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RESEARCH ARTICLE

Does Reimportation Reduce Price Differences for Prescription Drugs? Lessons from the European Union

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Objective. To examine the effect of parallel trade on patterns of price dispersion for prescription drugs in the European Union.
Data Sources. Longitudinal data from an IMS Midas database of prices and units sold for drugs in 36 categories in 30 countries from 1993 through 2004.
Study Design. The main outcome measures were mean price differentials and other measures of price dispersion within European Union countries compared with within non-European Union countries.
Data Collection/Extraction Methods. We identified drugs subject to parallel trade using information provided by IMS and by checking membership lists of parallel import trade associations and lists of approved parallel imports.
Principal Findings. Parallel trade was not associated with substantial reductions in price dispersion in European Union countries. In descriptive and regression analyses, about half of the price differentials exceeded 50 percent in both European Union and non-European Union countries over time, and price distributions among European Union countries did not show a dramatic change concurrent with the adoption of parallel trade. In regression analysis, we found that although price differentials decreased after 1995 in most countries, they decreased less in the European Union than elsewhere.
Conclusions. Parallel trade for prescription drugs does not automatically reduce international price differences. Future research should explore how other regulatory schemes might lead to different results elsewhere.

Key Words. Drug costs, economic competition, health care sector, internationality

Cross-national differences in prescription drug prices have been a topic of much discussion in the media and in policy circles (Baker 2004; Bright 2006). Researchers have described some of the underlying causes of these price differences, including international exchange rates and differences in patient demand and national income. Government regulations, such as price controls and reimbursement policies, can also contribute to price differences by fixing

prices or reducing the price sensitivity of patients or their agents (Danzon and Chao 2000; Stuart et al. 2000; Danzon and Furukawa 2003).

One way to reduce price differences would be to remove restrictions on the flow of prescription drugs across markets (i.e., to permit arbitrage). "Parallel trade," or "reimportation," has been proposed to allow people in countries with higher drug prices to acquire prescription drugs from countries with lower prices. In the United States, President Bill Clinton signed legislation in October 2000 to permit parallel trade under strict safety rules (Medicine Equity and Drug Safety Act 2000). Regulations to implement the legislation have not been developed, however, due to concerns about safety and logistics (Rubin 2000). Thus, parallel trade remains illegal in the United States. However, the question of whether parallel trade would reduce prescription drug prices in the United States and other countries without parallel trade remains open.

With parallel trade being illegal in the United States, we set out to examine data from the European Union, where parallel trade is permitted. Parallel trade is part of a comprehensive effort to move toward a single market for all goods, including prescription drugs, in the European Union (Farquason and Smith 1998). Nonetheless, safety concerns still exist and there are strict rules governing such trade. A parallel importer must obtain licenses to import products of identical chemical composition for each dosage form, dosage strength, and market of origin. The cost of the license is approximately €1,500 in most countries, or €3,480 for products approved through the European Agency for the Evaluation of Medicinal Products. If the product has packaging in a different language, a different brand name, or a different pack size, the parallel trader may also incur repackaging costs (Arfwedson 2004).

In economics, the law of one price states that identical tradable goods should have the same price in all locations (or the difference cannot exceed transportation costs). If not, it would be profitable for someone to arbitrage the price difference indefinitely and make infinite earnings (Mankiw 2007). Indeed, parallel traders act as arbitrageurs by purchasing products in low-price

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markets and reselling them in high-price markets. This trade can affect price dispersion in two ways. First, migration of products from low-price to high-price markets can reduce the average price paid for a particular product in high-price markets, especially if parallel traders sell their imports at lower prices than the original products in the high-price market, thus narrowing the price difference between markets. Second, manufacturers may reduce the prices of their products in high-price markets to match lower prices offered by parallel importers or in response to the threat of parallel trade. Thus, even if parallel trade does not actually occur, its possibility may constrain prices. In theory, firms could also raise prices in low-price markets to make parallel trade less appealing. In practice, however, price controls in the European Union allow little flexibility in this regard. Indeed, many countries impose mandatory price reductions over time. The specifics of price control policies have been described in detail elsewhere (Jacobzone 2000). The effect of such policies is that any price change in a country with price controls tends to be a reduction rather than an increase.

