Wholesale Pricing under Parallel Imports

Katherine M. Sauer
University of Southern Indiana

Abstract This paper empirically analyzes the relationship between wholesale prices and trade costs for parallel import goods (goods that are traded without the permission of the intellectual property right holder). Two existing general theories of PIs and pricing, horizontal arbitrage and vertical price control, are tested using data from the European Union where parallel trade is permitted. When pooling the countries, support for the arbitrage theory is found. However, support for the vertical price control theory is evidenced when analyzing high-priced exporters and low-priced importers.

Keywords: Parallel imports, wholesale pricing

JEL classification: F12, L11

1. Introduction

With the recent European Union expansion, the potential for arbitrage is growing as new low-priced markets are introduced into the integrated trading community. Many of the goods being traded are protected by some form of intellectual property right (IPR) be it patent, trademark, or copyright. In the EU, an IPR holder’s right to control the distribution of a good ends upon first sale within the Union. This means that arbitrage is permitted even if the patent, trademark, or copyright is still valid. Importing an authentic product meant for sale in one country into another country without the authorization from the IPR holder is termed parallel importation. Parallel trade is common in the EU among branded consumer goods such as perfume, electronics, clothing, and pharmaceuticals.

Two objectives of the European Union are the free circulation of goods and the protection of intellectual property. These two ends are often at odds with one another and have resulted in a policy debate over parallel imports (PIs). The community exhaustion treatment of IPRs (and hence the permission of PIs) encourages the free movement of goods and market integration. Consumers in higher priced markets will gain as prices converge to a lower level. In addition, this form of arbitrage can generate intra-brand competition, again benefiting consumers. PI activities are not costless, however. Resources must be spent on transportation and re-packaging. Authorized distributors may find PI firms free-riding on their services (e.g., marketing). This may result in fewer authorized firms entering the market or lower levels of pre- or post-sales services. Original manufacturers may see their profitability decrease as their ability to price discriminate is diminished. Finally, consumers in low priced markets may see their prices rise as market integration is realized.
Understanding exactly how parallel trade affects pricing and subsequently welfare is important for accurately addressing policy issues. There are currently two competing general theories of parallel imports and pricing: horizontal arbitrage and vertical price control. Both theories hypothesize a relationship between the wholesale price and trade costs. While the theories have been preliminarily empirically tested, this study seeks to provide a comprehensive analysis of all of the products subject to PI competition in the European Union. Previous studies have used a maximum of 53 products and two years of data; the current study will employ 515 products and ten years of data for the EU-15. In addition, case studies of broad product categories (e.g. pharmaceuticals) are conducted. The vertical price control theory is evidenced in every single country in at least one category of products. However, this theory does not explain pricing for every product category in every country. The arbitrage theory explains pricing for fewer products and fewer markets.

2. Background Literature and Theory

The economic literature has advanced several theories to explain why parallel imports arise. In each, parallel trade distorts the market in some way. Distortions may be resources wasted due to parallel trade activities, inefficient vertical pricing, or free rider problems. Maskus (2000) provides an overview of the literature, policy questions, and empirical evidence related to parallel trade in general. Malueg and Schwartz (1994) treat parallel trade as a mechanism for arbitraging away international price discrimination. Maskus and Chen (2004) propose a theory where the difference between wholesale and retail prices (vertical price control theory) ultimately determines the profitability of parallel imports. Chard and Mellor (1989) discuss the problems that emerge when parallel traders free-ride on authorized dealers’ local services (e.g. warranties, marketing costs).

Abstracting from any free-rider issues, there are two competing theories on parallel trade and prices: horizontal arbitrage and vertical price control (VPC). Arbitrage is possible when the wholesale price varies across markets. Since local demand attributes vary, so do local prices. It would be possible for a wholesaler to buy at a low price in one market and then re-sell the good to another wholesaler in a higher priced market. As long as the transportation cost is smaller than the price difference, a profit can be made on the transaction. Since the transaction is made at the same point in the supply chain (i.e. wholesale level), the arbitrage is horizontal.

Alternatively, a PI firm could buy at the wholesale price in one market and then sell the product in a different country’s retail market. This firm is exploiting the retail margin (difference between wholesale and retail price) between the markets. As long as the margin is larger than the transportation cost, the activity is profitable for the PI firm. VPC asserts that manufacturers need to set the wholesale price at a level that will ultimately induce the desired retail price. Setting the wholesale price optimally means there is a retail margin for PI firms to exploit. To reduce the margin (and PI competition), the manufacturer could set the wholesale price higher. However, the firm may no longer induce the desired retail price. Thus, the manufacturer faces a trade off between optimal vertical pricing and deterring parallel trade competition.

These theories have different predictions about how the manufacturer will set wholesale prices in
each market. Trade costs have a significant role in determining the profitability of parallel trade and will enter into the manufacturer’s wholesale pricing decision.

Suppose that the manufacturer of a good sells its product in two markets, $A$ and $B$. Demand in $A$ is given by $q_A = 1 - p_A$ and demand in $B$ is $q_B = S(1 - bp_B)$. Let $S$ be the population in market $B$ and the population in $A$ is normalized to 1. Let $b \geq 1$ so that market $B$ is more elastic. The manufacturer sells to distributors $D_A$ and $D_B$ at wholesale prices of $w_A$ and $w_B$ and faces a constant marginal production cost which is set to zero for simplicity. The manufacturer maximizes profits by choice of the wholesale price. Solving the model yields the following two propositions:

**Proposition 1:** According to the arbitrage theory, the equilibrium wholesale price in the importing market is constant as trade costs rise. In the exporting market, the wholesale price is decreasing in the trade cost until the markets are naturally segmented by a high trade cost.

**Proposition 2:** According to the VPC theory, the equilibrium wholesale price in the importing market is decreasing as trade costs rise. In the exporting market, the wholesale price is increasing and then decreasing in trade costs.

[proof: see Appendix]

Under the arbitrage theory, to block PI competition the manufacturer will set the wholesale price in the exporting market so it differs from the price in the importing market by exactly the trade cost. At very low transport costs, the wholesale price in the exporting market will need to be set almost as high as the price in the importing market. As trade costs rise, the wholesale price in the exporting market can be set lower. At some high level of transport cost, parallel trade is unprofitable so the markets stay segmented and the wholesale price in the exporting market can be set at its optimal level. In the importing market, trade costs will not affect the wholesale price. Figure 1 illustrates.

