize quantity data on bilateral trade flows among the countries in our sample in order to determine the direction of trade and construct price differences relative to the probable exporter for any one industry. The probability that a country in our sample is the exporter to a given destination for a good belonging to a given industry is constructed for each industry and destination as the ratio of imports from that country to the given destination over total imports to that destination. For each destination country and industry, we construct a weighted price as the sum of weighted exporting country prices, where the weights are simply the ratios from above and as described in detail in the data section. Finally, the prices in the destination country are compared to this weighted sum.

Once again, we estimate an equation similar to equation (2.3) where source κ is now a weighted sum of probable exporters and these probabilities are obtained as described above. In Table 2.7, we report estimates from this specification. The price data have already been cleansed of outliers following CTZ. However, the trade quantities used here introduce an additional source of outliers given the well known measurement problems with trade flows. Thus, in order to handle outliers, we minimize an absolute loss function and obtain the median estimator, so that coefficients are estimated by minimizing absolute deviations from the median rather than squared deviations from the mean.[26] Since as an estimate of central tendency the median is not greatly affected by outliers as the mean, this alleviates the outliers problem.[27]

[26] We also tried the Cook's D criterion to identify outliers which are then assigned smaller weights relative to other observations using iteratively re-weighted least square robust regressions. This method assigns a weight to each observation, with well-behaved less influential observations assigned higher weights, and only very extreme outliers completely removed from the sample. Results were very similar to those in Table 1.7.

[27] Similarly to demeaning explanatory variables in our OLS regressions previously, we now remove the median from all explanatory variables so that the constant is interpreted as the price deviation relative to the source at median levels of distance, real GDP per-capita, and population size in the sample.

Table 2.7 Regressions Using Comparisons Relative to Trade-weighted Probabilistic Exporter (with GDP per-capita)

	1975	1980	1985	1990
	Model1	Model1	Model1	Model1
Population	-.037*	-.025*	-.056*	-.044*
	(-8.36)	(-5.10)	(-13.66)	(-12.28)
GDP per-capita	.268*	.292*	.279*	.251*
	(8.09)	(9.24)	(11.35)	(12.48)
Distance	.080*	.044*	.047*	.044*
	(6.03)	(4.01)	(4.97)	(5.28)
Constant	.021*	.037*	.056*	.042*
	(3.63)	(5.42)	(10.25)	(8.45)
Pseudo R^2 (in percentage)	3.4	1.3	2.4	1.9
Observations	2759	3392	7322	6848
Countries	8	11	12	12

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. The eight countries in the 1975 sample are: Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands and the UK. Greece, Spain and Portugal are added in 1980, and Austria added in 1985.

The estimated coefficients for distance reported in Table 1.7 are estimated precisely and are always positive for 1975, 1980, 1985, and 1990. The estimated price elasticity of distance is as high as 8.0 percent in 1975 but declines down to 4.4 percent by 1990. These estimates taken in their totality suggest that transport costs are important for the determination of international price differences. Moreover, these estimates –using actual realizations of trade flows across countries- offer a clear improvement relative to those obtained using arbitrary comparisons in Table 2.1, but are qualitatively similar to those obtained assuming the most productive country in an industry to be the exporter for products of that industry. The estimates of the impact of the local cost component of trade costs reported in Table 2.7 are positive and precisely estimated for each year in our sample, with a price elasticity ranging from about 29 percent in 1980 down to about 25 percent in 1990. The size of the population is consistently estimated to have a negative impact on prices with estimated negative price elasticity, ranging from 2.5 percent in 1980 and 5.6 in 1985. Finally, the estimate of the constant term tells us that the importing country typically had prices which were 4.2 percent higher than the source at median levels of the explanatory variables in 1990.As a robustness check to the use of GDP per-capita, we utilize industry-specific real wage rates and report corresponding results in Table 2.8. Here, we do not consider the 1975 cross-section since the wage measure is not available for that year.

As expected, the real wage rate has a strong positive impact on prices, while population enters negatively in all cross-sections. The estimated price elasticity of distance ranges from a high of 5.2 percent in 1980 down to 3.8 percent in 1990.

Finally, we consider VAT differences as an additional explanation of price differences across countries and report results for this specification in Table 2.9. VAT differences have a strong but declining positive impact on price differences ranging from 112 percent in 1975 down to 61 percent in 1990 as tax rates become more homogeneous over the period. The estimated effect of distance ranges from a high of 7.5 percent in 1975 down to 3.1 percent in 1990. Similarly, the price elasticity of the local component of distribution costs captured by GDP per-capita is estimated positive and significant for all cross-sections. The impact of population size on prices is again negative across the board.

Table 2.8 Regressions Using Comparisons Relative to Trade-weighted Probabilistic Exporter (with Real Wage Rate)

	1980	1985	1990
	Model1	Model1	Model1
Population	-.010***	-.060*	-.049*
	(-1.85)	(-14.69)	(-10.79)
Real Wage Rate	.134*	.147*	.141*
	(9.25)	(13.08)	(10.58)
Distance	.052*	.040*	.038**
	(2.89)	(2.56)	(2.54)
Constant	.001	-.001	.030*
	(0.10)	(-0.16)	(5.06)
Pseudo R^2 (in percentage)	2.0	4.1	2.7
Observations	2766	5423	5910
Countries	10	10	11

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. The ten countries in the 1980 sample are: Denmark, France, Germany, Ireland, Italy, the Netherlands, Greece, Spain, Portugal and the UK. Austria added in 1985. The Netherland is not included in the 1985 cross-section because of insufficient number of wage data.

When we use the real wage rate instead of GDP per-capita, for Table 2.10, VAT again has strong but declining positive effect on prices for all years, ranging from 89 percent in 1980 down to 61.5 percent in 1990. Similarly the real wage rate has strong positive effect on price differences for all years. On the other hand, population enters negatively, and significantly for 1985 and 1990 but statistically insignificant for 1980. As usual, the effect of distance decreases monotonically by more than half; from 6.3 percent in 1980 down to 3.1 percent in 1990.

So far we have not accounted for consumption of domestic production. We now address this shortcoming of our analysis by allowing for the possibility that a product consumed at home can be an import or produced domestically. Domestically consumed production of country i for industry h is defined as the difference between total output of country i for industry h and exports of country i for that industry. As we did previously, in order to increase the likelihood that a certain good we consider in the price comparison is actually imported from an EU country, we consider a within-sample import ratio of 50 percent as a cutoff point. Results are reported in Table 1.11 to 1.14.[28]

As we can se in Table 2.11, when domestic production is considered distance coefficient fall for all three cross-sections relative to what is reported in Table 2.7, perhaps reflecting lower within-country transport cost. For example, for 1985 the estimated distance coefficient decreases from 4.7 percent to 1.4 percent. Moreover, we see again a tendency for a monotonically declining impact of distance over time as this falls from 1.6 in 1980 down to 1.1 in 1990. The domestic distribution cost as proxied by real GDP per-capita is similar to the specification without domestically consumed production for all three cross-sections. Finally, the price elasticity of population is estimated to be negative and significant for all cross-sections. In Table 2.12, we report estimates obtained by replacing real GDP per-capita with the real wage rate. Accounting for the effect of domestically consumed production, price elasticities for distance and real wage rate are positive and

[28] We cannot use the year 1975 since we do not have total output data for these countries. We also note that domestic production is calculated at 3-digit aggregation, the weights are generated at that level when we run the regressions with domestic production. The estimates without domestic production were generated by using weights in 4-digits. For the sake of comparability we also run the regressions without domestic production by using weights in 3-digits and estimates were very close to the ones reported in Tables 2.7 to 2.10.

Table 2.9 Regressions Using Comparisons Relative to Trade-weighted Probabilistic Exporter with VAT (with GDP per-capita)

	1975	1980	1985	1990
	Model1	Model1	Model1	Model1
Population	-.010** (-2.31)	-.011** (-1.99)	-.041* (-8.71)	-.029* (-6.87)
GDP per-capita	.253* (8.42)	.270* (6.89)	.180* (5.17)	.186* (8.12)
Distance	.075* (6.21)	.045* (3.51)	.058* (5.39)	.031* (3.49)
VAT	1.12* (10.18)	.804* (5.51)	.748* (6.29)	.606* (6.53)
Constant	.012** (2.23)	.025* (3.86)	.043* (8.82)	.028* (5.11)
Pseudo R^2 (in percentage)	5.6	2.8	4.5	2.2
Observations	2759	2775	5840	6848
Countries	8	8	9	12

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. The eight countries in the 1975 sample are: Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands and the UK. Austria added in 1985.Grrece, Portugal, and Spain are added in 1990 since VAT is not observed for these countries except in the 1990 sample

significant in all three cross- sections while the price elasticity for population is always estimated to be negative and statistically significant. Again, we see a decline in the price elasticity with respect to distance from 1.4 percent in 1980 down to 0.9 percent in 1990.

Finally we include VAT differences as an explanatory variable and report the results in Table 2.13. VAT differences have positive and significant effects for all years. Similarly, the distance and GDP per-capita coefficient are estimated to be positive and population negative and significant for all cross-sections. Estimates for the specification

Table 2.10 Regressions Using Comparisons Relative to Trade-weighted Probabilistic Exporter with VAT (with Real Wage Rate)

	1980	1985	1990
	Model1	Model1	Model1
Population	.006 (1.45)	-.045* (-9.23)	-.035* (-7.03)
Real Wage Rate	.119* (7.90)	.080* (4.28)	.111* (7.99)
Distance	.063* (4.31)	.048** (2.49)	.031** (2.01)
VAT	.893* (7.77)	.869* (7.86)	.615* (5.74)
Constant	.009 (1.58)	.015** (2.22)	.023* (3.86)
Pseudo R^2 (in percentage)	3.5	7.6	3.1
Observations	2164	3975	5910
Countries	7	7	11

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. The seven countries in the 1980 sample are: Denmark, France, Germany, Ireland, Italy, the Netherlands, and the UK. Austria added in 1985. Greece, Portugal and Spain are added in 1990 while the Netherland is not included in the 1985 cross-section because of insufficient number of wage data.

with real wage rates and VAT differences as explanatory variables reported in Table 2.14 are qualitatively similar to those in Table 2.13, with all variables having expected signs and statistically significant. The coefficient estimate for distance ranges from 1.0 percent in 1980 down to 0.7 percent in 1990. The impact of VAT on price differences falls from a high of 23 percent in 1980 down to 9.4 percent in 1990 as these rates become more homogenized across countries over the period.

Table 2.11 Regressions Using Comparisons Relative to Trade-weighted Probabilistic Exporter with Domestic Production (with GDP per-capita)

	1980	1985	1990
	Model1	Model1	Model1
Population	-0.25*	-.036*	-.031*
	(-27.85)	(-55.32)	(-31.97)
GDP per-capita	.268*	.277*	.202*
	(37.88)	(67.03)	(25.18)
Distance	.016*	.014*	.011*
	(10.95)	(13.10)	(6.51)
Constant	.004*	.014*	.012*
	(5.99)	(29.38)	(14.24)
Pseudo R^2 (in percentage)	2.8	3.8	2.3
Observations	3630	6399	5555
Countries	10	11	11

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. The ten countries in the 1980 sample are: Denmark, France, Germany, Ireland, Italy, the Netherlands, Greece, Spain, Portugal and the UK. Austria added in 1985.

2.4 Heterogeneity in Transport Costs Across Industries

We have shown that once we utilize information regarding the source of products sold in any two locations, transportation costs as measured by distance are estimated to be important in determining deviations from the law-of-one-price (LOP) for individual goods. Moreover, distance has been shown to have a positive significant and robust impact on absolute price dispersion in our sample of bilateral country comparisons. Here, we consider a specification with industry-specific distance coefficients that aims to explore the relative importance of transportation costs across different industries. This is

Table 2.12 Regressions Using Comparisons Relative to Trade-weighted Probabilistic Exporter with Domestic Production (with Real Wage Rate)

	1980	1985	1990
	Model1	Model1	Model1
Population	-0.24* (-25.25)	-.037* (-52.71)	-.028* (-25.30)
GDP per-capita	.335* (37.30)	.309* (47.28)	.193* (21.92)
Distance	.011* (6.87)	.014* (11.09)	.009* (4.79)
VAT	.068* (6.28)	.058* (6.93)	.085* (6.92)
Constant	.002* (2.59)	.003* (4.44)	.013* (13.95)
Pseudo R^2 (in percentage)	5.3	6.5	2.6
Observations	2810	4917	5555
Countries	7	8	11

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. The ten countries in the 1980 sample are: Denmark, France, Germany, Ireland, Italy, the Netherlands, Greece, Spain, Portugal and the UK. Austria added in 1985, while the Netherlands is not included in the 1985 cross-section because of the insufficient number of wage data.

again in line with Anderson and van Wincoop (2004) who consider heterogeneity in transport costsin their extension of Eaton and Kortum (2001) who assumed identical trade costs. As was the case with the measures of tradability and local factor input content used in Model 2 previously, industry-specific factors are informative about the absolute level of price dispersion but not about whether a price is higher or lower in certain geographic location. Thus, we consider the model with absolute price deviations as in Model 2, rather than the directional regression from Model 1.

Table 2.13 Regressions Using Comparisons Relative to Trade-weighted Probabilistic Exporter with Domestic Production with VAT (with GDP per-capita)

	1980	1985	1990
	Model1	Model1	Model1
Population	-0.10* (-13.92)	-.029* (-57.85)	-.027* (-27.53)
Real Wage Rate	.080* (30.01)	.094* (62.63)	.065* (18.38)
Distance	.014* (11.29)	.007* (7.65)	.009* (5.44)
Constant	.002* (3.10)	.002* (5.12)	.008* (9.62)
Pseudo R^2 (in percentage)	1.7	4.5	2.1
Observations	3537	5423	5454
Countries	10	10	11

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. The seven countries in the 1980 sample are: Denmark, France, Germany, Ireland, Italy, the Netherlands, and the UK. Austria added in 1985, and Greece, Portugal, and Spain are added in 1990 as VAT is not observed for these countries except in the 1990 sample.

Specifically, we consider a slightly modified version of Model 2 adding now industry-specific distance coefficients and excluding the industry-specific tradeability measure from CTZ. We implement this by utilizing information on the source of individual products to consider price comparisons relative to the most productive country in each industry.

Once we obtain industry-specific distance coefficients, we then rank the industries

Table 2.14 Regressions Using Comparisons Relative to Trade-weighted Probabilistic Exporter with Domestic Production with VAT (with Real Wage Rate)

	1980	1985	1990
	Model1	Model1	Model1
Population	-005* (-5.21)	-.027* (-58.17)	-.023* (-23.12)
Real Wage Rate	.149* (27.51)	.232* (40.94)	.062* (17.36)
Distance	.010* (6.94)	.008* (8.09)	.007* (4.26)
VAT	.229* (4.90)	.057* (10.13)	.094* (8.12)
Constant	.001*** (1.88)	.002* (3.59)	.009* (10.62)
Pseudo R^2 (in percentage)	3.4	10.0	2.6
Observations	2743	3975	5454
Countries	7	7	11

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. The seven countries in the 1980 sample are: Denmark, France, Germany, Ireland, Italy, the Netherlands, and the UK. Austria added in 1985, and Greece, Portugal, and Spain are added in 1990 as VAT is not observed for these countries except in the 1990 sample. The Netherlands is not included in the 1985 cross-section because of the insufficient number of wage data.

according to how high the distance coefficient is estimated to be, with the industry with the lowest distance coefficient ranked first and the one with the highest coefficient ranked last. To see how this ranking relates to the other measures of the importance of transportation costs we also report the ranking of the industries according to (1) the average value of goods within that industry classification, and (2) the degree of tradeability characterizing a certain industry. To obtain the “value” of the typical good in each industry used for ranking in Table 2.15, we average the common currency prices of each good across countries and then aggregate this average price across all goods that fall in the same ISIC classification. Assuming a fixed component of transportation costs, then the per unit transportation cost attributed to this fixed component should decline with the value of the good considered in column (1) of Table 2.15, with expensive goods having lower per unit costs. Tradeability is constructed as described in the data section. As we have argued there, tradeability has a direct interpretation as an inverse measure of effective trade costs.