The impact of parallel trade also depends on the incentives of key agents in each country to substitute parallel imports for (presumably more expensive) original products, much like the development of a market for generic versions of off-patent drugs. Some institutional features of particular countries may dampen such incentives, such as additional regulations on the profits of pharmacists, and patient copayments that are generally the same whether a drug is a parallel import or an original product. However, Kanavos et al. (2004) have noted that "traditionally high-price countries seem to have mature policies in place enabling their health insurance systems to benefit somewhat from parallel importation of pharmaceuticals."

The legalization of parallel trade and the elimination of exchange-rate fluctuations resulting from the adoption of the euro in most European Union countries should have reduced the dispersion of prescription drug prices in the European Union. We would expect to see a greater reduction in price dispersion over time in the European Union than in places where parallel trade is not allowed. For example, Goldberg and Verboven (2004) found such a reduction in automobile price dispersion in the European Union during a similar time period. In other sectors of the economy, such as gas, electricity, and telecommunications, price dispersion in the European Union fell from 1985 through 1999, and the standard deviation of the price index for tradable goods fell from 0.11 in 1990 to 0.05 in 1999 (European Commission 2001).

However, little evidence on the effect of parallel trade exists. When the British House of Commons considered the question of international exhaus-

tion of trademarks in 1999, its Committee on Trade and Industry noted, "[whilst] we appreciate that it is difficult to determine empirically the precise size and character of the flow of parallel imports, we share the Minister's concern that very little empirical research has been undertaken into the potential effects of international exhaustion" (House of Commons 1999). Evidence regarding the impact of parallel trade on price dispersion for prescription drugs is limited. Previous studies examined the effect on prices for top-selling drugs in select markets, but not how prices have changed across the European Union relative to changes in other countries (Ganslandt and Maskus 2004; Kanavos et al. 2004; Enemark, Pederson, and Sorensen 2006). Therefore, we analyzed price dispersion of a larger set of prescription drugs in the European Union over a 12-year period to address these questions.

METHODS

We obtained data for all prescription drugs in 36 therapeutic categories (see Supplementary Material Appendix SA1) in 30 countries from the first quarter of 1993 through the third quarter of 2004. The data constitute a subset of the IMS Midas database (IMS Health, Fairfield, CT), the most comprehensive source of information on international drug prices and sales. Therapeutic classes were selected in an effort to provide a mix of small molecules and biologics that have high use in most markets, as well as some with high costs (e.g., oncology products). A total of 1,023 chemicals (or unique chemical combinations) are included in these classes, and about 20 percent were still on patent at the end of the study period.

The data set contains information at the package level (e.g., chemicals, dosage form, strength, and pack size) on the quantity sold in each country through both retail and hospital channels, and through other important channels in the United States, such as sales to health maintenance organizations, clinics, and physician offices. The data set includes the ex-manufacturer price (i.e., the price paid by wholesalers to manufacturers), the wholesale price (i.e., the price paid by retailers to wholesalers), and the retail price per standard unit (i.e., the price paid by consumers or third-party payers) measured in U.S. dollars at the current exchange rate in each quarter. We used the ex-manufacturer price for two reasons. First, the retail distribution of pharmaceuticals varies substantially across countries and may lead to different price markups for reasons unrelated to parallel trade. Second, neither pharmacists nor patients in many countries, particularly European Union countries, may have

much incentive to find the lowest price for drugs, because profits are regulated or they face copayments that are the same whether the drug is a parallel import or an original product. Wholesalers likely have the most to gain from the use of parallel imports, and previous studies have established that parallel trade usually occurs at the wholesale level rather than the retail level (NERA 1999; Maskus and Chen 2002). However, we replicated the analyses using wholesale and retail prices and obtained similar results, so we report only the analysis of ex-manufacturer prices.