Under the VPC theory, there are four ranges of costs to consider: low, intermediate, high, and very high. When transportation costs are low the volume of parallel trade coming into the high income market may be large. The manufacturer can decrease this volume by setting the wholesale price in the importing market high and the price in the exporting market low. As trade costs rise, the wholesale price in the importing market can be set lower, but the wholesale price in the exporting market must be set higher.

As transportation costs increase to an intermediate level, more resources are wasted in parallel trade. The manufacturer will try to decrease both the volume of parallel trade and the price competition in the importing market. At this level of trade costs, the wholesale price in the importing market has fallen to the optimal level so increasing the wholesale price in the exporting market will be the strategy. A higher acquisition cost coupled with high trade costs will deter some parallel trade. The higher the trade costs, the higher the wholesale price in the exporting market.

When transport costs are high, the markets are naturally almost segmented. The manufacturer
can set the wholesale price in the exporting market to make it unprofitable to engage in arbitrage. Parallel trade can be blocked completely so no resources will be wasted in parallel trade activities. At some very high level of trade costs, the markets will be fully segmented. The firm can achieve optimal vertical pricing without the threat of parallel trade. Figure 2 illustrates.

With the relationship between wholesale prices and transportation costs established, consider that wholesale prices determine retail prices and quantities which in turn affect consumer surplus. Corollaries 1 and 2 describe the theoretical relationships between trade cost and welfare.

**Corollary 1:** According to the arbitrage theory, consumer welfare in the exporting market is increasing in the trade cost and is maximized when the markets are segmented and the wholesale price is set optimally. Consumer surplus in the importing market is unchanged as trade costs increase.

**Corollary 2:** According to the VPC theory, consumer welfare in the exporting market decreases until trade costs become high and then increases until the markets become fully segmented. Consumer surplus in the importing market will rise and then fall as trade costs rise.

[proof: see Appendix]

Under the arbitrage theory, the wholesale price in the importing market is unchanging with trade costs so the equilibrium quantity and retail price are constant as well. This means that consumer surplus in the importing market is constant in trade costs. In the exporting market, however, the wholesale price is a decreasing function of trade costs. This means that as trade costs rise, the equilibrium quantity will also rise (as the wholesale price falls). As quantity rises, the retail price will fall and thus consumer surplus in the exporting market will rise (as trade costs rise) and will be maximized when the markets are segmented and the wholesale price is set optimally.

Under the VPC theory, consumer welfare in the exporting market has a U-shape as trade costs rise. Initially, wholesale prices are increasing (as trade costs rise) so quantity is falling and the retail price is rising. This yields falling consumer surplus. When trade costs are high and the wholesale price is falling, the reverse is true. Consumers in the importing market will see their surplus rise and then fall as trade costs rise. As the wholesale price in this market falls, quantity rises, the retail price falls and consumer surplus rises. However, after the wholesale price falls to its optimal level consumer surplus will fall. This is because the quantity sold in the importing market is a function of both markets’ wholesale prices. The wholesale price in the exporting market is falling, but is still higher than optimal. This reduces quantity and increases retail price, thus decreasing consumer surplus.

3. **Empirical Analysis**

3.1. **Testable Hypothesis**

Since the arbitrage theory and VPC theory have different predictions about how wholesale prices are affected by trade costs (and ultimately have different welfare implications), it seems wise to test them with data. Understanding which theory is relevant in the real world can aid
policymakers in assessing the effects of PIs and trade liberalization on consumer welfare.

Wholesale price and trade cost data are often available. Recall that the arbitrage theory predicts that the wholesale price in the exporting (low income) market is a falling, convex function of trade costs. This would suggest that a linear trade cost term would exert negative influence on wholesale prices and that a squared trade cost term would be positive. The arbitrage theory predicts that the wholesale price in the importing (high income) market is independent of the trade cost. The VPC theory predicts that the wholesale price in the exporting market has an inverted U-shape, rising and then eventually falling. This suggests that a linear trade cost term would have a positive effect on wholesale prices and a squared term would have a negative effect. In the importing market, wholesale prices fall as the trade cost rises, suggesting the opposite signs on trade cost terms. Table 1 summarizes the predicted effect that increasing trade costs have on the wholesale price in each market.

3.2 Prior Related Empirical Findings

Previous economists have employed empirical tests of the VPC model. Maskus and Chen (2004) test their VPC theory using US export prices. Using 26 (10-digit Harmonized System) products, they model both the export price at the US border and the wholesale price in the importing market for the period 1993. They find that the US tariff rate operates as predicted by the VPC theory. Ganslandt and Maskus (2003) test the VPC theory using intra-EU export prices for 53 (8-digit HS) products for eight EU countries during the years 1998 and 1999. They analyze the structure of export prices set by the manufacturer at the border and find that the VPC theory is consistent with high-income countries. Evidence in favor of the arbitrage theory is found when pooling all countries together.

This paper will extend the empirical testing of the competing theories in several ways. First, an extensive number of products will be included in the analysis. Previous studies have used a maximum of 53 (8-digit) products; the current study will employ 515 (8-digit) products. Similar to the Ganslandt-Maskus work, this paper will look specifically at the EU where parallel trade is currently permitted. However, fifteen counties instead of eight will be examined. In addition, ten years worth of data are analyzed. Finally, an alternative measure of trade cost will be used in an attempt to resolve a known endogeneity issue.

Results are consistent with prior findings. In pooled regressions, the arbitrage theory appears to be the relevant theory for explaining pricing decisions on goods subject to PI competition. However, when analyzing high-price exporters and low-price importers, VPC appears to be the relevant theory.