If the above reasoning is valid, and as long as our industry-specific distance coefficients capture the relative importance of transportation costs across industries, these estimates should be closely related to the measures of value and tradeability considered here. Indeed, the correlation between the value ranking in column (1) and the distance coefficient ranking in column (3) is of the right sign, at 59 percent, and statistically significant beyond the one percent level. Moreover, the correlation between tradeability ranking in column (2) and the distance coefficient ranking in column (3) is similar in value and again statistically significant beyond the one percent level. As a robustness check, we run the regressions using wage rates in place of GDP per-capita. In this case, the correlation between the value ranking and the distance coefficients ranking is 35 percent and that between tradeability ranking and the distance coefficients ranking is 45 percent, both statistically significant at the five percent level.

2.5 Conclusion

The estimation of trade costs is important for a number of international macroeconomic models with implications regarding price differences across countries.

Transport costs are one component of trade costs that has received particular attention in the empirical literature. As policy-related costs of trade decline over time, the relative importance of transport costs can be increasing even as technological progress reduces their size over time. Moreover, progress in transport technologies might allow previously non-traded goods with higher per unit transport cost to enter international trade. Thus, the relevance of transport costs in determining price wedges and international quantity flows might remain important even as technological progress lowers the level of transport costs for any one good.

To enable us to estimate the costs of trading a good internationally, we rank countries based on their productivity in individual industries and compute product-specific international price differences relative to the most productive location for each industry. We have also used information on bilateral trade flows to determine the probable source of each product as a weighted average of the countries from which a destination country actually imports from. Identifying the source has made it possible to consider price comparisons that are relevant to the direction of trade and trade costs.

One commonly used measure for transport costs is physical distance from the origin of each product. Here, distance relative to the most productive country has a precisely estimated positive impact on international deviations from LOP and this is larger than

Table 2.15 Ranking Industries According to Relative Transportation Costs

Industry Description	(1) Ranking according to value[a]	(2) Ranking according to tradeabilty[b]	(3) Ranking according to distance[c]
Transport equipment	1	8	5
Machinery except electrical	2	3	1
Machinery electric	3	10	10
Other manufactured products	4	2	6
Professional and scientific equipment	5	1	15
Leather products	6	4	8
Furniture except metal	7	18	14
Wearing apparel except footwear	8	9	3
Footwear except rubber or plastic	9	5	4
Rubber products	10	13	9
Miscellaneous petroleum and coal products	11	15	7
Fabricated metal products	12	16	16
Textiles	13	7	13
Printing and publishing	14	23	21
Other chemicals	15	11	17
Beverages	16	19	19
Glass Products	17	20	20
Tobacco	18	21	12
Paper and products	19	12	2
Other non-metallic mineral products	20	22	23
Food products	21	17	11
Non-ferrous metals	22	6	18
Iron and steel	23	14	22
Rank correlation with column (3)	0.59	0.57	1.0

Notes: [a]: Ranking from more expensive to cheaper goods, [b]: Ranking from highly tradeable industries to low tradeability industries, [c]: Ranking of industry-specific distance coefficients from to high estimated price impact. These coefficient estimates were based on price comparisons relative to the most productive country in each industry for 1985.

the estimates obtained when arbitrarily assigning an equal probability of being source to each country. Our estimates of the impact of transport costs using actual realizations of trade flows across countries are qualitatively similar to those obtained under the assumption that the most productive country in an industry is the sole exporter for that industry. This confirms that productivity is a strong predictor of the direction of trade and that the assumption of the most productive country in an industry being the main exporter for all products of that industry is not a bad approximation.

An interesting feature that emerges is the falling importance of transport costs as witnessed in the declining estimated coefficient for the impact of physical distance on prices during the period from 1975 to 1990. This is consistent with economic intuition as transport technologies have been improving over time. Moreover, distance also matters for absolute price dispersion and so does the industry-specific measure of transport costs.

We also find that distribution costs are important in determining international deviations from LOP. That is, we re-confirm the well-known fact that countries with higher income per-capita –and thus a higher cost for the local inputs component- have higher prices. However, the small and sometimes insignificant impact of income on absolute price deviations suggests that for this group of countries that have relatively similar income levels, it is not the case that the price gap becomes larger as the income gap increases. At the same time, the industry-specific measure of local input costs has a positive impact on absolute price dispersion.

We conclude that utilizing relative productivity along with relative prices from survey data can help in identifying trade costs and their role in segmenting product markets.

However, future work should aspire to utilize microeconomic information on trade flows along with microeconomic relative prices in order to further improve our understanding of trade costs.

In addition, market size appears to be an important explanation for international price dispersion. As long as demand elasticities are positively related to the size of the market, this latter finding is consistent with markups being higher in smaller (less competitive) markets. Finally, VAT rate differences have been very strong determinants of price differences across the European countries in the sample. However, the impact of these tax differences has been declining throughout the period from 1975 to 1990 as would be expected from the EU policy of tax harmonization. Overall, the data is consistent with models where transport costs, distribution costs, market size, and taxes play important roles in the determination of international price differences.

CHAPTER 3

INTERNATIONAL PRICE DISPERSION and MARKET STRUCTURE

3.1 Introduction

As we discussed in Chapter 2, according to Crucini, Telmer and Zachariadis (2005) (CTZ) the law-of-one-price (LOP) and purchasing power parity (PPP) are about the cross-sectional distribution of international relative prices. By utilizing microeconomic price levels for a broad set of range of goods and services in all European Union (EU) countries over five-year intervals between 1975 and 1990, CTZ analyze the absolute law-of-one-price deviations. Their results demonstrate that good-by-good measures of cross-sectional price dispersion are negatively related to the tradeability of the goods and positively related to the share of non-traded inputs. In the previous chapter, we estimate an absolute price dispersions model based on the theoretical framework in Anderson and van Wincoop (2004). Our results suggest that absolute price dispersions are largely determined by the potential determinants discussed in this framework, namely trade costs, goods- specific characteristics, and the differences in taxes and markups.

In this chapter, we try to infer how price dispersion and market structure are related. More specifically in this chapter, the good-by-good price dispersions model discussed in CTZ and absolute price dispersions model discussed in Chapter 2 are estimated for homogeneous goods and differentiated goods separately. Differential impacts of the potential determinants of absolute price dispersion for homogeneous goods and differentiated goods enable us to conclude that market structure has significant impact on absolute international price dispersions.

According to Anderson and van Wincoop (2004), trade costs are large; they dominate production costs, vary across countries, and have two components: transportation cost and distribution costs. Transportation costs can be further divided in to two sub-categories as direct elements of transportation cost, such as freight charges and insurance shipments, and indirect elements such as holding cost during shipment, inventory cost, and preparation cost.

Similarly, Hummels (2001) argues that trade barriers play the most important role in models in international specialization and trade, therefore empirical works on those areas should take into account trade costs. However, assessing the actual value of such costs is a difficult task. Therefore, different studies in this area use different proxies for trade costs. For instance, Hummels (2001) provides a new data set on freight rates for a number of importers and estimates the relation between freight rates and physical distance between trading partners and his results confirm that trade costs are large and import choices are made so as to minimize transportation cost.

Another proxy for transportation cost is cif/fob ratios[29], and Bergstrand and Egger (forthcoming) use this measure in order to infer the importance of transportation cost in intra-industry trade.

Finally, physical distance between countries is the commonly used measure of transportation cost. Eaton and Kortum (2002) indicate that, trade diminishes dramatically with distance and prices vary across locations with greater distance between places

[29] For the discussion on the problems associated with cif/fob ratios, please refer to Hummels and Lugovskyy (2003).

farther apart. Rauch (1999) and Evans (2003) can be given as examples for the studies use distance as a proxy for transportation cost in quantity regressions. Crucini, Telmer and Zachariadis (2000) use distance as a measure of transportation cost in order to analyze the geography of price dispersion and their results show a strong positive relation between distance between the countries and price differences.

However, according to Berthelon and Freund (2004), there are vast differences in the distance elasticity of trade across products. Similarly, Crucini, Telmer and Zachariadis (2000) argue that, under monopolistic competition, assuming that goods are homogeneous when in fact they are different varieties of the same good would lead to unfounded rejection of law-of-one-price (LOP). Rauch (1999) is the one of the most appreciated works which considers the abovementioned issue. According to Rauch (1999), heterogeneity of products along with the dimensions of both characteristics and quality affect prices. In order to control for heterogeneity, Rauch (1999) split internationally traded commodities into three categories as commodities traded in organized exchanges, commodities with reference price, and differentiated commodities.

According to the theoretical framework discussed in Anderson and van Wincoop (2004), differences in markups are one of the potential determinants of international price dispersion. Similarly, Goldberg and Verboven (2001) argue that differences in markups are one of the potential sources for the differences in car prices across Europe. Product market competition is a multidimensional process and markup over marginal cost can be a sign of the level of competition in the market. However, calculation of markup is problematic since marginal costs are unobservable.[30] Campbell and Hopenhayn (2005) argue that larger markets are more competitive, and in more competitive markets producers must recover their fixed costs by selling more at lower markups. Similarly, due to Melitz and Ottaviano (2005), market size affects the toughness of competition. Bigger markets exhibit higher levels of product variety and host more productive firms that set lower markups and lower prices. By following these arguments, in Chapter 2, population size differences are used in order to control for markup differences.

The remainder of this chapter is organized as follows: Section 3.2 discusses the motivation behind our empirical application. Data are described in Section 3.3. Section 3.4 presents and discusses the estimation procedure and our results. Finally, Section 3.5 concludes.

3.2 Motivation

Imperfect market structure plays a significant role in explaining purchasing power parity (PPP) deviations. Cheung, Chinn and Fuji (1999) argue that, a firm's pricing power in monopolistic competition is determined by the elasticity of demand which depends on the substitutability among varieties within the industry. Therefore, product differentiation creates more dispersed prices and it can be a sign of market power.

In our study, we use the Rauch (1999) commodity classification in order to infer the effect of market structure on international price dispersion. Rauch (1999) divided

[30] There are different proxies proposed by studies in this area. For instance, Hall (1988) uses the Solow residual in order to calculate markups. Nevertheless, Hall's method requires many different instrumental variables and suffers from an identification problem. Roeger (1995) propose a different method based on price –based Solow residuals in order to solve the identification problem in Hall (1988). However, method used by Roeger (1995) overestimates markups. Finally, Gali (1995) uses the inverse of the share of labor in total cost as a proxy for markup.

internationally traded commodities into three groups. The first group is called commodities traded in “organized exchanges”. The second group is the commodities those are not traded in organized exchanges perhaps because the market is too “thin” so the price at the equilibrium would not cover the “set-up cost of the organized exchanges, but possess a “reference price”. Although these goods are not traded in an organized market, their prices can be quoted without mentioning the name of the producers since they are not branded commodities. Those characteristics of reference priced goods distinguish them from the goods traded in organized exchanges and the goods that belong to the third and the last category in classification; differentiated goods. Differentiated commodities do not possess a reference price, and their prices at any location must be adjusted for multidimensional differences in the good characteristics, which depend on the varieties available at the location and consumer preferences (Rauch, 1999). In other words, for differentiated goods, the price the monopolistically-competitive firm could charge depends on the elasticity of substitution between the varieties of the good (Crucini, Telmer and Zachariadis, 2000). Since having a reference price distinguishes homogeneous goods from the differentiated goods, according to Rauch (1999), the commodities traded in organized exchanges and those that possess a reference price can be considered as homogeneous commodities.

First, we analyze the effect of market structure on good-by-good price dispersions. The model we use originates from the one used by CTZ in which international price dispersion is characterized in terms of the characteristics of goods. According to CTZ, the first characteristic which determines international price dispersion is the “tradeability” of the good that is measured as the extent to which final goods are traded, and the second one is the share of non-traded inputs in the total cost of the goods. The expectation is a negative relation between tradeability and price dispersion since tradeability can be considered as the inverse of the industry specific transportation cost, and a positive relation between the non-traded input share and price dispersion since one would expect international price dispersion to be present for all retail prices; however, it would be larger for the goods for which the share of non-traded input is higher (Crucini, Telmer and Zachariadis, 2000). In the model, differences in tax rates are controlled by two group-specific dummy variables for classes of goods that are likely to face higher taxes and by value added tax (VAT) rates across countries and industries.

For different commodity types, we expect differential impact from the good characteristics on good-by-good price dispersions. More specifically, we anticipate a larger impact of tradeability and the non-traded input share for the homogeneous goods. Results in CTZ demonstrate that goods with higher tradability have lower price dispersion. However, the prices of the differentiated goods are determined by many different factors and since they are branded commodities, the producers of them will have pricing power. Therefore, we expect that the same amount of increase in the tradeability of good will decrease the price dispersion for homogeneous goods more. In addition to that, recall in Chapter 2, that the non-traded input share is considered as the industry-specific distribution cost. Since most of the homogeneous goods are bulky and/or perishable, their value/weight ratio will be lower than the ones for differentiated goods. So, assuming a fixed component to trade cost, expensive goods will have a lower per-unit cost. Based on this, we may conclude that the effect of non-traded input share on price dispersion for homogeneous goods would be higher relative to its effect for differentiated goods.

For the second model, our point of departure is the theoretical framework discussed in Anderson and van Wincoop (2004). Specifically, we construct the same absolute price dispersion discussed in Chapter 2 for homogeneous goods and differentiated goods separately in order to distinguish the effect of market structure on absolute price dispersion. As we did in Chapter 2, we utilize the physical distance between countries as a measure of the transport cost, the industry-specific real wage rates as measure of the local distribution cost, and population differences as a measure for mark-up differences. Tax differences are controlled by the dummy variables mentioned above, and where broadly available, by country and industry-specific VAT differences.

As it is explained in the previous chapter, taking the absolute values solves the "averaging-out" problem discussed in Crucini, Telmer and Zachariadis (2004), so distance can be used as a meaningful proxy for transportation cost even in the absence of the information of the source country for the product. By following Anderson and van Wincoop (2004), industry-specific tradability variable is used in order to control for the heterogeneity of transportation cost across industries. Furthermore, Rauch (1999) mentions the importance of controlling tradability of the different good categories when we attempt to assess the importance of distance. Similarly, in order to control for the heterogeneity across industries from the perspective of distribution cost, we utilize the non-traded input share as a measure of industry-specific local distribution cost.

Results presented in Chapter 2 show that the country-specific and the industry specific aspects of transportation costs and distribution costs, taxes and market size play important roles in the determination of absolute price dispersions. Henceforth, in this chapter, we attempt to infer the effect of these potential determinants for homogeneous goods and differentiated goods, separately. Since distance indicates the time elapsed during the shipment. For perishable goods the probability of surviving intact during the transit will be lower. Because of this and based on the above discussion, we expect higher price elasticity of transportation cost and distribution cost for homogeneous goods. Finally, since producers of differentiated goods have market power, we expect the effect of markup differences will be larger for differentiated goods.

3.3 Data Section

For the first model, let us denote P_{ij} as the price of good i in country j in units of some numeraire country currency. Thereafter, we can define the log deviations from the geometric-average European price as follows:

$$q_{ij} = \ln P_{ij} - \sum_{j=1}^{M} \ln P_{ij} \big/ M \tag{3.1}$$

where M is the number of countries in our data.

For the second model, let us denote the law-of-one-price (LOP) deviations as

$$g_{ijk} = \ln\left(e_{jk} P_{ij} \big/ P_{ik}\right) \tag{3.2}$$

where P_{ij} and P_{ik} are local currency prices of good i in country j and k respectively, and e_{jk} is the nominal exchange rate of country j in terms of country k currency.

As in the Chapter 2, common currency prices are obtained from CTZ with the outliers having been removed from the data. Similarly, value added (VAT) information, country specific dummy variables for large cars and vices are used in both specification, and population size, real wage rates, bilateral distance we use in the second specification are obtained from the same sources discussed in the data section of Chapter 2.[31]

Based on the discussion above, product differentiation is used as a measure of market structure. We utilize the Rauch (1999) classification in order to categorize goods in our data. Rauch (1999) has assigned 643 three-digit and four-digit Standard International Trade Classification (SITC) level industries according to whether they are traded in an organized exchange, or not traded in an organized exchange but having some "quoted" reference price, and finally not having any quoted price and therefore treated as differentiated. Data for Rauch classification and the industry concordances between ISIC Revision 2 and SITC Revision 2 which is used in order to match the Rauch[32] classification with CTZ price data are obtained from Jon Haveman's web page.[33]

Each good is assigned to a four-digit Standard International Trade Classification (SITC) category to be assigned into one of the good categories discussed in the Rauch classification. Rauch (1999) argues that possessing a reference price distinguishes homogeneous goods from differentiated goods. Moreover, the numbers of commodities

[31] For detailed discussion about these variables and data sources, please refer Chapter 2.