We identified drugs that were subject to parallel trade in two ways. IMS identifies some products as parallel imports in the MIDAS database, but only for Germany and the United Kingdom. We assumed that products sold elsewhere in the European Union by the same firms that were identified as selling parallel imports in the MIDAS database were also parallel imports. We verified that these firms were parallel traders by checking their names against the membership lists of parallel import trade associations in the European Union and lists of approved parallel imports available from regulators in the United Kingdom and Denmark. Our estimates of parallel trade activity are consistent with other studies using different data sets (Kanavos et al. 2004; Enemark, Pederson, and Sorensen 2006).

Statistical Analysis

This study examines the total impact on prescription drug pricing across the European Union that can be plausibly tied to parallel trade. If parallel trade amounted to perfect arbitrage, price dispersion would vanish in the European Union (or would reflect only transportation costs and, in this case, licensure or repackaging costs). If parallel trade affected prices in only a subset of countries, or if parallel trade affected prices only moderately in all countries, price dispersion would fall in the European Union, as compared with countries outside the European Union where parallel trade is not legal. Our analysis relies on a comparison of the "treated" countries (i.e., European Union countries) with "control" countries (i.e., non-European Union countries).

We calculated descriptive statistics on prescription drug volume and sales from across our market-basket sample. We do not address within-country price dispersion across packages (or across payers), because in countries outside of the United States there is typically a single payer. In all markets, a drug is usually marketed in many presentations (dosage forms and strengths), few of which may be the same in all countries. Because a cross-national comparison of packages would include only a subset of the 30 countries, we aggregated

to the drug level and used the quantity-weighted mean price across all presentations of a chemical combination in subsequent analyses.[1] As Danzon and Furukawa (2006) have noted, comparing prices at the drug level rather than the package level yields more matches across countries (though not without some tradeoffs in the precision of the comparison).

We measured price differentials as the absolute percent difference between the mean price across all presentations in each country and the mean price in all countries in the sample, all European Union countries in the sample, and all non-European Union countries in the sample. Although parallel trade occurred before 1995, it was after that year that much of the legal uncertainty concerning intellectual property was resolved and parallel trade became more widespread. In addition, Spain and Portugal, which tend to have relatively low drug prices, became legal sources of parallel exports in 1995.[2] Because it may take time for parallel traders to establish operations and apply for licenses, a change in price dispersion may not be immediate after the change in policy. Therefore, we report the distributions of price differentials for the periods 1993–1994, 1995–1999, and 2000–2004.

In addition to calculating mean price differentials, we calculated alternative measures of price dispersion, including the mean maximum price differential across countries, the coefficient of variation of the price for each drug across countries, and the standard deviation of the price for each drug across countries. Each of these measures has been used in other studies of price dispersion (Carlson and Pescatrice 1980; Brynjolfsson and Smith 2000; Sorensen 2000; Kanavos et al. 2004; Goldberg and Verboven 2004). If the law of one price holds, all should be equal to 0. We used Wilcoxon's signed-rank tests to compare price dispersion in European Union countries and non-European Union countries in the three time periods.

Because the results of the descriptive analysis could reflect differences in the products available across markets or differences in the products available across markets over time (as new drugs were introduced or were introduced in more countries), we also examined price dispersion using regression techniques similar to an approach by Goldberg and Verboven (2004). Specifically, for each country and quarter, we examined the relationship between the absolute log price difference of each drug and the mean European Union price for that drug while (1) controlling for country–drug fixed effects and (2) interacting a dummy variable equal to 1 for European Union countries with dummy variables for each year in the data set. We used the log price difference because the distribution of price differentials is highly skewed. Although the errors may be nonnormal, which makes standard t tests suspect, we have a

very large sample size, so the deviation from normality should be inconsequential for hypothesis testing. We repeated this analysis for the log price difference of minimum prices across all presentations of a drug within a country, because the lowest-priced products may be targeted at the most price-sensitive buyers, who may find parallel imports most appealing. We also repeated the analysis after excluding the United States from the data set, in case the value of the U.S. dollar caused changes in price dispersion over time. Note that changes in the value of the dollar would affect only the price differential between the United States and other countries, not the price difference between other countries using a different currency.