3.3 Empirical Specification

To test the theories, data from a single manufacturer setting wholesale prices along with trade cost data should be used. Readily available are data on export prices and trade costs at a detailed product level. Export prices will be used in lieu of wholesale prices; international prices are thought to accurately capture wholesale prices because a substantial amount of trade occurs through distributors. Hence, similarly to Ganslandt and Maskus (2003), the following
regression equation is estimated

\[ eprice_{cpt} = a + \beta_1 TC_{cpt} + \beta_2 TC^2_{cpt} + \beta_3 \frac{Y_m}{Y_c} + error_{cpt}. \]  

(1)

The dependent variable is defined to be the export price of product \( p \) at the border of source country \( c \) going to destination country \( m \) in year \( t \). Since the dependent variable is the export price at the border of the source market, it will become (after trade costs) the wholesale price in the destination market. Independent variables include the trade cost \( TC \) and a control for relative market size \( \frac{Y_m}{Y_c} \). Additionally, country, product, and period dummy variables will be included.

With regard to theoretical sign predictions, recall (from Table 1) that in an export market, a positive sign on the linear trade cost term and a negative squared term indicate support for VPC. The arbitrage theory predicts the opposite relationship between trade costs and wholesale prices in export markets. Theory does not have a clear prediction on the sign of the relative market size variable. On one hand, if the exporting market is large, it is likely to have high prices and results in a low ratio. This would indicate a negative coefficient. On the other hand, if the exporting market is large and very competitive, its prices may be low and the coefficient would have a positive sign.

3.4 Data

Parallel trade is not permitted in every country. The European Union does permit parallel trade between member states so there is an opportunity to test the theories using data from this region. However, actual data on parallel trade are not collected by customs. While at first blush this would seem to be a large limitation, the analysis is still justifiable. The mere threat of PI competition is often enough to induce the original manufacturer of a good to modify pricing decisions. The firm may deter PI competition by pricing in such a way that no PI firms actually enter the market. In this case, even if PI data were collected, the value and quantities of PI trade would be zero. Thus, it is appropriate to conduct the analysis using goods that are likely subject to PI competition. In addition, previous economic analysis on parallel trade is also executed using goods that were likely to face PI competition.

A 1999 study by The National Economic Research Associates in the EU indicates that the following categories of products are likely subject to parallel trade: cocoa, sugar confectionary, ice cream, alcohol, soft drinks, mineral waters, clothing, footwear, CDs, videodisks, soap, perfume, detergent, toiletries, consumer appliances, and consumer electronics. In addition, pharmaceuticals are considered since parallel trade is known to be a factor in that industry. These categories encompass 566 (8-digit HS) “products” in Eurostat’s online trade database, Comext. While eight digits is the most disaggregated level of data available from Comext, keep in mind it is still an aggregation. For example, 8-digit code 33051000 indicates “shampoos”. A trip down the hair-care aisle at your local retailer will assure you that there are a number of different varieties of shampoo products. As such, there is still some heterogeneity at the product level. The proper data to analyze would be identical products, however, 8-digits is the most disaggregated data available at this time.
Data on the 566 products are extracted for the fifteen EU countries prior to enlargement: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom. Data are annual over the period 1995-2004. Observations for each source and destination country include a product’s quantity in 100kg, and value in euros for exports and imports.

Export price
The export price is defined to be the export unit value. The unit value is calculated by dividing the export value by export quantity (measured in quantity per 100kg).

Trade Cost
In their comprehensive article on trade costs, Anderson and Wincoop (2004) note that using direct measures of trade cost (e.g. using ocean shipping rates and air freights gleaned from trade journals) is best but a widely used and often readily available option is to use national customs data on the value of imports with and without charges for insurance and freight. Commonly used in the literature, trade cost is calculated as the ratio of import unit value to export unit value. This captures the actual product-and market-specific trade cost, per unit, and is also known as the “CIF/FOB” measure of transportation cost. However, since in this case the dependent variable is also the export unit value, using the CIF/FOB measure of trade cost would result in an endogeneity problem.

At present there is not another readily available measure of trade cost that is both product and market specific. To avoid the endogeneity issue, an average of the export unit values will be used. Since the dependent variable is the export unit value for a specific product and importer from exporter , the export unit value used to calculate the trade cost will be the average export unit value for the same product and importer from all exporters excluding exporter .

Control Variables
The market size control variable is defined as the ratio of the importing country’s population to the exporting country’s population, as is suggested by theory. EU country population data is available from Eurostat. Dummy variables for country, product, and period are also included.

After matching product-period-destination observations with their corresponding product-period-source observations and eliminating outliers, the dataset contains 108,339 records of matched-partner observations and 513 8-digit products. Table 2 illustrates the average wholesale price of goods going to each country. The price level is calculated as the average export unit value to a specific country, relative to the mean export unit value in all fifteen countries. Theory suggests that countries with high prices are likely destination markets. The UK, France, Italy, and Luxembourg are the countries with the highest prices. Countries such as Greece, Spain, and Portugal are likely source markets.

3.5 Regression Results

Ordinary Least Squares regressions are estimated separately for each country as an exporter, using all other countries as destination markets. As there are over 500 products and their means
vary greatly, heteroskedasticity is a problem. Robust standard errors are used and are clustered at
the 4-digit product level. Table 3 contains the results.\textsuperscript{20} In the pooled regression, the linear trade
cost coefficient is negative and the squared term is positive, both are significant. This indicates
support for the arbitrage theory. The same result is found in a majority of the individual country
regressions. The exceptions are Denmark and Portugal (which have a negative linear trade cost
term but insignificant squared terms), Austria, Finland, The Netherlands, and Spain.

Recall that the regressions included a control for population and dummy variables for product,
period, and destination market. The population ratio coefficient is significant and positive in the
pooled regression. This indicates that larger export markets may be more competitive and have
lower prices. In the individual country regression, the population coefficient was only significant
for Austria and Portugal. In Portugal, however, the sign was negative. The majority of the
product dummy variables are significant, indicating idiosyncratic pricing at the 8-digit product
level. With regard to destination market dummy variables, in the vast majority of export markets
the coefficients were insignificant. For Austria and Portugal, however, the destination market
dummy coefficients were significant.\textsuperscript{21} Period dummy variables varied in significance.