[32] Because of the ambiguities in the trade data, Rauch (1999) defines two different types of commodity classifications. The first classification is called the liberal classification. In the "liberal" commodity classification, the number of differentiated goods is at the minimum number. The second one is called the "conservative" commodity classification and it contains the maximum number of differentiated goods. For this study, the liberal classification is used, however we also estimate the specifications by using the conservative classification, and the results were very similar to the ones reported in this chapter.

[33] www.macalester.edu/econdata/page/haveman

traded in organized exchanges are quite limited. Therefore, goods traded in organized exchanges and reference priced goods are combined as homogeneous goods.

CTZ data contain many price observations for different brands of the same good. According to Rauch (1999), homogeneous goods possess a reference price and they are not "branded". However, because price data is more disaggregated than the Rauch classification, some branded goods are classified as homogeneous goods when the Rauch classification is merged with CTZ price data. In order to be consistent with Rauch (1999), these goods have been dropped from the data. In addition to that, by following Bergstrand and Egger (forthcoming), we conclude that vices (alcoholic beverages and tobacco products) are faced with important product differentiation. Therefore, branded goods in the vices category are considered as differentiated goods although according to the Rauch classification, some of them are classified as the commodities with a reference price.[34]

Our first specification, by following CTZ, relates the good-by-good measures of cross-sectional price dispersion with tradeability of the good and the share of the non-traded inputs required for production. These two industry-specific variables are also used in the second model in order to control for the heterogeneity across industries in transportation cost and distribution cost, respectively. As in the second chapter, both of the variables are obtained from CTZ[35]. Both tradeability and non-traded input share

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[34] We also estimate the specifications by keeping the goods in the categories proposed by Rauch (1999). This change does not bring any important changes in the results.

[35] Recall from Chapter 2, tradeability defined as the ratio of the total trade in each industry in our sample divided by the total output of the same industry across the same countries, and the shares of the non-traded

variables are constructed in a more aggregate way than the Rauch (1999) classification. As a result, goods belong to different product types may have the same tradeability and the non-traded input share levels which makes it difficult to distinguish the effect of market structure on price dispersion. In order to cope with this issue, we generate the Rauch-category weighted tradeability and the non-traded input share variables.

Data required for calculating weights are obtained from the dataset World Trade Flows: 1962-2000. This dataset reports the bilateral trade data in the four-digit SITC classification. In order to calculate weights, first we denote s_{jk}^{m} as the trade in the industry m between countries j and k. Then we proceed to define the total trade for each industry as $S^{m} = \sum_{l=1}^{L} s_{l}^{m}$ where L is the number of bilateral pairs that we have trade data for. Finally, for each ISIC code, we seek the share of each product category in the total trade by using the shares described above as weights for tradability and the non-traded input share.

3.4 Estimation and Results

In order to analyze the effect of market structure on international price dispersion, we use two different specifications. The first one investigates the effect of market structure on the good-by-good distributions of prices. The second specification attempts to show the impact of product differentiation on absolute price differences by using both country-specific and industry-specific potential determinants of price dispersion discussed in Chapter2.

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inputs required to produce the final goods are computed by CTZ from 1988 the United Kingdom (UK) input-output tables.

3.4.1 Market Structure and Good –by-Good Price Dispersion

The first specification, originated from the model used by CTZ. Specifically, we estimate the following equation:

$$Var(q_{ij} \mid i) = \alpha_0 + \alpha_1 \ln(trad_i) + \alpha_2 \ln(nt_i) + residual \qquad (3.3)$$

where $Var(q_{ij} \mid i)$ is the sample variance of q_{ij} across countries j, $trad$ is the tradeability of goods and nt denotes the non-traded input share of the good. The results in CTZ demonstrate that good-by-good price dispersions which are measured by the sample variance of q_{ij} are negatively correlated with tradeability and positively correlated with the non-traded inputs required to produce the final good. Because of the reasons discussed in the above sections, when estimating the model for homogeneous goods and differentiated goods separately, we expect higher price elasticity estimates of both tradeability and the non-traded input share for homogeneous goods.

As it was mentioned, according to Cheung, Chinn and Fuji (1999) product differentiation creates more dispersed prices, and it can be a sign of market power. We plot the estimate of the density of $Var(qij|i)^{0.5}$, the standard deviations of the law-of –one-price deviation for good i across countries j[36] . The visual evidence supports their argument. Estimates and t-statistics from the above specification with ordinary least squares (OLS) and correcting standard errors for the heteroskedasticity are presented in Table 3.1.

[36] For the graphs of the empirical distributions of the standard deviations of LOP deviations for the other cross-sections please refer to Appendix A.

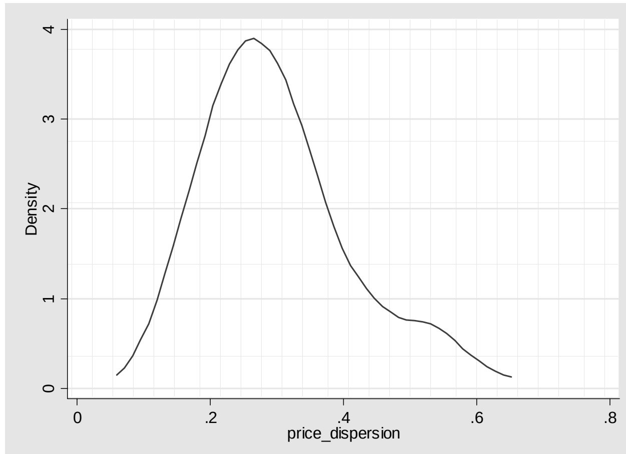

Figure 3.1 Empirical Distribution of $Var(q_{ij}|i)^{0.5}$ for Homogeneous Goods-1990

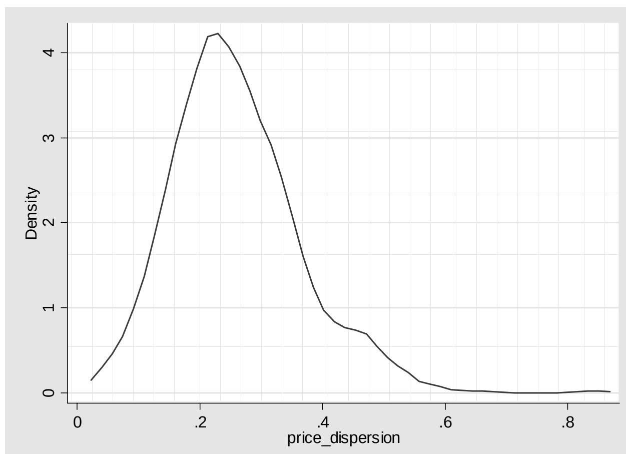

Figure 3.2 Empirical Distribution of $Var(q_{ij}|i)^{0.5}$ for Differentiated Goods-1990

Model 1 reports the estimates for pooled data and they are consistent with the findings of CTZ for all four cross-sections. [37] Results show that, as in CTZ, the cross-sectional price dispersion is negatively related with tradeability and positively related with the non-traded input share. For instance, for 1985, the price elasticity of tradeability and the non -traded input share are estimated as -5 percent and 5.5 percent respectively.

[37] The Rauch classification does not include services. Therefore, we re-estimate the model of CTZ by using the full sample in order to check the robustness of results to exclusion of services from the data.

Model 2 and Model 3 present the results for homogeneous goods and differentiated goods respectively. For all four cross-sections, tradeability has consistently higher impact for homogeneous goods than differentiated goods. The impact of tradability on prices for differentiated goods is about half that of the homogeneous goods for 1980, 1985 and 1990. For example for 1990, price elasticity for tradeability is estimated -5.1 percent for homogeneous goods whereas only -2.2 percent for differentiated goods.

When we re-estimate Equation 3.1 for homogeneous goods and differentiated goods separately, our findings indicate that, there is a positive and significant relation between the non-traded input share and good specific price dispersion and estimates are consistently higher for homogeneous goods. For instance, for the year 1975, there is a positive and significant relation between the non-traded input share and price dispersion for homogeneous goods. However, the coefficient estimate of the non-traded input share for differentiated goods is statistically indistinguishable than zero for differentiated goods. For the year 1980, the impact of non-traded input share on price dispersion for differentiated goods is about the half of the homogeneous goods; 9.9 percent and 4.5 percent respectively. Similarly, for 1985, price elasticity due to the non-traded input share is estimated as almost 8.6 percent regarding homogeneous goods and 4.6 percent and for differentiated goods, and for the year 1990, the price elasticity of the non-traded input share for homogeneous goods and for differentiated goods are estimated as 6.2 percent and 2.2 percent respectively.

Finally, we consider taxes as another potential determinant of price dispersion. As discussed in the above sections, taxes are controlled by industry and country specific value added taxes differences and two dummy variables, namely dummies for large cars and vices. Vices and large cars have large price dispersion which may be rather attributable to differences in excise taxes across countries (Crucini, Telmer and Zachariadis, 2000). We expect larger price dispersion for the goods belong to these specific categories.

In order to calculate before-VAT prices, first let us denote P_{ij} as the after-VAT price of good i in country j in units of numeraire country currency and v_{ij} as the VAT rate for country j and good i. So we can further define $\tilde{P}_{ij} = P_{ij} \big/ (1 + v_{ij})$ where $\tilde{P}_{ij}$ is the before-VAT price of good i in country j. Then we can transform the before-VAT price data $\tilde{P}_{ij}$ into log deviations from the geometric average of European price as we did for the after-VAT prices:

$$\tilde{q}_{ij} = \ln(\tilde{P}_{ij}) - \sum_{j=1}^{M} \ln(\tilde{P}_{ij}) \Big/ M \qquad (3.4)$$

where M is the number of countries in our sample. Finally, we can generate $Var(\tilde{q}_{ij} \mid i)$ as a measure of good-by-good price dispersions by using before-VAT prices.

For this specification, we estimate the following model:

$$Var(\tilde{q}_{ij} \mid i) = \alpha_0 + \alpha_1 \ln(tr_i) + \alpha_2 \ln(nt_i) + \alpha_3 lc + \alpha_4 v + residuals \qquad (3.5)$$

where *lc* represents the large cars dummy , *v* represents the dummy variable for vices and all the other variables are the same as Equation 3.3. Results for this specification are presented in Table 3.2.

As for the above specification, Model 1 summarizes the estimations for pooled data and Model 2 and Model 3 report the results for homogeneous goods and differentiated goods, respectively. Coefficient estimates of large cars and vices dummies have the anticipated positive signs except for 1975. For the cross-sections 1975 and 1990, for all three models, both tradability and the non-traded input share coefficients before and after the inclusion of taxes are nearly unchanged. For 1980, the estimated coefficients for tradability for all three models are very similar to the results reported in Table 3.1, however, the coefficient estimate for the non-traded input share falls to 4.8 percent relative to 5.7 percent for pooled data, to 8.9 percent relative to 9.9 percent for homogeneous goods and to 3.6 percent relative to 4.5 percent for differentiated goods. For year 1985, coefficient estimate of tradability in Model 2 falls about 20 percent, relative to the results before the inclusion of tax differences into the model, and finally the price elasticity of the non-treaded input share in Model 2 falls to 7.4 percent in Table 3.2 relative to 8.6 percent in Table 3.1 and finally for Model 3 increases from 4.6 percent to 5.7 percent.

We have reported two goodness of fit for the regressions (R^2). R^2 is the fraction of variance explained based on the raw data, and it is necessarily low and does not give a lot of information since it reflects the different levels of aggregation of the dependent variable and explanatory variables. When the raw price data is used, intersectoral price dispersion can not be explained; therefore estimations will have low R^2 values. (Crucini, Telmer and Zachariadis, 2000) In order to alleviate this problem, we follow CTZ and aggregate the data as the same level with explanatory variables. As we can see from Table 3.1 and Table 3.2, goodness-of-fit from aggregate regression (R^{2*}) are higher than the ones that is obtained from raw data.

3.4.2 Market Structure and Absolute Price Dispersion

The second empirical analysis is based on the theoretical model discussed in Anderson and van Wincoop (2004). Specifically, we re-estimate the following equation for the pooled sample, for the homogeneous goods and for the differentiated goods separately:

$$\left|g_{ijk}\right| = \alpha_0 + \alpha_1 \left|pop_{jk}\right| + \alpha_2 \left|y_{jk}^{h}\right| + \alpha_3 dist_{jk} + \alpha_4 X_h + \varepsilon_{ijk} \qquad (3.6)$$

where $\left|g_{ijk}\right|$ is the absolute value of the log deviation from the law-of-one-price for good i between countries j and k, $\left|pop_{jk}\right|$ is the absolute value of the log difference in population size between countries j and k, $\left|y_{jk}^{h}\right|$ is the absolute value of the log real wage rate differences between countries j and k for industry h, $dist_{jk}$ the log distance between countries j and k, and X_h is a vector of industry and good specific variables; tradability of the good, the non-traded input share, and two dummy variables for specific good categories for which we have information about large tax differences.

Table 3.1 Good-by-Good Price Dispersion

	1975			1980			1985			1990		
	Model1	Model2	Model3	Model1	Model2	Model3	Model1	Model2	Model3	Model1	Model2	Model3
Tradeability	-.028* (-4.50)	-.129** (-2.29)	-.023* (-4.15)	-.040* (-4.62)	-.071* (-3.08)	-.033* (-3.23)	-.050* (-7.43)	-.070* (-3.06)	-.034* (-4.55)	-.039* (-6.81)	-.051* (-2.70)	-.022* (-3.22)
Non-traded input share	.026* (2.68)	.137* (2.30)	.010 (0.73)	.057* (4.65)	.099* (3.94)	.045* (3.07)	.055* (6.19)	.086* (3.99)	.046* (4.22)	.041* (5.05)	.062* (3.61)	.022** (2.21)
Constant	-.010 (-0.31)	-.379*** (-1.88)	.036 (1.13)	-.055 (-1.65)	-.176** (-2.15)	-.026 (-0.66)	-.066* (-2.68)	-.136** (-1.82)	-.042 (-1.43)	-.037*** (-1.71)	-.079 (-1.28)	-.010 (-0.39)
R2	.08	.14	.10	.08	.10	.07	.08	.06	.06	.07	.05	.03
$R2^*$	.22	.48	.24	.25	.32	.23	.27	.18	.24	.34	.24	.27
# of observation	289	106	183	356	143	213	814	271	543	823	255	568

Notes: * p-value<1%, ** p-value<5%, *** p-value<10%. Model 1 is pooled data; Model 2 and Model 3 presented the results for homogeneous goods and differentiated goods respectively. The eight EU countries considered for 1975 are Austria, Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands and the UK. Greece, Portugal and Spain are added in 1980 and Austria in 1985. R^2 is the goodness-of fit from raw data, R^{2*} is the goodness of fit fro the regression for which the dependent variable is aggregated at the same level with explanatory variables

Estimates with ordinary least squares (OLS) and heteroskedasticity-corrected t-statistics are presented in Table 3.3. Model 1 reports the results for pooled sample estimation. Our findings are qualitatively similar to those presented in Chapter 2. The coefficients for distance are estimated precisely and positive across the board and are as high as 8.3 percent in 1980 but declines down to 4 percent in 1990. Moreover, the impact of distance on absolute price differences decreases monotonically through the period which is consistent with the findings of Rauch (1999). As in Chapter 2, absolute real wage rate differences that capture the local cost component attributed to labor but specific to each industry, enter in expected way for pooled data; estimated price elasticity of real wage is positive and significant for all cross-sections. Coefficient estimates for the industry-specific tradeability variable indicate that, goods belonging to highly tradable industries will have lower price differences; furthermore, higher local input share means higher absolute price differences. So, as in Chapter 2, both industry- specific and country-specific local distribution cost matter for absolute price dispersions. Dummies for large cars and vices also have positive and significant impact on absolute price differences. Finally, as in Chapter 2, population size has positive and significant impact for all three cross-sections which implies possible role for mark-up differences as a determinant of absolute price dispersions.