This "difference-in-differences" approach is one way to identify the effects of parallel trade. In other words, because prices in countries outside the European Union after 1995 should not have been affected by parallel trade, this approach allowed us to compare price differences in European Union and non-European Union countries before and after parallel trade. If non-European Union countries experienced a decline in price dispersion at the same time that European Union countries were "treated" with the legalization of parallel trade, and if this change affected only non-European countries, then our difference-in-differences approach would be invalid. However, reductions in transportation costs, greater price transparency, and other forces that would be likely to affect price dispersion would affect all countries, not only non-European Union countries. The inclusion of country–drug fixed effects addresses concerns about changes in the supply of drugs over time that might have driven changes in price dispersion as we focused on within-country and within-drug changes in price differentials. We also estimated the same regression using a time trend instead of a dummy variable for the post-1995 period to capture any gradual changes during this period.

RESULTS

Table 1 describes the data available for the analysis. We included information on 1,023 prescription drugs in 30 countries. There were 7,133 chemical–dosage form–strength combinations—a mean of 6.96 presentations per drug available anywhere, but only 2.36 presentations available per country. The mean parallel importer share was 18 percent at the presentation level and 12 percent at the drug level, because not all presentations of a drug were subject to parallel trade. Although some countries (notably Sweden, Denmark, and the Netherlands) experienced a marked increase in the penetration of

Table 1: Data Available for the Analysis

Variable	*n*	*Mean*	*SD*	*Minimum*	*Maximum*
Quarters	47	—	—	—	—
Countries*	30	—	—	—	—
Therapeutic classes†	36	—	—	—	—
Drugs	1,023	—	—	—	—
Unique presentations‡	7,133	—	—	—	—
Observations with parallel trade	16,546	—	—	—	—
Presentations per drug across all countries	1,023	6.97	14.7	1.0	172.0
Presentations per drug in each country	1,023	2.36	2.6	1.0	32.0
Share of parallel imports for a presentation‡	16,448	0.18	0.2	0	1.0
Share of parallel imports for a drug§	8,761	0.12	0.2	0	1.0
Ex-manufacturer price of presentation‖	518,995	34.33	148.8	6.4	12,775.4
Standard units of a presentation sold in quarter	519,011	13.85	70.5	1.0	2,846.0

*The following countries were included in the analysis: Argentina, Australia, Austria, Belgium, Brazil, Canada, China, Colombia, the Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Poland, Portugal, South Africa, South Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

†See Supplementary Material Appendix SA1.

‡"Presentation" refers to a drug–dosage form–strength combination.

§Conditional on parallel trade taking place.