Since parallel trade occurs between markets with price differentials, one would expect to see an
even more pronounced effect the greater the disparity in price. As such, the sample is narrowed
to include only the high-priced countries (France, UK, Italy, Luxembourg) as source markets and
the low-priced countries (Spain, Portugal, Greece) as destination markets. Table 4 presents the
results.\textsuperscript{22}

In the pooled regression with all four high-priced countries exporting to the low-priced markets,
the coefficients are significant and signs are consistent with the VPC theory. Recall that the
coefficients from the pooled regression for all exporters to all importers supported the arbitrage
theory. These results indicate that when parallel trade is likely (i.e. when there is a greater price
differential), then the manufacturer will exert vertical price control. In the individual high-priced
country regressions, VPC support is found in the United Kingdom, Italy, and weakly in
Luxembourg. The coefficients for France are not significant indicating that the VPC theory is
not relevant for that market.

4. Discussion

As in previous work testing theories of parallel trade and wholesale pricing, support is found for
the VPC theory in high priced markets. The VPC theory has clear predictions regarding the
relationship between trade costs and welfare. Therefore, markets where VPC is evidenced need
to assess to the current level of trade costs before considering trade liberalization. When trade
costs are already low, lowering trade costs will leave consumer surplus unchanged in the
importing market and will decrease consumer welfare in the exporting market. Thus, a reduction
in trade costs is not a good idea from a global consumer welfare point of view. When trade costs
are at an intermediate level, reducing them will increase consumer welfare in both markets. At
high levels of trade cost (but not so high that the markets are segmented), consumers in the
exporting market will gain and consumers in the importing market will lose as the cost falls. The
effect on global consumer welfare may be positive or negative.
The ten countries that joined the European Union during the 2004 enlargement have relatively low GPD per capita. Table 5 contains 2004 GDP per capita for all of the countries in the European Union, sorted from high to low. Recall that Spain, Portugal, and Greece were the low-income parallel exporters before the enlargement. All of the recent accession countries have similar or lower income per capita. These markets will be likely parallel exporters. If the VPC theory is relevant for these markets, then consumers in these export markets will see a reduction in welfare as they join the Union and firms engage in parallel trade. Consumers in the higher income importing markets should see an increase in their welfare.

5. Conclusion

In this paper, I empirically test two opposing theories of pricing and parallel trade. Support for the VPC theory is evidenced for the high priced exporters. The VPC theory has some clear predictions on consumer welfare when parallel trade is allowed. Because the VPC theory explains firms’ pricing decisions in the face of trade costs for a variety of products in several markets of the European Union, consumers in low income countries that join the EU may see their welfare diminished. Policymakers in nations considering legalizing PIs will want to consider the type of products affected by PI competition as well as current trade costs before taking any action.

Endnotes

* Author’s email address: kmsauer1@usi.edu. Special thanks to Keith Maskus, Mattias Ganslandt, Scott Savage, and Anna Rubinchik for numerous and helpful comments and conversations. Warm gratitude is extended to Elija Hart for data wrangling assistance.

1. This is known as “regional exhaustion” of an IPR. International exhaustion of IPRs stipulates that distribution rights end upon first sale anywhere. National exhaustion asserts that rights end upon first sale in each country.

2. Parallel imports are legitimate goods, not knock-offs or counterfeits.


5. Danzon (1997) notes that with regard to pharmaceutical products specifically, nation price regulation also plays a role in explaining parallel imports.

6. Prices may also vary due to quality or exchange rate fluctuations.
7. Maskus and Chen (2002 and 2003) note that it is possible for PIs to flow from countries with high retail prices to those with lower retail prices.

8. Figure drawn according to the theoretical model. See the Appendix for derivation.

9. Figure drawn according to the theoretical model. See the Appendix for derivation.

10. In this model, the arbitrage takes place at the wholesale level. When arbitrage occurs at the retail level, then consumer surplus in the importing market increases as arbitrage competition lowers the price.


12. The specification of $Y_m/Y_c$ is akin to the ratio of destination market population to source market population from the theoretical model.

13. The NERA study used market research to provide a basis for estimating how interested parties might respond to a change in the trademark exhaustion regime. It focused on ten sectors, which were mainly chosen on the basis of the importance of trademarks in the sector. The sectors were mainly consumer goods because consumers are likely to use trademarks as an indication of quality. The analysis was restricted to ten sectors to keep the scope of the study within reasonable limits. Four categories of interested parties were interviewed: trademark owners, import/export associations, consumer organizations, and SME organizations. Position papers and other submissions by interested parties were also examined.

14. The database can be accessed at “http://fd.comext.eurostat.cec.eu.int/xtweb/”.


16. Supplemental quantity data is also available and the entire analysis is repeated using this measure of quantity for robustness.

17. As an alternative, the trade cost is proxied using the distance in kilometers between country capitals. Regressions are run using trade cost and distance separately as well as a specification including both measures. These alternative specifications did yield significant results.

18. After computing both import and average export unit values, observations for which the import unit value was less than the average export unit value were dropped.

19. Extreme values of elasticity and relative market size would be needed for low priced markets to be destination markets.

20. Product and country dummy results for each regression are too numerous to present succinctly. The signs and significance of the dummy variables are discussed later in the paper.
21. In the Austria regression, only the coefficients for Portugal and Sweden were insignificant. In Portugal, only Belgium was insignificant.

22. Since they are so numerous, the dummy variables for product, period, and source market are omitted from the table.

References


Figure 1: Wholesale Prices, Arbitrage Theory

Figure 2: Wholesale Prices, Vertical Price Control Theory
Table 1. Hypothesized Relationship of Trade Cost to Wholesale Prices

<table>
<thead>
<tr>
<th>Theory</th>
<th>Price in Export Market</th>
<th>Trade Cost</th>
<th>Price in Import Market</th>
<th>Trade Cost Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arbitrage Theory</td>
<td></td>
<td>-</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Vertical Price Control Theory</td>
<td></td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2. Average Export Price to a Specific Country, Relative to the Mean Export Price to the Other EU Countries