Then, in order to evaluate the effect of market structure, we re-estimate the equation 3.6 for homogeneous goods and differentiated goods. Results are presented in Table 3.3 in Model 2 and Model 3, respectively indicate that, as distance between

Table 3.2 Good-by-Good Price Dispersion with Tax

	1975			1980			1985			1990		
	Model1	Model2	Model3	Model1	Model2	Model3	Model1	Model2	Model3	Model1	Model2	Model3
Tradeability	-.028* (-4.45)	-.127* (-2.24)	-.023* (-4.01)	-.040* (-4.85)	-.073* (-2.95)	-.035* (-3.59)	-.048* (-6.72)	-.055* (-2.82)	-.033* (-3.95)	-.040* (-6.90)	-.051* (-2.70)	-.021* (-2.99)
Non-traded input share	.025* (2.68)	.136** (2.31)	.010 (0.81)	.048* (4.11)	.089* (3.33)	.036** (2.53)	.058* (6.02)	.074* (3.71)	.057* (4.45)	.041* (5.09)	.062* (3.61)	.021** (2.09)
Large cars	.0002 (0.01)		-.003 (-0.21)	.026*** (1.73)		.024 (1.61)	.102* (3.42)		.106* (3.56)	.036* (2.57)		.038* (2.70)
vices	-.010 (-0.88)		-.010 (-0.75)	.035** (2.24)		.036** (2.06)	.088* (2.76)		.107* (3.31)	.032** (2.33)		.050* (3.52)
constant	-.007 (-0.28)	-.376** (-1.86)	-.034 (-1.16)	-.067** (-2.13)	-.193** (-2.23)	-.037 (-1.00)	-.073* (-2.78)	-.094 (-1.63)	-.069** (-2.07)	-.042*** (-1.92)	-.079 (-1.28)	.010 (0.33)
R2	.08	.14	.10	.08	.09	.09	.09	.06	.11	.08	.05	.06
$R2^*$	.23	.48	.24	.26	.26	.27	.40	.20	.36	.37	.24	.36
# of observation	289	106	183	356	143	213	814	271	543	823	255	568

Notes: * p-value<1%, ** p-value<5%, *** p-value<10%. Model 1 is pooled data; Model 2 and Model 3 presented the results for homogeneous goods and differentiated goods respectively. The eight EU countries considered for 1975 are Austria, Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands and the UK. Greece, Portugal and Spain are added in 1980 and Austria in 1985. R^2 is the goodness-of fit from raw data, R^{2*} is the goodness of fit fro the regression for which the dependent variable is aggregated at the same level with explanatory variables.

countries increases so does the absolute price dispersions. For the differentiated goods (Model 3), we can observe that, the impact of distance decreases monotonically through the period. The price elasticity of distance estimated as 8.7 percent in 1980, 4.7 percent in 1985 and 2.9 percent for 1990. In other words, from 1980 to 1990, price elasticity of distance declines almost 70 percent. However, for the homogeneous goods, distance coefficient is estimated as 7.5 percent in 1980, and 8.1 percent and 7.3 percent for 1985 and 1990, respectively. This finding is consistent with the argument discussed in Berthelon and Freund (2004). Improved communication technologies help to reduce the search costs which are more important for differentiated goods; nevertheless we do not observe a similar trend for the homogeneous goods (Berthelon and Freund, 2004).

For both types of goods, real wage rate differences enter as a positive determinant of price dispersions. Price elasticity of the real wage rate for homogeneous goods estimated as 10 percent in 1980, 8.6 percent in 1985 and 10.4 percent in 1990. Unlike the homogeneous goods, the impact of country-specific aspect of the local distribution cost for differentiated goods declines monotonically from 1980 to 1990; from 8.8 percent in 1980 to 6.8 percent in 1985, and finally to 5.3 percent in 1990. This finding also support the argument discussed in Berthelon and Freund (2004). Moreover, for all three cross-sections, the estimated impact of the real wage rate on absolute price differences is higher for homogeneous goods than the differentiated goods. As it was discussed above, since most of the homogeneous goods in our sample are bulky and /or perishable commodities, we expect them to have higher weight/price ratio compared to differentiated goods.

Table 3.3 Absolute Price Dispersion with Product Differentiation

	1980			1985			1990		
	Model1	Model2	Model3	Model1	Model2	Model3	Model1	Model2	Model3
Population	.007* (2.71)	.006 (1.29)	.007** (2.43)	.003*** (1.90)	-.004 (1.24)	.006* (3.23)	.005* (3.46)	-.001 (0.24)	.008* (4.58)
Wage rate	.092* (18.03)	.100* (10.69)	.088* (14.37)	.075* (17.98)	.086* (9.67)	.068* (14.93)	.067* (18.04)	.104* (12.02)	.053* (13.43)
Distance	.083* (22.02)	.075* (10.62)	.087* (19.67)	.057* (16.33)	.081* (11.64)	.047* (11.85)	.040* (15.11)	.073* (12.70)	.029* (9.84)
Tradability	-.082* (-24.62)	-.086* (-7.66)	-.071* (-18.60)	-.080* (-30.41)	-.072* (-7.81)	-.067* (-22.43)	-.066* (-28.82)	-.095* (-11.27)	-.046* (-17.48)
Non-traded input share	.101* (18.48)	.121* (9.68)	.100* (13.64)	.089* (21.40)	.100* (10.70)	.093* (17.18)	.058* (15.48)	.111* (12.86)	.036* (7.76)
Large cars	.147* (7.93)		.155* (8.33)	.195* (7.33)		.202* (7.58)	.099* (9.33)		.101* (9.43)
Vices	.042* (3.28)		.061* (4.51)	.127* (8.16)		.152* (9.62)	.068* (4.54)		.080* (5.27)
Constant	-.593* (-20.01)	-.564* (-9.36)	-.620* (-17.65)	-.363* (-13.57)	-.504* (-8.72)	-.309* (-9.98)	-.180* (-8.67)	-.544* (-10.69)	-.045*** (-1.90)
R^2	.09	.07	.09	.06	.05	.05	.05	.06	.03
# of observations	20653	6803	13850	36130	10333	25797	45752	11604	34148
# of countries	10	10	10	10	10	10	11	11	11

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. The ten countries in 1980 sample are, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain and the UK. Austria is added in 1985. We have to exclude the Netherlands from 1985 sample because of the insufficient number of wage observations.

Therefore, trade cost for the homogeneous goods would be higher than that of the differentiated goods.

Results in Table 3.3 indicate that, both industry-specific aspect of transportation cost which is measured by tradability of the good and the country-specific aspect proxied by the bilateral distance between countries matter for absolute price dispersions. For both types of commodities, tradability has a negative and significant impact on absolute price dispersions and as in Table 3.1 and Table 3.2, tradeability has larger effect on the absolute price dispersions for homogeneous goods. This tells us the same amount of increase in tradeability of goods will decrease the price dispersion for homogeneous goods more than the differentiated goods.

The price elasticity of the non-traded input share for homogeneous goods estimated precisely, and it is around 10 percent for all three cross-sections. Similarly, the non-traded input share has a positive and significant effect on absolute price differences for differentiated goods yet decreases monotonically from 10 percent in 1980 to 9.3 percent in 1985, and finally to 3.6 percent in 1990. We can conclude that both country-specific and industry-specific aspects of distribution cost are important for the absolute price dispersion for the differentiated commodities.

For this specification, tax differences are controlled by two dummies: one for large cars and the other one for vices. Results in Table 3.3 show that both of the dummies also have positive and significant impact on absolute price differences for differentiated goods. If a good belongs to the group classified by these dummies, the absolute price differences between countries will be larger.

Coefficient estimates of population differences indicate some interesting aspects. As it mentioned above we expect markup differences would matter more for differentiated goods since the producers of those goods have some pricing power depending on the substitutability of the products. We can see from Table 3.3 that for the homogeneous goods, for all three years estimated coefficients of population differences are statistically indistinguishable than zero. However, price elasticities of population differences for differentiated goods are positive and significant across the board.

Finally, we add the country and industry specific value added taxes (VAT) differences in to the analysis and re-estimate the Equation 3.6. Before-VAT prices are defined as $\tilde{P}_{ij} = P_{ij} / (1 + v_{ij})$ where P_{ij} is the after-VAT price of good i in country j in units of numeraire country currency, v_{ij} is the VAT rate for country j and good i and $\tilde{P}_{ij}$ is the before-VAT price of good i in country j. VAT rates are unavailable for Greece, Spain and Portugal for the cross-sections except 1990. So, there are only seven countries with VAT rates for 1980 and 1985 and that makes it harder to get reliable results. Therefore, we estimate the specification with before-VAT prices only for year 1990 for which all 11 countries in our data have the VAT rates. Results are presented in Table 3.4.

As before results for the pooled data are presented in Model 1, Model 2 and Model 3 show the results for homogeneous and differentiated goods, respectively. For all three models, the coefficient estimates of the country-specific potential determinants of the absolute price differences virtually unchanged in the specifications without the VAT reported in Table 3.3. Coefficient estimates of tradability with before-VAT prices change to -10.2 percent from -9.5 percent for differentiated goods and to -4.6 percent from -4 percent for homogeneous goods. For both types of commodities, the price elasticity of the non-traded input content of the good nearly unchanged with the inclusion of VAT. Finally, the two dummies have positive and significant impact on the absolute price differences for differentiated goods as we anticipated.

Moreover, we can see that the results hold the established relation between homogeneous goods and differentiated goods. Coefficient estimates for country-specific transportation cost and industry-specific aspect of the transportation cost are higher for homogeneous goods. Similarly, country-specific and industry-specific distribution cost matter more for homogeneous goods relative to differentiated goods. Finally, as in Table 3.3, impact of population differences on absolute price dispersions is statistically indistinguishable than zero for homogeneous goods whereas it is positive and significant for differentiated goods.

3.5 Conclusion

In this chapter we attempt to explain the effect of market structure on international price dispersions. In order to characterize the market structure, we use the commodity classification proposed by Rauch (1999). In this classification, Rauch (1999) categorized the internationally traded commodities as commodities traded in organized exchanges, goods those are not traded in organized exchanges but possess a reference price and differentiated goods. Each good in our price data is assigned one of the good categories defined by Rauch (1999). Since having a reference price distinguishes homogeneous goods from differentiated goods, commodities traded in organized

Table 3.4 Absolute Price Dispersion with Product Differentiation and with VAT

	1990		
	Model1	Model2	Model3
Population	.005* (3.51)	.002 (0.43)	.007* (4.16)
Wage rate	.069* (18.91)	.106* (12.52)	.056* (14.13)
Distance	.041* (15.57)	.073* (12.72)	.030* (10.41)
Tradability	-.061* (-26.46)	-.102* (-12.12)	-.040* (-15.18)
Non-traded input share	.051* (13.80)	.114* (13.20)	.031* (6.80)
Large cars	.124* (11.61)		.126* (11.66)
vices	.054* (3.77)		.068* (4.66)
constant	-.174* (-8.41)	-.573* (-11.30)	-.044*** (-1.88)
R^2	.05	.07	.03
# of observations	45752	11604	34148
# of countries	11	11	11

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. The ten countries in 1990 sample are, Austria, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain and the UK.

and reference priced goods are combined as homogeneous goods. Then we estimate two specifications in order to assess the impact of market structure on international price differences.

Our departure point for the first specification is the model discussed in CTZ. We attempt to explain the effect of good-specific characteristics used by CTZ on the good-by-good price dispersions for homogeneous goods and differentiated goods separately.

Our second specification originated from the theoretical model discussed in Anderson and van Wincoop (2004). Model describes the transportation cost, distribution cost, and differences in taxes and markups as potential determinants of international price dispersion. As in Chapter 2, we utilize physical distance between the countries as a measure of transportation cost, industry specific real wage rates as a measure of local distribution cost, and population differences as a measure of markup differences. Tax differences are controlled by two dummy variables for vices and large cars, and where broadly available by VAT rates. In order to control the heterogeneity across industries in transportation and distribution costs, we also utilize industry-specific variables tradability and the non-traded input share of the final good. Our results indicate that i) in both specifications, price elasticity of tradability and the non-traded input share estimated higher for homogeneous goods. This finding confirms our expectations, since the pricing decision of differentiated goods is a multidimensional issue; it depends on the elasticity of substitution between the available variety of product, preferences as well as the trade. Moreover since most of the homogeneous goods are bulky and/or perishable items, distribution costs are also higher for them. ii) Country specific measure of distribution cost is estimated significantly for both commodity groups, and we have higher estimates for homogeneous goods. iii) Country specific aspects of transportation cost distance, is estimated positive and significant for both types of products, and higher for homogeneous goods than differentiated goods. Furthermore, the price elasticity of distance decreases monotonically over the period for differentiated goods, but it remains almost constant for homogeneous goods. This result is parallel with the argument made by Barthelon and

Freund (2004) and Rauch (1999) that the decrease in search cost over the years affect the differentiated goods more than the homogeneous goods. It should also be noted that Bergstarnd and Egger (forthcoming) reached the same conclusion by using cif/fob ratios as a proxy for transportation cost instead of bilateral distance .iv) Finally, markup differences are more important for differentiated goods.

CHAPTER 4

CONCLUSION

This dissertation work set out to investigate the reasons behind the international price dispersion. Crucini. Telmer and Zachariadis (2005) state that "theory places much starker restrictions on LOP deviations than on their changes", and the gap between theory and empirics can be bridged through the use of microeconomic price levels. However due to data limitations most empirical work has examined the time-series distribution of international relative prices. This dissertation addressed this issue by utilizing a unique and comprehensive dataset on absolute LOP deviations that enabled us to make cross-sectional comparison of the price of the same good.

The comparison of prices across countries is one of the several ways of investigating market integration. Because of costly trade markets do not integrate completely (Melitz and Ottaviano, 2005). Anderson and van Wincoop (2004) argue that trade costs have economically sensible magnitudes and patterns across countries and across goods, suggesting useful hypotheses for a deeper understanding of them. Since direct measures of trade costs are usually sparse and inaccurate, using indirect measures as a complement is inevitable (Anderson and van Wincoop 2004).

Price levels of individual goods provide indirect information about trade costs. However the literature on inference about trade costs from final goods prices remains largely devoid theory; therefore some theoretical background on this literature will help us learn more about trade costs from evidence on prices (Anderson and van Wincoop, 2004). The first essay on this dissertation, "International Price Dispersion and Direction of Trade" adds to the existing literature by empirically testing the theoretical model discussed in Anderson and van Wincoop (2004). According to the "theoretical background" discussed in this work, in order to assess trade costs from price levels, the source country needs to be identified for each product. In order to succeed, we have used two different approaches. In our first approach, productivity levels of countries were used as a factor which determines the source country. Based on Eaton and Kortum (2001), Eaton and Kortum (2002), and Eaton, Bernard, Jensen, and Kortum (2003) we have used the most productive country in each industry as a reference country. As a second approach, we utilized bilateral trade flows in order to compute price levels in the hypothetical exporter country. In both specifications, bilateral distance between the probable source and the destination country were employed as a measure of transportation costs. When the most productive country was used as a reference country, estimated coefficients of distance improved. Moreover, results obtained from the specification which uses productivity as a determinant of the source country are qualitatively very similar to ones obtained from the second specification which uses the information from real trade partners. This finding indicated that productivity is a strong predictor of the direction of trade.

Results also demonstrated that, the other potential determinants discussed in Anderson and van Wincoop (2004), local distribution costs, taxes, and markup differences also have significant impact on international price dispersion. Overall, we could conclude that the data was consistent with the models where transportation cost, local distribution costs, market size, and tax differences play significant roles in the determination of international price dispersion.

There is a growing interest on the role of market structure in explaining LOP deviations. The second essay, “International Price Dispersion and Market Structure” has discussed the effect of market structure on international price differences. More specifically, we categorized goods as homogeneous goods and differentiated goods by using the well-known Rauch commodity classification, and have investigated the impact of determinants of price dispersion for these categories separately. The first specification based on the model discussed in CTZ. According to this model, tradeability of the good and its non-traded input content largely explain LOP deviations. For the second specification we have used the theoretical model in Anderson and van Wincoop (2004), Results of both models demonstrated that transportation and local distribution costs, both in country-specific and industry-specific levels, have larger impact on the absolute price dispersion for homogeneous goods. Furthermore, the monotonically decreasing impact of distance we observed for the full sample could be observed only for differentiated goods. In sum, our results confirmed the argument in Berthelon and Freund (2004) and Rauch (1999): Decrease in search cost over the period has affected price dispersion of differentiated goods more than homogeneous goods.

Finally, market size appeared to be more important for the differentiated goods. It can be concluded that there are vast differences in elasticities of the determinants of price dispersion across different types of goods. Further studies should include this issue into the analysis.

In summary, the results in this dissertation show that our data is consistent with the theoretical model according to which international price differences are largely determined by trade costs, taxes and markups. As Anderson and van Wincoop (2004) suggested, the death of distance is exaggerated; both international trade costs and local distribution cost are large and there is an important relation between trade costs and market structure.