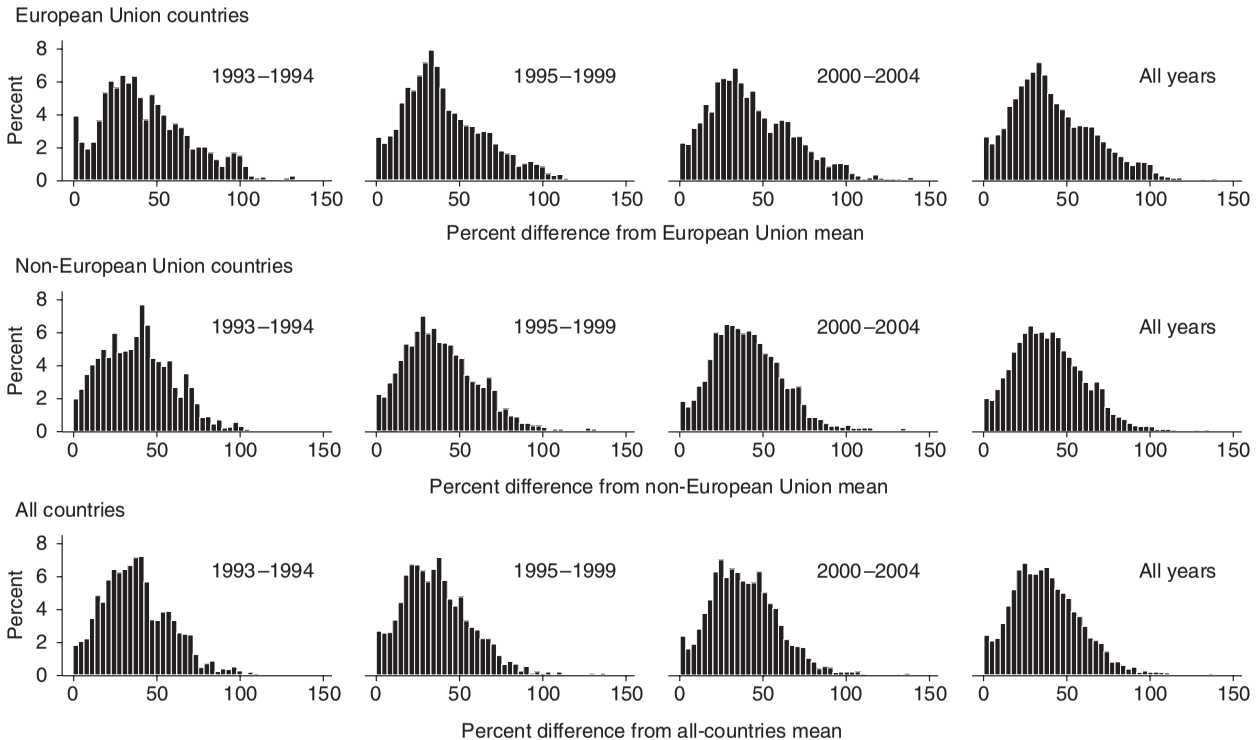
‖Values are expressed as 2000 U.S. dollars. Negative prices were excluded from the analysis. All values are reported to two significant digits.

SD, standard deviation.

parallel imports during the study period, even the threat of parallel trade (in countries that did not show an increase) could have an effect on prices if manufacturers adjust prices to make arbitrage less attractive.

Figure 1 shows the mean distribution of mean price differentials for European Union countries, non-European Union countries, and all countries by time period. The mean price differential is the percentage difference between the ex-manufacturer price and the mean price for the same drug across countries. (The patterns were similar when we used wholesale prices and retail prices instead of ex-manufacturer prices [data not shown].) As shown in Figure 1, there was substantial price dispersion across all countries and within the European Union. There was a slight reduction over time in the number of

Figure 1: Distributions of Prescription Drug Price Differentials by Time Period in European Union Countries, Non-European Union Countries, and All Countries



extreme price differentials. However, about half of the price differentials exceeded 50 percent in all three sets of countries in each time period. Although we had no reason to expect a reduction in price differentials among non-European Union countries, the distributions among the European Union countries did not show a dramatic change concurrent with the adoption of parallel trade.

Table 2 presents summary statistics for the aforementioned group measurements and for the mean standard deviation and the mean coefficient of variation of prescription drug prices across all countries and in the European Union. In each set of countries over time, there was little change in the magnitude of any of the measures of price dispersion, except for a marked increase in the standard deviation. In European Union countries, the mean price differentials were significantly different between the 1995–1999 period and the other time periods, but the difference between the 1993–1994 and 2000–2004 periods was not statistically significant. The maximum price differentials for European Union countries in the 2000–2004 period were statistically different from the earlier periods and, in fact, increased over time. The mean standard deviation of prices across countries actually increased between the period before parallel trade and the more recent observations (all countries, 16.1–20.6; European Union countries, 10.8–17.3).