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>112.9</td>
<td>111.2</td>
<td>100.1</td>
<td>90.6</td>
<td>85.8</td>
<td>87.6</td>
<td>87.9</td>
<td>91.3</td>
<td>92.1</td>
<td>88.0</td>
</tr>
<tr>
<td>Belgium</td>
<td>111.6</td>
<td>106.0</td>
<td>106.8</td>
<td>106.9</td>
<td>94.3</td>
<td>89.3</td>
<td>91.6</td>
<td>89.4</td>
<td>90.5</td>
<td>89.0</td>
</tr>
<tr>
<td>Denmark</td>
<td>93.4</td>
<td>95.5</td>
<td>85.8</td>
<td>87.0</td>
<td>91.7</td>
<td>83.1</td>
<td>87.0</td>
<td>99.8</td>
<td>89.9</td>
<td>84.8</td>
</tr>
<tr>
<td>Finland</td>
<td>89.6</td>
<td>90.4</td>
<td>79.0</td>
<td>84.8</td>
<td>87.6</td>
<td>77.9</td>
<td>84.2</td>
<td>86.1</td>
<td>87.2</td>
<td>76.8</td>
</tr>
<tr>
<td>France</td>
<td>88.6</td>
<td>91.4</td>
<td>113.9</td>
<td>121.3</td>
<td>136.7</td>
<td>149.4</td>
<td>124.4</td>
<td>121.1</td>
<td>135.5</td>
<td>144.9</td>
</tr>
<tr>
<td>Germany</td>
<td>94.7</td>
<td>92.6</td>
<td>112.9</td>
<td>103.9</td>
<td>95.3</td>
<td>99.9</td>
<td>96.3</td>
<td>95.8</td>
<td>96.5</td>
<td>94.7</td>
</tr>
<tr>
<td>Greece</td>
<td>124.7</td>
<td>113.1</td>
<td>99.0</td>
<td>89.9</td>
<td>90.4</td>
<td>86.8</td>
<td>88.8</td>
<td>90.0</td>
<td>89.8</td>
<td>93.5</td>
</tr>
<tr>
<td>Ireland</td>
<td>83.2</td>
<td>89.0</td>
<td>92.9</td>
<td>88.7</td>
<td>89.0</td>
<td>85.7</td>
<td>84.7</td>
<td>92.7</td>
<td>93.9</td>
<td>88.4</td>
</tr>
<tr>
<td>Italy</td>
<td>101.2</td>
<td>104.8</td>
<td>98.0</td>
<td>112.6</td>
<td>110.6</td>
<td>109.8</td>
<td>112.5</td>
<td>119.7</td>
<td>109.0</td>
<td>103.5</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>103.1</td>
<td>100.2</td>
<td>102.5</td>
<td>121.0</td>
<td>113.7</td>
<td>100.6</td>
</tr>
<tr>
<td>Netherlands</td>
<td>94.7</td>
<td>96.4</td>
<td>95.0</td>
<td>90.4</td>
<td>94.5</td>
<td>85.7</td>
<td>93.1</td>
<td>94.8</td>
<td>93.9</td>
<td>89.3</td>
</tr>
<tr>
<td>Portugal</td>
<td>111.6</td>
<td>107.3</td>
<td>99.1</td>
<td>119.5</td>
<td>111.4</td>
<td>125.2</td>
<td>125.4</td>
<td>85.8</td>
<td>86.9</td>
<td>124.1</td>
</tr>
<tr>
<td>Spain</td>
<td>87.1</td>
<td>87.2</td>
<td>86.4</td>
<td>82.9</td>
<td>82.5</td>
<td>82.0</td>
<td>90.5</td>
<td>89.4</td>
<td>84.0</td>
<td>87.2</td>
</tr>
<tr>
<td>Sweden</td>
<td>93.1</td>
<td>98.9</td>
<td>93.3</td>
<td>88.9</td>
<td>86.8</td>
<td>85.8</td>
<td>88.0</td>
<td>94.9</td>
<td>86.9</td>
<td>81.1</td>
</tr>
<tr>
<td>U.K.</td>
<td>108.3</td>
<td>113.6</td>
<td>109.9</td>
<td>111.3</td>
<td>111.8</td>
<td>109.2</td>
<td>112.6</td>
<td>122.7</td>
<td>119.4</td>
<td>110.3</td>
</tr>
</tbody>
</table>
### Table 3. The Effect of Trade Cost on Wholesale Prices

<table>
<thead>
<tr>
<th>Trade Cost</th>
<th>Trade Cost Squared</th>
<th>Population Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Pooled</td>
<td>-63.11 **</td>
<td>21.10</td>
</tr>
<tr>
<td>Austria</td>
<td>-53.41</td>
<td>50.33</td>
</tr>
<tr>
<td>Belgium</td>
<td>-675.60 **</td>
<td>165.79</td>
</tr>
<tr>
<td>Denmark</td>
<td>-401.37 **</td>
<td>164.79</td>
</tr>
<tr>
<td>Finland</td>
<td>-198.45</td>
<td>610.98</td>
</tr>
<tr>
<td>France</td>
<td>-356.90 **</td>
<td>94.09</td>
</tr>
<tr>
<td>Germany</td>
<td>-268.56 **</td>
<td>57.08</td>
</tr>
<tr>
<td>Greece</td>
<td>-404.17 **</td>
<td>82.06</td>
</tr>
<tr>
<td>Ireland</td>
<td>-702.36 **</td>
<td>306.87</td>
</tr>
<tr>
<td>Italy</td>
<td>-80.88 **</td>
<td>27.35</td>
</tr>
<tr>
<td>Luxem.</td>
<td>-216.31 **</td>
<td>75.10</td>
</tr>
<tr>
<td>Nether.</td>
<td>-37.24</td>
<td>19.51</td>
</tr>
<tr>
<td>Portugal</td>
<td>-218.30 **</td>
<td>56.74</td>
</tr>
<tr>
<td>Spain</td>
<td>-349.78 **</td>
<td>70.62</td>
</tr>
<tr>
<td>Sweden</td>
<td>-557.94</td>
<td>297.22</td>
</tr>
<tr>
<td>UK</td>
<td>-459.26 **</td>
<td>57.31</td>
</tr>
</tbody>
</table>