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APPENDIX A DATA

Table A1 Industry Availability of the TFP Level Data

Industry Description	ISIC
Food Products	311
Beverages	313
Tobacco	314
Textiles	321
Wearing apparel except footwear	322
Leather products	323
Footwear except rubber or plastic	324
Furniture except metal	332
Paper and products	341
Printing and publishing	342
Other chemicals	352
Miscellaneous petroleum and coal products	354
Rubber products	355
Glass and products	362
Other non-metallic mineral products	369
Iron and steel	371
Non-ferrous metal	372
Fabricated metal products	381
Machinery except electrical	382
Machinery electric	383
Transport equipment	384
Professional and scientific equipment	385
Other manufactured products	390

Table A2 Availability of the Import Flows Data

Industry Description	ISIC
Meat and meat preparations	3111
Dairy products and bird's eggs	3112
Vegetables and fruits	3113
Fish, crustaceans, mollucs, preparations thereof	3114
Margarine, imitate.lard, and other prepared edible fats	3115
Fixed vegetable oils and fats	3115
Cereal and cereal preparations	3116
Macaroni, spaghetti, and similar products	3117
Bakery products	3117
Sugar and honey	3118
Sugar confectionary and other sugar preparations	3119
Cocoa	3119
Chocolate and other food preparations containing cocoa	3119
Coffee and coffee substitutes	3121
Tea	3121
Spices	3121
Edible products and preparations n.e.s	3121
Alcoholic beverages	3133
Non alcoholic beverages n.e.s	3134
Tobacco and tobacco manufactures	3140
Textile fibres (except wool tops) and their wastes	3210
Textile yarn, fabrics, made.up articles, related products	3210
Articles of apparel and clothing accesories	3220
Leather, leather manufactures, n.e.s	3230
Footware	3240
Furniture and parts thereof	3320
Pulp and waste paper	
	3410

(cont.)

Paper, paperboard, articles of paper, paper pulp/board	3410
Registers, exercise books, notebooks etc.	3420
Printed matter	3420
Artificial resins, plastic materials, cellulose esters and ethers	3513
Dyeing, tanning, and coloring materials	3521
Essential oils and perfume materials; toilet polishing and cleaning preparations	3523
Chemical materials and products n.e.s	3529
Coal coke and briquettes	3540
Petroleum, petroleum products and related materials	3540
Rubber manufactures n.e.s	3550
Other artificial plastic materials, n.e.s	3560
Combs, hair slides and the like	3560
Glassware	3620
Clay construct. Materials and refractory construct. materials	3691
Portlan cement, cement fondu, slag cement etc..	3692
Nails, screws, nuts, bolts,etc iron and steel	3710
Aluminum foils, of a thickness not exceeding 20 mm.	3720
Other tools for use in hand	3811
Cutlery	3811
Office machines and automatic data processing equipment	3825
Sewing machines, furniture for sewing machines and parts	3829
Household type refrigerators and freezers	3829
Telecommunications and sound recording apparatus	3832
Gramophone records, recorded tapes etc..	3832
Household type electrical and non electrical equipment	3833
Electrical app. such as switches, relays, fuses, plugs etc..	3839
Batteries and accumulators and parts	3839
Filament lamps, no infrared ultraviolet lamps	3839
Int combustion piston engines for outboard prop.	3841

(cont.)

Passenger motorcars, for transport of passengers and goods	3843
Motorcycles, motorscooters, invalid carriages	3844
Photographic apparatus, optical goods, watches	3850
Medical instruments and appliances	3850
Orthopedic appliances, surgical belts	3850
Pins and needles, fittings, based metal beeds etc.	3900
Children's toys, indoor games	3900
Other sporting goods and fairground amusement	3900
Pens, pencils, and fountain pens	3900
Jewelry, goldsmiths and other art. of precious metals	3900
Musical instruments, parts and accessories	3900
Mechanical lighters and parts	3900

Table A3 Sample of Goods with Rauch Classification Codes

SITC	GOOD DESCRIPTION	RAUCH CODE
111	Beef, fresh-blade-bone steak	w
111	Pork-fresh, belly	w
116	Pig Liver, fresh	w
116	Tongue of beef-fresh	w
240	Processed cheese	w
350	Dried cod-salted	w
422	Long grained rice-in plastic bag	w
577	Peanuts-in plastic bag	w
585	Apple juice-natural, in carton	w
114	Turkey-frozen (15 to 18 weeks old)	r
142	Mortadella	r
142	Cocktail sausages-tinned	r
223	Natural yoghourt	r
371	Tuna fish-in oil	r
460	Flaked oats-without vitamis	r
589	Fruit-based baby food	r
6415	Box of paper handkerchief: double	r
7781	Dry battery: r6	r
483	Spaghetti-without eggs	n
619	Caramel sweets	n
1110	Orange soda-sparkling, selected brand	n
1222	Cigarettes, light, with filter, selected brand	n
5530	Perfume, selected brand	n
6973	Pressure cooker: selected brand	n
7751	Washing machine: 5 kg., selected brand	n
7810	Motor car: engine of 1700 cc or over, selected brand	n
8510	Mans sport shoes, selected brand	n

Note: w: goods traded in organized exchanges, r: reference priced goods, n: differentiated goods

Figure A1 Empirical Distributions of $Var(q_{ij}|j)^{1/2}$

<u>1975</u>

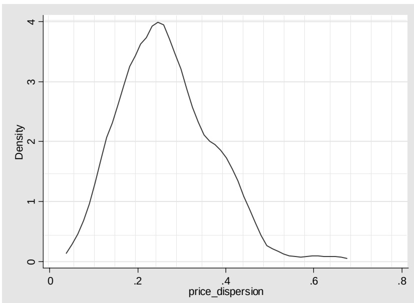

Figure A1.1 Pooled Data

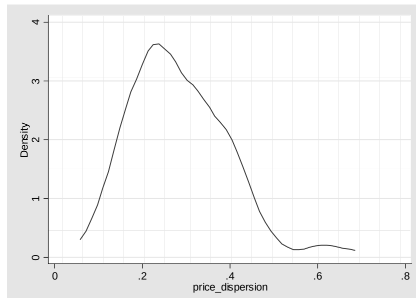

Figure A1.2 Homogeneous Goods

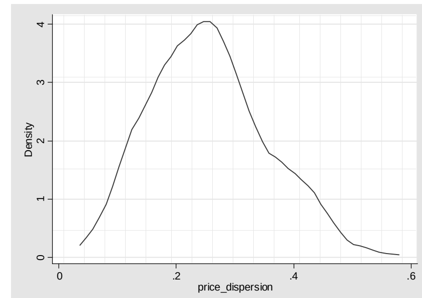

Figure A1.3 Differentiated Goods

<u>1980</u>

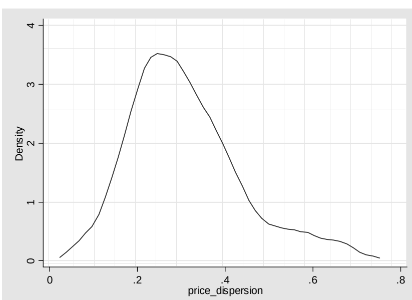

Figure A1.4 Pooled Data

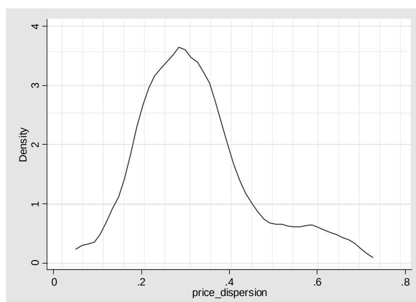

Figure A1.5 Homogeneous Goods

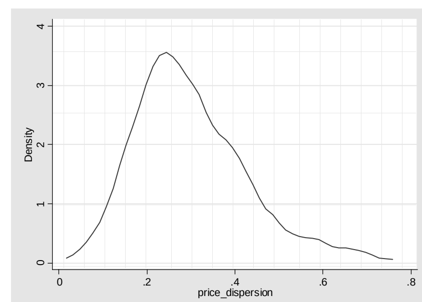

Figure A1.6 Differentiated Goods

(cont.)

1985

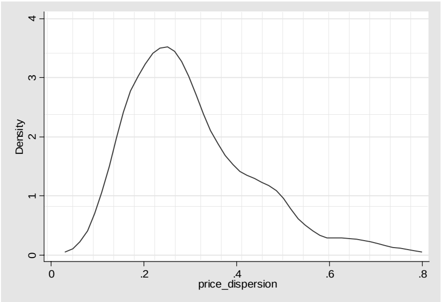

Figure A1.7 Pooled Data

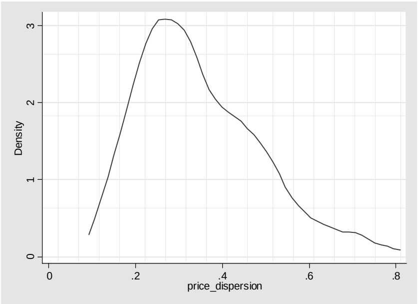

Figure A1.8 Homogeneous Goods

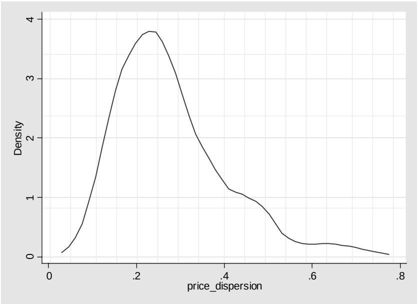

Figure A1.9 Differentiated Goods

1990

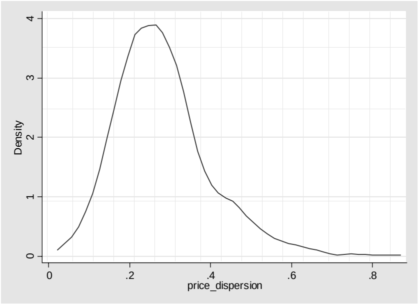

Figure A1.10 Pooled Data

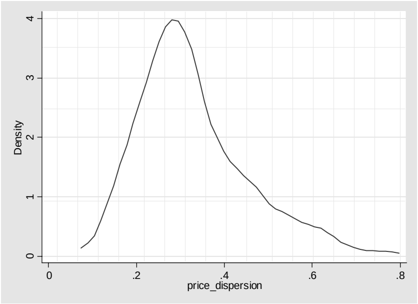

Figure A1.11 Homogeneous Goods

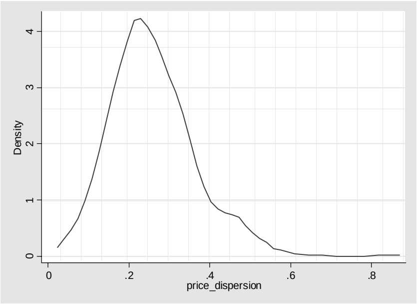

Figure A1.12 Differentiated Goods

Figure A2 Empirical Distributions of LOP Deviations

1975

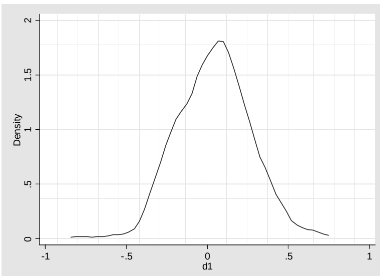

Figure A2.1 Germany

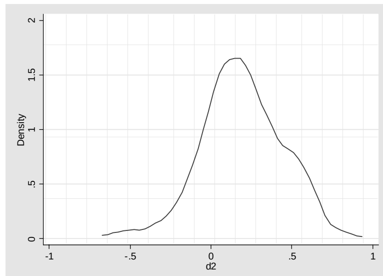

Figure A2.2 Denmark

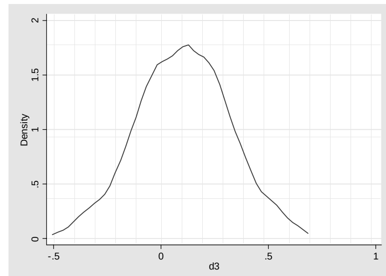

Figure A2.3 France

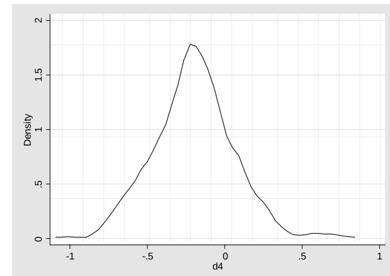

Figure A2.4 United Kingdom

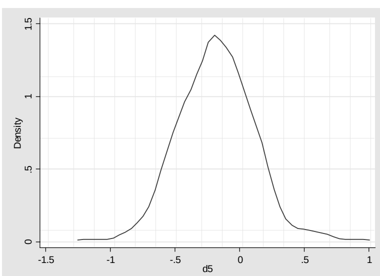

Figure A2.5 Ireland

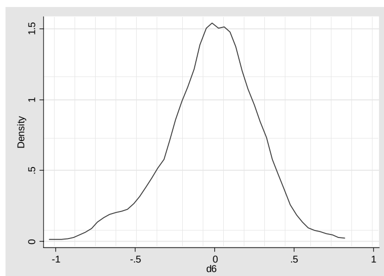

Figure A2.6 Italy

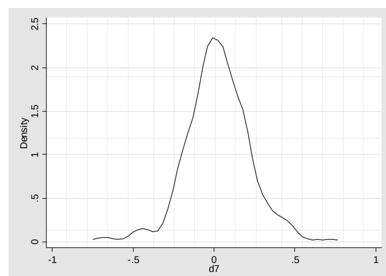

Figure A2.7 Netherlands

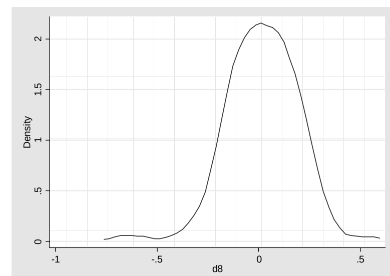

Figure A2.8 Belgium

(cont.)

<u>1980</u>

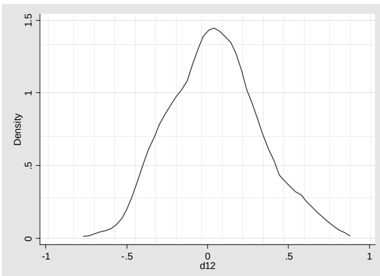

Figure A2.9 Germany

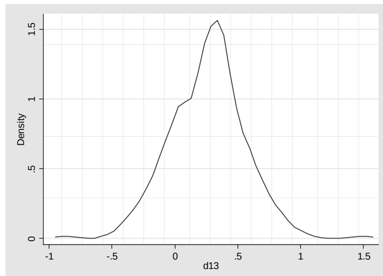

Figure A2.10 Denmark

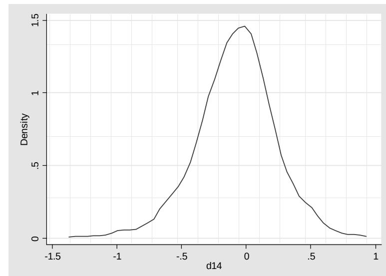

Figure A2.11 Spain

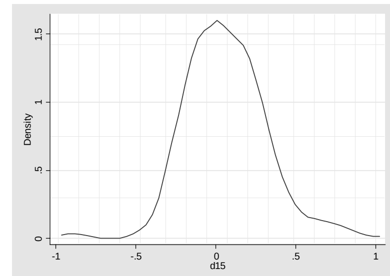

Figure A2.12 France

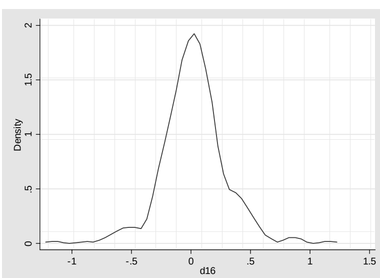

Figure A2.10 United Kingdom

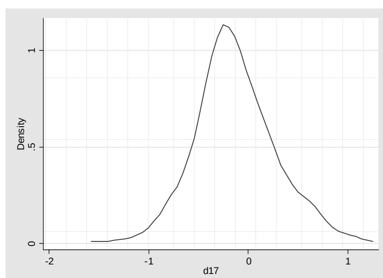

Figure A2.11 Greece

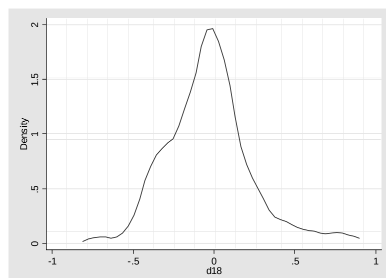

Figure A2.12 Ireland

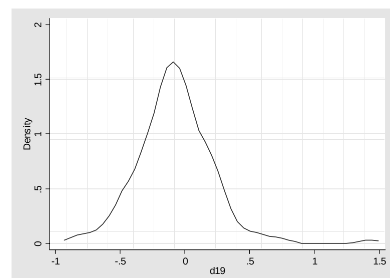

Figure A2.13 Italy

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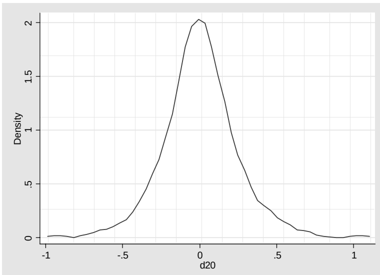