Table 2 also shows p-values for Wilcoxon's tests of price dispersion measures between the time periods for all three country subsets. Price dispersion was greater outside of the European Union than within it. Comparisons of dispersion in each of the three time periods between each country category (data not shown) showed that dispersion was significantly different across country categories.

Table 3 presents the results of the regression analysis. Each row contains the estimated coefficient for the dummy variable for each year, with one column for the main effect and another column for the interaction with the European Union dummy variable. Across all specifications, the results indicate a reduction of price dispersion after 1995 for all countries relative to the first year in the data set (1993); all coefficients after 1995 are negative and statistically significant at the 1 percent level. However, the interaction with the European Union variable is frequently positive and statistically significant, particularly for the most recent years. In the post-1995 period, only in 2000 and 2001 did price differentials fall more for European Union countries than for other countries. The qualitative results are the same across our choice of average or minimum price differences and the inclusion or exclusion of the United States from the data set.

Table 2: Summary Statistics

	Period			*p-Value**		
Variable	*1993–1994*	*1995–1999*	*2000–2004*	*1993–1994 versus 1995–1999*	*1995–1999 versus 2000–2004*	*1993–1994 versus 2000–2004*
All countries						
Maximum price differential, percentage of all-countries mean (median)	221.53 (223.99)	215.92 (214.69)	233.44 (235.86)	.03	<.001	.03
Mean price differential, percentage of all-countries mean (median)	50.61 (50.82)	48.70 (48.57)	51.50 (51.53)	< .001	<.001	.10
Coefficient of variation†	0.73	0.70	0.75			
Standard deviation‡	16.12	20.71	29.85			
EU countries						
Maximum price differential, percentage of EU mean (median)	148.32 (221.04)	152.95 (152.82)	162.21 (162.02)	.28	< .001	<.001
Mean price differential, percentage of EU mean (median)	43.56 (43.77)	40.97 (40.58)	42.65 (42.58)	< .001	.003	.24
Coefficient of variation†	0.60	0.57	0.59			
Standard deviation‡	10.80	12.80	17.28			
Non-EU countries						
Maximum price differential, percentage of non-EU mean (median)	205.55 (206.60)	187.36 (186.40)	200.73 (200.59)	< .001	<.001	.53
Mean price differential, percentage of non-EU mean (median)	51.92 (52.07)	51.98 (51.74)	54.11 (53.95)	.48	< .001	.005
Maximum price differential, percentage of EU mean (median)	151.47 (153.66)	161.80 (161.87)	169.98 (169.88)	< .001	.002	< .001
Mean price differential, percentage of EU mean (median)	93.37 (91.81)	111.26 (112.69)	101.96 (98.01)	.36	.13	.88
Coefficient of variation†	0.74	0.73	0.76			
Standard deviation‡	19.28	27.31	35.86			

**p*-Values from Wilcoxon's tests.

†Mean of (standard deviation of price/mean of price) within drug name across all countries.

‡Mean standard deviation of drug price across all countries.

EU, European Union.