** Significant at the 5% level.

### Table 4. High Price Countries as Exporters

<table>
<thead>
<tr>
<th>Trade Cost</th>
<th>Std. Error</th>
<th>Trade Cost Squared</th>
<th>Std. Error</th>
<th>N</th>
<th>R-sqr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pooled Regression</td>
<td>9.1529</td>
<td>** 4.4130</td>
<td>-0.0029</td>
<td>** 0.0016</td>
<td>10602</td>
</tr>
<tr>
<td>France</td>
<td>-3.7523</td>
<td>2.2817</td>
<td>0.0014</td>
<td>0.0008</td>
<td>3465</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>4.4953</td>
<td>** 6.2418</td>
<td>-0.0028</td>
<td>** 0.0039</td>
<td>2806</td>
</tr>
<tr>
<td>Italy</td>
<td>41.8941</td>
<td>** 18.9150</td>
<td>-0.0505</td>
<td>** 0.0239</td>
<td>4290</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>113.0330</td>
<td>** 589.4540</td>
<td>0.2308</td>
<td>8.9270</td>
<td>41</td>
</tr>
</tbody>
</table>

** Significant at the 5% level.
Table 5. GDP Per Capita 2004

<table>
<thead>
<tr>
<th>Country</th>
<th>GDP Per Capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxembourg</td>
<td>56,828</td>
</tr>
<tr>
<td>Ireland</td>
<td>36,884</td>
</tr>
<tr>
<td>Denmark</td>
<td>36,368</td>
</tr>
<tr>
<td>Sweden</td>
<td>31,420</td>
</tr>
<tr>
<td>Netherlands</td>
<td>30,055</td>
</tr>
<tr>
<td>Austria</td>
<td>29,120</td>
</tr>
<tr>
<td>UK</td>
<td>28,728</td>
</tr>
<tr>
<td>Finland</td>
<td>28,685</td>
</tr>
<tr>
<td>Belgium</td>
<td>27,710</td>
</tr>
<tr>
<td>France</td>
<td>27,382</td>
</tr>
<tr>
<td>Germany</td>
<td>26,846</td>
</tr>
<tr>
<td>Italy</td>
<td>23,344</td>
</tr>
<tr>
<td>Spain</td>
<td>19,774</td>
</tr>
<tr>
<td>Cyprus</td>
<td>17,072</td>
</tr>
<tr>
<td>Greece</td>
<td>15,141</td>
</tr>
<tr>
<td>Portugal</td>
<td>13,470</td>
</tr>
<tr>
<td>Slovenia</td>
<td>13,097</td>
</tr>
<tr>
<td>Malta</td>
<td>10,695</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>8,499</td>
</tr>
<tr>
<td>Hungary</td>
<td>8,018</td>
</tr>
<tr>
<td>Estonia</td>
<td>6,693</td>
</tr>
<tr>
<td>Slovakia</td>
<td>6,156</td>
</tr>
<tr>
<td>Poland</td>
<td>5,334</td>
</tr>
<tr>
<td>Lithuania</td>
<td>5,248</td>
</tr>
<tr>
<td>Latvia</td>
<td>4,805</td>
</tr>
</tbody>
</table>
Appendix

Arbitrage Model

Suppose that the manufacturer \( M \) of a good sells its product in two markets, \( A \) and \( B \). Demand in \( A \) is given by \( q_A = 1 - p_A \) and demand in \( B \) is \( q_B = S(1 - b p_B) \). Let \( S \) be the population in market \( B \) and the population in \( A \) is normalized to 1. Let \( b \geq 1 \) so that market \( B \) is more elastic. \( M \) sells to distributors \( D_A \) and \( D_B \) at wholesale prices of \( w_A \) and \( w_B \) and faces a constant marginal production cost which is set to zero for simplicity.

No Parallel Trade

In a world with no parallel trade, each distributor sells only in their intended market and maximizes profits by choice of quantity:

\[
\max_{q_A} \Pi_A = q_A (1 - q_A) - w_A q_A \quad \text{(1A)}
\]

and

\[
\max_{q_B} \Pi_B = q_B \left( \frac{S - q_B}{bS} \right) - w_B q_B \quad \text{(2A)}
\]

Solving the first order conditions yields

\[ q_A(w_A) = \frac{1 - w_A}{2} \quad \text{(3A)} \]

and

\[ q_B(w_B) = \frac{S(1 - bw_B)}{2} \quad \text{(4A)} \]

\( M \) sets the wholesale prices to maximize profits,

\[
\max_{w_A, w_B} \Pi_M = q_A w_A + q_B w_B \quad \text{(5A)}
\]

Substituting (3) and (4) into (5), taking first order conditions, and solving gives the profit maximizing wholesale prices,

\[ w_A^* = \frac{1}{2} \quad \text{and} \quad w_B^* = \frac{1}{2b} \quad \text{(6A)} \]

Since \( w_A > w_B \), if parallel trade were permitted and trade costs were less than \( (w_A - w_B) \), then \( D_B \) could make a profit by buying in \( B \) and re-selling to \( D_A \).

Equilibrium quantities are

\[ q_A^* = \frac{1}{4} \quad \text{and} \quad q_B^* = \frac{S}{4} \quad \text{(7A)} \]

so equilibrium retail prices are
\[ p_A^* = \frac{3}{4} \quad \text{and} \quad q_B^* = \frac{3}{4b}. \]  \hfill (8A)

Consumer surplus in each market is

\[ CS^A = \frac{1}{32} \quad \text{and} \quad CS^B = \frac{S}{32b}. \]  \hfill (9A)

**Parallel Trade Permitted**

Suppose now that parallel trade is permitted. Let the marginal cost of transporting a good from \( B \) to \( A \) be equal to \( t \). As long as the transportation cost is not too large, it will be profitable to engage in parallel trade. The distributor in \( A \) is indifferent between purchasing from the original manufacturer or from \( DB \). Assume that \( DB \) will sell at a wholesale price slightly (epsilon small) below \( w_A \) to ensure that all of its volume is sold. This means that the manufacturer will not be making any sales in market \( A \).