FigureA2.14 Netherlands

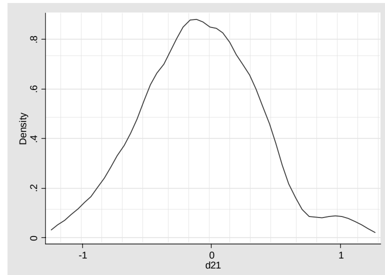

Figure A2.15 Portugal

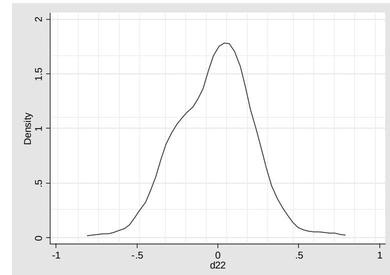

Figure A2.16 Belgium

<u>1985</u>

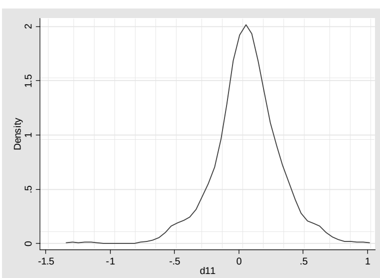

Figure A2.17 Austria

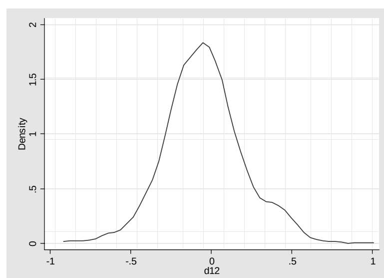

Figure A2.18 Germany

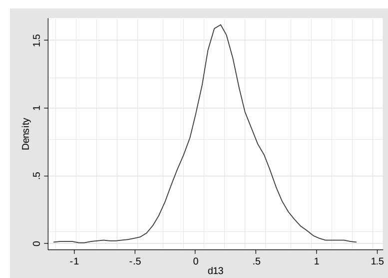

Figure A2.19 Denmark

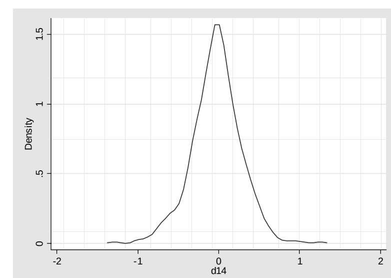

Figure A2.20 Spain

(cont.)

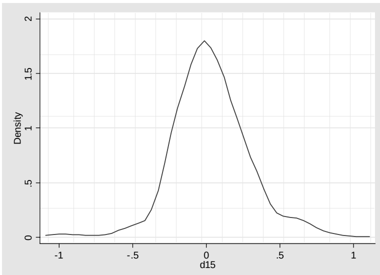

Figure A2.21 France

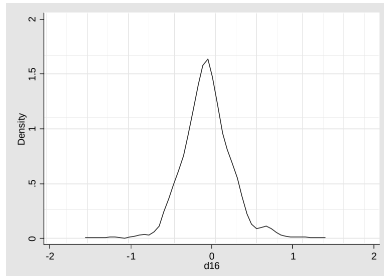

Figure A2.22 United Kingdom

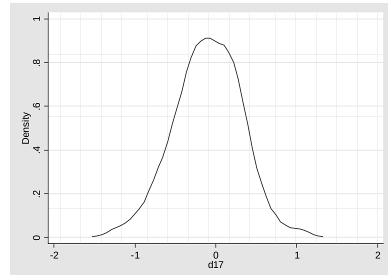

Figure A2.23 Greece

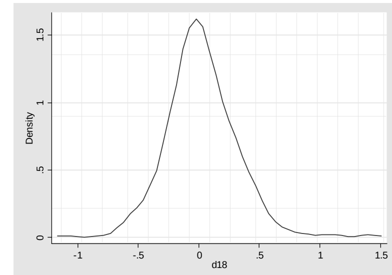

Figure A2.24 Ireland

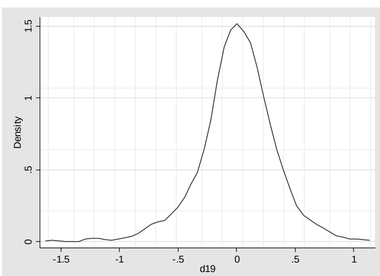

Figure A2.25 Italy

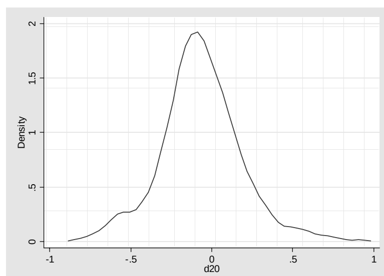

Figure A2.26 Netherlands

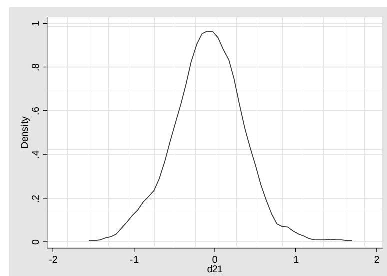

Figure A2.27 Portugal

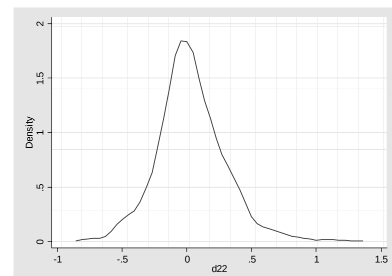

Figure A2.28 Belgium

(cont.)

1990

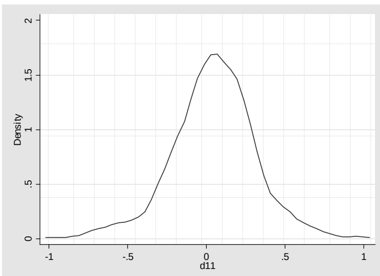

Figure A2.29 Austria

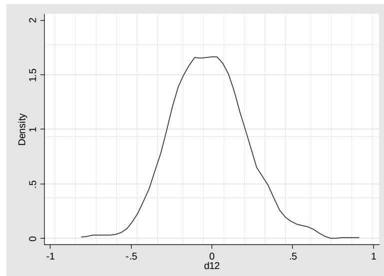

Figure A2.30 Germany

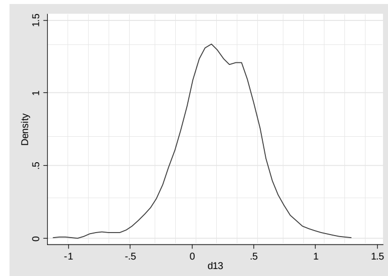

Figure A2.31 Denmark

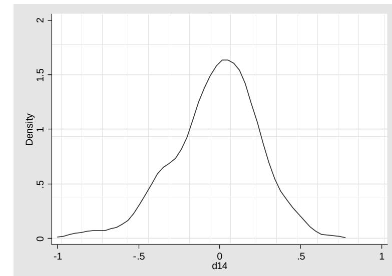

Figure A2.32 Spain

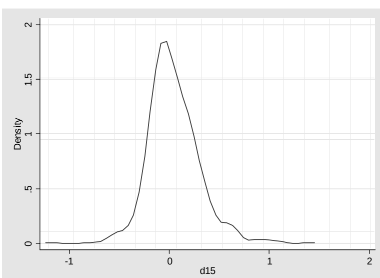

Figure A2.33 France

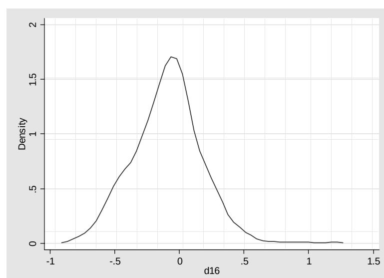

Figure A2.34 United Kingdom

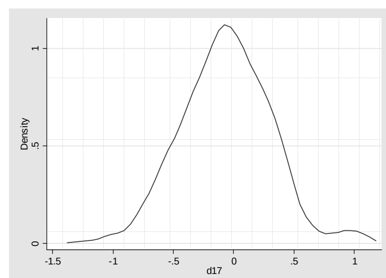

Figure A2.35 Greece

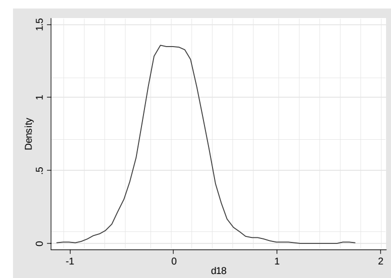

Figure A2.36 Ireland

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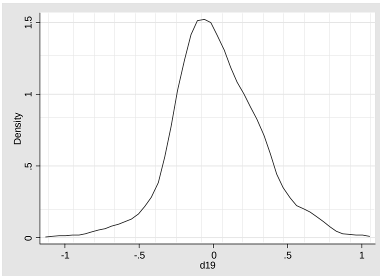

Figure A2.37 Italy

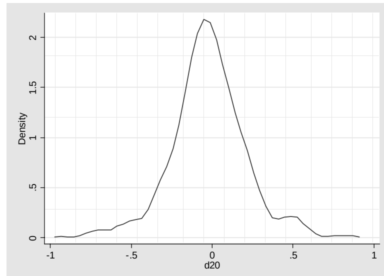

Figure A2.37 Netherlands

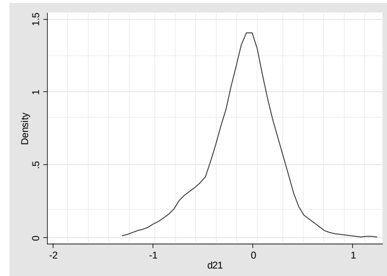

Figure A2.38 Portugal

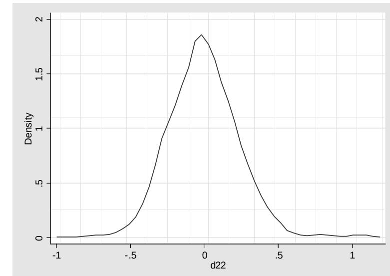

Figure A2.39 Belgium

Figure A3 Empirical Distributions of LOP Deviations for Homogeneous Goods

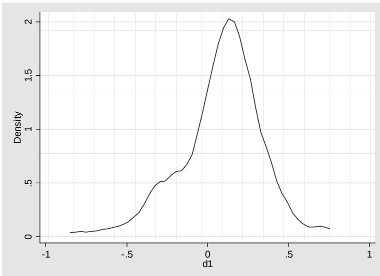

Figure A3.1 Germany

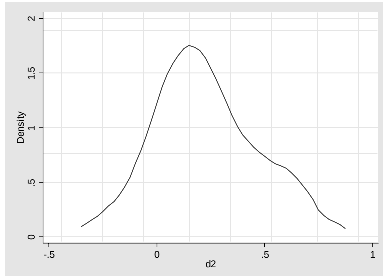

Figure A3.2 Denmark

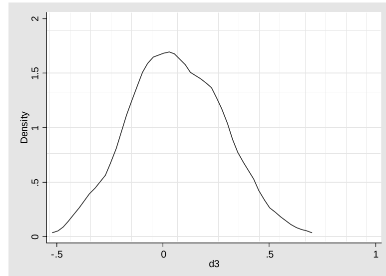

Figure A3.3 France

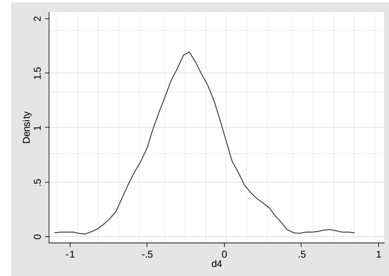

Figure A3.4 United Kingdom

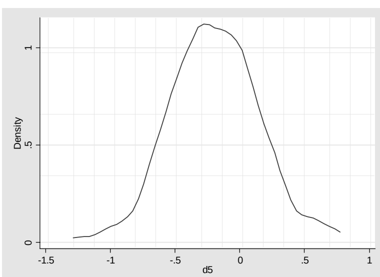

Figure A3.5 Ireland

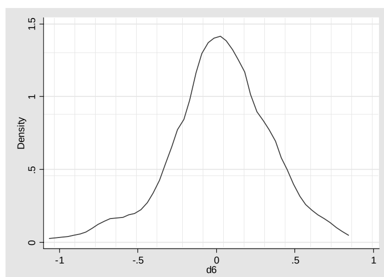

Figure A3.6 Italy

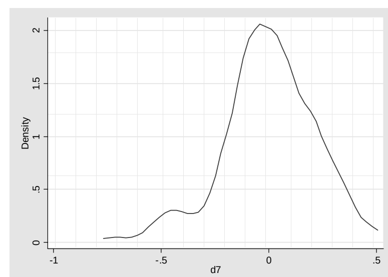

Figure A3.7 Netherlands

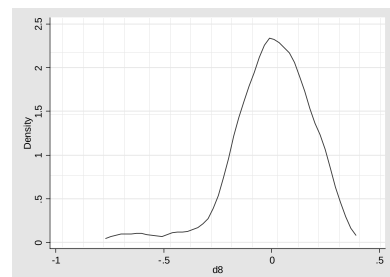

Figure A3.8 Belgium

(cont.)

1980

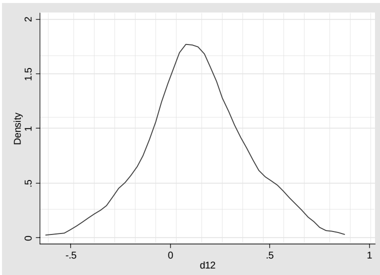

Figure A3.9 Germany

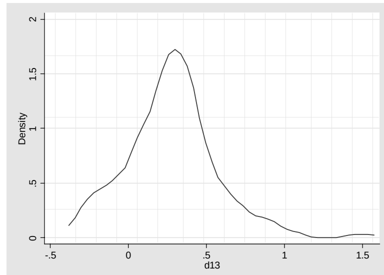

Figure A3.10 Denmark

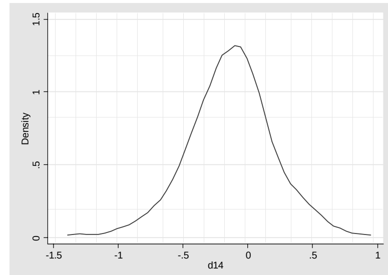

Figure A3.11 Spain

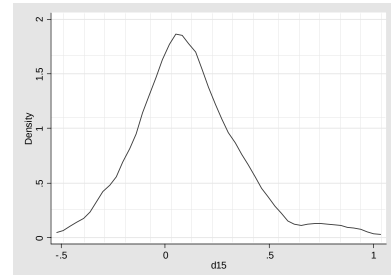

Figure A3.12 France

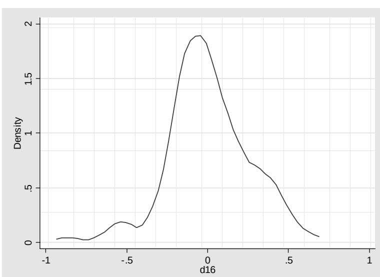

Figure A3.13 United Kingdom

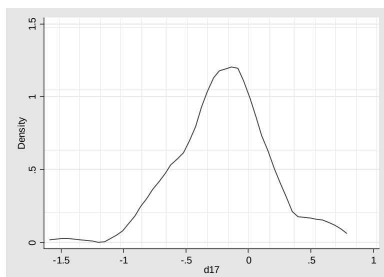

Figure A3.14 Greece

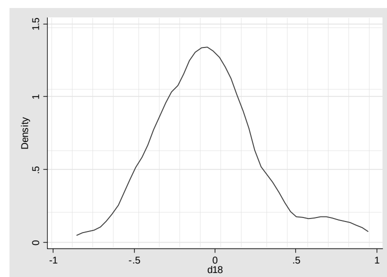

Figure A3.15 Ireland

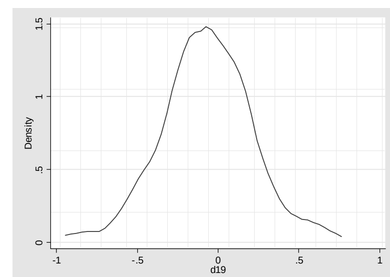

Figure A3.16 Italy

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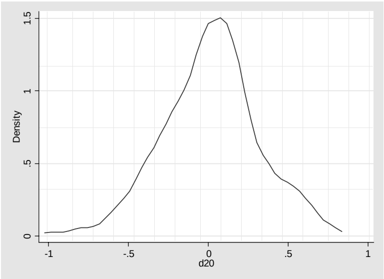