Table 3: Results from Regressions of Log Price Differentials

	Quantity-Weighted Average Price		*Coefficient (Standard Error)*		*Minimum Price*		*Coefficient (Standard Error)*	
Year	*Non-EU Countries*	*EU Countries*	*Non-EU Countries, Excluding U.S.*	*EU Countries*	*Non-EU Countries*	*EU Countries*	*Non-EU Countries, Excluding U.S.*	*EU Countries*
Intercept	0.885 (0.003)†		0.827 (0.003)†		0.923 (0.003)†		0.847(0.003)†	
1994	0.019 (0.005)†	−0.050 (0.007)†	0.024 (0.005)†	−0.053 (0.007)†	0.005 (0.006)	−0.041 (0.008)†	0.009 (0.006)	−0.042 (0.008)†
1995	−0.210 (0.006)†	0.023 (0.007)†	−0.189 (0.006)†	0.011 (0.007)	−0.237 (0.007)†	0.023 (0.009)†	−0.224 (0.007)†	0.019 (0.009)†
1996	−0.207 (0.006)†	0.025 (0.007)†	−0.192 (0.006)†	0.018 (0.007)†	−0.238 (0.007)†	0.033 (0.009)†	−0.234 (0.007)†	0.035 (0.009)†
1997	−0.168 (0.006)†	−0.012 (0.007)	−0.162 (0.006)†	−0.010 (0.007)	−0.201 (0.007)†	0.012 (0.009)	−0.207 (0.007)†	0.025 (0.009)†
1998	−0.193 (0.006)†	0.029 (0.007)†	−0.191 (0.006)†	0.035 (0.007)†	−0.226 (0.007)†	0.044 (0.008)†	−0.237 (0.007)†	0.061 (0.009)†
1999	−0.148 (0.006)†	−0.001 (0.007)	−0.150 (0.006)†	0.009 (0.007)	−0.161 (0.007)†	−0.004 (0.008)	−0.174 (0.007)†	0.016 (0.009)
2000	−0.069 (0.006)†	−0.065 (0.007)†	−0.079 (0.006)†	−0.046 (0.007)†	−0.071 (0.007)†	−0.082 (0.008)†	−0.088 (0.007)†	−0.058 (0.008)†
2001	−0.075 (0.006)†	−0.047 (0.007)†	−0.083 (0.006)†	−0.029 (0.007)†	−0.072 (0.007)†	−0.065 (0.008)†	−0.091 (0.007)†	−0.038 (0.008)†
2002	−0.130 (0.006)†	0.013 (0.007)	−0.139 (0.006)†	0.032 (0.007)†	−0.118 (0.007)†	−0.015 (0.008)	−0.136 (0.007)†	0.011 (0.008)
2003	−0.161 (0.006)†	0.052 (0.007)†	−0.159 (0.006)†	0.059 (0.007)†	−0.144 (0.007)†	0.019 (0.009)†	−0.153 (0.007)†	0.036 (0.009)†
2004	−0.172 (0.006)†	0.069 (0.008)†	−0.159 (0.006)†	0.068 (0.008)†	−0.144 (0.007)†	0.024 (0.009)†	−0.143 (0.007)†	0.033 (0.009)†
F	301.87		268.77		264.01		244.94	
R^2	0.0348		0.0323		0.0306		0.0295	
n	189,919		182,802		189,919		182,802	

*The unit of observation in the regressions is drug–country–quarter. The dependent variable is the log price difference between the ex-manufacturer price for a drug in a country and the mean price for that drug in the European Union. Regressions included country–drug fixed effects and were estimated using the XTREG procedure in *Stata* (StataCorp LP, College Station, TX).

†Coefficient is significantly different from 0 at the 1% level.

EU, European Union.

DISCUSSION

Parallel trade is thought to be one way to reduce cross-market price discrimination by prescription drug manufacturers (Danzon and Chao 2000; Ridley, Grabowski, and Moe 2006). In the United States, pressure to permit parallel trade has resulted from growing concerns about high drug prices and international price disparities. In this study, using data from the European Union, we found little evidence that parallel trade affected price dispersion of prescription drugs over a 12-year period.

Specifically, we looked at information on over 1,000 products in 36 categories in 30 countries over a 12-year period to determine whether price dispersion decreased in the European Union (where parallel trade is permitted, especially after 1995) and non-European Union countries (where parallel trade is not permitted). In both descriptive analysis and regression analysis, we found that about half of the price differentials in prescription drugs exceeded 50 percent in all European Union and non-European Union countries in each time period, and that the distributions of prices among European Union countries did not show a dramatic change concurrent with the adoption of parallel trade. In regression analysis, we found that although price differentials decreased after 1995 for most countries, they decreased less in the European Union than elsewhere.