Since parallel trade is only profitable for \( DB \) when \( w_A > w_B + t \), the manufacturer could completely block parallel trade by setting the wholesale price in market \( B \) so it differs by exactly \( t \) from the wholesale price in market \( A \). When trade costs are zero, \( M \) will have to set the wholesale price in market \( B \) exactly equal to the wholesale price in market \( A \). There comes a point when the transportation cost is high enough that parallel trade is deterred naturally and the manufacturer can price optimally in the exporting market as in (6). This market segmenting trade cost is

\[ t_0 = \frac{b - 1}{2b}. \]  \hfill (10A)

To block parallel trade while setting \( w_A \) optimally, the wholesale price in market \( B \) is set according to

\[ w_B^* = \frac{1}{2} - t. \]  \hfill (11A)

Equilibrium quantity and retail price in the exporting market are

\[ q_B^* = \frac{S(2 - b + 2bt)}{4} \]  \hfill (12A)

and

\[ p_B^* = \frac{1}{2b} + \frac{1 - 2t}{4}. \]  \hfill (13A)

Equilibrium quantity and retail price in the importing market are the same as in (7) and (8).
Turning to the welfare effects, since the wholesale price in the importing market is unchanging with trade costs, so are the equilibrium quantity and price. This means that consumer surplus in the importing market is constant in trade costs as well. In this model, the arbitrage takes place at the wholesale level. When arbitrage occurs at the retail level, then consumer surplus in the importing market increases as arbitrage competition lowers the price. In the exporting market, however, the wholesale price is a decreasing function of trade costs. More explicitly, consumer surplus in the exporting market is

\[ CS^B = \frac{S}{2b} \left( \frac{2 - b + 2bt}{4} \right)^2, \]  

(14A)

and differentiating yields

\[ \frac{\partial CS^B}{\partial t} = \frac{S}{2} \frac{(2 - b + 2bt)}{4} > 0 \]  

(15A)

so consumer welfare in the exporting market is increasing in the trade cost and is maximized when the markets are segmented and the wholesale price is set optimally.

**Vertical Price Control Model**

This is the formal model put forth by Maskus and Chen (2004). Suppose again that the manufacturer M of a good sells its product in two markets, A and B. Demand in A is given by \( q_A = 1 - p_A \) and demand in B is \( q_B = S(1 - bp_B) \). Let \( S \) be the population in market B and the population in A is normalized to 1. Let \( b > 1 \) so that market B is more elastic. M faces a constant marginal production cost that is set to zero for simplicity. M sells its product through distributors \( D_A \) and \( D_B \). M will offer a contract to each of the distributors in the form of \((w_i, F_i)\) where \( w \) is the wholesale price, \( F \) is a franchise fee, and where \( i = A, B \).

**No Parallel Trade**

Taking the contracts \((w_i, F_i)\) as given, The distributors’ profit functions from sales are

\[ \Pi_A = q_A(l - q_A) - w_Aq_A \]  

(16A)

and  

\[ \Pi_B = q_B \left( \frac{S - q_B}{Sb} \right) - w_Bq_B . \]  

(17A)

Taking first order conditions and solving for the quantities yields

\[ q_A(w_A) = \frac{1 - w_A}{2} \]  

(18A)

and  

\[ q_B(w_B) = \frac{S(1 - bw_B)}{2} . \]  

(19A)
Thus retail prices are

\[ p_A(w_A) = \frac{1 + w_A}{2} \]  
(20A)

and

\[ p_A(w_A) = \frac{1 + bw_B}{2b} \]  
(21A)

and distributors’ profits from sales are equal to

\[ \Pi_A(w_A) = \frac{(1 - w_A)^2}{4} \]  
(22A)

and

\[ \Pi_B(w_B) = \frac{S(1 - bw_B)^2}{4b} \]  
(23A)

Turning now to the contract, the manufacturer can capture all of the distributors’ profits by setting the franchise fees equal to profits,

\[ F_A(w_A) = \Pi_A(w_A) = \frac{(1 - w_A)^2}{4} \]  
(24A)

and

\[ F_B(w_B) = \Pi_B(w_B) = \frac{S(1 - bw_B)^2}{4b} \]  
(25A)

The wholesale prices will be chosen to maximize the manufacturer’s profits,

\[ \Pi^M(w_A, w_B) = \frac{(1 - w_A)^2}{4} + \frac{S(1 - bw_B)^2}{4b} + w_A \frac{(1 - w_A)^2}{2} + w_B \frac{S(1 - bw_B)^2}{2b} \]  
(26A)

Equation (28) is also global industry profits. Equilibrium wholesale prices are

\[ w_A^* = 0 \quad \text{and} \quad w_B^* = 0 \]  
(27A)

Since the marginal cost of production is normalized to zero, it makes sense that the wholesale prices are also zero.

Equilibrium quantities are

\[ q_A^* = \frac{1}{2} \quad \text{and} \quad q_B^* = \frac{S}{2} \]  
(28A)

making retail prices

\[ p_A^* = \frac{1}{2} \quad \text{and} \quad p_B^* = \frac{1}{2b} \]  
(29A)
Consumer welfare in each market is

\[ CS^A = \frac{1}{8} \quad \text{and} \quad CS^B = \frac{S}{8b}. \] (30A)

Parallel Trade Permitted

Suppose now that the manufacturer has no legal authority to prevent \( D_B \) from selling in \( A \). Let the marginal cost of transporting a good from \( B \) to \( A \) be equal to \( t \). Let \( t \leq 1/2 \) so it is not too costly to engage in parallel trade activities. If \( D_B \) does choose to sell in \( A \), then let \( D_B \) and \( D_A \) compete in a Cournot fashion.