Figure A3.17 Netherlands

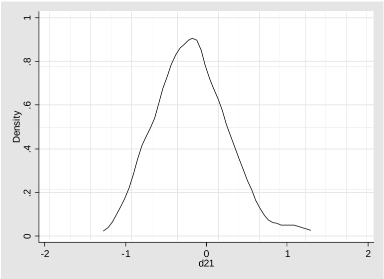

Figure A3.18 Portugal

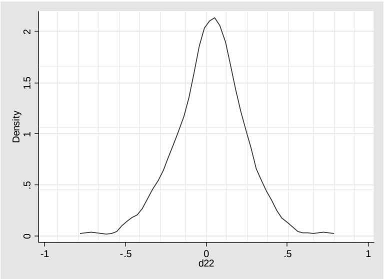

Figure A3.19 Belgium

1985

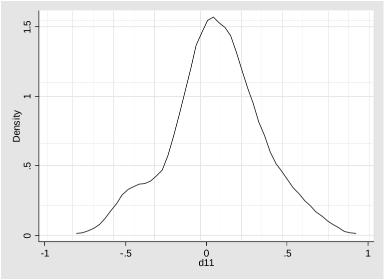

Figure A3.20 Austria

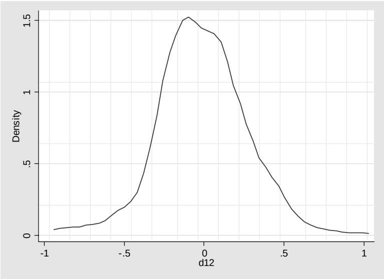

Figure A3.21 Germany

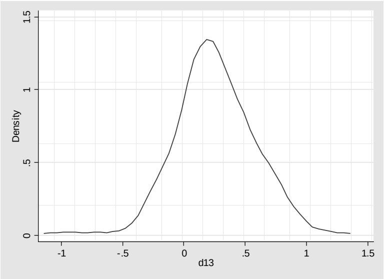

Figure A3.22 Denmark

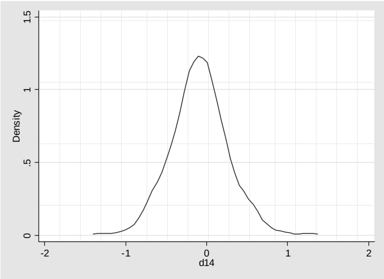

Figure A3.23 Spain

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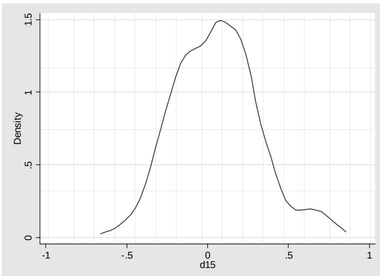

Figure A3.24 France

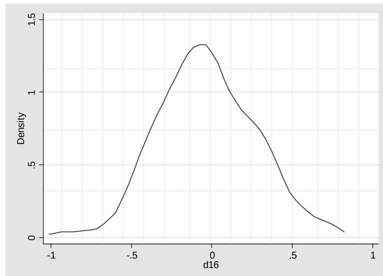

Figure A3.25 United Kingdom

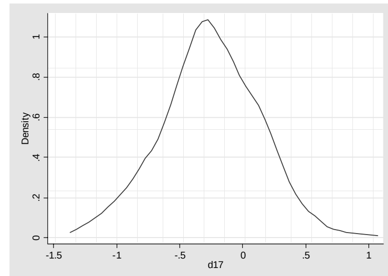

Figure A3.25 Greece

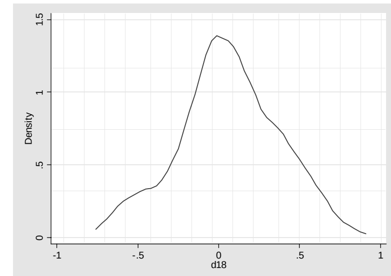

Figure A3.26 Ireland

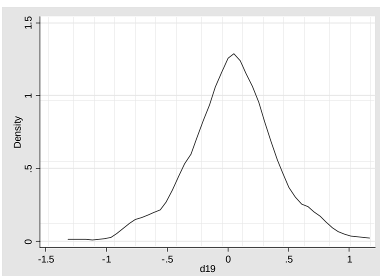

Figure A3.27 Italy

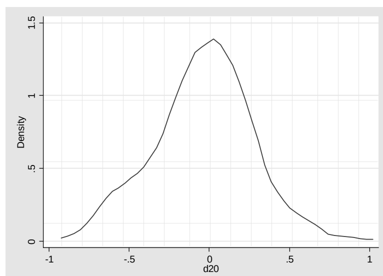

Figure A3.28 Netherlands

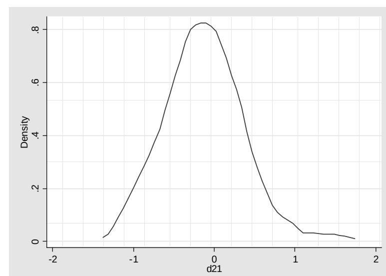

Figure A3.29 Portugal

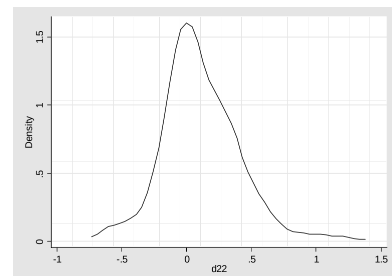

Figure A3.30 Belgium

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<u>1990</u>

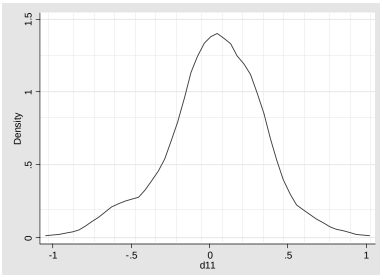

Figure A3.31 Austria

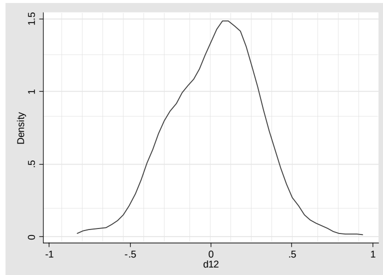

Figure A3.32 Germany

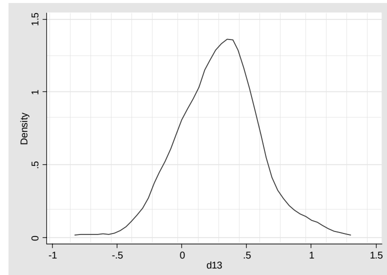

Figure A3.33 Denmark

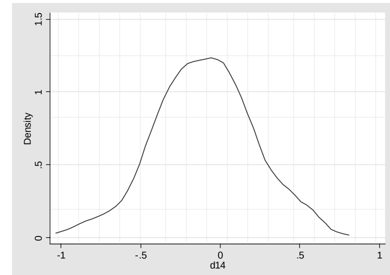

Figure A3.34 Spain

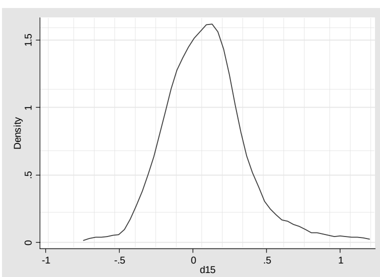

Figure A3.35 France

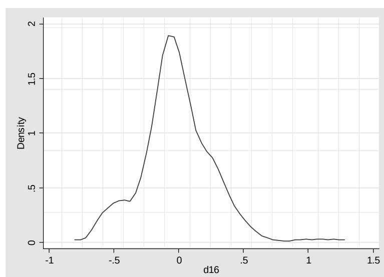

Figure A3.36 United Kingdom

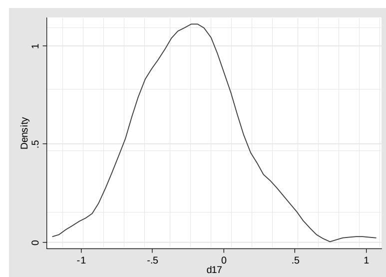

Figure A3.37 Greece

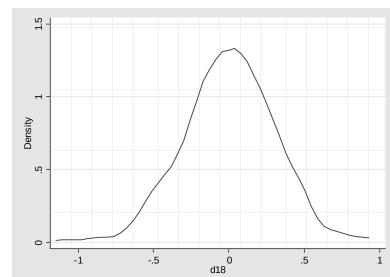

Figure A3.38 Ireland

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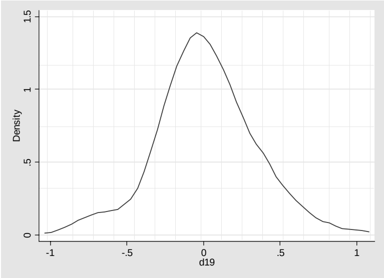

Figure A3.39 Italy

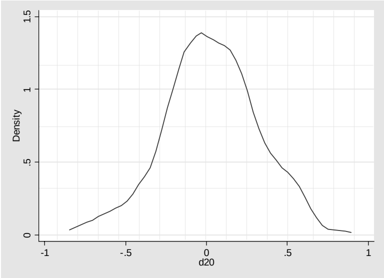

Figure A3.40 Netherlands

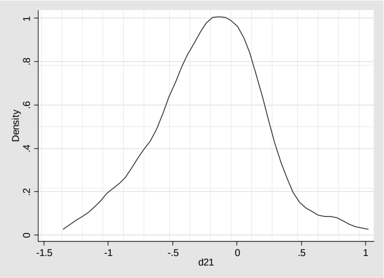

Figure A3.41 Portugal

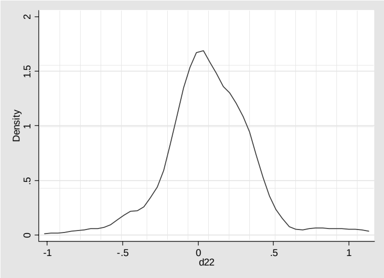

Figure A3.42 Belgium

Figure A4 Empirical Distributions of LOP Deviations for Differentiated Goods

<u>1975</u>

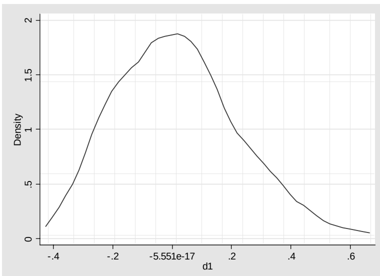

Figure A4.1 Germany

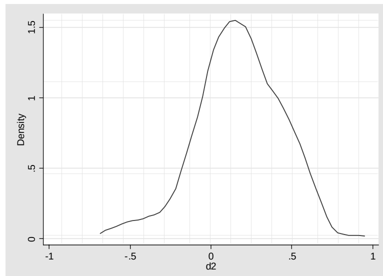

Figure A4.2 Denmark

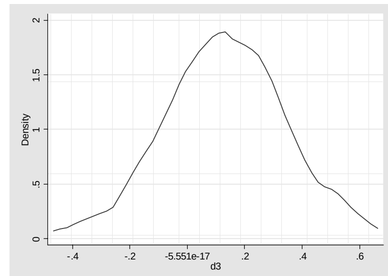

Figure A4.3 France

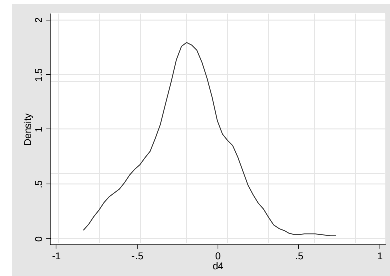

Figure A4.4 United Kingdom

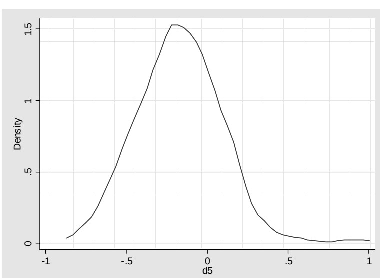

Figure A4.5 Ireland

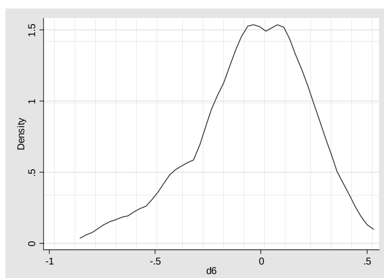

Figure A4.6 Italy

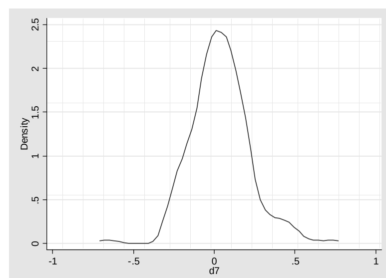

Figure A4.7 Netherlands

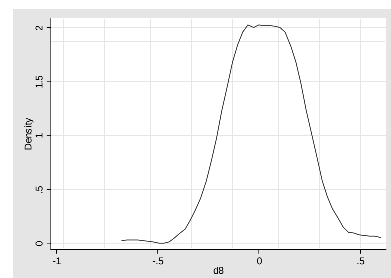

Figure A4.8 Belgium

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<u>1980</u>

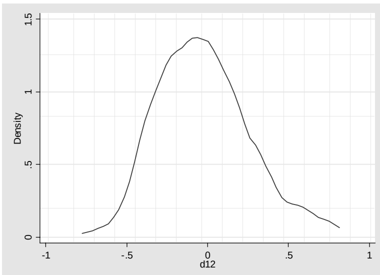

Figure A4.9 Germany

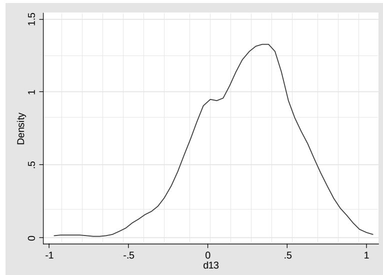

Figure A4.10 Denmark

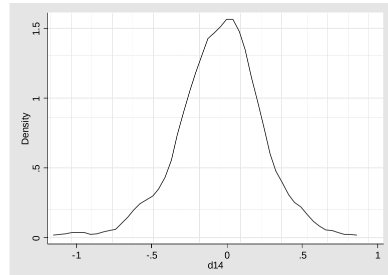

Figure A4.11 Spain

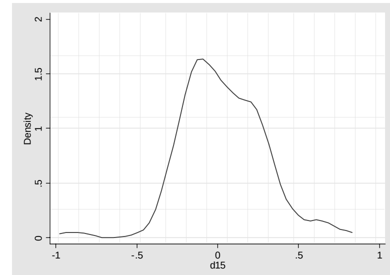

Figure A4.12 France

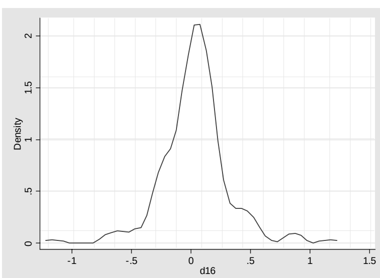

Figure A4.13 United Kingdom

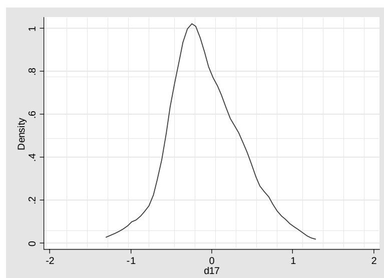

Figure A4.14 Greece

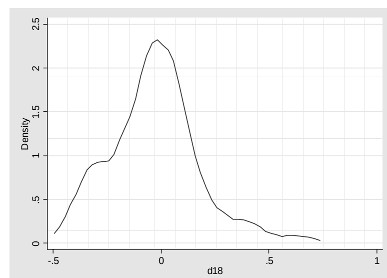

Figure A4.15 Ireland

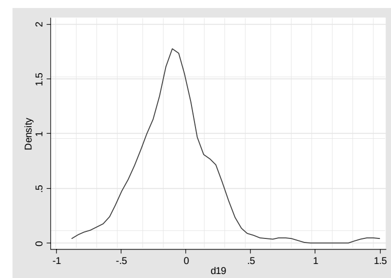

Figure A4.16 Italy

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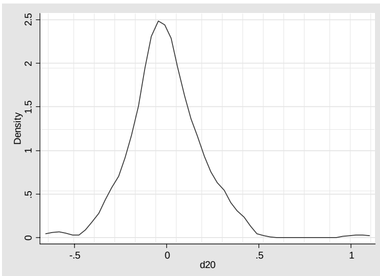