To be clear, we do not suggest that parallel trade had no effect anywhere, or that parallel trade does not have the potential to have a significant impact on prescription drug markets. Our findings imply that the legalization of parallel trade does not necessarily lead to a reduction in price differences across countries. Some impediments to parallel trade in the European Union have been examined in greater detail elsewhere (Kyle 2007).

The lack of a direct effect of parallel trade may be due to the particular regulatory scheme adopted in the European Union (i.e., individual country licenses at the dose-pack level) and to responses by manufacturers to continue price discrimination through the use of different packaging and brand names (Kyle 2007). Important differences between the European Union and U.S. markets regarding the regulation of parallel trade and other aspects of pharmaceutical markets make it difficult to predict how parallel trade would fare in the United States. Unlike national health insurance programs in European countries, many patients in the United States purchase prescription drugs on a self-pay basis or within tiered copayment structures (Joyce et al. 2002; Huskamp et al. 2003). Because these patients are more sensitive to drug prices than their European counterparts, parallel trade may have greater opportunity to impact prices in the United States.

In addition to the relative insensitivity to prescription drug prices among patients in the European Union, the profits of pharmacists are regulated in many countries. Although the Netherlands and the United Kingdom use "clawback" mechanisms, which enable savings from the use of parallel imports to be shared between pharmacists and the government health authority, pharmacists in other European Union countries have little incentive to find a low-cost supply.

Another area of uncertainty concerns rationing of supply to low-price countries, a strategy attempted by firms in Europe and in dealings with Canadian Internet pharmacies that sell prescription drugs illegally to patients in the United States. Competition laws in the European Union may limit the ability of firms to ration, because rationing may be interpreted as an abuse of market power. However, it is unclear how U.S. and Canadian competition laws would affect rationing. Given the relatively small size of the Canadian prescription drug market (roughly one-tenth the size of the U.S. market), it is unlikely that parallel trade from Canada alone would have a large impact on prices in the United States (Porter 2004).

Our analysis has some limitations. First, we assessed pharmaceutical products in 36 therapeutic categories, but there may be different results in drug categories that we did not examine. Second, parallel trade may have less effect in the European Union than it would in higher-price markets like the United States, where pharmacists, insurers, and patients have greater incentive to switch to less expensive prescription drugs. In any case, it is clear that the development of a regulatory infrastructure for parallel trade does not automatically reduce international price dispersion for prescription drugs.

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NOTES

1. For example, a drug that sold 5 units of a presentation at $5, 10 units of a presentation at $10, and 10 units of a presentation at $1 would have a quantity-weighted mean price of $(5/25) \times 5 + (10/25) \times 10 + (10/25) \times 1 = \$6.00$, whereas a drug that sold 5 units of a presentation at $5, 15 units of a presentation at $10, and 5 units of a presentation at $1 would have a quantity-weighted mean price of $(5/25) \times 5 + (15/25) \times 10 + (5/25) \times 1 = \$7.04$. The $7.04 reflects the fact that more relatively expensive units were sold.
2. When Spain and Portugal became member states of the European Union, they were required to make changes to their patent laws to provide the same level of intellectual property protection as other member states. Also, a derogation period that prohibited parallel exports of products that had not received strong patent protection before membership was imposed for both countries, which ended in 1995.

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SUPPLEMENTARY MATERIAL

The following supplementary material for this article is available online:

Appendix SA1: HSR Author Matrix.

Appendix A1: Therapeutic Classifications Included in the Analysis.

This material is available as part of the online article from http://www.blackwell-synergy.com/doi/abs/10.1111/j.1475-6773.2008.00838.x (this link will take you to the article abstract).

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