Consider equilibrium in market \( A \). At this point, take \((w_i, F_i)\) as given. The distributors’ profit functions from sales in market \( A \) are

\[ \Pi^A_i = q^A_i(1 - q^A_i - q^B_i) - w_A q^A_i \] (31A)

and  \[ \Pi^A_B = q^B_i(1 - q^A_i - q^B_i) - q^A_i(w_B + t). \] (32A)

The superscript represents the market (in this case market \( A \)) and the subscript represents the distributor. The first order conditions are

\[ 1 - 2q^A_i - q^B_i - w_A = 0 \] (33A)

and  \[ 1 - q^A_i - 2q^A_i - w_B - t = 0 \] (34A)

as long as \( w_B + t \leq 1/2 \). Quantities as a function of wholesale prices are

\[ q^A_i(w_A, w_B) = \frac{1 - 2w_A + w_B + t}{3} \] (35A)

and  \[ q^B_i(w_A, w_B) = \frac{1 + w_A - 2w_B - 2t}{3} \] (36A)

The retail price in market \( A \) is therefore

\[ p^A(w_A, w_B) = \frac{1 + w_A + w_B + t}{3} \] (37A)

Distributors’ profits in market \( A \) are,

\[ \Pi^A_i(w_A, w_B) = \frac{(1 - 2w_A + w_B + t)^2}{9} \] (38A)
and \( \Pi_B^A(w_A, w_B) = \frac{(1 + w_A - 2w_B - 2t)^2}{9} \). (39A)

Now consider equilibrium in market \( B \). The distributor in this market will maximize profits by choice of retail price. As before, \((w_1, F_i)\) is taken as given at this point. The profit equation is

\[
\Pi_B^A = S(1 - b p_B^A)(p_B^A - w_B)
\] (40A)

and the equilibrium price and quantity are

\[
p_B^A(w_B) = \frac{1 + bw_B}{2b}
\] (41A)

\[
q_B^A(w_B) = \frac{S(1 - bw_B)}{2}.
\] (42A)

This distributor’s profits in market \( B \) are

\[
\Pi_B^B(w_B) = \frac{S(1 - bw_B)^2}{4b}.
\] (43A)

Turn now to the choice of contract. When setting the franchise fee, the manufacturer can capture all of the distributors’ profits. Thus the franchise fees are,

\[
F_A(w_A, w_B) = \Pi_A^A(w_A, w_B)
\] (44A)

and \( F_B(w_A, w_B) = \Pi_A^A(w_A, w_B) + \Pi_B^B(w_A, w_B) \). (45A)

The manufacturer will then choose the wholesale prices to maximize profits,

\[
\Pi^M = F_A(w_A, w_B) + F_B(w_A, w_B) + w_Aq_A^A + w_B(q_B^A + q_B^B).
\] (46A)

The (simplified) first order conditions are

\[
1 - 2w_A - 2w_B - 5t = 0
\] (47A)

and \( 2 - 4w_A - 4w_B + 8t - 9Sb = 0 \) (48A)

so the equilibrium wholesale prices are

\[
w_A^* = \frac{1 - 5t}{2} - \frac{2t}{Sb}
\] (49A)
and \[ w_A^* = \frac{2t}{Sb} \text{.} \] (50A)

Notice that the optimal wholesale price in market \( A \) is decreasing in the trade cost. There must be some trade cost at which this wholesale price reaches its optimal level of zero. Setting (52) equal to zero we find that this threshold trade cost \( t_1 \) is equal to

\[ t_1 = \frac{Sb}{4 + 5Sb} \text{.} \] (51A)

Therefore, (52) and (53) are the equilibrium wholesale prices over the range \( t < t_1 \). When the trade cost passes the \( t_1 \) threshold, then the optimal wholesale prices are

\[ w_A^* = 0 \text{.} \] (52A)

and \[ w_B^* = \frac{2(1 + 4t)}{4 + 9Sb} \text{.} \] (53A)

Notice that the wholesale price in market \( B \) is still increasing in the trade cost. This will be the case until \( w_B + t = 1/2 \). This second threshold occurs when the trade cost is equal to

\[ t_2 = \frac{3Sb}{2(4 + 3Sb)} \text{.} \] (54A)

So, for \( t > t_2 \) the optimal wholesale prices are

\[ w_A^* = 0 \text{.} \] (55A)

and \[ w_B^* = \frac{1}{2} - t \text{.} \] (56A)

After the second threshold is passed, the wholesale price in market \( B \) is decreasing in the trade cost. While not presented here, it is straightforward to solve for equilibrium quantities and retail prices.

Welfare in each of the markets depends on the trade cost. Consumer surplus in the importing market is,

\[ CS^A = \begin{cases} \frac{(1+t)^2}{8} & \text{if } t < t_1 \\ \frac{[2 + 3Sb(2-t)]^2}{2(4 + 9Sb)} & \text{if } t_1 \leq t < t_2 \\ \frac{1}{8} & \text{if } t \geq t_2 \end{cases} \] (57A)
and in the exporting market is,

\[
CS^B = \begin{cases} 
\frac{(S - 2t)^2}{8Sb} & \text{if } t < t_1 \\
\frac{[4 + 9Sb - 2b(1 + 4t)]^2}{8b(4 + 9Sb)^2} & \text{if } t_1 \leq t < t_2 \\
\frac{S[2 - b(1 - 2t)]^2}{32b} & \text{if } t \geq t_2
\end{cases}
\]  
(58A)

Differentiating each with respect to trade costs yields

\[
\frac{\partial CS^B}{\partial t} = \begin{cases} 
\frac{(1 + t)}{4} > 0 & \text{if } t < t_1 \\
\frac{[2 + 3Sb(2 - t)](-3Sb)}{(4 + 9Sb)^2} < 0 & \text{if } t_1 \leq t < t_2 \\
0 & \text{if } t \geq t_2
\end{cases}
\]  
(59A)

and

\[
\frac{\partial CS^B}{\partial t} = \begin{cases} 
\frac{-(S - 2t)}{2Sb} < 0 & \text{if } t < t_1 \\
\frac{[4 + 9Sb - 2b(1 + 4t)](-2)}{(4 + 9Sb)^2} < 0 & \text{if } t_1 \leq t < t_2 \\
\frac{S[2 - b(1 - 2t)]}{8} > 0 & \text{if } t \geq t_2
\end{cases}
\]  
(60A)

So, in the importing market, welfare is increasing then decreasing in the trade costs. As long as \(0 < t < t_2\), the consumers in the importing market have higher welfare when parallel trade is permitted. When trade costs exceed \(t_2\), consumer surplus is the same as when parallel imports are restricted. In the exporting market, welfare is decreasing until the second threshold of trade costs is reached and then increases until trade costs segment the market. Consumers in this market have lower welfare over the entire range of profitable trade costs \((0 < t < 1/2)\) when parallel trade is permitted.