Figure A4.17 Netherlands

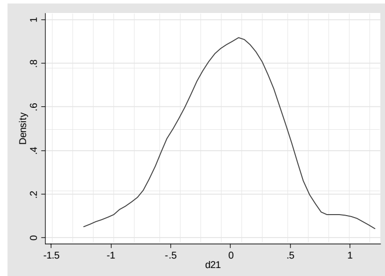

Figure A4.18 Portugal

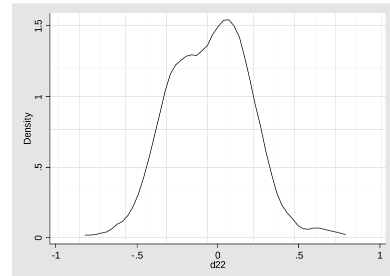

Figure A4.19 Belgium

<u>1985</u>

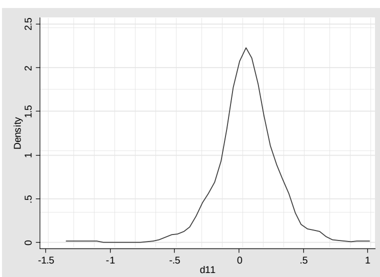

Figure A4.20 Austria

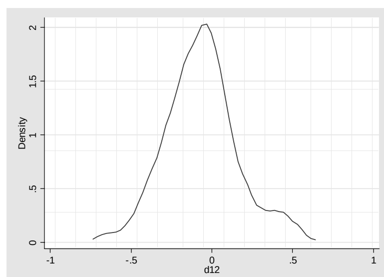

Figure A4.21 Germany

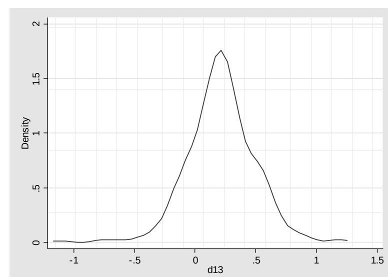

Figure A4.22 Denmark

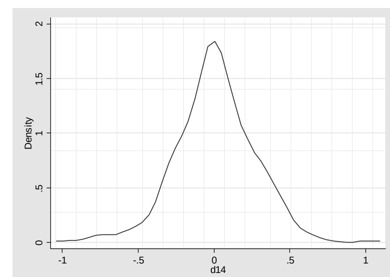

Figure A4.23 Spain

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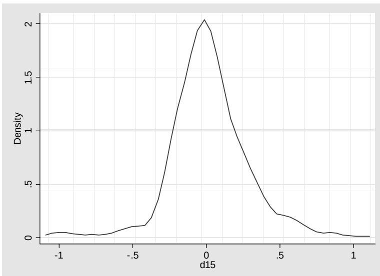


Figure A4.24 France

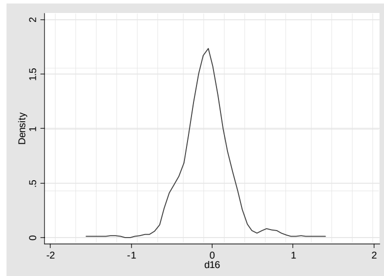


Figure A4.25 United Kingdom

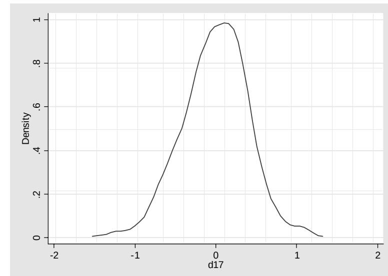


Figure A4.26 Greece

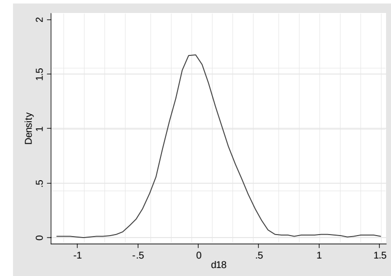


Figure A4.27 Ireland

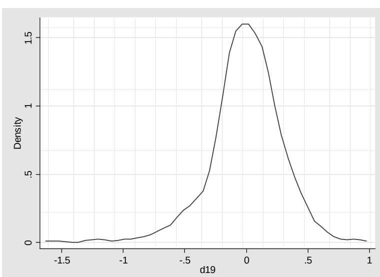


Figure A4.28 Italy

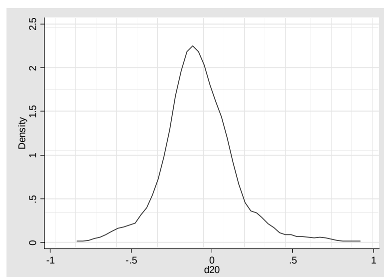


Figure A4.29 Netherlands

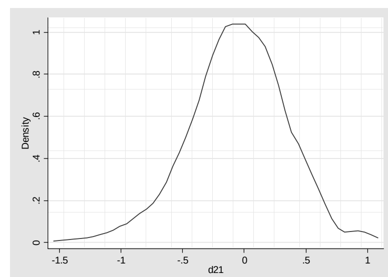


Figure A4.30 Portugal

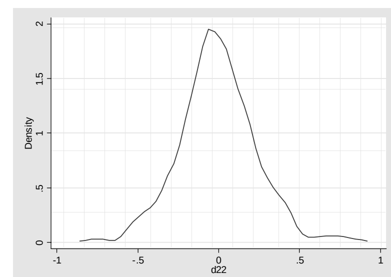
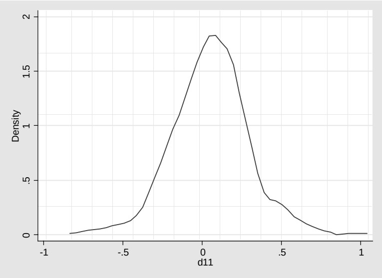
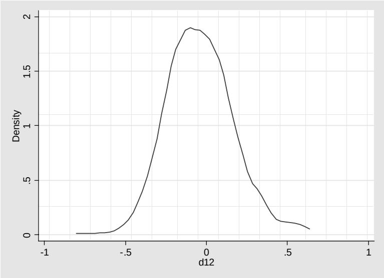


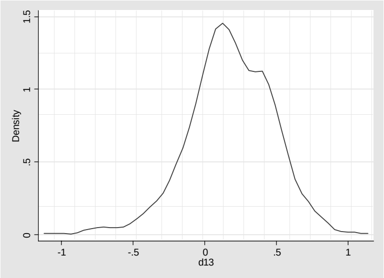
Figure A4.31 Belgium

(cont.)

1990







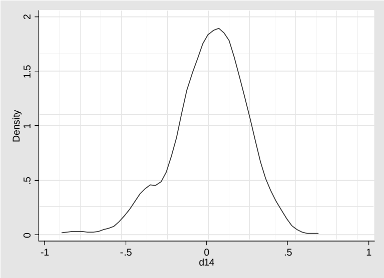
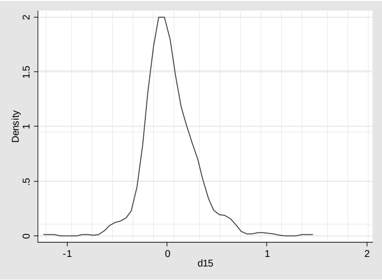
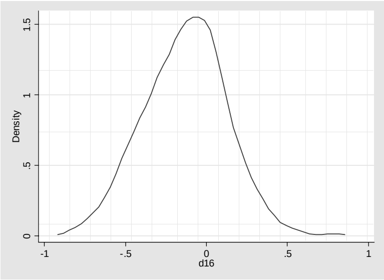
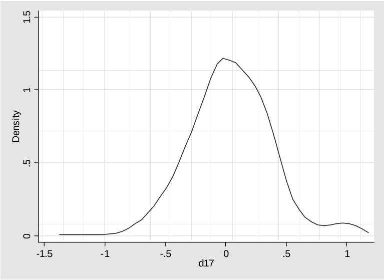


Figure A4.32 Austria **Figure A4.33 Germany** **Figure A4.34 Denmark** **Figure A4.35 Spain**







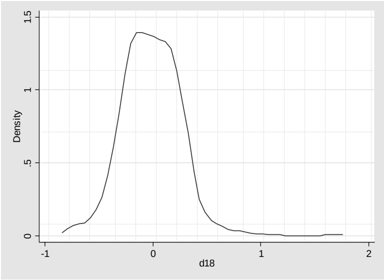


Figure A4.36 France **Figure A4.37 United Kingdom** **Figure A4.38 Greece** **Figure A4.39 Ireland**

(cont.)

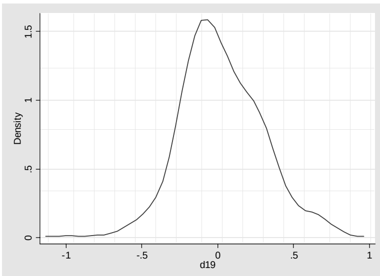


Figure A4.40 Italy

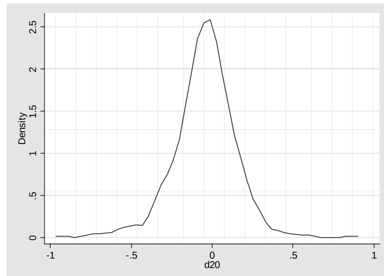


Figure A4.41 Netherlands

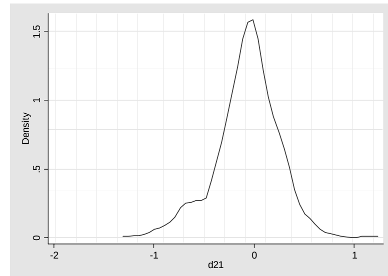


Figure A4.42 Portugal

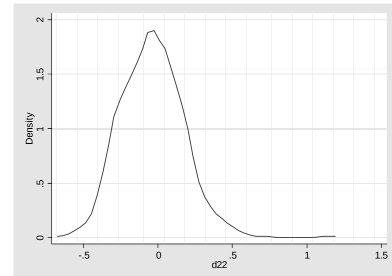


Figure A4.43 Belgium

APPENDIX B CONSTRUCTION OF THE CAPITAL STOCK FOR EACH INDUSTRY

The Database on Investment and Capital for Agriculture and Manufacturing reports the total capital stock for the manufacturing sector (TK). In order to calculate capital stock for each manufacturing industry, we assume that the share of investment for the industry in total manufacturing for specific year is equal to its share of the capital stock. We calculate total manufacturing sector investment by using capital formation data for 28 manufacturing industries, and then obtain each industry's share of total manufacturing for each country. However, since some countries have missing observations for some industries the shares of the remaining industries are overestimated. In order to resolve this problem, we use the following approach for each cross-section:

Let us denote $I_{\max}$ as total investment in the manufacturing sector for countries that have no missing values. Then, the industries that have missing investment values for at least one country are excluded and the sum of capital formation for the remaining industries is denoted for each country j as I_j. We now define

$$Fraction = \frac{1}{N}\sum_{j=1}^{N}\left(I_j / I_{\max} \right)$$

where N is the number of countries that are used to calculate $I_{\max}$. We assume this fraction is the same for countries that have missing capital formation data for one or more industries. Then for each industry h and country j, we define $weight_{hj} = I_{hj} / N_{hj}$. If a country has missing data, then the share of capital stock for each industry h is defined as $share_{hj} = \left[TK_j\right] * \left[Fraction\right]$ and its capital stock is now given by

$$K_{hj} = weight_{hj} * share_{hj}.$$

If the country does not have missing data then we assume the share of investment for each industry is simply equal to its share in the capital stock given as $share_{\max_{hj}} = I_{hj} / I_{\max_{hj}}$ and then its capital stock is given by

$$K_{hj} = \left[TK_j\right] * \left[share_{\max_{hj}}\right]$$

APPENDIX C RESULTS FOR ARBITRARY REFERENCE COUNTRY COMPARISONS

Table C1 Germany as a Reference Country

	1985			1990		
	Model1	Model2	Model3	Model1	Model2	Model3
Population	-.060*	-.001	.008	-.068*	-.011**	.009
	(-9.89)	(-0.19)	(0.55)	(-10.72)	(-2.00)	(0.53)
GDP per-capita	.395*	.046	-.017	.835*	.416*	.260
	(8.05)	(0.87)	(-0.12)	(11.68)	(6.13)	(1.55)
Distance	.042	.093*	.144**	.267*	-.093*	.040
	(1.48)	(4.06)	(2.18)	(7.40)	(-3.38)	(0.61)
Tradability		.011	-.015		-.057*	-.043
		(0.85)	(-0.69)		(-4.44)	(-1.36)
Non-traded input share		.003*	.005**		.001	.003
		(2.60)	(2.26)		(0.67)	(0.68)
Large cars		.266*			.169*	
		(4.02)			(4.92)	
Vices		.143*	.089***		.135*	.095**
		(6.11)	(1.83)		(5.76)	(1.98)
Constant	.037***	.281*	.285*	.047*	.261*	.251*
	(2.33)	(15.87)	(6.32)	(3.09)	(11.73)	(4.30)
R^2(in percentage)	4.5	4.8	17.3	5.7	5.7	23.2
Observations	4244	4244	161	3567	3567	133

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. In Model 2 we take absolute values for all variables. In Model 3 we use the mean of absolute LOP deviations. The eight countries considered here are: Austria, Denmark, Germany, Greece, Ireland, Portugal, and the UK.

Table C2 United Kingdom as a Reference Country

	1985			1990		
	Model1	Model2	Model3	Model1	Model2	Model3
Population	-.064* (-10.18)	-.011*** (-1.79)	-.019 (-1.21)	-.047* (-6.81)	.004 (0.52)	.006 (-0.31)
GDP per-capita	.278* (9.26)	.137* (3.46)	.275** (2.30)	.379* (9.61)	-.055 (-0.99)	.215 (1.40)
Distance	-.004 (-0.31)	.115* (12.51)	.158* (5.75)	.034** (2.27)	.109* (9.37)	.107* (2.68)
Tradability		-.042** (-2.48)	-.054** (-1.96)		-.030*** (-1.81)	-.007 (-0.21)
Non-traded input share		.005* (3.96)	.006*** (1.93)		.003 (1.51)	.008*** (1.84)
Large cars		.097*** (1.84)			.035 (1.28)	
Vices		.131* (4.43)	.097** (2.16)		.128* (4.22)	.147* (2.98)
Constant	.027*** (2.32)	.297* (15.20)	.287* (6.58)	.108* (8.47)	.336* (13.17)	.199* (3.24)
R^2(in percentage)	3.2	5.1	29.0	3.4	4.7	21.0
Observations	4184	4184	160	2834	2834	130

Note: *p-value< 0.01, **p-value < 0.05, ***p-value < .10. In Model 2 we take absolute values for all variables. In Model 3 we use the mean of absolute LOP deviations. The eight countries considered here are: Austria, Denmark, Germany, Greece, Ireland, Portugal, and the UK.

VITA

Ozlem Inanc was born near Waldbroll, Germany, on May 6, 1975. She is the daughter of Yildiz Inanc and Husnu Inanc and is the younger sister of Oner T. Inanc. Ozlem Inanc was raised in Eskisehir, a vivid Anatolian city within the heartland, some one hundred miles southwest of the Turkish capital Ankara. In 1995, she graduated high school from Eskisehir Fatih Fen Lisesi (Eskisehir Science Branch High School). In 1999, she graduated from Hacettepe University, in the Turkish capital Ankara, with a Bachelor of Arts degree in economics as the valedictorian of her class. Later on she received a Master of Science degree from the same university in 2001. She also holds a Master of Science degree from Louisiana State University which was awarded to her in 2003. She received her Doctor of Philosophy degree in economics from Louisiana State University in May 2007.